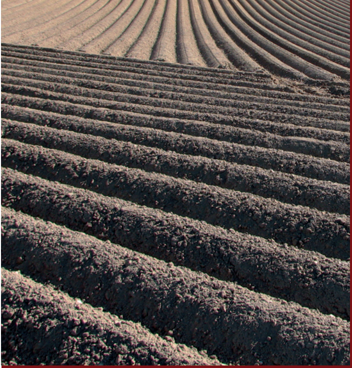
National Soil properties monitoring by means of the French soil test database

Nicolas N. Saby, Blandine Lemercier, Dominique D. Arrouays, Christian Schvartz, Hervé Squividant, Stéphane Follain, Pascal Denoroy



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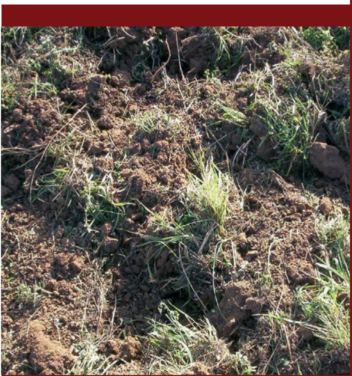

Book of Abstracts

Winfried E. H. Blum, Martin H. Gerzabek and
Manfred Vodrazka (Eds.)

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Annotation

In the following we are publishing the abstracts as submitted by the authors.

The symposia are in numerical order.

The posters are ordered according to the postersessions 1 – 4 during which they were presented.

Keys and Abbreviations:

S01	**Symposium 01**
A	**Time Block A (see programme)**
KL	**Keynote Lecture**
P	**Poster Presentation**

The Editors

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Symposia

Posters

Symposia

S01 Soil Organic Matter

S01.A.KL
Stabilization of organic matter in top- and subsoils: Mechanisms and Mysteries

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In the past 10 years, the understanding for the mechanisms underlying the stabilization of soil organic matter has deepened considerably. Three basic mechanisms have been identified, namely recalcitrance, interactions with minerals and occlusion within aggregates. For a long time, the selective preservation of recalcitrant organic compounds and the formation of recalcitrant humic substances, has been regarded as the most important mechanism for soil organic matter (SOM) stabilization. Methodologically, recalcitrance is difficult to assess, since the persistence of certain SOM fractions or specific compounds may also be caused by the other stabilization mechanisms. If only free particulate SOM (fPOM) is considered, it rarely reaches ages exceeding 50 years. Older fPOM particles have often been identified as charred plant residues or as fossil carbon. From this and other evidence, it is concluded that the selective preservation of recalcitrant primary biogenic compounds is not a major SOM stabilization mechanism. The oldest and therefore most stable SOM fractions are generally found in subsoils and are closely associated with minerals with part of this fraction being resistant to strong oxidative reagents. In topsoils, occlusion within micro-aggregates effectively protects SOM from microbial degradation for several decades, while SOM in larger aggregates has similar turnover times as bulk SOM.
Despite this progress in knowledge, several unresolved questions regarding SOM stabilization mechanisms remain:

1. SOM consists of substructures or fragments that have been clearly identified as carbohydrates, peptides and low molecular organic acids that should be easily degradable. Are they all associated with minerals, or can they also be protected within SOM "supramolecules"?
2. Why is the oldest SOM generally found in subsoils? Is it because there are more unoccupied mineral surfaces? Or is the low SOM content leading to spatial isolation from the sparse microbial population?
3. SOM in- and outputs in topsoils can be quantified, modeled and attributed to mechanisms rather well. For subsoils, where up to 70% of total SOM is stored, far less data is available and understanding of processes or mechanisms is lost in obscurity.

S01.A.01
Decomposition of Norway spruce needles and fine roots - how much is mineralized and how much is leached as DOC?

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Changes in climate or forest management practices leading to increased litter production will most likely result in increased leaching rates of dissolved organic carbon (DOC) from the O horizon. The rhizosphere is often assumed to have a large carbon flux associated with root turnover and exudation. However, little has been done to quantify the amount of DOC originating from root litter.
We study decomposition of root and needle litter of Norwegian spruce (Picea abies) through laboratory incubation of five different substrates: fresh needle litter, aged needles from the litter layer, fresh and dead roots from mineral soil samples and seven-year-old dead roots from litter bag studies, all substrates collected from the same site in the south of Sweden. After respiration measurement, the substrates are percolated with artificial throughfall water. DOC and UV absorbance are measured in the percolated water. We also study sorption of DOC to ferrihydrite, as a measure of DOC's ability to be stabilised by iron (hydr)oxide surfaces. As expected, DOC production initially was highest for fresh roots and fresh needle litter. A month later, all root treatments produced less DOC than both needle treatments, but the quality of DOC (specific UV absorbance) seemed to be similar for all substrates. The adsorption test showed that, for most substrates, DOC adsorbed strongly to the ferrihydrite. The experiment is on-going (February 2008) and more results will be presented at the conference.

S01.B.01
Wintertime C-fluxes in a forest soil of the Swiss Jura: Clues from a 13C labeled litter addition

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Recent studies in high-latitudes suggest that biological activity during winter can contribute considerably to annual soil carbon fluxes. Although the ongoing global warming is most distinctive in the wintertime, very little is know on the importance and the sources of soil's CO_2 effluxes in the temperate zone over winter. A small increase in winter temperature may alter soil organic carbon balance significantly, since temperature sensitivity is known to be high at temperature close to 0°C and soil moisture is rarely a limiting factor in the cold season.
To gain more insight into the components of CO_2 effluxes from soils during wintertime, we are performing a labeled litter experiment in a montane mixed forest in the Swiss Jura (680m a.s.l.). By the end of November 2007 we have replaced native litter by ^{13}C labeled beech leaves and twigs. Due to the more negative ^{13}C of our litter (-40.7‰) vs. native mineral soil (-27‰) we can identify the origin of respired CO_2 - mineral soil organic C or fresh litter.
Considerable CO_2-fluxes occurred during winter (> 0.6 µmol CO_2 m^{-2} s^{-1}), even when the soil was frozen down to 10cm. 3% of litter C was lost by DOC leaching during the first two months. The contribution of litter C to total soil respiration varied with time from 0 to 60%. While CO_2-release from mineral soil was highly correlated with soil temperature (10cm), litter decomposition responded much faster to variation in air temperature. Moreover, drying-up of the litter layer seems to constraint CO_2-release from litter. Our results show that (1) considerable amounts of SOC are lost in the cold season, (2) the sources of respired CO_2 vary strongly with time, and (3) that the litter-derived CO_2 effluxes are driven by air temperatures during daytime and the frequency of rainfalls.

S01.B.02
Effects of plant litter input on lignin degradation in forest soils

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The input of plant litter largely governs carbon dynamics in soils. Microbial degradation of lignin is assumed to control C mineralization and the production of dissolved organic matter (DOM) during later stages of litter decomposition. Global climate change will affect the quantities of plant litter input into forest soils. Therefore, it is necessary to understand how changes in litter input rates influence lignin degradation and related soil processes. Our objective was to study how experimentally doubled annual aboveground litter input and exclusion of fresh litter affect lignin degradation and its transfer into aqueous phase. We analysed soil samples (forest floor, 0-5 cm, 5-10 cm) from 3 long-term experimental sites, located in the mixed beech-oak forest “Steigerwald” (Bavaria, Germany), the douglas fir forest “H.J. Andrews” (Oregon, USA) and the sugar maple forest “Bousson” (Pennsylvania, USA), using the CuO method. The litter input was manipulated over a period of 8, 10 and 16 years, respectively. Additionally, lignin-derived compounds were analysed in DOM samples from one of these sites.
Initial results showed that doubling the annual litter input caused enhanced lignin degradation, possibly as a result of co-metabolic lignin degradation upon the availability of fresh and easily degradable organic matter. Lignin-derived compounds in DOM samples increased upon the litter addition. We assume that accelerated lignin degradation is responsible for the increased production of DOM in the forest floor which is commonly observed with increased litter inputs.

S01.B.03
Decomposition and microbial colonisation of litter affected by the depth of incubation in a column experiment

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An incubation experiment was carried out with maize (*Zea mays L.*) litter to analyze the decomposition and microbial colonization effected by the depth of litter incubation. Therefore 20 cm high columns were filled by two types of disturbed and sifted (2mm) soils. The soils used were a sand from the experimental site of the IBDF in Darmstadt and a loam from the experimental site “Hohes Feld” in Angerstein near Göttingen. Litter of maize was incubated at depths of 0-5 cm and 15-20 cm. The experiment was carried out in PVC columns on sand-bed for 57 days at 19°C and 40% water holding capacity with the following 6 treatments: (1) sand control, (2) loam control, (3) sand with litter at 0-5 cm, (4) sand with litter at 15-20 cm, (5) loam with litter at 0-5 cm, (6) loam with litter at depth of 15-20 cm. After the incubation time of 57 days, the columns were destructively sampled and microbial biomass C, biomass N, ergosterol and the loss of litter were measured. With the analysis of the $\delta^{13}C$ in litter, soil, microbial biomass and carbon dioxide, the translocation of decomposed carbon was monitored. First results showed no impact of the incubation depth on microbial biomass in the loam, whereas a significant influence (α=0.05) was detected in the sand. There, the ergosterol content was significantly higher at 0-5 cm (1.5 µg g^{-1}) than at 15-20 cm (4.0 µg g^{-1}). Furthermore, the ergosterol content of loam showed no significant differences at 0-5 cm (3.6 µg g^{-1}) and at 15-20 cm (3.9 µg g^{-1}). The microbial biomass C contents did not differ at any depth in the sand (0-5 cm; 280 µg-C g^{-1};15-20 cm; 340 µg-C g^{-1}) and in the loam (0-5 cm; 410 µg-C g^{-1}; 15-20 cm; 330 µg-C g^{-1}).

S01.B.04
Soil biodegradation of maize roots: relative importance of chemical characteristics and endogenous microflora

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Roots remaining after crop harvests constitute one of the main sources of carbon entering the soil and contribute to build up the soil organic matter pool. Unlike for plant above-ground parts, few studies relate in details the processes driving soil decomposition of roots. The chemical quality of crop residues is a well-known factor that influences their decomposition in soil and associated carbon and nitrogen fluxes. For instance, the proportion of the cell wall fraction and its composition are known to have a strong impact on crop residues decomposition. Roots are characterized by a high content in cell walls when compared to above-ground parts and most of these are strongly lignified.
To assess the precise role of the chemical quality of cell wall components on the kinetics of carbon mineralization, roots of different maize genotypes including “brown-midrib” mutants and normal maize were used. These lines were shown to have similar soluble and cell wall contents while they differ significantly in the cell wall composition despite root anatomy and tissue distribution did not vary. Carbon mineralization kinetics of maize roots differed markedly between the genotypes confirming the importance of specific cell walls properties on carbon mineralization. However, scanning electron microscopy investigations revealed contrasted microbial colonization on root samples before soil decomposition. We hypothesize that these endogenous microorganisms may partly be responsible of the initial variations of the cell walls quality observed between genotypes. A study was thus performed to evaluate the impact of the endogenous microorganisms on root chemical characteristics and on the kinetics of carbon and nitrogen mineralization.

S01.B.05
Effect of litter quality on organic matter composition of earthworm casts

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Earthworms contribute to decomposition and stabilization of organic matter (OM) in soil. The digestion during intestinal passage inside worms may lead to a change in the composition of OM. The Fourier Transform infrared spectroscopy (FTIR) can be used to characterize the OM composition in form of hydrophobic (A) and hydrophilic (B) functional groups (i.e., A/B-ratio). It is largely unknown whether the type of litter the earthworm is feeding affects the OM composition in casts. The objective was to compare the composition of OM within casts of the primary decomposer *lumbricus terrestris* with that of corresponding litter samples. Litter from 10 different plant species including leaves of birch, beech, oak, spruce, pear, mustard and wheat straw (3 replicates) was offered separately to *L. terrestris* in microcosms containing a Luvisol soil. The OM composition of casts, collected from the soil surface after 4-weeks, and of litter was analyzed with FTIR (DRIFT technique). The A/B ratio of casts was generally increased as compared to that of the soil. For most litter types, the A/B ratio of cast was relatively similar except for casts from birch (*Betula pendula*) and pear (*Pyrus communis*) where the hydrophobic group contents strongly increased (i.e., 3-times higher A/B ratio as compared to wheat (*Triticum aestivum*) or beech (*Fagus sylvatica*) casts. The higher A/B ratios seem to be related to the relative higher C/N ratios in the casts from *Betula pendula* and *Pyrus communis* feeding experiments. The assumption that worm casts may enrich hydrophobic OM components could be verified only partly. The results indicate that digestion of litter by the worm may change OM composition. However particulate and soluble OM fractions in the earthworm casts could have contributed to such differentiation.

S01.B.06

Implications of rising atmospheric CO2 concentration for plant biomass and soil organic matter changes on a molecular level

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Lipids are main components of plant materials and soil organic matter (SOM). Parts of lipids were thought to be part of the stable fraction of SOM. In addition to C3-/C4-crop change experiments, free air CO2 enrichment (FACE) experiments yield potential to determine turnover rates without changing the quantity and quality of the biomass, which commonly occurs during C3-/C4-crop change experiments. However, plant lipid composition was found to be modified in FACE experiments, but modifications were not uniform for several plants. Temporal trends of lipid modifications of plants and their implications for lipid incorporation and turnover in soil have been determined scarcely. Previous studies observed a different protection of organic carbon in soil physical fractions. However, the distribution and turnover of lipidic compounds within and thus the meaning of soil physical fractions for turnover calculations on a molecular level has not been determined.
Here, we describe the influence of elevated atmospheric CO2 concentration on lipid composition in plants and soil. With time the lipid composition of individual plants varied slightly due to changing growth conditions. At the same time wheat and associated herbs revealed different changes on a molecular level under FACE and thus a different sensitivity against environmental changes expected during the next decades. These facts imply a different development of the biomass quality under FACE conditions and have an influence on turnover of lipids in bulk arable soils and soil physical fractions. As expected, occluded particulate organic matter (oPOM) yields larger amounts of degraded plant debris and lipidic compounds in comparison to free particulate matter. The protection of altered lipids in oPOM against further degradation results in a significantly slower turnover when compared to lipids present in fresh biomass. Future soil quality changes can be expected due to biomass changes under elevated CO2 - even on a molecular level.

S01.C.01

The increase in dissolved organic matter concentration in leachates from undisturbed soil cores after stop-flow mainly originates from decaying biomass

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Dissolved Organic Matter (DOM) plays an important role in soil genesis and in transport of soil pollutants with affinity for organic matter. It follows that understanding of DOM-facilitated transport of solutes and of organic matter dynamics in mineral soils requires information about the dynamics of DOM. In a preliminary experiment 12 undisturbed soil columns (10 *cm* high, 6 *cm* diameter) were leached with a $CaCl_2$ 10^{-3} *M* solution at a rate of 16 *mm/day*. Leaching the columns decreased DOC concentration in the effluents from 24.4 ± 6.1 *mg C/l* to a constant base level of 7.8 ± 3.8 *mg C/l* after 2 pore volumes. The Specific UV Absorbance (SUVA) of DOC in the leachates was 29.6 ± 4.8 *l/(g.cm)* and did not change significantly during leaching. A stop-flow increased DOC concentration by, on average, 6 *mg C/l* suggesting that a fraction of DOC is slowly released in soil. The SUVA decreased by 14 *l/(g.cm)* after stop-flow, suggesting that the increase of DOC was unrelated to humic substances but to decaying biomass.
To further test the hypothesis that stop-flow DOC mainly originates from biomass, a new column experiment was set-up. A pulse of ^{13}C labeled DOC solution was applied to undisturbed, leached soil columns at two flow rates: 4 and 16 *mm/day*. Leachate volumes, $DO^{13}C$ concentrations and SUVA of the column effluents were monitored regularly. Preliminary results show unretarded breakthrough of the ^{13}C pulse but considerable degradation, suggesting that part of the microbial biomass will turn ^{13}C labeled. After breakthrough of the $DO^{13}C$ pulse, irrigation was stopped for 11 days and columns dried out. Currently, the columns are being leached again with a $CaCl_2$ 10^{-3} *M* solution. In addition to the monitoring of $DO^{13}C$ concentrations and SUVA, the effluents are being fractionated (DAX-8-resin) to assess the hydrofobicity of the DOC.

S01.C.02

Influence of dissolved organic matter movement on the net balance of carbon and nitrogen in pasture soils

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There are increasing concerns that pastoral soils in temperate regions are losing soil carbon (C) and nitrogen (N). The aim of this study was to quantify the influence of some of the factors that may be contributing to these losses in soils. We examined the effects of movement of dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) beyond the rooting depths that may have had on the net balance of C and N in pasture soils. Lysimeters (230 mm diameter x 250 mm depth) were collected from six dairy pastures (four from allophanic and two from gley soils) and placed into a growth chamber at 20ºC with 16 hrs daylight. These lysimeters were periodically leached for six months. The leachates were analysed for DOC, DON, NO_3 and NH_4.
Based on the concentrations of DOC and DON measured in the leachates and multiplying these concentrations with the site specific annual rainfall factors, amounts of C and N that could potentially moved beyond the rooting depths on annual basis were estimated. We estimated leaching losses of DOC and DON from soils to be between 330-1830 kg C ha^{-1} yr^{-1} and between 40-127 kg N ha^{-1} yr^{-1} as DON. These leaching losses of DOC and DON could account between 13-65% loss of total C and 17-30% loss of total N in these soils which was estimated by Schipper et al. (2007). The gley (poor draining) soils lost significantly greater amounts of DOC and DON than the free draining allophanic soils. Our results demonstrate a need to take into account movement of DOM when calculating net C and N balance in soils.

S01.C.03

Rapid vertical changes of soil organic matter composition under juvenile Beech trees - a lysimeter study

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In our study we tried to relate SOM turnover and composition with different litter input qualities and depth. For our study eight lysimeters at the Helmholtz-Zentrum Muenchen were used with a surface area of 1 m2 and 2 m depth, filled with soil (Dystric

Cambisol) from a forested site in southern Germany. On every lysimeter four juvenile Beech trees (Fagus sylvatica L.) were grown. In April 2006, after removal of the old litter layer, four lysimeters received 15N-labelled Beech litter and the other four lysimeters received the same amount of unlabelled Beech litter. In September 2006 all lysimeters were sampled and the upper soil layers (0-2 cm, 2-5 cm and 5-10 cm) were subjected to a physical SOM fractionation. Composition of litter samples and SOM fractions were studied by stable isotope techniques and 13C-CPMAS NMR spectroscopy.
We found higher contents of particulate OM (POM) fractions for the soils with 15N-labelled litter input. In all lysimeters remarkable high losses in O/N-alkyl C were detected with ongoing decomposition from free to inner aggregate POM fractions, leading to over 50% alkyl C for the occluded POM<20µm. Furthermore, we found clear increases of alkyl C / O/N-alkyl C ratios within the first 10 cm of soil depth, which implies large vertical SOM heterogeneities on a horizon scale. Sampling on field scales on a horizon basis can therefore be biased by these found heterogeneities. Additional we could track vertical changes in SOM related to root exudates due to the 13C-labelling via gassing of the young Beech trees.

S01.C.04
Does water stress affect composition and stabilization of SON? - A 15N labelling phytotron experiment

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Nitrogen availability and partitioning in the soil are central factors for growth and development of forest ecosystems, but the knowledge about the proceeding mechanisms for the sequestration of N into the SOM is still deficient.
The prognosticated climate change with higher temperatures and longer drought periods will affect growth and development of beech forests in central Europe and thus will affect quality and quantity of the SON.
We conducted a 15N labelling phytotron experiment under controlled conditions to study distribution and stabilisation of ON within different soil fractions and to elucidate to what extent water stress affects SON partitioning.
For the experiment, 16 containers, filled with homogenized surface- and subsoil of a Leptic Phaeozem were planted with 2 yrs-old-beech trees (8 x 8 and 8 x 15 beech) and placed in 4 phytotrons for four month. For half the containers, water supply was reduced to simulate water stress. 15N labelling was conducted through application of a fertilizer solution (15NH4, 15NO3) and soil samples were taken directly following application and after 4, 7, 13 and 24 days. Soil samples were physically fractionated and were analysed for hydrolyzable N, 15N content and chemical composition of ON by 15N NMR spectroscopy.
Within 24 days of incubation, we could already observe a decrease of 15N in all containers. 15N-contents in the control containers were generally lower than those in water stress treated containers, maybe due to higher microbial activity and plant growth caused by a better water availability. Chemical degradation studies are expected to give more information about chemical and microbial stability of SON sequestered in the different physical fractions. NMR spectroscopic pre-experiments showed no differences in the quality of immobilized ON, indicating that with respect to alteration of the N-fraction by water stress quantitative factors dominate over qualitative structural changes of the SON.

S01.D.01
Decomposition and stabilisation of soluble vs.structural C fractions from plant residues in soils

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Many agricultural soils have lost a substantial fraction of their carbon during the last decades. Replenishing these stocks is a major challenge for modern soil management techniques. In particular, it is important to determine what type of organic matter is preferentially stabilised in soils, notably in terms of origin and molecular structures.
Stabilised soil organic matter has long been considered as composed of macromolecular structures directly inherited from complex or structural plant molecules such as lignin. Recent isotopic studies require this paradigm to be reconsidered. Lignin monomers have shown a turnover time of about 20 years in French loamy agricultural soils. In contrast, turnover time of soil-extracted polysaccharides can exceed 40 years. Some ^{14}C incubation studies have indicated that glucose-derived carbon can have a longer residence time in soils than carbon from more complex molecules like cellulose.
The present research was designed to test the hypothesis that carbon derived from soluble plant molecules has a longer residence time in soils than carbon from plant structural molecules. This hypothesis was tested in long-term incubation experiments conducted with labeled plant residues. We used ^{13}C pulse labeling to produce a foliar material displaying contrasting isotopic signatures between water soluble and insoluble (structural) molecular fractions. This material was incubated for more than a year in a loamy soil. Mineralized CO_2 and ^{13}C-CO_2 signatures were periodically determined. The time-series data were interpreted through a simple three-pool isotopic model, which yields decomposition rates and stabilization yield efficiencies for the soluble and structural components. As expected, the decomposition rate was much higher for soluble than structural compounds. However, results indicate that the stabilization yield efficiency was higher for soluble than for structural compounds. This suggests that, in the long-term, carbon derived from soluble compounds would contribute more to stable SOM than that originating from structural molecules.

S01.D.02
Impact of Calcium cations on the formation of coordinative cross-linking in Soil Organic Matter (SOM)

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Multivalent cations are expected to affect coordinative cross-linking of organic molecules. In SOM cross-linking may form glassy molecular networks. An increasing glassy character of polymers can be shown by the increase of the glass transition behaviour temperature. In SOM a similar behaviour is shown and can be characterized by the step transition like glass transition behaviour temperature (Ts). In this study the behaviour of Ts in SOM with different Ca2+ concentration was determined. Our intention was to create soil samples with a high level of networking in SOM by Ca2+. Our hypothesis was that different concentration of Ca2+ and the manner of addition leads to differences in Ts of an organic layer. We expected increasing Ts with increasing Ca2+-concentration in the soil especially for slow addition (in several steps) of Ca2+.
We added Ca2+ by percolation with a Ca2+-soil-solution (5, 8 and 10 mmol/l). Each sample was percolated for four times with the same solution. Between the percolation steps the soil was dried and Ts was measured by Differential Scanning Calorimetry.
In all samples an increase of Ts with final Ca2+ content in the soil was observed. Surprisingly the slope of this relation

increased with decreasing Ca2+ concentration in the percolating solution, such that Ts is not a sole function of the Ca2+ content in soil. The results suggest that Ca2+ induce coordinative cross-links in SOM and therefore intensification in the glassy character of the organic matrix. Furthermore the method of addition has an essential effect on the formation of coordinative cross-links in organic matter. The current results suggest that cross-linking is a slow and sensitive process, which needs further investigation for understanding.

S01.D.03
Estimating the relative importance of stabilisation mechanisms for lignin

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Three stabilisation mechanisms for soil organic matter are discussed in the literature (i) selective preservation due to recalcitrance, (ii) spatial inaccessibility and (iii) interactions with mineral surfaces. The objective of our study is to estimate the relative importance of the proposed stabilisation mechanisms for lignin, a component of soil organic matter with turnover times in the range of decades. We hypothesise that lignin is stabilised not only through chemical recalcitrance, which was for a long time considered the most important stabilisation mechanism for lignin, but also through spatial inaccessibility and to a small extent through interactions with mineral surfaces. We tested this hypothesis by quantifying CuO oxidation products (VSC-lignin) in arable soil fractions from a combined aggregate size and density fractionation. We compared the lignin distribution throughout the fractions in an arable soil cropped with C3 plants, and 18 years after converting this soil to continuous cropping with C4 plants (maize). Compound specific ^{13}C isotope analysis allowed tracking old C3-lignin in individual soil fractions over time. We attributed the three stabilization mechanisms to the fractions as follows: C3-lignin in light fractions after 18 years is stabilized mainly by recalcitrance, in medium density fractions it is mainly stabilized by spatial inaccessibility (i.e. occlusion in macro- and microaggregates), whereas C3-lignin found in heavy density fractions is stabilized mainly by association with minerals. First results show that after 18 years C3-lignin had decreased in the light but not in the heavier fractions. Old lignin therefore seemed to be stabilised in these heavier fractions, particularly in the medium density fraction which stored two thirds of the old lignin in year 18. This result points out the importance of lignin stabilization in micro- or macroaggregates.

S01.D.04
Priming effect of stable soil organic matter pools: a test of two contradictory hypotheses.

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The priming Effect (PE) is a process that strongly influences the balance of carbon (C) in soils by altering the mineralization rates of soil organic matter (SOM) following inputs of fresh organic matter (FOM). Experimental data have shown that PE can be either positive or negative (i.e an over- or under-mineralization of SOM induced by FOM additions) but the mechanisms controlling the sign of PE remains unclear. In the present paper we are testing two contrasting hypotheses that aim to explain priming effect. One considers that the soil stable pool of organic matter cannot be submitted to positive PE whereas the other considers the competition between two microbial communities (r and K strategists) ever lead to positive PE. The main experiment consisted in adding 13C-cellulose to soil that as not recevied any organic matter addition for 70 years with or without amendments of r-strategists microorganisms. By comparing the differences in 13C-CO2 with a negative control without cellulose, we observed negative PE on the SOM stable pool, with a higher intensity when r-strategists microorganisms were inoculated. In our experiment, the sign of PE of the stable pool of SOM does not seem to be controlled by the community of r-strategists microorganisms.

S01.D.05
"Black nitrogen" - an important fraction of the stable soil organic matter pool

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Charcoal, produced during vegetation fires is well recognized as an important C sink within the global C cycles. Whereas high intensity fire can lead to complete destruction of the organic layer, moderate and prescribed wildfire result in minor alterations of soil organic matter (SOM) content and sometimes even result in an increase of organic C and N due to input of partly charred material or litter. Our studies demonstrated that moderate heating of vegetation residues leads to little changes of the C/N ratios in the charred product. It can be as wide as high as 440 to 630 for burnt woody material but also as narrow as 7 as it was found for char from grass material. In particular the latter show that during charring, N has a tendency to be incorporated into structures which are fairly resistant to heating. As it will be demonstrated by model studies and solid-state 13C and 15N NMR spectroscopy those structures are mostly pyrrole/indole-type N with minor contribution of pyridine N. In non-woody chars and in pyrogenic soil organic matter, such N-heteroaromatics can consume up to 17% and sometimes even 60% of their organic C.
The low biological availability of this nitrogen has an impact on biomass production but also on soil organic matter turnover. As demonstrated by its presence in SOM of a forest soil even 24 years after the last fire and in Neolithic paddy soils, this pyrogenic N seems to be relatively stable and thus it is expected to have a long term impact on soil biochemistry. The data collected so far clearly show that aside from "Black Carbon" (BC), "Black Nitrogen" (BN) certainly needs more attention if a better understanding of SOM stabilization is wanted.

S01.D.06
Multi-scale study of the evolution of organic matter during the podzolisation of laterites in the upper Amazon basin

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In the upper Amazon basin, the development of podzols at the expense of clay-depleted laterites is a natural process that leads to the remobilization of elements like Al, Fe and Si previously accumulated as a result of the ferrallitization process. Together with soil organic matter (OM), they are redistributed within soil profiles or exported towards black rivers commonly draining podzolic areas. OM plays a key role in podzol development, in particular through its complexation with metals, and in turn undergoes structural modifications related with the podzolisation process.
The present study is a multi-scale investigation, from microscopic to molecular scales, of OM characteristics during the podzolisation of laterites in the upper Amazon basin. To this

end, it focuses on key soil samples of a toposequence representative of the latosol / podzol transition in the low-elevation plateaux of the Rio Negro basin, and combines micromorphology, spectroscopic investigation of main functional groups (^{13}C NMR, FTIR) and molecular-scale characterization of free lipids (GC-MS) and water-extractable OM (thermally assisted methylation).
To the best of our knowledge, these different techniques have never been combined to investigate OM in podzols, although their combination provides much information on OM sources and fate during the development of podzols. For instance, we showed that OM morphology changes in relation with microbial activity (as reflected by lipid analysis), itself probably influenced by increased waterlogging and acidity. As for functional groups, they are consistent with the formation, translocation and accumulation of Al-OM complexes during the podzolisation process, as inferred by ^{27}Al NMR. At last, the study of WEOM reveals that after a first stage of OM accumulation in spodic horizons, OM can be remobilized and possibly exported towards river networks and feed the waters of the black rivers of the area.

S01.E.01
Characterisation of antioxidants in soil organic matter

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It has been suggested that soil organic matter could have antioxidant properties (Rimmer, 2006) and that the presence of antioxidants could have a significant effect on SOM dynamics. In this paper results are presented of antioxidant capacity (AOC) measurements on soil extracts. The soil samples were obtained from 24 sites representative of the range of UK soils (brown soils, gleys, podzols, peats and lithomorphic soils) and included material from both surface and subsurface horizons. Extracts were obtained using 4 M NaOH at 150°C. The AOC assay was the Trolox Equivalent Antioxidant Capacity, which is based on the decrease of concentration of a coloured free radical solution when mixed with an antioxidant and calibrated against Trolox standards. A number of phenolic acids in the extracts were also quantified, because they were likely to be the principle antioxidant molecules extracted. The AOCs of the soils were strongly correlated with soil organic matter content, so that generally samples of surface horizons had greater AOCs than subsurface samples. There was a strong correlation between AOC values and total phenolic acids. The total phenolic acids, when expressed per gramme of soil carbon, were generally less in subsoil samples than in surface samples, suggesting that they are degraded during humification. The quantities of the different phenolic acids also changed with depth, suggesting that some are more resistant to degradation than others.
Rimmer, D.L. 2006. Free radicals, antioxidants, and soil organic matter recalcitrance. European Journal of Soil Science 57, 91-94.

S01.E.02
Separation of free particulate organic matter from bulk soil by electrostatic attraction

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Separation of non mineral associated soil organic matter from bulk soil samples is necessary for aspects of soil organic matter research. Here we present a new method to separate free particulate organic matter from soils and, at the same time, avoid the artefacts that are inevitable when samples are suspended in H_2O or high molar salt solutions. We used the charge difference between a positively charged glass surface and negatively charged, particulate organic matter as the mechanism of separation. Air dried soil samples (< 2 mm) from nine arable and nine forest topsoils representing a wide range of soil properties (texture, soil organic carbon, pedogenic oxides, pH) were sieved into five particle size fractions and subjected to electrostatic attraction from a charged glass dish. The total content of electrostatic separated particulate organic matter ranged between about 0.05 and 140 g kg^{-1} soil. The organic carbon content of particulate organic matter from different particle size fractions varied between 140 and 470 g kg^{-1}. Raster electron images indicate a selective electrostatic separation of POM from mineral phases. The new method is able to remove an ecologically distinct free particulate organic matter fraction from air dried topsoils samples without subjecting a sample to the carbon losses and/or carbon transfers that are inevitable when a sample is exposed to an aqueous phase.

S01.E.03
Elucidating the reaction of sulfadiazine with soil humic acid with 15N-CPMAS-NMR spectroscopy

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Binding and release of a xenobiotic and its metabolites in soil is mainly determined by the type of interaction with soil components like organic matter or the mineral phase. Nuclear magnetic resonance (NMR) can be used for the characterization of bound residues as binding of the xenobiotic, or its metabolites, to the soil matrix causes shifts in the initial positions of the NMR signals of the compound.
15N-CPMAS-NMR spectroscopy was applied to study the interactions between antibiotics as sulfadiazine (SDZ) and natural organic matter (NOM) in the presence/absence of the natural enzyme laccase and synthetic air. Through the use of synthesized model compounds, we were able to show formation of covalent amide bonds.
Density functional theory (DFT) calculations are a powerful tool to support such NMR studies of xenobiotics. They can help interpret the spectra of bound residues, for example, by predicting shifts for possible model bonds. We successfully used first-principles quantum chemical calculations to support and check the interpretation of 15N-CPMAS NMR spectra of bound residues of different xenobiotics e.g. 2-aminobenzothiazole or simazine. DFT calculations will also be used to support the interpretation of the 15N-spectra of sulfadiazine and its reaction products.

S01.E.04
Investigation of the effects of soil organic matter on water repellency by atomic force microscopy

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Atomic force microscopy (AFM) was used to elucidate the roles of organic material in determining soil water repellency. Surface images together with distributions of adhesion force (between AFM probes and surfaces) were obtained from a selection of soil particle and model surfaces. Adhesion forces measured both in air and water were used to quantify capillary forces (reflecting surface wettability) and the distribution of organic material upon underlying inorganic surfaces respectively. Particles from sandy soils of various water repellencies, obtained from various countries, were examined in their natural condition, following extraction with isopropanol/ammonia (to remove the soil organic matter (SOM) fraction causing repellency) and following application of extracts to both the extracted soil particles and to clean, model, planar glass (PG) surfaces. Similar examination was made of acid-washed sand (AWS) and PG surfaces following exposure to organic compounds.
Topographic images allow quantification of surface roughness, and phase images indicate surface heterogeneity. Phase angle

distributions (PADs), obtained from phase images, of natural soil particles and model surfaces exposed to soil extracts or organic compounds were broader than those of AWS and the extracted soil particles, facilitating assessment of the distribution of organic material over the surface.
Readily wettable PG and AWS surfaces exhibited higher adhesion forces in air than surfaces exposed to organic material suggesting a large contribution from capillary forces in the former. Distributions of adhesion force in water (eliminating the capillary force) reflect the distribution of organic material over the surfaces and these often reflect the distribution suggested by PADs. Higher adhesion forces in water indicate a local strong hydrophobic interaction whereas a lower adhesion force in humid air reflects a weak hydrophilic interaction. These measurements allow direct evaluation of the contributions of particle surface properties, determined at µm-nm scales, to the water repellency of corresponding bulk soils.

S01.F.01
In situ investigation of SOM coatings on soil particles using fluorescence imaging

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Bulk soil properties, such as soil wettability, are thought to be determined from contributions made, by organic coatings on soil particles surfaces. These are difficult to study in their natural state. New non-invasive microscopic techniques offer means to obtain some information about such complex surfaces.
Laser Scanning Confocal Microscopy (LSCM) is used in many biological investigations, where auto-fluorescence or that arising from artificially introduced fluorophores is used to obtain images of specimens. These may be obtained from scans made at several focal planes and combination of the images provides information about specimen 3D structure.
LSCM has been used to obtain images of soil humic acids from auto-fluorescence arising from their complex molecular structure. Some humic acids exhibit auto-fluorescence with light emission occurring at various wavelengths.
Images of individual soil particles, from various sandy soils, displaying different degrees of wettability were obtained by irradiation with laser light at wavelengths of 488 nm and 543 nm. The fluorescent emission was quantified and correlated with bulk soil total organic carbon (TOC) and/or bulk wettability. Good correlations between TOC and particle fluorescence were obtained.
Additionally, LSCM allows examination of the emission spectrum, albeit at modest resolution, through a series of wavebands. This provides further information concerning the nature of the organic material associated with a particle.
Correlation of information obtained by LSCM with bulk soil properties and with individual particle properties is instructive in attempts to determine the extent to which bulk properties reflect those of the constituent particles. One approach in pursuit of this is to determine wettability of individual soil particles. This has been attempted using a technique based on the dynamic Wilhelmy plate method for surface tension measurement, wherein the ability of a particle to support a filament of water is determined.

S01.F.02
The nature, distribution and significance of organic carbon within structurally intact soils

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Soil represents a major storage component of terrestrial organic carbon (OC). Although the amount of organic carbon is frequently quantified, the precise location of this carbon remains unresolved. Organic carbon is stored as the rate of OC-input exceeds mineralisation. The balance between these two processes is controlled by biotic and abiotic factors including: climate, soil type, land-use, vegetation type, particle size and soil structure. The sensitivity of OC to decomposition is dependent not only upon its intrinsic chemical recalcitrance, but also its location within the soil structure. Soil structure provides OC with chemical and physical protection, the extent of which varies between structural units, in return carbon contributes to soil structural stability. Soil structural units and OC-binding agents are sensitive to environmental change and physical disturbance, as a result OC-storage and soil structural stability are transient in nature.
To date, the majority of research that has advanced our understanding of how soil structure influences the storage of OC has relied upon some form of fractionation technique to separate aggregates from the bulk soil. However this approach has its disadvantages as much of the soil structure is destroyed; clearly when studying the impact of soil structure upon OC-storage it is advantageous to use a method that minimises disturbance to the soil structure.
In this study undisturbed soil samples collected in kubiena tins have been taken from the long-term agricultural experimental fields at Rothamsted Research Station (Hertfordshire, UK). The aim is to compare the location of OC, in soils with contrasting organic carbon contents and a well documented land-use history.
Results from thin-section analysis will be presented, including conventional micromorphology, image analysis and sub-microscopy combined with microscale chemical analysis (SEM-EDX). The influence of structure (aggregation and pore space) on the spatial location of carbon will be evaluated from these measurements.

S01.F.03
Understanding soil structure dynamics during organic matter decomposition: techniques for mapping C distributions onto 3-D soil structure

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To date, our understanding of carbon (C) dynamics in soil relies heavily on physical measures of aggregates such as size distribution and stability to understand the impact of soil heterogeneity on decomposition rates and C sequestration. Such techniques exert physical forces to obtain macro- and micro- aggregates from soil. In the process the spatial relationships between aggregates are lost and the true spatial distribution of C is obscured. What are needed are techniques that allow the study of organic matter decomposition within undisturbed soil structures.
X-ray tomography provides exciting opportunities to study the dynamics of soil structure *in situ.* However, its ability to track organic matter decomposition and the incorporation of C into those structures is limited. Techniques such as SEM-EDX are increasingly being used to study the chemistry of organic materials in soils through the analysis of C, O and N ratios. Their application to soil thin sections allows C mapping, but only in 2-dimensions. This paper reports on the preliminary findings of a study to combine sequential 2-dimensional elemental maps produced using SEM-EDX with 3-dimensional visualizations of soil structure produced by X-ray micro-tomography.

S01.F.04
Drying state and wettability of soil samples assessed by DRIFT spectroscopy

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It is widely accepted that soil water repellency is caused by organic coatings on mineral particles. Many investigations suggest that the structural composition and arrangement of molecules and functional groups on particle surface rather than the total amount of soil organic matter affect water repellency. Occurrence of soil water repellency is often linked with increasing dryness of soil. But, after long contact with water, repellent soils may regain wettability.
This study aimed to assess the relation between soil water repellency, water content and the re-arrangement of organic molecule parts on particle surfaces. We investigated the effect of drying procedures on water repellency and DRIFT spectroscopic parameters for soils from two anthropogenic sites in Berlin, namely Buch and Tiergarten. The initially wettable and water repellent soil samples were dried under various conditions. Water drop penetration time (WDPT) and DRIFT spectroscopic parameters were obtained from the dried and field moist subsamples. Absorption in DRIFT spectra at 3000 cm-1 and 2800 cm-1 caused by CH bands is used as an indicator for OM induced "surface hydrophobicity". To eliminate the effect of water content on the spectral parameters, the CH band absorption was normalised with the integral area of the total spectrum (4000 and 400 cm-1). This normalisation allowed for the first time a separation between water content induced effects and surface hydrophobicity induced effects on soil wettability. The water content influences the wettability by the percentage of water covered area and the thickness of the water film on the soil surfaces whereas the surface hydrophobicity influences the wettability by three-dimensional arrangement of organic molecules more precisely by the percentage of outward directed hydrophobic alkyl chains.

S01.F.05
Use of physical fractionation and pyrolysis-GC/MS to study compost organic matter incorporation into a loamy soil organic matter

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A field experiment (INRA-Veolia Environment, Feucherolles, France) has been initiated to study the effects of urban composts (sludge co-composted with green wastes, GWS, municipal solid waste compost, MSW, biowaste compost, BW) compared to a farm yard manure and control plots without organic application, on soil and plant qualities. After 4 applications (in 8 years) of urban waste composts, the C contents in the ploughed layer have increased compared to the control treatment but with various intensities among the organic treatments. However, information is missing on the effect of compost application on Soil Organic Matter (SOM) quality and on long term trends of Organic Matter (OM) stocks in soil. A special question addresses the processes of composted incorporation into SOM.
The objective of the work is to study the C distribution in particle size and density fractions (PSDF) isolated from soils amended with composts and to characterize their chemical composition using pyrolysis coupled with gas chromatography and mass spectrometry (Py-GC/MS) to better understand the incorporation of composted OM into SOM. Soils have been sampled in the ploughed layer of GWS, MSW and control treatments 2 months after the 4th compost application.
The results of PSDF of soils pointed out that mass, C content, C quantity, and proportions of total C were larger in the particulate organic matter > 50 µm (POM) fractions in soils amended with MSW and GWS than in the control treatment. The largest increases were observed in the POM of the GWS-amended soil probably because of the higher stabilization of the GWS compost. Py-GC/MS revealed the chemical fingerprint of compost OM on OM quality of the POM fractions in soil sampled two months after compost application. The C contained in 0-50 µm fractions, especially important for mid to long-term C storage, also increased with compost inputs.

S01.F.06
Pyrolysis-GC/MS characterization regarding the influence of climate and vegetation on the composition of soil organic matter under natural ecosystems

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Soil organic matter (SOM) is an important element of ecosystem dynamics. So far, most research linking SOM to environment, ecosystems and land use focuses on total organic carbon contents. The composition of this SOM has received less attention, whereas it has been shown to greatly influence carbon cycles. A better understanding of the global relation between environmental characteristics, vegetation and SOM composition is vital. This study compares the SOM composition of 18 soil samples taken under tundra, taiga, steppe, temperate forest and tropical forest using SOM fingerprinting by Pyrolysis-GC/MS.
Results indicate a clear difference in SOM composition, reflecting climate (degree of decomposition) and vegetation (coniferous or broadleaved). Biomes from colder climates (tundra, taiga and steppe) contain a larger amount of sugar monomers relative to N compounds and tundra and taiga have a clear dominance of even-over-odd fatty acids suggesting a lower microbial decomposition. Taiga has a different lignin composition. Tundra has relatively more lipids and aromatic components than steppe. Forests mainly differ in their lignin composition and the amount of lipids and aromatics, separating the coniferous temperate forest from the broadleaved forests. Tropical forests have a higher contribution of N components.

S01.G.01
Can we use benzenepolycarboxylic acids as molecular markers to trace the formation temperature of wood char?

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Wood char is an important source of environmental black carbon that contributes to the long-term C cycle. Increasing formation temperature may reduce the degradability of wood chars significantly. Information about the formation temperature of natural chars in the environment is difficult to obtain. However, the maximum temperatures experienced by chars might be reflected by their chemical properties.
The analysis of benzenepolycarboxylic acids (BPCA) as a quantitative measure for black carbon in soil samples is a well-established method. The oxidation of polycondensated black carbon molecules leads to the formation of BPCA, which subsequently can be quantified by GC-FID. The individual BPCA acids are characterised by their degree of carboxylation. The relative contribution of the individual acids to total BPCA-C depends on the cluster sizes of black carbon (i.e. degree of condensation and aromaticity of the chars). Here, we tested if the BPCA patterns reflect the maximum temperature experienced by laboratory produced wood char.
Small wood chips of chestnut hardwood (Castanea sativa) were pyrolysed at maximum temperatures between 250 and 1000 °C under constant N2 stream. The maximum temperatures were

held constant for 5 hours. The chars were then characterised using the BPCA method to trace changes in individual BPCA-C contribution to the total content. Further, the samples were analysed for BET-N2 specific surface area, char colour and elemental composition (CHNO).
First results indicate that at higher temperatures the proportion of those BPCA reflecting a higher degree of condensation is increasing. Our results will provide data to test the suitability of BPCA molecular markers as an explicit measure for the formation temperatures of natural wood chars in order to characterize chars from different environments and to improve our understanding of the fire history of ecosystems.

S01.G.02
Use of bidirectional reflectance rpectroscopy (BRS) to predict organic carbon content in volcanic soils

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Soil Reflectance Spectroscopy Analysis (SRSA) is a non-destructive, rapid technique recently developed as an alternative to traditional, time-consuming and costly laboratory methods for characterising soil mineralogy. The aim of this study was to predict organic carbon (OC) content using bidirectional reflectance spectroscopy (BDS). BDS was used in conjunction with parametrization using the second derivative of the Kubelka-Munk function and colour calculation. This study was conducted on 77 volcanic soil profiles from several European countries. Total OC content was determined using a CHN Analyser. Bidirectional reflectance (BRF) was measured in the visible and infrared region (400 -2500 nm) using an ADS Field Spectroradiometer. The spectral measurements were conducted on air-dried soils, previously sieved at < 2 mm and ground in an agate mortar for 10 minutes in order to exclude the influence of micro-aggregation. Ground samples were gently pressed against unglazed white paper in order to avoid undesired particle orientation. In order to eliminate the influence of external light, we constructed a black box out of paper to surround the equipment. Spectral data were transformed into their remission functions and then the second derivative curves of these functions were calculated. The amplitude of absorption bands (Y2) was computed as the difference between the second derivative minima at ca. 926 nm and maxima at ca. 946 nm. This band seems to be related to the quantity of OC. The amplitude of Y2 was greater for the soil horizons with high OC content, whereas soil profiles that did not produce a Y2 band had extremely low OC content. This result was consistent among all soil profiles studied. Additional support was provided by the correlation between the Munsell Value and the amplitude of Y2. This study indicates that the amplitude Y2 centred around 900 nm is linked to the variation in soil OC content

S01.G.03
How good is ^{13}C isotope analysis in assessing dynamics of organic compounds in soil? - The example of lignin

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Studies of soil organic matter dynamics by natural ^{13}C labelling, i.e. after land use changes from C3 plants to C4 plants, rely on the assumption of constant inputs for correct data interpretation. However, in reality, (i) annual biomass production varies approximately by ±20 % between years, (ii) root/shoot ratios vary according to moisture and nutrient conditions, (iii) the content of specific compounds (such as lignin) in plant litter can vary by a factor of two during the last month of growth, and (iv) isotopic label can differ by at least 1 ‰ V-PDB between plant parts.
In this study we assess how these violations of the assumptions affect the precision of results from stable isotope studies. We use lignin-derived phenols as an example of plant-derived organic compounds in soil.
We set up a model that simulates replicate experimental periods, in which biomass yield, root/shoot ratio, and lignin content of the biomass vary independently between individual years, whereas decomposition rates are fixed. During 2000 replicate runs, the model produces a distribution of possible decomposition rates that could have been measured with the given experimental approach but with differing inputs. This serves as a measure of the uncertainty of the actually determined decomposition rate. The model also allows assessing the effect of inhomogeneous isotope distribution between roots and shoots on the measured decomposition rate.
Our modelling study showed that for experimental periods <5 a, turnover time estimates are strongly affected by individual extreme years. However, uncertainty is reduced with increasing experimental time. At experimental periods of >20 a, apparent turnover times can be estimated with an uncertainty of ±20 %. Our results also showed that both roots and shoots have to be considered for determination of the plant isotopic difference to minimize systematic errors due to inhomogeneous isotope distribution between plant parts.

S01.G.04
Relationship between carbon dynamics and microbial communities determined by the natural 13C abundance of SOM and lipid biomarkers

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A better understanding of microbial involvement in soil organic matter (SOM) decomposition would improve models of SOM dynamics. Soil organic matter comprises different C pools that vary in mass and turnover rate with water soluble organic C (WSOC) being the smallest but most reactive pool.
The study focussed on the dynamics of microbial communities, WSOC, the non-extractable fraction of SOM and respiration using the variation in natural ^{13}C abundance of different SOM fractions and FAME (Fatty Acid Methyl Ester) as well as C budgets to better understand how microbial communities were linked to the degradation of SOM, and particularly to WSOC. The soil was from the ploughed layer of a cultivated silt loam eutric cambisol (%C=1,3%, $\delta^{13}C$=-26.2‰). Samples were incubated at field capacity and 20°C in the dark for 6 months. Changes in the C content and $\delta^{13}C$ signature of respired CO_2, WSOC, bulk soil, microbial biomass and FAME were monitored during the incubation.
Mass balance analyses showed significant relationships among WSOC, the respiration rate and microbial biomass C. The observed changes in the composition of FAME suggested that at least 3 different physiological groups of microorganisms were involved in OM decomposition at different stages during the mineralisation kinetics. The ^{13}C content of CO_2 and microbial C decreased with time suggesting that more labile substrates where more enriched in ^{13}C than resistant material. Paradoxically, no significant evolution of the isotopic signature of the WSOC was observed. The stability of the WSOC fraction ^{13}C signature may have been due to inputs of enriched microbial C and depleted recalcitrant C. Finally, ^{13}C analyses of FAME revealed an evolution in the source of C for microorganisms.

S01.H.01
Sequestration of organic carbon in soil by chemical technology

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Soil organic carbon (SOC) is the major carbon reservoir of the biosphere. Extensive deforestation and intensive agricultural management have led to an increasing transfer of carbon from soil organic matter (SOM) to atmospheric CO_2, with an estimated current loss rate of 8×10^{14} g C/year. Attention must be devoted to stabilize SOM and turn it into a global carbon sink.
Among natural organic matter components, humic substances (HS) represent the most persistent pool in SOC accumulation with mean residence time of several hundreds years. The HS are association of relatively small and heterogeneous molecules containing both hydrophilic and hydrophobic domains (Piccolo, 2002). We have previously shown that HS may be oxidatively or photochemically oxidized into oligo- and poly-mers under enzymatic and biomimetic catalysts (Piccolo et al., 2000, 2005; Cozzolino and Piccolo, 2002; Smejkalova and Piccolo, 2005). Here we report the effect of the photo-oxidative reaction under biomimetic catalyst conducted *in situ* in three Mediterranean soils. Results on soil physical stabilization and emission of CO_2 from soils will be illustrated. This contribution illustrates a possible chemical technology to be applied to soils to control their natural emissions of GHG.

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S01.H.02
Estimate of changes in carbon balance of Russia, 1990-2005

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Land use system in Russia has been considerably changed during last 15 years. According to the different sources, 10-34 Mha of arable soils were abandoned since 1990. Abandonment of cultivated lands led to vegetation succession and restoring of soils and was accompanied by the changes in carbon fluxes between atmosphere, plant, and soils. This study provides a quantitative estimation of changes in carbon balance and soil carbon pool after conversion of croplands to original vegetation. Based on own field studies and literature analysis, we have estimated the carbon accumulation rates for main soil types: Albeluvisols, Phaeozems, Chernozems, and Kastanozems. The rate of C-sequestration changed from 42 to 484 g $Cm^{-2}yr^{-1}$ depending on soil genesis and period of abandonment. As a rule, C-accumulation rate was higher during first years after land use change from arable to grasslands. Our calculations have shown that total C-accumulation induced by conversion of croplands to natural vegetation amounted to 241-274 Tg for Russian territory during 1990-2005. It was also found that former croplands acted as carbon sink and their C balance constituted (-56)-(-240) g $C{\cdot}m^{-2}{\cdot}yr^{-1}$. Based on our field studies we can conclude that former croplands of temperate zone become a stable C sink after 4 years of land conversion to permanent grasslands. The average carbon balance of abandoned lands was (-191) g $C{\cdot}m^{-2}{\cdot}yr^{-1}$. Since 1990 the total C-sink for Russian territory may be estimated 277-970 Tg C due to the conversion of former croplands to permanent grasslands.

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S01.H.03
Composition and turnover of soil organic matter fractions and aggregation in semiarid steppe topsoils as driven by organic matter input

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Grazing is one of the most important factors that may reduce soil organic carbon (SOC) stocks and subsequently aggregate stability in grassland topsoils. The central aim of this study was to analyse the quality and quantity of SOC fractions and their contribution to aggregate formation, stability and carbon sequestration as affected by increased inputs of organic matter due to grazing exclusion. We applied a combined aggregate size, density and particle size fractionation procedure and aggregate stability measurements to sandy steppe topsoils with different organic matter inputs due to different grazing intensities (continuously grazed = Cg, winter grazing = Wg, ungrazed since 1999 = Ug99, ungrazed since 1979 = Ug79). Higher inputs of organic matter led to higher amounts of OC in coarse aggregate size classes (ASC) and especially in particulate organic matter (POM) fractions. We found no grazing-induced changes of soil organic matter (SOM) quantity in fine ASC and mineral fractions. SOM quality (13C CPMAS-NMR spectroscopy, neutral sugars) was comparable between different grazing intensities, but SOM in ungrazed plots was more decomposed across all fractions. We found generally higher radiocarbon activities in Ug79 compared to Cg. Aggregate stability, analysed as resistance to sonication, was higher in Ug79 compared to Cg. Higher litter inputs in grazing exclosures increased POM quantity, led to faster SOM turnover and resulted in the formation and stabilisation of coarse aggregates. Organo-mineral associations were affected by higher turnover times as radiocarbon activities increased, but OC saturation of this pool did not change. To summarise, additional litter inputs are sequestered in the intermediate POM pool and the long-term pool of organo-mineral associations is close to saturation. We conclude that management changes in steppe ecosystems do not necessarily increase carbon sequestration and their assumed potential to act as carbon sinks has to be questioned.

S01.H.04
Organic carbon content of forest and agricultural soils in Slovenia

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Soil organic matter content has important effects on numerous soil properties. Usually it is calculated from the content of soil organic carbon (SOC) which can be directly measured in the soil samples. Contents of SOC in organic and mineral horizons of 886 soil profiles stored in the Slovenian Soil information system (TIS) database are presented and grouped according to different land usages. The results show that ploughed soils have the highest stock of SOC in mineral part of soil (164±10.8 t/ha on average) despite their lowest (2,1 %) percentage of SOC and the absence of the organic horizon within the soil profile. The reasons for high quantity of the SOC stock in ploughed (= arable) soil are the soil deepness, high average bulk density of the soil, and agricultural practice with high manure input. The next are forest (150±7.7 t/ha, 4.7%) and pasture (150±13,5 t/ha, 4.9 %) soils. Grassland soils have the lowest stock of SOC (143±7.8 t/ha, 3.1 %). Additionally, average contents of SOC for mineral soil were calculated for nine most widespread soil types.

S01.H.05
Early evolution of the soil organic matter pool as measured on a high alpine chronosequence

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Knowledge of soil organic matter (SOM) turnover rates is very important for the quantification of soils as sources and sinks of atmospheric CO2. A complicating factor is that SOM is a complex mixture that ranges from fresh fragments to recalcitrant compounds that all have a different stability. Obviously, the recalcitrant fraction is ultimately responsible for long-term terrestrial carbon storage. Reasons for organic matter preservation may be intimate association or adsorption with the mineral fraction, protection against water-soluble microbial enzymes by micropores inside soil aggregates, or the hydrophobic nature of some organic matter. Newly exposed landscapes provide a natural experiment to investigate the roles these mechanisms play. Here we present insights in the early development of alpine soils that were gradually exposed after glacier retreat in Central Switzerland. Initial SOM accumulation is clearly present along the 150 year long chronosequence, which shows an exponential increase in TOC content. Chemical and physical separation techniques combined with chemical fingerprinting techniques like IR and X-Ray spectroscopy of grain size and chemically defined SOM fractions along the chronosequence, as well as analysis of specific compounds, gives insight in the buildup and relative importance of the various pools of SOM over time. More specifically, the use of radiocarbon analysis as natural tracer for the age of various organic carbon pools is explored. Comparison of the 14C content of SOM pools of different chemical resilience against oxidation, as well as of a number of specific compounds with a varying degree of hydrophobicity, may provide much insight in the mechanisms that play a role in carbon dynamics.
An inventory of the total carbon content in the glacier forefield as well as the measurement of CO2 fluxes and the export as dissolved inorganic and organic carbon will give additional insight in the carbon dynamics of young developing soils.

S01.H.06
Changes in soil carbon contents in long-term experimental grassland plots in Northeast England between the 1980s and 2006

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A recent report of widespread declines in soil C concentrations in the UK over 10-25 years has focussed attention on the importance of re-sampling previously characterized sites to assess long-term trends in soil C contents and the importance of soils as a potentially volatile and globally-significant reservoir of terrestrial C. The Palace Leas meadow hay plots at Cockle Park, Northumberland, UK have received different manure and fertilizer treatments since 1897, but have otherwise been under constant management. Six of the plots probably represent the only grassland site in the UK and one of the few in the world at which changes in soil C over several decades can be assessed. In the 1980s, the soil C contents (not concentrations) were measured systematically for six plots and in 2006 we re-sampled the same six plots and determined soil C contents. Four of the plots showed no net changes in soil C contents, but two plots apparently showed net losses of soil C of 15 and 17% (amounting to 1.8 and 1.5 kg C m^{-2}), respectively, since the 1980s. However, the percentage differences in the soil C contents between the 1980s and 2006 were in the same range as the variation in bulk density with soil water content. When the differences with time in total C contents for all six plots were examined using a paired *t*-test, i.e. regarding the plots as six replicate permanent grasslands, there was no significant difference between the 1980s and 2006. These observations, which are based on measured soil C concentrations and bulk densities from known sites that have been under constant management, question the extent of losses in soil C due to a widespread environmental change in recent decades.

S01.I.01
Soil organic matter decomposition in tropical forests: a translocation experiment along an altitudinal transect in Peru.

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Tropical forests store large amounts of organic carbon above- and below-ground, and are among the ecosystems most vulnerable to future climate change. To determine the influence of climate change on soil organic matter decomposition processes in tropical ecosystems, we translocated soil cores between 4 sites along an altitudinal transect in the Peruvian Andes. The transect covers an altitude difference of almost 3000 m with a difference in mean air temperature of 14°C and soil temperature of 13°C between the highest and lowest sites. The vegetation of the 4 main sites varies from montane cloud forest to lowland tropical rain forest. The CO2 effluxes and volumetric water contents of translocated root- and litter-free soil cores have been measured biweekly, along with the soil respiration rates of adjacent intact soil collars. We have also measured soil respiration rates during 24h periods to separately quantify the sources of soil CO2 efflux. Additionally, we are sub-sampling the translocated cores at increasing time steps (months to years) to determine carbon loss and carbon distribution within different soil layers. Organic soil horizons have been analyzed by NMR spectroscopy, and mineral soil layers by separation into soil carbon fractions with different stabilization mechanisms. Initial results after 6 months show that between 74% and 90% of the variance of the CO2 flux rates from the translocated soil cores can be explained by soil temperature and volumetric water content. Surprisingly, the respiration rates of intact soil collars along the entire transect do not vary significantly, but the Q10 values do. Variations in day- and night-time respiration rates of intact soil collars may be mainly driven by litter respiration and to a smaller degree by root respiration. NMR spectra of initial and translocated soil cores show no substantial changes in soil carbon composition in the organic layers after 6 months.

S01.I.02
Temperature sensitivity of SOM decomposition with depth: influence of SOM protection

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On a global scale, 60% of the C stock in the upper meter of the soil is found below 20 cm. Predicting impacts of climate change on soil C stocks therefore depends on accurate knowledge of changes in temperature sensitivity of SOM decomposition with depth. However, much remains unclear about how temperature sensitivity (Q_{10}) is affected by the driving factors that change with depth, like SOM quality and SOM protection. While decreasing

quality is expected to increase Q_{10}, we hypothesized that increasing protection would decrease Q_{10}, since SOM protection limits substrate availability for decomposition.
We investigated this hypothesis using respiration data of bulk soil (with or without ^{13}C-labeled maize residue) and different size fractions (macroaggregates, microaggregates and silt) of two soil layers (5-15 cm and 95-105 cm) of a loamy agricultural soil incubated at 25°C and 35°C. We calculated Q_{10} values for different stages of the decomposition process.
During the first stage of the incubation, Q_{10} values for soil and size fractions suggest that the most important control for temperature sensitivity in the deeper layer is SOM protection, while in the top layer it is rather C quality than SOM protection. Q_{10} values for residue C suggest that residue decomposition is not yet affected by C protection during the first month of incubation.
While addition of maize residue had no effect on SOM decomposition rate or Q_{10} in the top layer, we observed a large priming effect in the deeper layer. Because this priming effect was larger at 25°C than at 35°C, the primed C had a Q_{10} value below 1.
Incubations are continued to determine the effect of decreasing C quality with time on Q_{10}, while monitoring soil microbiology will enable us to investigate if differences in priming with temperature and depth are related to changes in microbial communities.

S01.I.03
Effects of a simulated summer drought on the contributions of new and old carbon to the CO2-efflux of Swiss grassland soils

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In grasslands summer drought might affect the carbon cycle, including soil respiration and the carbon transfer from litter to the soil. In this study we used ^{13}C-depleted biomass to i) investigate the effect of simulated drought on plant and soil carbon dynamics in Swiss grasslands, and ii) for the first time we have attempted to separate fresh litter respiration and total soil respiration in grassland.
The sites were located in grasslands at three research stations at 400 m, 1000 m and 1900 m a.s.l.. We measured i) total soil CO_2-efflux every 2-4 weeks at each station and ii) $^{13}CO_2$-efflux biweekly at 400 m a.s.l., after having applied 0.7 kg m^{-2} of ^{13}C-depleted biomass. Drought was simulated with rainfall shelters for 10-11 weeks, excluding about 150-300 mm of rainfall from the plots in 2007.
Our first estimates of soil respiration rates (298-461 mg C m^{-2} h^{-1}) during the growing season fell within the range of published data for grasslands. The simulated drought significantly reduced the total soil CO_2-efflux by approximately 21 % at 400 m, 23 % at 1000 m and around 38 % at 1900 m a.s.l.. The decline in soil respiration under drought conditions found here is consistent with results from CO_2-efflux measurements across Europe during the heat wave in summer 2003. For the first time the effect of drought on the contribution of fresh litter to the total soil CO_2-efflux in grasslands was determined using ^{13}C-depleted biomass. The artificial summer drought reduced CO_2-efflux from fresh litter by 48 % over the whole growing season at 400 m a.s.l..
Our data showed that summer drought reduced soil respiration, especially the new biomass respiration. However, for a complete ecosystem carbon budget we need additional data covering several growing seasons, including e.g. changes in biomass quantity and quality and DOC fluxes.

S01.I.04
Elevated CO2 stimulates microbial growth and exoenzymes in soil aggregates

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Microbial decomposition of soil organic matter (SOM) is controlled not only by physico-chemical soil properties and environmental parameters, but also by the amount and composition of plant residues as well as rhizodeposition. Elevated atmospheric CO_2 can alter plant residues composition and its amount, hence affecting the rates of microbial metabolism in soil and turnover of C and N. We investigated the effects of elevated CO_2 on growth rates and enzyme activities of soil microorganisms in bulk soil and in three aggregate-size classes.
Soil samples from FACE plots (Hohenheim, Germany) under ambient (380 ppm) and elevated CO_2 (540 ppm; for 5 years) were separated to aggregates using dry sieving. Bulk soil and isolated large macro- (>2 mm), small macro- (0.25-2) and microaggregates (<0.25) were amended with glucose and nutrients to stimulate unlimited microbial growth. Soil respiration was approximated based on microbial growth kinetic and the maximal specific growth rates (μ_{max}) and microbial biomass amount were calculated. The activities of extracellular enzymes: β-glucosidase, chitinase, phosphatase and sulphatase were measured by fluorogenically labelled substrates in bulk soil and aggregates before and after glucose activation.
The distribution of soil aggregates (>2 mm: 30%, 0.25-2 mm: 60%, and <0.25 mm: 10%) has not changed after 5 years of elevated CO_2. μ_{max} were significantly higher under elevated compared to ambient CO_2. Under both CO_2 treatments μ_{max} increased in the following order: large macroaggregates < small macroaggregates < microaggregates. Total microbial biomass significantly increased with decreasing aggregate size for both CO_2 treatments. The activity of all soil enzymes significantly increased under elevated CO_2. However, no effect of aggregate size on enzyme activities was observed. Increase of μ_{max} values and enzyme activities under elevated CO_2 indicates stimulation of fast growing microorganisms. This stimulation by elevated CO_2 was especially pronounced in microaggregates.

S01.J.01
Intensive grazing leads to degradation and spatial homogenization of topsoils in two major steppe types in Inner Mongolia, P.R. China

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Overgrazing in semi-arid grasslands results in degradation of steppe vegetation associated with changes in the amount and composition of soil organic matter (SOM). The effect of intensive grazing on quantity and quality of SOM was assessed by comparison of continuously grazed (CG) and since 1979 ungrazed (UG79) plots in *Leymus chinensis* and *Stipa grandis* dominated steppe types in Inner Mongolia, China.
At all sites grids with spacings of 15 m and 5 m were sampled at 0 - 4 cm to elucidate the spatial structure of topsoil parameters. Each sample was analysed for bulk density, texture, soil organic carbon (SOC) content, total N and S content, inorganic C, pH, and $\delta^{13}C$.
All CG plots have significantly increased bulk densities and decreased SOC, total N and S contents. The *Stipa* dominated site shows higher bulk densities and lower SOC, total N and S

contents and stocks at CG and UG79 than the *Leymus* dominated site.
Spatial patterns of the investigated topsoil properties change from a pure nugget or patchy to a homogeneous distribution under intensive grazing at both steppe types.
The observed changes at CG plots can be attributed to the combined effect of animal trampling, reduced above- and belowground organic matter input, and erosion in consequence of heavy grazing. This leads to degradation of soil aggregation and release of aggregate-protected SOM, associated with enhanced susceptibility to soil erosion.
A higher sensitivity of *Stipa* dominated sites to intensive grazing compared to *Leymus* dominated sites can be explained by drier soil conditions associated with a lower degree of stabilisation of SOM in microaggregates and organo-mineral associations and a lowed input of organic matter. Increased heterogeneity at sites with grazing exclusion can be ascribed to vegetation recovery due to formation of "islands of fertility", and deposition of windblown material in ungrazed plots.

S01.J.02
Is soil organic matter the link between soil management and soil resilience in agricultural soils in England?

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Soil organic matter (SOM) has a considerable effect on many properties and functions of soils and, in agricultural systems, the SOM content is largely controlled by soil management. We predicted that SOM, and hence soil management, would affect the important property of soil resilience: the ability of soil to resist and recover from stress. We therefore set to challenge this hypothesis by selecting soils from a range of sites in England, where both arable and grassland agriculture was being practiced, for laboratory testing.
Soils were subjected to either a 200 kPa compression stress in the laboratory as a physical stress or to one of two biological stresses: 18 hours heating at 40 °C (transient stress) or the addition of $CuSO_4.5H_2O$ (chronic stress). The soil functions that were used to assess the response of the soil to the physical and biological stresses were soil pore space (void ratio) and grass substrate induced respiration respectively.
Compression reduced pore space significantly in all soils, particularly the grassland soils of high SOM content. Following compression however it was the grassland soils that recovered more pore space than the arable soils. Particulate SOM and water redistribution following removal of the compression stress appeared to be important for the immediate recovery of pore space.
Resilience to the Cu-stress appeared to be closer related to SOM than was resilience to the heat stress. The transitory nature of the heat stress might affect soils similarly whereas the effect of the Cu-stress, being more long-term, is probably determined by those soil characteristics that have resulted from long-term soil management.
We were able to demonstrate a positive relationship between SOM content and resilience and conclude that grassland soils, where management allows the build-up of SOM, are more resilient to physical and biological stresses than arable soils.

S01.J.03
Soil organic matter dynamics in a long-term field experiment comparing conventional and organic farming: Evidence from fractionation and modelling

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Soils globally store significant quantities of carbon as organic matter (OM). Management is a major driver for OM in soil, and some management practices have been advocated to sequester C and to mitigate the atmospheric increase in [CO_2]. We investigated a long-term (28 years) agricultural experiment in Switzerland where conventional, bio-organic and bio-dynamic practices are compared under identical crop rotations. In this study we address whether i) management effects are distinguishable from changes over time for total and OM in physical-chemical fractions, ii) OM dynamics can be simulated with sufficient confidence using the organic carbon turnover model RothC in combination with radiocarbon dating and iii) our current perception of OM in pools vs. fractions withstands rigorous testing using a well-characterized field trial.
For most treatments we measured an OM decline over 28 years though there was no pronounced management change at commencement of the experiment. Time was a more important factor for OM contents than treatment. The decline of bulk soil OM was mostly on expense of mineral-associated matter whereas particulate OM increased. We also observed an unexpected and partially significant increase in stable NaOCl-resistant OM that was previously thought to be unaffected by management. The RothC model was used to simulate the fate of OM over the course of the four crop rotations. OM changes in the bio-dynamic treatment were smallest and simulated by assuming a slower decay for composted manure in accordance to manure treatments at this site and by consideration of the slightly finer texture.
The results do not fully support a previously reported match of pools and fraction for the RothC model probably because management-induced differences were rather small. The latter also questions whether organic vs. conventional farming are an option to sequester C when similar amounts of organic fertilizers are applied.

S01.J.04
Conversion of cropland into grassland: Potential for soil organic carbon sequestration?

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Rapid loss of soil organic carbon (SOC) has been shown after conversion of grassland into cropland. SOC accumulation after re-conversion of cropland into grassland is a slow process which is amplified by the amount of SOC stabilized by adsorption and the SOC transport into the subsoil. Two adjacent cropland and grassland sites - one with a Vertisol with 23 years after conversion and one with an Arenosol 29 years after conversion - were sampled down to 60 cm depth. Concentrations of SOC were measured before and after density fractionation in two light fractions and a mineral associated fraction with C adsorbed on mineral surfaces. For the soil profiles SOC stocks and radiocarbon (^{14}C) concentrations of mineral associated C were determined to access the combined processes of stabilisation and translocation down the soil profile.
SOC stocks and mineral associated SOC concentrations were increased in the upper 10 cm of the grassland soils compared to the croplands. This corresponded to the root biomass distribution and is reflected in an increased proportion of non-stabilized light fraction. Total SOC stocks were not significantly different between grassland and cropland at both sites when the whole profile was taken into account. High subsoil SOC stocks (>10 cm depth) at the cropland sites compensated high SOC stocks at the surface horizons of the grassland. ^{14}C concentrations indicated a rapid incorporation of fresh C into deeper horizons at the Vertisol site. Active C management on the cropland sites yielded SOC stocks equal to extensive grassland SOC stocks. At the Arenosol site the impact of land use conversion on SOC accumulation was limited by low total clay surface area available for C stabilisation. Thus, subsoil´s

potential for SOC storage has to be taken into account when land use change effects on SOC are assessed.

S01.J.05
Impact of tillage on carbon and nitrogen storage of two Haplic Luvisols

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The effects of reduced tillage systems (minimum tillage = MT) on soil organic carbon (Corg) and N sequestration are not completely understood. Thus, the objectives were to investigate the impact of a MT system (to 5-8cm) on water-stable aggregates and particulate organic matter (POM) and on storage of Corg and N in two loamy Haplic Luvisols in contrast to conventional tillage (CT) (to 25cm). Surface soils (0-5cm) and subsoils (5-20cm) of two experimental fields near Göttingen, Germany, were investigated. Both sites (Garte-Süd and Hohes Feld) received both tillage treatments since 37 and 40 years, respectively. In the bulk soil of both fields Corg, N, microbial carbon (Cmic), and microbial N (Nmic) concentrations were elevated under MT in both depths. Likewise, water-stable macroaggregates (>0.25mm) were on average 2.6 times more abundant under MT than under CT but differences in the subsoil were generally not significant. For surface soil under MT, all aggregate size classes <1mm showed about 48% and 56% increased Corg concentrations at Garte-Süd and Hohes Feld, respectively. For greater macroaggregates (1-2, 2-10mm), however, differences were inconsistent but elevations of N contents were regular over all size classes reaching 72% and 64%, respectively. In the surface soil, tillage system did neither affect the yields of free POM and occluded POM nor their Corg and N contents. Moreover, more Corg and N (125-238%) was associated under MT within the mineral fractions investigated. To sum up, similar to no-tillage, a long-term MT treatment of soil enhanced the stability of macroaggregates and thus was able to physically protect and to store more organic matter (OM) in the surface soil in contrast to CT. The increased storage of Corg and N did not occur as POM but as mineral-associated OM.

S01.J.06
Nitrogen retention and plant uptake on a highly weathered central Amazonian Ferralsol amended with compost and charcoal

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Inspired by the sustained fertility of anthropogenic Terra Preta soils in the central Amazon Basin, we studied the effect of charcoal as soil amendment. The use of charcoal as recalcitrant soil amendment can have important implications for sustainable land use in the humid tropics and the earth's carbon budget. Leaching losses of nitrogen (N) are a major limitation of crop production on strongly weathered soils and under heavy rainfalls, as in the humid tropics. We established a field trial in the central Amazon Basin (near Manaus, Brazil), in order to study the influence of charcoal and compost on the retention of N. Fifteen months after organic matter admixing (0 - 0.1 m soil depth), we added ^{15}N labelled ammonium sulphate (27.5 kg N ha^{-1} $(NH_4)_2SO_4$ at 10 atom% excess). The tracer was measured in the top soil (0 - 0.1 m) and plant samples were taken at two successive sorghum (*Sorghum bicolor* L. Moench) harvests. The N recovery in biomass was significantly higher when the soil contained compost (14.7 % of applied N) in comparison to only mineral fertilized plots (5.7 %), due to a significantly higher crop production during the first growth period. After the second harvest, the N-retention in the soil was significantly higher in the charcoal amended plots (15.6 %) in comparison to only mineral fertilized plots (9.7 %). The total N recovery in soil, crop residues and grains was significantly ($P < 0.05$) higher in compost (16.5%), charcoal (18.1%) and charcoal plus compost treatments (17.4%), in comparison to only mineral fertilized plots (10.9%). Organic amendments increased the retention of applied fertilizer N. One process within this retention was found to be the recycling of N taken up by the crop.

S01.K.01
Soil structure dynamics and carbon sequestration

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Soil structure has a strong impact on SOM turnover. The recently developed CIPS model demonstrates this very successful. The partition of the total pore space into micro, meso- and macropores and the subsequent distribution of specific microbial activity to these classes proofed to be very useful to understand long term dynamics without sophistic assumptions like an inert pool. The CIPS model has recently been integrated in the CANDY model in order to perform more complex scenario simulations.
It is well known that SOM has an impact on soil structure. A new submodel in CANDY has been developed in order to simulate these effects also. In this context we consider as structural indicators field capacity (FCAP), permanent wilting point (PWP) and total pore volume (PV) because these are used to control the soil water dynamics in the CANDY model and also as proxies to identify the pore space classes in CIPS. The main driver of soil structure changes is PV depending on the ratio of bulk density to particle density which are both dependent on SOM. FCAP and PWP can be calculated using a pedotransfer function if PV is known. Particle density is calculated using the approach of RÜHLMANN ET AL. (2006) depending on SOM content. Bulk density is modelled following the concepts of SCHAAF(1998) (tillage and recompaction) and RÜCKNAGEL(2007) (compaction from machinery). The resulting model handles soil structure no longer as a constant parameter but a soil state variable depending on management, climate and SOM.
The integrated CANDY&CIPS model simulates not only the dynamics of SOM pools but also their ages that are varying between 10 to 3000 years if SOM is in steady state.

S01.K.02
Micro-scale modelling of carbon turnover driven by microbial succession at a biogeochemical interface

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The detritusphere is a very thin but microbiological highly active zone in soil. To trace the fate of litter carbon in the detritusphere we developed a new 1D dynamic mechanistic model. In a microcosm experiment soil cores were incubated with ^{13}C labelled rye residues ($\delta^{13}C$=299‰), which were placed on the surface. Microcosms were sampled after 3, 7, 14, 28, 56 and 84 days and soil cores were separated into layers of increasing distance to the litter. Gradients in soil organic carbon, dissolved organic carbon, microbial biomass and activity were detected over a distance of 3 mm from the litter layer. The newly developed 1D model simulates both the total carbon and the ^{13}C carbon pools and fluxes, so that it was possible to include the ^{13}C data in model optimisation. The special feature of the model is that it operates with two decomposer populations; the first one is assumed to be dominated by bacteria (initial-stage decomposer) and second one by fungi (late-stage decomposer). Moreover, in the model the dissolved organic carbon (DOC) pool is divided into two sub pools. Each DOC pool is consumed by one of the decomposer populations. After parameter optimisation the model explained 92% of the observed variance. The model output provides a comprehensive insight into the carbon cycling within the detritusphere. The simulation results showed among others that after 84 days about 10% of total litter C was transferred to the soil organic matter (SOM) pool. From the evolved CO_2 71% was litter-derived and 29% was soil-derived. From the litter-derived CO_2, 69% was directly formed in the litter layer. The remaining 31% was transported to soil before mineralisation. Our study shows that a combination of experimental work and mathematical modelling is a powerful approach to provide a comprehensive insight into the small-scale carbon turnover in soil.

S01.K.03
A model of the formation and movement of Dissolved Organic Nitrogen (DON) in soil

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Dissolved organic matter (DOM) is increasingly regarded as a key component of carbon and nutrient cycling in terrestrial ecosystems. Dissolved organic carbon (DOC) is becoming regarded as the most likely source of substrate and energy for the living micro-organisms that drive these cycles and DOC in percolating water is thought to be a significant pollutant from forest ecosystems. Plants are now known to be able to take up small amounts of Dissolved Organic Nitrogen (DON) although whether these amounts are small because the amounts in soil are limited or because the DON is transient is not yet clear. We report here on a computer simulation model of the carbon and nitrogen cycles under plants growing in agro-ecosystems and analyse the production, turnover and losses of DOC and DON. Two distinct kinds of DOC are envisaged, although the model is not limited to two, a hydrophilic component that moves readily in water and a hydrophobic component that binds strongly to soil particles. The hydrophilic component is rich in N and the hydrophobic component relatively depleted. In this way the C:N ratio of DOM can vary. We validate and test the model with respect to several sets of data: (i) measurements of DOC and N leaching following the application of sugar beet residues to soil (ii) measurements of the longevity of DOC applied with manures to soil (iii) DOC and DON leaching from under experimental plots in the Broadbalk, Woburn ley-arable and Brimstone experimental fields in the UK. With this model we were able to obtain good simulations of the movement and retention of DOC and DON in soil and we explore the contribution of DON to the nitrogen cycle in agricultural ecosystems.

S01.K.04
RothC-Biota - a carbon accounting tool

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Land use change involves changes in the amount of carbon stored in plants and soils. Whilst the amount of carbon change in aboveground vegetation can easily be measured, belowground carbon in roots and soils is more difficult to assess. National carbon inventories require simple ways to calculate changes in carbon stocks when land use changes.
The Rothamsted soil carbon model (RothC) needs independently calculated or measured plant litter production as input data. The purpose of this project was to make a plant component to RothC, so that plant carbon as well as plant litter input to the soil carbon model can be dynamically calculated.
The model was based on a previously published model for plant productivity (Biota). It was parameterised using measured data on root turnover, litterfall and plant allocation. The land cover types used were grassland, three generic crop types and two generic tree types. The model was calibrated for Northern UK, but could easily be calibrated for other areas. Initial tests shows that plant biomass could be predicted with reasonable accuracy.

S02 Soils and Climate Change

S02.H.KL
Do soils change when climate changes ?

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Climate change scenarios predict not only changes in mean temperature and rainfall but also changes in their distribution. For example, observations show increased frequency of extreme events. These include the intensity, duration and frequency of heat waves and associated periods of drought. Also, extreme rainfall events with associated flooding seem to be becoming more frequent. It seems reasonable to investigate whether such possible changes may affect the properties of our soils.
Effects of temperature and water supply on crop growth and soil microbial activity are quite well known and have been studied and modelled for decades. Soils that are warmer, but still moist and well-aerated, will produce not only larger crop growth and yield but also greater aerobic microbial activity in the soil with increased emissions of carbon dioxide (CO_2). Wetter soil is more susceptible to structural damage for example by compaction, and this can lead not only to reduced crop growth but also increased anaerobic microbial activity with resulting increased emissions of nitrous oxide (N_2O). The global warming potential (GWP) of N_2O is about 300 times that of CO_2.
Soil physical properties can also change significantly. For example, soil that is wet for a long period can develop low friability which can result in clod production during tillage with consequent poor seedbed conditions for seed germination and seedling emergence. Also the authors have investigated effects of drying and rewetting on the structure and stability of soils. Structure has been quantified in terms of micro-aggregation as measured with a laser particle size analyser. Stability has been measured by scattering by readily-dispersible clay (RDC) which is a measure of soil instability. Drying and re-wetting can cause major decreases in the content of RDC. This is because this process causes the formation of stable micro-aggregates which incorporate the clay.
The conclusion is that soils can change their properties and behaviour significantly in response to aspects of climate change. Soil physical properties should not be assumed to be constant and non-varying under all conditions. As a consequence, modelling of the effects of different climate change scenarios should also take into account likely changes in soil properties and behaviour.

S02.H.01

Investigating the use of Bayesian Belief Networks to assess the influence of climate change on soil quality

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Modelling the risk factors driving an environmental problem can be challenging when published data describing variables and their interactions are sparse. For example, climate change is thought to affect soils in a number of ways. Most prominent is the hypothesis that climate change is likely to result in a reduction of organic carbon. However, merely demonstrating that carbon stocks have changed provides little basis for managing or maintaining those stocks in the future. In reality, changes in carbon stocks are likely to be influenced by a number of climatic, geogenic, and anthropogenic factors; some of which will act directly on soil carbon, while others will modify existing processes, some will act in isolation, while others will require inclusion of a range of other variables. Many of these factors, and their complex interactions, may be poorly understood thus reducing the ability of the analyst to make policy-relevant conclusions.
In traditional approaches, the inherent complexity in ecological systems is often dealt with by focussing on single, narrow aspects of the problem. The result is an understanding of how different factors behave in isolation, but less understanding of how these associations may interact or be modified. Bayesian nets can provide a basis for rationalising complex interactions, and integrating available information. Here we investigate the utility of a Bayesian Belief Network (BBN) to integrate available quantitative data with qualitative information, and demonstrate how BBNs can 'learn' as new information becomes available. As an example, we explore the major factors influencing carbon stocks in an upland peat soil, and the ability of this approach to predict the consequences of climate change and/or different management scenarios. The dynamic and interactive nature of BBNs provides a framework that can not only identify the major drivers of carbon loss, but also elucidate practicable policy-relevant management solutions.

S02.H.02

Temperature sensitivities of greenhouse gas formation processes

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If carbon and nitrogen stored belowground is transferred to the atmosphere by a warming-induced acceleration of greenhouse gas formation, a positive feedback to climate change could occur. In order to simulate such effects by mathematical models a detailed understanding of the temperature sensitivities of these processes is needed.
We measured fluxes of N2O, NO, NO2, CO2, and CH4 on intact soil cores obtained from thirteen European sites in order to assess the influence of temperature and soil moisture on potential gas emission rates from soils, which covered different climates all over Europe and included four different land use types: croplands, forests, grasslands and wetlands.
We found up to fourfold higher temperature sensitivities of N2O compared to CO2 formation, which can be explained by a combination of reactions leading to an increase of anaerobic zones around soil particles. Activation energies for N2O increased with soil moisture in most sites. Highest temperature sensitivities were found in soils from sites with low annual precipitation.
Temperature sensitivities of NO formation often doubled the activation energy of CO2 formation indicating an involvement of both chemical and biological processes. Activation energies for NO decreased with soil moisture in cropland, grassland and wetland soils.
Activation energies of CO2 did not change significantly with soil moisture or land use type. However, they were highest in soils with low pH and a high C/N ratio, supporting the theoretical assumption that the decomposition of recalcitrant organic matter may be more temperature sensitive than of more easily decomposable substrates. Our study provides the basis for improving biogeochemical models to simulate C and N trace gas exchange in terrestrial ecosystems under changing climate conditions.

S02.H.03

Temperature sensitivity of soil respiration in a sandy soil from Sahel region

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Global Soil respiration (SR) amount ~60 PgC annually, nearly 8% of atmospheric CO2 recycle each year through this process. The heterotrophic component represents between 50 and 100% of the total SR. The temperature (T) dependence of SR is commonly described by Q10 (Q10 = SRT+10/SRT). These Q10 index are central in the models of the soil organic matter dynamics. But, in a global change context, these models may not be adapted for forecasted T conditions, especially extreme events (the models were not tested for a use with soil T beyond 40°C).The objective of this study was to evaluate the T sensitivity of SR in a sandy soil representative of the Sahelian region where soil subsurface T (SST) is regularly already above 35-40°C and can even reach values up to 55°C. Soil incubations were realized with a soil from Saria (Burkina Faso) at three T: 30°C (mean SST at Saria), 35°C in order to simulate a global warming of +5°C and 40°C to simulate extreme event conditions. Kinetics of SR at these three T were followed during 35 days (pre-incubation period). Then the soils samples were split at 13, 20, 30, 35, 40, 50 and 57°C to study the Q10 values in respect of the pre-incubation T and also during times. Q10 were calculated using both the van't Hoff equation (Q10 is constant) and Arrhenius model (Q10 is T dependent). Results showed that even in a depleted C soil, SR increases with T. However, Q10 decreased with both T (from 2.4 at 30°C to 1.7 at 40°C) and duration of pre-incubation. Finally it was observed that Q10 decreased towards values close to the unit for T above 40°C just after the end of the pre-incubation, and even above 20°C, 21 days after the end of pre-incubation.

S02.H.04

Interactions of Pedogenesis, Nitrogen and Carbon Stocks on a Transect Study Across the Qinghai-Xizang (Tibet) Plateau

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The Qinghai-Xizang (Tibetan) Plateau is a key area concerning the environmental evolution of the earth at regional as well as global scales and proves to be particularly sensitive to Global Change. It is the largest low-latitude and high-altitude permafrost area in the world with more than half of its total surface affected by permafrost. This permafrost region is characterized by strong diurnal patterns, high radiation on the surface as well as a distinct geothermal gradient that mainly control the permafrost distribution and thus soil temperature and soil moisture conditions.
During two expeditions in 2006 and 2007, in total 60 sites were investigated on the central-eastern Tibetan Plateau along a 1,500 km long north-south transect. The research focused exclusively on alpine steppe and meadow grassland vegetation. Sites with continuous or discontinuous permafrost as well as areas without or heavily degraded permafrost were investigated for comparison of soil dynamics under various environmental

settings. The central question was how C- and N-stocks can be both related to other soil properties and general ecological parameters. Another major goal was to assess impact of global change on permafrost and its implication concerning the carbon and nitrogen cycles.
Due to the high number of samples and the large-scale transect-concept, sophisticated statistical analysis were carried out showing significant relationships between pedological parameters as well as carbon and nitrogen contents. Importantly, in high altitude grassland ecosystems precipitation and soil moisture conditions were determined as the main influencing parameters of C- and N-stocks in turn closely linked to temperature. Both stocks are coupled with complex feedback mechanisms between permafrost, aeolian processes and the stage of pedogenesis. The latter can be described by acidity, carbonate content and grain size distribution. Permafrost and aeolian sedimentation are a function of relief position, parent material, human impact and seasonal climatic fluctuations.

S02.I.01
Long-term trends (1959-2006) in soil temperature, evidence for sub-soil warming and microbial responses

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There are relatively few long-term temperature records that include sub-soil measurements. By analysing one of the few such dataset, recorded at the Scottish Crop Research Institute in eastern Scotland, trends of increasing average temperatures for soil at 10, 20, 30, 50 and 100 cm depth have been detected. The increases in soil temperature over the 47 years for which data are accessible is between 1.3 and 1.5ºC which is close to the rise in mean air temperatures over the same period of 1.3ºC (increase in mean minimum air temperature = 0.9ºC and increase in maximum air temperature = 1.7ºC). There was no noticeable difference in the warming trend at or below 20 cm depth in the soil, but at 10 cm the soil had warmed slightly less over the period. The most important observation, however, was the warming in the sub-soil at 100 cm, which followed the rising trend of the overlying soil closely. There were significant increases in the t-sum (cumulative soil temperatures; degree.days) for soil at all depths and for the soil temperatures on both the coldest and hottest days (according to air temperatures) over the 47 year period. However, there was no evidence of heat imbalances in the soil which would lead, for example, to the sub-soil staying warmer for a longer period in the year with increasing time. The effect of increased soil temperatures for biological processes in the soil were assessed by measuring the temperature response functions of carbon mineralization by soil micro-organisms from different depths. The responses of carbon mineralization are used to explore the implications of soil carbon storage at different depths.

S02.I.02
Factors controlling C mineralisation in topsoil and subsoil are different

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It is estimated that in excess of 50% of the soil carbon stock is found in the subsoil (below 20 to 30 cm). Despite this very few studies have paid attention to the subsoil. Although surface and subsurface horizons differ in pedological, environmental and physicochemical features, which are likely to affect the mechanisms and biological actors involved, models of carbon dynamics tend to treat the subsoil as “less concentrated” topsoil. In other words, the processes underlying C dynamics are assumed to be the same but with lower gross fluxes in the subsoil. The aim of this study was to test this assumption by analysing factors governing in organic matter decomposition in topsoil and subsoil (between 80 and 100 cm). To this end, we established incubations that lasted 51 days, in which factors that were thought to control organic matter mineralization were altered: oxygen concentration, soil structure, and the energetic and nutritional status. At the end of the incubations measures of microbial biomass and of catabolic profiles of the microbial communities were carried out. The mineralization per unit organic carbon proved to be as important in the subsoil as it was in surface samples, in spite of lower carbon contents and different catabolic profiles. Differences in the treatment effects indicated that the controls on C dynamics are different in topsoil and subsoil: disrupting the structure of the subsoil caused a 75 % increase in mineralization while the surface samples remained unaffected. On the other hand, a significant priming affect was found in the topsoil but not in the subsoil samples. Spatial heterogeneity in carbon content, respiration and microbial communities was greater in subsoil than in topsoil at the field scale. These data suggest greater attention should be paid to the subsoil if global C dynamics is to be fully understood.

S02.I.03
Climate warming induced changes in temperature regimes of the East European Cryosols and associated soils

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East European Russian Arctic is the major area of Cryosol distribution in Europe. Cryosols develop here on the “warm” sensitive permafrost. At present, the permafrost is degrading in response to air temperature forcing. Air temperatures demonstrated a clear increasing trend since mid-1970es. To trace soil responses, we monitored soil temperatures since 1996. In total, 14 one-to-nine-year-long records were obtained. Intermediate results of the study were published elsewhere. Here we discuss climate warming effects on soils based on 1996-2007 data. Neither one of the regional weather stations measures soil temperatures in Cryosols, however, records from non-permafrost soils of the discontinuous permafrost zone are available allowing assessment of recent changes against the long-term norms.
Mineral Cryosols belong to Subgelic and organic Cryosols to Pergelic temperature classes of Soil Taxonomy, whereas non-permafrost soils belong to Isofrigid-Cryic class with a few Frigid-Cryic exceptions. Values of soil temperature indices registered recently were still within the limits of these classes. However, statistically significant warming trends were observed in soil temperatures and the depths of seasonal thaw/freezing. A number of extreme soil climate events was registered. Mean annual soil temperatures above 0ºC and the seasonal freezing which did not reach permafrost table were observed in Cryosols, whereas non-permafrost soils showed the about-zero or extremely shallow winter freezing. In the longer run such events were not exceptional, though extremely rare. Against the warming trend their effects are amplified being not fully compensated by the subsequent soil climate dynamics.
Consequences of the rapid changes in soil temperatures which can be expected under the continuing warming include soil surface subsidence which amounted 18 cm in 8 years at our monitoring site and release of greenhouse gases due to decomposition of the previously frozen organic matter.
The study was supported by the NSF, INTAS and the Russian Academy of Sciences.

S02.I.04
Soil organic carbon stocks in the Canadian permafrost region and their role in climate change

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The total soil area of the permafrost region of Canada was found to be approximately 5,173 x 10^3 km^2, which is 72% of the soil area of Canada. Permafrost-affected mineral soils cover approximately 2,530 x 10^3 km^2 and nonpermafrost mineral soils cover approximately 1,694 x 10^3 km^2. Organic soils (peatlands), both permafrost-affected and nonpermafrost, are a common feature of the region and cover approximately 949 x 10^3 km^2.
The soil organic carbon content in the Canadian permafrost region varies according to soil type, with organic soils (peatlands, total depth) and cryoturbated, permafrost-affected mineral soils (0-100 cm) having the highest mean values (30-120 kg m^{-2}). The soil organic carbon stocks (mass) (SOCM) in this region were estimated to be 196 Gt for the 0-100 cm depth, which is approximately 76% of the total soil carbon in Canadian soils at this depth. Most of the SOCM occurs in the Cryosols (permafrost-affected soils) and organic soils (peatlands), which contain approximately 63% of the SOCM in the 0-100 cm depth. Some limited data suggest that a considerable amount of organic carbon also occurs below the 100 cm depth in cryoturbated mineral soils and peatlands.
The calculated values presented here indicate that organic carbon in the soils of the permafrost region of Canada accounts for approximately 56% of North American and 15% of global soil organic carbon at the 0-100 cm depth. Much of this soil carbon will be vulnerable to release because of the large temperature increases (3-4 °C) predicted to result from climate change.

S02.J.01
Soil carbon sequestration potential in newly established prairies in previously cultivated Mollisols

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In addition to its aesthetic and environmental qualities, prairie restorations can potentially act as a C sink and offset rising atmospheric CO_2. Recent research in the past ten years has repeatedly shown the benefits of prairie restorations to sequester soil organic C by measuring changes in soil C content, however, this measurement alone does not determine whether a site is a net sink or a source for CO_2. The determination of potential atmospheric CO_2 sequestration in the soil requires an assessment of the ecosystem's metabolism. The objective of this study was to determine soil C sequestration potential of newly established prairie (prairie remnant, 1993, 1998, and 2003 sites) on previously cultivated land and soil surface CO_2-C emission using a C budgeting approach. Soil C content, vegetation type (cool and warm season grasses, forbs, and legumes), aggregate size distribution, soil surface CO_2-C emission, above and below ground plant biomass and microbial biomass were measured. Preliminary findings suggest; (i) that total C potential input differences between sites were only observed in root biomass contribution; (ii) total soil surface CO_2-C emissions were strongly related to year since establishment and vegetation type within site; (iii) the prairie remnant site had the greatest soil C content while the cropland sites and the youngest prairie had the least (iv) and soil C content increased as time since establishment increased in prairie restorations, although at a decreasing rate. Calculations of net C input show that the youngest prairie restorations had the biggest potential for sequestering C, although it took less than a decade before these sites ceased as a major net sink for CO_2-C compared to prairie remnants and cropland. Furthermore, findings suggest that root biomass and time since establishment may be the leading factors in determining the effectiveness of prairie restorations on soil C sequestering potential.

S02.J.02
Long-term monitoring of C dynamics in a temperate grassland ecosystem via stable isotopes (13C) in a Free Air CO2 Enrichment (FACE) experiment

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Since pre-industrial times (1750), fossil fuel burning and land use change has led to a 34% rise in atmospheric CO_2 of currently 380 ppm. The elevated atmospheric CO_2 concentrations enhance photosynthesis but also increase respiratory C losses from ecosystems with a yet unknown net effect for net soil C stores. Between August 2004 and December 2006 we examined the effects of elevated CO_2 on ecosystem respiration (R_{eco}) and soil CO_2 concentrations in a FACE experiment near Gießen, Germany on a permanent grassland (start: May 1998). In July 2004, the $\delta^{13}C$ signature of the enrichment-CO_2 was switched from -25 to -48‰, to trace ecosystem C-fluxes without concomitant priming effects of a CO_2 step increase.
Under elevated CO_2 +20%, the overall contribution of root-derived soil respiration was 55% in the top 15 cm of the soil. The ^{13}C signature of R_{eco} and soil air CO_2 showed lowest values during the growth period, indicating a higher contribution of plant-derived CO_2 at that time. The mean contribution of root, leaf and soil respiration on R_{eco} was 29 ±18%, 32 ±23% and 38 ±20%, respectively. A significant decrease in soil air $\delta^{13}CO_2$ with soil depth indicated a relatively higher contribution of root-derived CO_2 in the deeper soil layers. The $\delta^{13}CO_2$ gradient showed a clear annual dynamics with a significant impact of soil temperature. The steepest $\delta^{13}CO_2$ gradients occurred during winter but became less distinctive during summer. The CO_2 enrichment enhanced R_{eco} by 13% above ambient but did not result in increased soil C sequestration after 9 years of elevated CO_2. No CO_2-induced differences in the temporal dynamics of R_{eco}, soil air [CO_2] and the $\delta^{13}C$ signature were observed. The seasonal variability recorded in the long-term monitoring may explain partly-contrasting findings of other studies where no long-term sampling was performed.

S02.J.03
Free air CO2 enrichment-induced life form- and species-specific responses of collembolans in arable soil

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Effects of atmospheric CO2 enrichment on life strategy and species composition as well as individual density of collembolans were analysed under sugar beet and winter wheat cultivation in a long-term CO2 enrichment field experiment (FACE: Free Air CO2 Enrichment) at the Federal Research Institute for Rural Areas, Forestry and Fisheries (vTI) in Braunschweig (Germany). The use of isotopically labelled CO2 allowed tracing of the surplus C by means of stable C-isotopic signatures (δ13C). δ13C values of collembolan species, plant material, and soil indicated CO2 impacts on C-translocation. The studies were carried out at two plant developmental stages to consider seasonal aspects.
The δ13C values of crops significantly increased from above- to below-ground plant parts. Under FACE conditions, the stable C-isotopic signatures of all plant parts significantly decreased. The δ13C values of collembolan species differed significantly depending on CO2 treatment and crop and showed a distinct tendency depending on plant growth stage. Under FACE, the δ13C values of collembolans generally decreased. The extent of this shift varied, depending on species and life strategy. Under FACE conditions, the hemiedaphic life form type showed a stronger depletion in 13C when wheat was cultivated. In the

control, similar δ13C values were detected for euedaphic and hemiedaphic species.
Atmospheric CO2 enrichment-induced changes in occurrence, density and dominance distribution of collembolan species differed strongly between crops and their developmental stages and indicated crop specific below-ground effects due to different food qualities in the rhizosphere. FACE effects were stronger under sugar beet compared to winter wheat cultivation. Generally, atmospheric CO2 enrichment led to a higher collembolan diversity in the late growing season and increased the proportion of hemiedaphic in relation to euedaphic species in a community.
The results indicate CO2-induced changes in the root-derived carbon resources, which specifically affect collembolan species according to their preferred food sources.

S02.J.04
Cereal-based plant production systems to mitigate greenhouse gas emissions- a Danish perspective

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The Danish government has recently included article 3.4 in the Danish CO_2 accounts under the Kyoto protocol, whereby carbon sequestration in crop- and grassland will be included in the national greenhouse gas inventory. This accentuates the need for developing cropping systems, which minimises greenhouse gas emissions. Greenhouse gas emissions from the cultivation of arable soils account for 57% of the total emissions from Danish agriculture. Carbon sequestration may be accomplished by increasing the carbon input to the soil or by decreasing the turn-over rate of organic matter. There is room for carbon sequestration in Danish arable soils grown with cereal-based rotations, as the carbon content is relatively low and decreasing.
In 2007, we initiated the CoolCrop project, which focus on sustainable Danish plant production systems to mitigate global warming. We hypothesize that the greenhouse gas emissions from Danish arable soil can be substantially reduced by implementing crop production systems based on reduced tillage in combination with versatile crop rotations and residue retainment. We also hypothesize that growing deep-rooted catch crops can substantially increase carbon sequestration. These hypotheses are now tested experimentally and the information is incorporated into the FASSET soil-plant-atmosphere model. At EUROSOIL 2008, we will present experimental data from a field experiment located at a sandy loam and a loamy sand. Four different tillage treatments are tested within five crop rotations. The crop rotations are all suited for arable production farms, but differ in the proportion of spring cereals and oil seed crops in the rotation. In addition the rotations differ with respect to retainment of straw and use of catch crops. The tillage systems range from conventional tillage with mouldboard ploughing to direct drilling. At EUROSOIL 2008 the experimental results will be supplemented by model predictions of the effect of different soil management.

S02.J.05
Effect of Silicate Fertilizer and Tillage Systems on Mitigating Methane Emission during Rice Cultivation

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Slag type silicate fertilizer (hereafter, silicate fertilizer), being potential source of active iron oxide as an electron acceptor and available silicate, was applied at 4 Mg ha^{-1} in tillage and no tillage plots before rice transplanting to investigate their effects on suppressing methane emission during rice cultivation. CH_4 emission rates from the tillage and no tillage rice fields decreased significantly with silicate fertilizer application during rice cultivation. The soil Eh decreased rapidly after flooding, while methane emissions significantly increased with the development of rice growth stages. However, silicate amendment significantly decreased CH_4 emissions from the tillage and no tillage paddy soils, which could be due to the reduction of ferric iron and increased concentrations of active iron and free iron oxides in soil, being acted as electron acceptors. Total seasonal CH_4 emission was decreased by 20 % and 36% in tillage and no tillage rice field respectively, with 4 Mg ha^{-1} silicate amendment, while rice grain yield was increased by 18 % and 13%, respectively. The increased rice yield was attributed due to the stimulation of leaf photosynthetic rate and improved yield components by silicate fertilization.
Rice plant growth parameters such as number of tillers, leaf area index, shoot biomass, root biomass, root volume, root porosity etc. and the soil parameters such as soil porosity, soil pH, available silicate and phosphate concentrations, total iron, active iron, free iron and ferrous iron concentrations in soil significantly increased with silicate fertilization, which were negatively correlated with CH_4 emission.
Therefore, silicate fertilizer could be a good soil amendment for reducing CH_4 emission as well as increasing rice productivity both in tillage and no tillage paddy soil.

S02.J.06
Changes in total soil C under different crop management systems and in never-tilled soil in a long-term experiment

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Monitoring soil carbon (C) plays an important role in understanding the influence of different land uses and management practices on C sequestration. Changes in C content vary across landscape as a result of complex interactions among different factors including historical soil C levels, soil texture, topographical attributes, and land use and management practices. The objectives of this study are, first, to examine the changes in soil total C contents that occurred during the past 15-20 years in soils under agricultural management and in never tilled soils of Southern Michigan, USA, and, second, to explore the relationships between these changes and soil and topographical attributes. The data were collected from two long-term experiments established in 1986 and 1988, respectively. Geo-referenced samples were collected from both experiments prior to establishment and then the locations were resampled in 2006-2007. Studied agricultural practice treatments included conventional chisel plowed management, conventional no-till management, and organic chisel plowed management with legume cover crops. Non-agricultural treatment was a mid-successional plant community on a never tilled soil. Preliminary data analyses indicated that since 1980's the total C has significantly decreased under conventional chisel plowed management and in never tilled soil. Soil C under no-till management and under organic management with cover crops tended to be higher than that of the conventional chisel plowed management, however, it has not increased as compared to 1980's. That is, the conservational management practices appeared to have prevented total C loss as compared to conventional management but they did not lead to gains in absolute C amounts. Relationships between changes in total C and soil properties and topography and results of modeling soil C in the studied treatments using SALUS will be presented and discussed.

S02.K.01
Assessing long-term management and climate effects for comparing local adaptation strategies

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Data from four long-term Russian field experiments (LTEs) on soddy-podzolic soils of different textures were used for separation the effects of management and climate factors on yields based on modeling with Climate-Soil-Yield - a dynamic simulation model of agroecosystem productivity. The model was used to compare simulated water-limited yield under optimal N nutrition with the experimental results obtained in treatments with different levels of N input. Reaching new level of soil fertility needs not less than 10-20 years but it demonstrates further changes after achieving near-equilibrium state. The changes in the observed trends for different fields with the same treatments are related to the initial level of soil fertility and different crop-climatic year combinations. This approach allowed using the model forecasts with coarse resolution for description local yield dynamics in the specific LTE's treatments based on the smoothed trends, thus including the effect of local soil fertility dynamics on crop yields in 2000-2050. Based on future yield estimates crop management impacts on C sequestration were predicted with the RothC model. Adaptation simulations include alteration of crop rotation system, organic fertilization, and more extensive use of perennial crops. Introduction of adaptation practices will allow increasing C sequestration potential in the study area by the years 2010-2020, mainly as a result of C gains by soils with physical clay content of more than 30%. Under adaptation C sequestration potential could be increased by at least 40 % in heavy soils. For light soils the expected climate changes will result in the increased input item of the soil carbon budget and can potentially reduce of 1 t/ha C of SOC losses (2000-2050) for control treatment. For organic fertilization treatment, the potential for carbon sequestration is estimated at 3 t/ha C with the most favorable climate conditions for C sink in 2030-2040.

S02.K.02
Modelling green house emissions associated with application of biowaste to land

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There is increasing demand on the usage of biowaste in agriculture and related sectors. This is related to the increasing pressure of returning waste to land and the need to convert waste to useful product. Some of these waste products are composted either with green or food waste. Compost is a good source of soil amendment as it increases water holding capacity, organic matter and provides nutrients to plants and soil microbial community. Nutrient benefits to crops derived from compost can be very beneficial in the light of escalating prices of inorganic fertilisers. However this has to be balanced with corresponding releases of green house gas (GHG), particularly nitrous oxide.
In this project we have considered different biowaste streams comprising green waste compost, green and food waste compost, food waste compost, digestates from green and food waste and anaerobic digestion liquor. We considered the application of these different biowaste streams to different land uses such as agriculture, grassland and as topsoils to establish Short Rotation Coppice (SRC) on brownfield sites. In the agricultural sector we considered use of compost on three contrasting soil types (light, medium and heavy) with suitable crop rotation comprising of cereals (wheat, barley), oil seed rape and root vegetables (eg potatoes and sugar beet). In the grassland sector we used compost for establishing grass for sheep and cattle grazing. We used the model Daycent which is a biogeochemical model to predict the release of N_2O, CH_4 and CO_2 associated with the application of these different biowaste streams to the various landuses mentioned above.
Initial results show that when comparing GHG emissions associated with the application of compost (taking into account its fertiliser nutrient contributions and reducing application of inorganic fertiliser) and inorganic fertiliser, the release of N2O is greater in the former than the latter.

S02.K.03
Effect of elevated CO_2 on the N cycle in grazed pasture

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Increasing levels of atmospheric CO_2 are expected to enhance plant growth and accumulation of carbon (C) in soil. However, the responses of terrestrial ecosystems to elevated CO_2 also depend on the availability of nutrients and in particular, nitrogen (N). Under elevated CO_2 it is hypothesized that increased competition between plants and soil microorganisms for available N will lead to a progressive N limitation in ecosystems especially in natural ecosystems with low external N inputs. So far, little is known about how N-limited and natural ecosystems respond to elevated CO_2.
The aim of our study was to determine the effects of long-term elevated CO_2 (475 ppm) on N transformations in a grassland soil under grazing and to see if and how progressive N limitation may be alleviated. Therefore we performed a ^{15}N tracing experiment to quantify the gross N transformation rates in soil from a grazed pasture (New Zealand) that had been under ten years of Free Air CO_2 Enrichment (NZ-FACE). To analyze the complex network of simultaneously-occurring N transformations in soil a numerical ^{15}N tracing model was used in combination with a Monte Carlo sampling technique. In addition we investigated the production of nitrous oxide (N_2O), an important greenhouse gas with a high global warming potential.
Results will be presented on the effect of elevated atmospheric CO_2 on the internal N cycling in the pasture soil. In particular, we show how the N mineralization-immobilization turnover of this grassland was altered including the feedback of elevated CO_2 on the production of N_2O.
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S02.K.04
Quantification of gross N transformation rates in soils via ^{15}N tracing

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In ^{15}N tracing experiments one or more soil N pools are enriched with ^{15}N. Subsequently, the N concentrations and ^{15}N enrichments are determined in the ^{15}N labelled but also in various product pools over time. The quantification of gross N transformation rates among the various soil N pools is based on ^{15}N dilution and enrichment principles. In their pioneering work in the 1950s, Kirkham and Bartholomew considered two pools, an organic N pool and one mineral N pool and developed analytical solutions for the mineralisation and immobilisation process in soil. Since then more complex ^{15}N models have been developed that take into account the N transformations among the various soil N pools. Non-linear optimization techniques are used to identify the parameters in ^{15}N tracing models. This talk outlines the principles of ^{15}N tracing techniques and describes the development of ^{15}N tracing models for the analysis of gross N transformations. A focus will be on the presentation of newly developed ^{15}N tracing techniques that are based on Bayesian data analysis to analyse complex N dynamics in soil. With these new techniques, for the first time, it is possible to analyse the dynamics of nitrite and gaseous N species as well as the effect of climate change on soil N dynamics.

S03 Soil Erosion

S03.D.KL

Challenges for soil erosion modelling across scales and disciplines

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Knowledge in understanding the mechanisms for soil erosion and surface runoff is increasing constantly. However, our possibilities to convert this knowledge into process oriented predictions of what would be the effect of particular management activities for the environment are still very restricted. This as much more as soil erosion research is becoming a central part of more general environmental models, because surface runoff and sediment act as transporting agents for various dissolved and solid substances. In addition, interdisciplinary integrated research efforts raise the need for developing new skills for erosion researchers. In my talk I will try to work out some of the challenges erosion researchers are faced with, emphasising the different processes at various spatial and temporal scales. Examples will be given to demonstrate how research may lead to new options in successfully combating soil loss.

S03.D.01

Assessing soil erosion in Mediterranean karst landscapes of Lebanon using remote sensing and GIS

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Maps showing the potential for soil erosion at 1:100,000 scale are produced in a study area within Lebanon that can be used for evaluating erosion of Mediterranean karstic terrain with two different sets of impact factors built into an erosion model. The first set of factors is: soil erodibility, morphology, land cover/use and rainfall erosivity. The second is obtained by the first adding a fifth factor, rock infiltration. High infiltration can reflect high recharge, therefore decreasing the potential of surface runoff and hence the quantity of transported materials. Infiltration is derived as a function of lithology, lineament density, karstification and drainage density, all of which can be easily extracted from satellite imagery. The influence of these factors is assessed by a weight/rate approach sharing similarities between quantitative and qualitative methods and depending on pair-wise comparison matrix.
The main outcome was the production of factorial maps and erosion susceptibility maps (scale 1:100,000). Spatial and attribute comparison of erosion maps indicates that the model that includes a measure of rock infiltration better represents erosion potential. Field investigation of rills and gullies shows 87.5% precision of the model with rock infiltration. This is 17.5% greater than the precision of the model without rock infiltration. These results indicate the necessity and importance of integrating information on infiltration of rock outcrops to assess soil erosion in Mediterranean karst landscapes.

S03.D.02

Quantitative analysis of soil erosion and sediment yield of the Alaki Chay basin to optimal management it (Iran-Azerbaijan)

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The Alaki Chay basin with an area of 205.5 km^2 is located on the northwest of Tabriz city. Tectonically uplifting, vast extension of potentially sensitive formation to erosion, intensive human activities, and runoffs leads to intensive soil erosion and transporting especially topsoil to the plain area and out of the basin. As a result of mophometric drainage system, basin coefficient shape and evaluation of sediment yield with Arnold, Arnoldus, Sepaskah, Fournier indicated the rate of soil erosion is high in the basin. Annually sediment yield of basin is 41474010 ton/ha/year and average sediment yield of basin in hectare evaluated 201.82 ton/ha/y and indicated intensive soil erosion via runoffs. The high gradient streams and river beds (high mountains 3000 and 3100 meter) from marl and inresistant soil formation, also human activities prepared background for intensive soil erosion and turbulence floods occurrence. The results of some climatic indices (such as Hydrothermal coefficient (HTK) and soil wetness fluctuation (Ws), showed the basin very prone to rill and gully genesis or runoff erosion. In the warm seasons especially in summer occasionally intensive rainfalls leads to occurrence of flash drastic flood and often destroys villages and agricultural lands with reasonable damage. According to the climatic, geomorphology, tectonic condition, erosional systems, some suitable methods and techniques suggested to management and control of soil erosion in the Alaki Chay river basin.

S03.D.03

Uncertainty assessment of suspended sediment estimates from sediment rating curves in a small mountain catchment in the Southern Pyrenees, Spain

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Accurate predictions of suspended sediment yield (SSY) in mountain catchments are needed to guide management decisions and assess the potential impact of soil loss on site productivity and downstream aquatic resources. However significant uncertainties are involved in such predictions. A ten-year-long series of suspended sediment load (SSL) measurements obtained at Cal Rodó catchment (Southern Pyrenees) was analysed to estimate the range of measurement errors under experimental conditions. SSL obtained from sediment rating curves (SRC) were compared with SSL estimated through an infra-red backscattering turbidimeter, an ultra-sonic beam attenuation solids sensors and an automatic sampler. SRC were developed for yearly and seasonal data, in the form of a power function between SSL and discharge. The SSL estimates for every event and whole period, and their errors were simulated for uncertainty analysis using Monte Carlo methods, based on their residual analyses and distribution function for every episode. A difference of half order of magnitude was found between estimates obtained by both methods. The confidence interval boundaries at the 90% level of confidence were larger and outside the interval defined for sensors. Error sources include the imperfect correlation between sediment concentrations and discharge, and the quality of sensor readings and calibration equations. In the case of sensor malfunction, a modelling approach was needed to estimate sediment concentration during periods without measured data. Sediment transport estimates from SRC using similar temporal resolution of data and in mountain environments need to be taken cautiously in management decisions.

S03.D.04

Soil water and wind erosion estimation by using the test areas, GIS land use and soil map

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Water erosion can mostly occur in southern and south eastern part of Estonia where the landscape is hilly. Soils affected by different stage of erosion process occupy 1.2% of total area of Estonia. Earlier investigations are showing that considerable part of this area is used for agricultural production and can be therefore subject for soil loss and lower productivity. The idea of current investigation was to evaluate the soil water erosion according to the land use - is the land under the intensive cultivation where we can expect higher erosion damage or is it under the permanent grasslands where the erosion is minimal. According to the land use data the area of cereals, potato, vegetables, short-term grasslands, permanent grasslands and semi-natural grasslands was specified. For estimation the real state of erosion the method of test areas was used. The test areas (municipalities) were selected on the district where eroded soils are predominant and by using the digital soil map (1:10000) the areas of potential erosion risk according to the current land use were screened out. The results of test areas were extrapolated all over the Estonia and it turned out that only the 0.8% of cultivated land is located on eroded soils. It was figured out that mostly the area of erosion endangered soils is covered by permanent grassland and therefore not prone to the erosion damages. However the share of eroded land under the cultivation in tested municipalities is from 17 to 21% and in farm level the share of erosion affected soils under the crop rotation can be much higher. In this level the protection measures against the erosion have major importance to maintain soil fertility and preserve the soil functions.

S03.E.01

Soil Erosion Survey for Saxony using the EROSION-3D Simulation Model

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Soil erosion models are increasingly used, in order to gain information about the temporal and spatial distribution of erosive soil transport, deposition and to simulate the effects of soil erosion control measures. In this study the EROSION 3D simulation model is applied for surveying soil erosion and deposition on the catchment scale covering the entire state of Saxony (Germany). EROSION 3D is an extensively validated, GIS based soil erosion model which is used since more than 10 years. However, model application for an entire state is a new challenge, because of the enormous data requirements and complex data processing operations. In this context the study includes the compilation, validation and generalisation of existing land use and soil data in order to generate a consistent EROSION 3D input dataset for the entire state of Saxony.

The project aims to extend the parameterization software DPROC by an interactive GIS-component which enables the user to select arbitrary hydrological watersheds including the related soil and land use data. Based on these data DPROC automatically creates the according EROSION 3D input files using a relational database of primary data and model specific data.

Up to now these database covers not all relations completely. Therefore, a second focus of the study refers to the validation and extension of the database, which were created in the mid-1990s based on rainfall simulation experiments. A campaign of further extensive experiments provide additional information with respect to the effects of new soil management practices (e.g. longtime conservation tillage according EAFRD) on water infiltration and soil loss.

The project should end up in a user-friendly, timesaving and improved software package for the simulation of soil loss and deposition on a regional scale providing essential information for the planning of conservation measures particularly under consideration of expected land use and climate changes.

S03.E.02

Modelling winter cover crop management impact on runoff and erosion in a continuous maize cropping system

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The hydrological impact of crop management practices has to be evaluated on a continuous time scale and modelling this effect requires models sensitive to temporal changes in surface properties. The objective of the present study is to model the impact of different winter cover crop management practices on runoff and erosion at plot scale in a continuous maize cropping system through long term scenario analysis. Given the limitations of existing models, a new, continuous, physically-based, spatially-distributed plot-scale runoff and erosion model with dynamic soil surface properties has been elaborated (CREHDYS). After being calibrated on the basis of 3 years of runoff and erosion measurements on 90 m² erosion plots in a continuous maize cropping system with and without winter cover crop, the model has been run for a continuous maize cropping system over a 30 years period. Scenarios for the intercropping period were: bare post-harvest fully crusted soil, bare soil with superficial disk harrowing and 4 combinations of different destruction and burial dates of a winter cover crop. In addition, the effects of slope gradient, soil texture and the presence of wheel tracks during the maize growing season were also tested. Principal model results indicated that the strongest reduction in runoff and erosion was achieved for the latest possible destruction date (April 1). In the case of early cover destruction, early burial offered a better protection against extreme events than a late burial because of the positive effect of tillage during burial. As compared to superficial disk tillage after maize harvest, very early cover destruction led to similar average performance while early cover destruction permitted a better protection against extreme events. Finally, wheel tracks and slope gradient were found to have a strong influence on runoff and erosion.

S03.E.03

Estimation of erosion and sediment rates using E.P.M. method (case study: Veladareh Basin, Ardabil, Iran)

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Veladareh basin is located in the eastern site of Sabalan volcanic massive and north of Sarein town. The length of Veladareh River is 37.75 kilometer and its drainage basin area is

37.3 squire kilometer. In this study has been estimated the rates of erosion in the four sub-basin of Veladareh using E.P.M. method. The results showed that in upper ports of the basin (Arandareh catchment), the erosion rate is high, because of high sloe gradient. But in the lower parts (Veladareh, Erdymosa and north Erdymosa sub-basins) the rates of erosion are low; because of low sloe gradients in these parts. Rates of especial erosion in the whole basin and in catchments of Arandareh, Veladareh, Erdymosa and north Erdymosa were calculated; 10.3, 14.3, 8.7, 8.6 and 8.6 ton per hectare in the year, respectively. Also, potential sediment discharge in the whole basin and mentioned catchments, were estimated 29008, 10331, 7912, 5676 and 5179 cubic meter in the year, respectively. In the Arandareh catchment as compared with the others, there are both high slope gradient and susceptibility of rocks to erosion and sediment yield. While in the other catchments includes: Veladareh, Erdymosa and north Erdymosa, decreasing of slope gradient factor affects on other agents to produce a little amounts of sediment yield. Therefore, the potential sediment discharges of these catchments have been decreased.

S03.E.04
Quantitative modeling of the impact of landscape structure on soil morphogenetic processes in a complex agricultural landscape

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Soil redistribution within the landscape is increasingly investigated because it modifies local soil properties and is a major process of soil degradation in agro-ecosystems. Hedgerow networks in the landscape are adapted human-made objects that can be used to study soil redistribution processes within the landscape while water erosion redistributes soil, as hedges act as barriers to the physical transfers of soil particles.
The aims of this study were to use pedological knowledge on soil-landscape evolution to simulate quantitatively the effect of human-made landscape structures on soil redistribution at fine spatial and temporal scales.
We conducted a detailed field survey in a historically documented area, to establish a 3D map of the pedological cover, to quantify spatial variations of soil horizon geometry within the landscape in relation to anthropogenic landscape structures.
Water-erosion processes within a landscape have been modeled using a mechanistic model where the change in soil thickness over time depends on the transport of soil through a diffusive transport and a water erosion process taking into account anthropogenic landscape structures e.g. hedges.
Subsequently this model was applied to study the effect of different scenarios of land use and management on landscape evolution, and on variation of local soil thickness.
Field data results highlight the complexity of the spatial organisation of the soils within the landscape: topsoil horizon geometry is clearly influenced by topography landscape structures and deeper horizons seem not influenced by these structures.
Simulation results suggest that the combination of diffusive transport and water erosion could significantly modify the topography and soil redistribution over a few centuries.
Hedges modify soil distribution and landforms by favoring deposition in the uphill position and soil erosion in the downhill position in agreement with field observations.

S03.F.01
Physico-chemically induced erosion: Case study at the Lago di Vico (Latium)

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Intense hazelnut cultivation at the Lago di Vico volcanic region (Latium, Italy) induces strong erosion of the soils. The soils of this region are Andosols and andic Cambisols, characterised by allophane, forming stable micro-aggregates. Due to fertilisation, the soils of the hazelnut plantations show very high phosphate-concentrations. Phosphate has been shown to increase the surface charge and thus the dispersibility of soil colloids. Our hypotheses are that P-fertilisation (1) increases the dispersion of the micro-aggregates, (2) increases the erodibility of the soils and (3) decreases the amount of organic matter enclosed within micro-aggregates.
To test our hypotheses we sampled soil from the hazelnut plantations as well as from natural forest sites. We analysed the P-saturation and the dispersibility, and the wettability of the soils. In addition we did a density fractionation of soil organic matter. In a further experiment we will add phosphate to selected soil samples and test the effect on the soil parameters mentioned above. To investigate the effect of phosphate addition on the erodibility of soils we will do irrigation experiments.
The phosphate concentration and the dispersibility of the sampled soils were correlated significantly. In addition, the wettability of the soils under hazelnut (high P) was significantly lower than under natural forest (low P). This might be due to increased surface charge of soil colloids and to a change in the quality of soil organic matter. With increasing dispersibility of the soil samples the amount of mineral-associated organic matter decreased. Our results indicate that high P-fertilisation may induce the dispersion even of allophane-micro-aggregates, with their well-known high stability. It is to be expected that these processes increase the erodibility of the soils. We are further testing this hypothesis with still running experiments, whose results will be presented, additionally.

S03.F.02
Mapping occurrence of soil water erosion in Sicily by a logistic and multivariate geostatistical analysis

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Many decisions about land planning in Europe are taken at regional level and require regional generalization of thematic information. Land planning must consider the application of the EU soil thematic strategy, which foresees the monitoring of soil water erosion. Sicily is an area of Europe among the most threatened with soil erosion.
The aim of this work was to obtain a probabilistic map of soil water erosion occurrence in Sicily, extending the information coming from different field surveys.
A set of 3,518 field data was collected by soil surveys (1,248), geomorphological maps (2,135) and LUCAS project database (135). 400 points were randomly chosen to be control points. The following raster data were collected as ancillary information: a lithological map, a land use map, a DEM, Landsat TM and Aster images. The DEM, in particular, was elaborated to obtain further ancillary information: slope; aspect; curvature classes; cachment area, slope, aspect and height; flow path length (FPL); topographic wetness index (TWI); stream power index, LS-USDA-factor and 7 landform classes. A physiographic map of Sicily was obtained by stereoscopic aero-photograph interpretation. Categorical maps (lithology, land use, physiography, curvature and landform classes) were transformed into indicator maps. All the other ancillary raster data were standardized so to range from 0 to 1.
The target variable was considered a logit ($1/1 + e^{-Z}$), because of its dichotomic nature (presence or absence). The exponent Z of

the logit was interpolated in a subset area through a multiple linear regression (MLR), an ordinary kriging (OK) and a kriging with external drift (EDK). On the basis of control points MLR gave the best index of agreement (0,94 for MLR, 0,64 for EDK, 0,49 for OK). MLR was extended to all Sicily obtaining an index of agreement of 0.65. Photo-interpreted physiography, lithology, FPL and TWI were the best predictors.

S03.F.03
Sediment and nutrient loss from five Irish tillage soils at a 30 mm hr^{-1} rainfall intensity

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In erosion events, nutrients can be transported from soils in surface runoff or on soil particles that are detached during erosion. Laboratory flume studies on soil slabs using a rainfall simulator provide excellent controlled conditions in which nutrient and sediment releases from soils can be examined and quantified. In this study, the nutrient and sediment releases from 5 tilled soils from Clonmel, Co. Tipperary, Letterkenny, Co. Donegal, Tullow, Co. Carlow, Bunclody, Co. Wexford, and Fermoy, Co. Cork were examined at two slopes, 10 and 15 degrees, and under a rainfall intensity of 30 mm hr^{-1}. Each rainfall simulation comprised 3 successive 1-hr rainfall events at time intervals of 1 hr and 24 hrs to determine the effects of the interval between rainfall events on the transport of soluble phosphorus (P) in runoff. Suspended sediment (SS) and nutrients in runoff water from each soil tended to decrease with consecutive simulated rainfall events. The SS and dissolved reactive phosphorus (DRP) releases were highest from the Clonmel and Tullow soils, respectively, during the first 1-hr rainfall event. Relationships between the mean weighted nutrient concentrations in the surface runoff and soil properties were investigated. These relationships could help in predicting the runoff of SS, particulate phosphorus (PP), and DRP from Irish tillage soils.

S03.F.04
Monitoring of Water Erosion in Croatia - Fifteen Years of Experience

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Soil losses were recorded during the fifteen years (1994-2008) investigation cycle. Stationary measurements of soil loss by water erosion, carried out on Stagnic Luvisols in central Croatia under different tillage systems (The check plot - fallow; Ploughing up and down the slope; No-tillage; Ploughing across the slope; Very deep ploughing across the slope and Subsoiling across the slope) in crop rotations: maize; soybean; winter wheat; oil rape and spring barley with sown in soybean. The results indicate that soil losses are much higher in the production of spring row crops (maize and soybean) compared to winter crops (wheat and oil rape) and spring barley with soybeans. The highest soil losses are observed in row crops production with over 80% annual erosion, in the seedbed stage, immediately upon sowing. The period from May to mid-June is the riskiest period for water erosion in the agroecological conditions of central Croatia if low density spring row crops are grown in the field. There are no critical periods of high risk in the production of winter crops, and negligible erosion is uniformly distributed throughout the whole growing season. The trend of increasing participation of low density spring crops compared to high density winter and fodder crops on the arable areas in the Republic of Croatia indicates that the problem of water erosion on sloping terrains will be increasingly present. Based on the results of our fifteen year investigations, we recommend that soils susceptible to erosion, such as Stagnic Luvisols, should be ploughed across the slope, and that solely high density crops or fodder crops should be grown on more inclined slopes. Such tillage protects the soil from erosion and water recourses from immission of pollution with different chemical agents, commonly applied in intensive crop production.

S03.F.05
The evaluation of aggregate size distribution and associated phosphorus as a function of landscape position along field tramlines

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The transfer of phosphorus (P) from soils to watercourses is considered a serious problem for water quality in many agricultural areas. It is well documented that erosion by overland flow is the dominant process by which soil components are detached, transferred and deposited within and out of cultivated fields. Phosphorus and particle size distribution in soil aggregates is an important property with regard to P transfer during runoff and erosion events because of the different susceptibilities of aggregate fractions to disaggregation and P desorption reactions.
The quantity of sediment-bound P delivered to the field edge is a function of soil erosion rate, amount of sediment deposition within the field, and the quantity of P selectively adsorbed to the eroding soil particles or aggregates. Current research is concerned with evaluating the potential for vertical P transfers from sediment deposition zones within erodible, cultivated fields. Spatial patterns of soil aggregate- and particle-size distribution, and soil P concentration were investigated along tramlines in a cultivated field dominated by a silty clay loam.Results illustrated the preferential transport of aggregate fractions in the <2- and 20-53-µm size ranges towards the depositional regions of the field. In the depositional regions, significantly ($P < 0.05$) higher accumulations of clay- and fine silt-sized particles were found in the < 53- µm aggregate fraction than in the larger aggregate fractions (> 53 µm). These accumulations correlated positively with the labile P ($NaHCO_3$-Pi) concentration of clay- and fine silt-sized components, as well as P enrichment ratio (PER). The environmental implications of these spatial relationships between aggregate-size distribution, particle size composition and P status are discussed.

S03.F.06
Spatial variability on runoff and soil mobilization in vineyards: comparison between plots with different disturbance degree

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The present study presents runoff rates and soil mobilization by runoff and their spatial variability within the plot in two vineyards in the Penedès region (NE Spain) with different disturbance degree after levelling. Both plots are trained vines, with a 1.3 m x 3.1 m pattern. Vine rows are perpendicular to the maximum slope gradient with a hillside ditch every eight rows.
Soil and runoff losses were colleted in the two plots after 10 erosive events in 2004, using 50 cm- width Gerlach collectors at three transects along the slope, with three replications at each position. The sampling points were located in all cases one row above the terrace. At the same points basic infiltration rates were evaluated in the field using rainfall simulations.
The results point out the influence of the levelling degree on erosion rates and runoff and the high variability between the different locations as function of the resulting soils

characteristics after levelling. In the less disturbed plot (LDP), no significant differences in runoff rates were observed between points for the analysed events. However, in the most disturbed plot (HDP), significant higher runoff rates were observed in the upper part of the plot than down slope, due to the higher susceptibility to soil sealing in the areas which soil surface was removed. Runoff rates recorded in the lower part of the plot were, on average, 20% lower than in the upper part of the slope, where due to levelling, water retention capacity was lower not only due to higher soil sealing susceptibility but to lower soil depth. In those positions runoff rates up to 71% were recorded. In addition, sediment concentration in runoff was higher in the HDP plot than in the LDP plot, and with significant differences between points, particularly in the HDP.

S03.G.01
Comparing soil erosion and sediment production in two contrasted catchments from ^{137}Cs measurements

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Soil erosion and agricultural nonpoint pollution are two closely related problems. Assessing both processes at the catchment scale by conventional techniques is a time and resource consuming exercise, which needs to be carried over many years to integrate the interannual variability of climate. Fallout radionuclides (FRNs) offer an interesting way to bypass some of the limitations of conventional approaches and thus to complement them. To illustrate the potential of the FRN technique, the spatial extent and rates of soil redistribution (erosion, deposition) and the net sediment production were investigated from ^{137}Cs measurements in two catchments located in France and Canada. Despite the fact that both catchments exhibited very contrasted conditions in terms of climate, soil, topography and land use, the ^{137}Cs data produced results that located logically the erosion and deposition areas within the catchments. Estimated erosion, deposition and net sediment production rates were in agreement with the agri-environmental conditions prevailing in each catchment and in accordance with data obtained from other studies in each country. Due to higher soil erodibilities and more intensive land use, the French watershed (180 ha) exhibited higher erosion rates. However, the intermittent character of runoff in the catchment resulted in a significant deposition of eroded soil, leading to a net sediment yield of 1.9 Mg ha^{-1} yr^{-1} and a sediment delivery ratio (SDR) of 59%. In the Canadian catchment (80 ha), less erodible soils and long rotations involving forage crops led to lower erosion rates but the intense spring runoff, resulting from snowmelt, translated into reduced deposition. The result was a higher net soil loss, at 2.9 Mg ha^{-1} yr^{-1}, and a SDR over 90%. These results confirm that FRNs are an efficient tool to compare the effect of different agri-environmental conditions on soil erosion and sediment production.

S03.G.02
Prediction of the Surface Soil Shear Strength in Semiarid rangeland Using PTFs

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Modeling soil erosion and runoff requires accurate estimates of surface soil shear strength in field or regional scale. The utility of PTFs in modeling soil shear strength has rarely been reported .Hence, the objectives of this study are (i): to investigate the applicability of PTFs in estimating surface shear strength (ii): to compare the performance of the two methods: multiple linear regration and artificial neural networks (ANNs). The measured data was used to derive these functions. Soil shear strength was directly measured, using vane shear. The easily/readily parameters were consisted of bulk density, organic carbon and particle size distribution. Based on the correlation of the soil distribution and vegetation growth patterns across a topographically heterogeneous landscape, topographic and vegetation attributes in addition to pedologic attributes were used to develop pedotransfer functions (PTFs) for predicting soil shear strength in the semiarid rangeland of Iran. Twenty PTFs functions were then developed, using different input parameters. The results indicated that accuracy of the derived PTFs can well predict the soil shear strength.

S03.G.03
Assessment of soil erosion through the use of ^{137}Cs-method at Mochovce site, Slovakia

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The Soil erosion rate was measured in Slovakia on experimental plots and in elementary watersheds. Since 90ties the ^{137}Cs-method is used in order to provide information on long-term soil erosion rate. This presentation provides the results of soil erosion study using ^{137}Cs-method at Mochovce site in Slovakia.
The sampling was done along the multiple transects (13 transects with 88 points) and at 7 reference points. The soil erosion rates were calculated from measured ^{137}Cs-activities using the conversion models elaborated at Exeter University, Great Britain (Proportional Model - PM, Simplified Mass Balance Models - SMBM and Mass Balance Models - MBM).
The results indicate soil erosion at the slopes and an accumulation in the valley bottom as indicated by the ^{137}Cs-activity distribution. At the slopes it reaches usually 5000 - 7000 Bq.m^{-2} (minimum of 4792 Bq.m^{-2}) what is 50-70% of mean value of reference profiles (9 835 Bq.m^{-2}) and in the valley 10000 to13000 Bq.m^{-2} (maximum of 17571 Bq.m^{-2}) what is 100-130% (180%) of reference value.
The soil redistribution rates calculated by different models were compared and the input parameters were discussed in detail. Most realistic results are provided by MBM. The erosion rates reach 17 to 63 t.ha^{-1}year^{-1} (average of 39 t.ha^{-1}year^{-1}) and the deposition rates are 3 to 69 t.ha^{-1}year^{-1} (average of 32 t.ha^{-1}year^{-1}). Soil redistribution map was generated by GIS.
The measured values are 2,5 times higher than average erosion rate of 13 t.ha^{-1}year^{-1} from plot measurements carried in similar climate, soil, slope inclination, land use conditions. This difference is mainly due to longer slopes at Mochovce site (slope impact factor of 2-2,2, USLE) and also due to different time scales and different erosion processes involved (3 years, only runoff erosion for plot measurements and 40-50 years, runoff, wind and tillage erosion for ^{137}Cs method).

S03.G.04
Soil detachment under vegetation - kinetic energy of splash erosion under forest as a function of different tree and shrub species

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The mechanisms that control soil erosion under forest are very dynamic in space and time and the processes of reducing splash detachment under shrubs and forests in relation to species richness and species composition are not yet well understood. Therefore, the presented results of a splash erosion experiment seek to investigate the relationship between three tree and two shrub species and soil erosion (detachment of unit sand from splash cups). Main process to be analyzed will be the modification of kinetic energy of precipitation by its pass through the tree canopy and the shrub layer in relation to rainfall intensity, duration and frequency.

S04 Soil Compaction

S04.H.KL
Effects of Soil Compaction on Soil Biota and Soil Biological Processes

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The technical committee ,,Biological Assessment of Soils" of the German Soil Association (BVB) currently discusses the following questions:
- How can soil degradation due to soil compaction be assessed from the soil biological point of view?
- Are the compaction thresholds identified by soil physicists also suitable for the assessment of negative impacts on soil organisms and biological processes?
- Does soil compaction cause long-term or irreversible effects on soil organisms and their functions?
- Can soil organisms (e.g. ecosystem engineers like earthworms) revoke soil compaction?

For this purpose, an in-depth evaluation of datasets from more than 200 relevant papers, which were published in the last four decades, has been carried out. Our literature analysis showed effects of soil compaction to vary with respect to the organism group considered. Soil compaction generally caused a decrease of numbers of soil animals. The diversity of soil fauna seemed to be less affected. In contrast microbes and microbial driven processes could be enhanced by compaction due to an increase of medium pores.
Nearly all studies in the context of soil-compaction-soil-biota-interactions, considered only the topsoil. The effects of wheel loads and wheeling frequencies on soil biota and rehabilitation processes thereafter mainly depended on site related issues like soil texture and the applied soil tillage system. Furthermore, on arable land subsoil compaction is of particular importance but has been neglected so far.
Up to now we do not know at what compaction rates adverse effects on soil organisms and soil biological processes (e.g. nitrification) will occur. For this purpose we compile results on compaction experiments (field and laboratory studies) in an excel based database in order to derivate significant threshold values. Results of the data evaluation will be discussed.

S04.H.01
Rheological investigations in soil micro mechanics: structuring processes on a micro scale

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Rheological methods have been introduced to soil micro mechanics within the last few years. A rotational rheometer with a parallel-plate measuring device is used to achieve parameters, which may define soil as viscoelastic material. Hence, latest data deriving from conducted amplitude sweep tests with controlled shear deformation will be presented.
Test results are mainly influenced by physical as well as physicochemical properties of both, disturbed and undisturbed saturated and predrained soil samples. Water content, texture, organic matter compounds, contents and kind of clay minerals, carbonate, (hydr)oxides, and cations may have an effect on stiffness, structural stability, shear behaviour, and shrinkage/swelling potential. Storage factor G' and loss factor G'', yield point and yield area, loss factor tan δ and the linear viscoelastic range (LVE) range characterise microstructural properties of soil on the particle-to-particle scale. A comparison of clay rich kaolinitic and smectitic samples, well-structured material originating from Rothamsted research plots amongst others lead to significant differences in structural stability and may function as link to shrinkage/swelling potential. In addition, a classification of rigid-nonrigid or elastic-viscous material can be done considering the loss factor.

S04.H.02
Elasticity of pre-consolidated soils under monotonic increasing and cyclic loads

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Soil compaction is an ongoing issue of concern in agricultural land use. The concept of pre-compression stress is a well known tool for characterizing the stability of soils against volumetric deformation. Applying this concept it is usually assumed that soils behave fully elastic in the stress range of re-compression and fully plastic in the stress range of virgin compression. We have tested the validity of this assumption by quantifying the elasticity of pre-consolidated soils along the stress-strain path during consolidation tests. Natural as well as remoulded soils have been taken and loaded in an oedometer with three different methods: a) ordinary monotonic increasing loads; b) monotonic increasing loads with an unloading step in between each loading step; c) cyclic loading with 80 kPa for 100 cycles at different times for each loading-unloading interval. Elasticity indices have been calculated for b) and c) and compared to the pre-compression stress of the samples. Test results will be discussed in view of their meaning for predicting volumetric soil deformation with respect to agricultural land use.

S04.H.03
The elasto-plastic behaviour of a variously grazed steppe soil from Inner Mongolia, P.R. China, under cyclic loading

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In Inner Mongolia, P.R. of China, increasing grazing intensities of sheep and goats have led to an increasing degradation of the grassland, accompanied by increased water- and wind erosion and desertification.
Depending on the intensity and frequency of mechanical forces acting upon the soil, they lead to a modification of soil structure as indicated by changed values of precompression stress and a changed sensitivity to cyclic loading processes. Modified stability parameters lead to modified soil functions, e.g. saturated hydraulic conductivities.
In this study repeated loading-unloading-reloading cycles as exerted on the soil by grazing sheep and goats or agricultural machinery and their effect on the mechanical behaviour of the soil is investigated. As shown by Peth and Horn (2006), increasing numbers of loading-unloading-reloading cycles induce texture-dependent soil deformation, even if the value of

precompression stress is not exceeded during the loading processes.
Own results show various grazing intensities representing various loading frequencies to strongly influence the mechanical behaviour of the soil, displayed by the stress-strain behaviour of undisturbed soil samples from four different grazing intensities. The stress-strain behaviour of the samples has been determined under statically and cyclically applied loads. The precompression stress has been determined according to Casagrande both fort the cyclic and the static loading path.
Furthermore cyclic loading experiments (100 loading-unloading-reloading cycles) under a load representing the static contact area pressure of a sheep hoof (~80 kPa) have been conducted to simulate the dynamic alternation of load and exhibit the elasto-plastic behaviour of the soil.

S04.H.04
Compaction of cultivated soils: compressibility according to soil suction

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Soil compaction by wheeling of agricultural machinery is one of the main processes of physics damage to soil in Europe. Stress propagation and the induced soil deformations during traffic depend on unsaturated soil mechanical parameters (*i.e.* the compressibility Cc and the preconsolidation pressure p_c). These parameters are highly variable in time and space because they depend on soil structure and soil moisture state at wheeling. Numerous authors described the soil mechanical strength as function of the hydraulic and mechanical stresses for geotechnical purpose. Generally they consider that the compressibility C_c decreases with the suction. This study aimed at analysing the effect of soil suction on the compression curve for cultivated soils. Oedometric compression tests with suction control using the osmotic method were carried out on a loamy soil and a sandy soil. Tests were performed on remoulded samples with an initial density of 1.1 or 1.45 Mg m^{-3} with suction varying from 0 to 200 kPa and under vertical stresses lower than 500 kPa. The results showed that the change in the compressibility C_c with soil suction depends on soil texture and bulk density. The compressibility Cc remained quasi constant with suction, and decreased slightly as soil suction decreased for the sandy soil (at both initial bulk densities of 1.1 Mg m^{-3} and 1.45 Mg m^{-3}) and for the loamy soil at 1.45 Mg m^{-3}. The loamy soil at 1.1 Mg m^{-3} exhibited a different behaviour: the suction affected strongly the shape of the compression curve when the suction approached zero. At saturation, the compression curve did not verify a logarithmic model anymore and the compressibility C_c defined as the maximum derivative of the compression curve was found to sharply increase at zero suction.

S04.I.01
Mechanical behaviour of structured and homogenized paddy soils under cyclic loading

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In paddy rice fields, soil structure is changing due to puddling induced mechanical shear stresses as well as drying and wetting cycles. A common statement in the literature is that soil structure is destroyed due to puddling. Long term effects of puddling on soil structure have not been studied yet. However, soil structure plays an important role for soil physical properties like water- and gas-flux or shrinkage behaviour of a soil. The aim of this work is to show interrelations of soil structure, soil management, and cultivation history of paddy fields because the soils were cultivated with rice for 20 and >100 years, respectively. To characterize soil structure and their stability we investigated the mechanical behaviour of paddy fields in a typical red soil region of subtropical China under cyclic loading with a focus on soil physical parameters like elasticity of the soil, rebound, pore volume, and the pore water pressure behaviour during the cyclic loading test. Cyclic loading is encountered, e.g. during puddling, because soil preparation leads to fast alternating soil stresses. Furthermore, mechanical stresses and hydraulic stresses (pore water pressure) are linked and result in a more intense soil weakening. It could be shown that soil structure still exists after 20 years and even after 100 years of puddling. But the soil structure stability is reduced due to continuous puddling for many years. Soil deformation is affected amongst other things by pore water pressures and/or that result in destroying of cementing bonding agents of soil particles. It could be shown that the 100 years old paddy field exhibits a less negative pore water pressure (due to less soil structure stability) compared to the 20 years old paddy field during loading time, which results in a higher deformation due to a decrease of the effective stress.

S04.I.02
Stress transmission in soil: Effects of tyre size, inflation pressure and wheel load

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We urgently need increased quantitative knowledge on stress transmission in real soils loaded with agricultural machinery. 3D measurements of vertical stresses under tracked wheels were performed in situ in a Stagnic Luvisol (clay content 20 %) continuously cropped with small grain cereals. The tests took place in the spring at field capacity when the topsoil had not been tilled for 1½ year. Two Nokian ELS Radial-ply tyres (800/50R34 and 560/45R22.5) were loaded with two specific loads (30 kN and 60 kN). We used rated tyre inflation pressures for traffic in the field (<10 km h-1 driving speed). Seven load cells were inserted horizontally from a pit with minimal disturbance of soil in each of three depths (0.3, 0.6 and 0.9 m), covering the width of the wheeled area. The position of the wheel relative to the transducers was recorded using a laser sensor. Finally, the vertical stresses near the soil-tyre interface were measured in separate tests by 17 stress transducers across the width of the tyres. The results showed that the inflation pressure controlled the level of maximum stresses at 0.3 m depth, while the wheel load was correlated to the measured stresses at 0.9 m depth. This supports the principle behind the elasticity theory. However, if fitting the Söhne model to stress measurements in all three depths, the stresses were underestimated at 0.3 and 0.6 m depth, and overestimated at 0.9 m depth. A fit of the model based on data only at 0.3 m depth indicated that stresses were transmitted nearly without down damping through the 0-0.3 m soil layer (average concentration factor of 29.0 across the four treatments). Our results thus qualitatively confirm the principle of elasticity but highlight the need to model arable soil as a two-layer system.

S04.I.03
Effect of the inflation pressure on stress distribution and soil physical properties under dynamic load

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Due to economisation and productivity enforcement in agriculture there is a development to higher levels of mechanisation. Combined field operations, bigger working width and therefore interconnected the requirement of higher pulling forces and heavier machinery are leading to higher wheel loads on the fields. With increasing size and weight of agricultural machinery we find arable soil more and more “under pressure”. Soil compaction as a result of mechanical stress below the wheels constitutes a severe problem for sustainable agriculture.

Within a cooperative project of the institute of plant nutrition and soil science of the University of Kiel and the institute of agricultural engineering from the University of Applied Science Südwestfalen there were done outdoor wheeling experiments with wheel loads up to 7.5 Mg. To insert the external loads there was used a tractor pulled load frame which is enabled to change its load, velocity, the tire type and the inflation pressure. Stress impact and its distribution below the wheel as well as the deformation were determined in three measuring depth by using a combined stress state transducer (SST) and displacement transducer system (DTS). Experimental plots have been sampled in the range of the load tracks to characterize changes in soil stability parameters (precompression stress), hydraulic and aeration properties under laboratory conditions.
The measurements took place on four different field sites of university experimental farms under consideration of two soil types and two soil tillage treatments. Aim of the investigation is to quantify the influence of tire inflation pressure on stress impact and soil properties under consideration of conservational and conventional tillage treatment.

S04.I.04
Evaluation of frequency and total area of machinery passages in the field when using different tillage systems

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Passages of heavy agriculture machinery across a field are a common practice nowadays but they are mainly random. As a result of this fact, soil is exposed very often to repeated passages and thus irreversible structural changes connected with soil compaction. According to literature sources and many experiments, the soil compaction caused by traffic reduces soil infiltrability, hydraulic conductivity, porosity, aeration and increases bulk density and impedance for root exploration. The guidance systems and controlled traffic (CT) farming system, which is based on maintaining the same wheel lane for several years for each field operation, is one of the tools which can be used in soil protection against soil compaction.
In order to gain enter data for further CT systems observation, several measurements concerning frequency and total area of machinery passages in a field were done. DGPS receivers were placed into a machine for monitoring of all machinery passages across observed fields with 2 s logging time for position data saving. All field operations in the particular field were observed for 3 variants of tillage systems during one year. Conventional system with ploughing, conservation tillage and direct seeding systems were evaluated. The total area covered/run-over by all machine's tyres were calculated with help of the software ArcGIS 9. Also repeatedly run-over areas were detected. The results showed that 96 % of the total field area was run over with a machine at least ones during a year, when using conventional tillage, and 65 % and 43 % of the total field area were run-over when using conservation tillage and direct seeding respectively. It was calculated that 144 % of covered area was run-over repeatedly for conventional tillage, 31 % for conservation tillage and only 9 % for direct seeding. The results show considerable high number of tyre's contacts with soil.

S04.J.01
A universally applicable term to express the stress situation in soils and its use

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For handling problems in connection with water regime in soils there are two terms at hand which describe the most important properties of water in the special condition of just being positioned in the solid matrix. These are water content (θ) and its energetic state i.e. water pressure and tension (ψ_H and ψ_M). Elder, well established parameters of characteristic situations like field capacity or permanent wilting point were fit in successfully into this system.
For the solid soil matrix an equivalent for θ is the easily determinable dry bulk density (d_B). An equivalent for the intensity term is not equally obvious. If tension situation in the fluid matrix is taken as isotropic the equivalent in the solid grained matrix is different in principle. Here anisotropy can persist if it was created by temporary loads like human activities of manifold kind. Using the approach of compaction states as developed in classical soil mechanics with normal (NC) and precompacted state(PC) allows to consider anisotropy.
NC is observed only in virgin soils with prevalent pedologic development. PC is observed in freshly deposited sediments without pedologic development, all soils with anthropogenic influence and such with free water in their subsoil.
Coefficient of stresses at rest (K_0) is unambiguous with NC situations ($K_0 = 1$). PC situations are characterized by $K_0 > 1$. K_0 values for soil profiles can be calculated from bulk densities (d_B) using packing characteristics or from penetration resistance obtained with simple hand driven probe. The higher the PC of a profile the less is its further compactability. The general concept and its applicability will be presented during the lecture.

S04.J.02
Evolution of structural soil properties after compaction and varying management practices

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To assess the degree of compactness of a soil quantitatively, and as a means of physical soil protection, guide values for physical soil parameters are in discussion. Guide values have to account for the effects of soil structure on soil functions, which include not only physical, but also bio-chemical aspects. However, the judgement of soil structure depends both on functional aspects and on the dynamics of its evolution: Long-lasting deformations are far more critical than short-term damages.
Because little quantitative information is available on soil structure assessment, a field experiment has been started to investigate and quantify the functional relationships between soil structure, soil environment and microbial soil properties as well as the rate of structural regeneration depending on soil management practices.
In a field trial in Zurich, Switzerland, on an arable soil (cambisol, 20% clay, 26% silt, 1.4% org. C), three main treatments were installed, in which different structural states were effected by compaction and mechanical loosening, using conventional farming practices. Each of these treatments was carried out under actual weather conditions as well as under irrigation in order to amplify the effects of compaction for unambiguous identification. Maize, wheat, barley and ley were used for crop rotation.
Soil structure was characterized by collecting data on porosity, permeability and stability of undisturbed soil cores, living conditions for soil organisms were described by field measurements of soil moisture and gas concentrations in the soil air.
First results of physical soil analysis confirm the expected changes of topsoil structure caused by the experimental treatments. Compaction, especially combined with irrigation, induced more often more pronounced situations with reduced oxygen and enhanced CO_2 concentrations in soil air. Regeneration of compacted soil structures was less intensive in soils with a continuously moist regime than in soils with repeated drying/wetting cycles.

S04.J.03
Predicting thermal conductivity based on soil strength and texture

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Soil thermal conductivity is an important factor influencing the energy balance. The thermal conductivity is influenced by soil moisture, type and associated texture and organic matter content. The thermal conductivity is largely influenced by the size of the contacts between neighbouring soil particles that are enhanced by soil compaction and water films. The contacts and bonding between the particles are reflected in penetration resistance and porosity. Penetration resistance and water content can be much more easily measured than the thermal conductivity. Therefore, we propose new regression equations to determine the relationships between the thermal conductivity and penetration resistance and porosity in variously grained three soils (sandy loam, two silt loams) as well as snow. The data on soil penetration resistance, water content, bulk density and sand content (2-0.02 mm) were used as independent variables in the regression equations. The independent variables used for prediction of thermal conductivity are also indicative of the mechanical behaviour of soils. The regression equations based on penetration resistance, porosity and content of sand predicted better the thermal conductivity than those based on penetration resistance and porosity for any given soil type. To predict the thermal conductivity of different soil types soils (with different content of sand) the regression equation with incorporation of sand content can be used but with less accuracy. As to snow, the input data (penetration resistance, bulk density) for the regression equations were taken from the literature (Sturm et al., 2002). The regression equations based on the penetration resistance and porosity predicted better the snow thermal conductivity than those based on bulk density only.

S04.J.04
A method to assess the risk of soil compaction in france using a soil water model

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Soil compaction is one of the major processes of soil degradation in Europe (see the proposal for a directive of the European Parliament on the protection of the soil, 2007). Compaction is mainly due to the mechanization of agricultural and forest activities which involves passage of increasingly heavy machines often at times when the weather may be unfavorable. If the factors of variation of the intensity of soil compaction are well known, it is not the case for its mapping. The aim of this study is to build a methodology to map predictions of the risk of soil compaction on a national scale. The susceptibility of soil to compaction increases with the soil water content. This study, therefore, proposes a procedure using the soil water model STICS. Firstly, STICS is calibrated to estimate the water content of various types of French soils. Secondly, STICS is coupled with a Geographic Information System (GIS) on the scale of France. Thirdly, STICS is applied to various types of French soils mapped at 1:1,000,000 scale in a geographical data base of France at several degrees of soil compaction. The results of the soil water model are the soil water content estimates during farming operations with the knowledge of mechanical properties of soils and of pressures applied by machines. This will lead to a map showing the risk of compaction for French soils.

S04.J.05
Continuous on-field tillage force monitoring

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It is well known that the high tillage force values influence plant yield notably. Thus, tillage force mapping can be an effective tool for site-specific management. This information should be provided in the most simple, labor-effective and low-priced way. The cost of the tool or rather the measurement should be commensurate with the value of the information provided. Soil resistance measurement with penetrometer provides only discontinuous field information. To receive proper amount of data we need to measure with an on-line method. According to earlier developments that were carried out in our institute the authors are presenting new results.
The system is based on the electro-hydraulic system (EHS) of a tractor. Load cells are installed in the EHS, which provide electric signals with the forces affecting the hydraulic system. The induced voltages from the load cells using an RS232-ADC module were fed to the DellAxim x50v PDA throughout Quatech DSCF-100 two port RS232 serial Compact Flash Card. A software developed by the institute records and displays the digitized summarized signals of the load cells and writes to the main memory of the PDA together with the position (GPS) information in *.txt format. This file format is available for every GIS software for later processes, so the results can be displayed spatially.
This new innovation makes the earlier development more accurate and provides the system to use in practical field-works. In addition to all the accessories are simple and available at relatively low cost rate. Using today's technical development state makes the whole process user friendly.

S04.J.06
Soil Compaction Modeling, Hand and Numerical Solving, Comparisons and Applications

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The soil compaction is seeing like a mechanical pollution produce by the farm machinery traffic on the farm land. The authors expose the main results obtained during the investigation of the soil compaction problem. For solving the soil compaction problem the authors have applied two different ways. First way uses the analytical solving for soil compaction phenomena and obtain solution which give the possibility to estimate the influence of some process parameter about the compaction degree. The second consist in the structural solving, which use the finite elements modeling for the soil and using different loads.
A synthetically comparison between the two types of solutions are given in the paper.
In our studies we consider that the soil bulk density is the main characteristic of the soil compaction. Generally, this characteristic is, not given by the classical structural solution, and many others solutions don't give the soil bulk density space-time variation.
In the article we comment some aspects of the two proposed way for modeling the compaction phenomenon. We refer to the material laws which we are using to the soil body, the boundary condition and, especially, the calculus of the loads of the soil, generated by the contact between the vehicle wheel and the soil. Also, we comment the result which a structural way can be provide and which result, usually not include the bulk soil density space variation. The presented results in the article will try to assess the density space variation in the compacting soil.
Using the obtained results we can evaluate the time period that which is necessary a deep tillage for the soil compaction amelioration.

S04.K.01
Subsoil compaction as a climate damage indicator

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Some forms of soil compaction occur on arable lands both in Hungary (1.82 million ha) and in Croatia (0.97 million ha) having negative impacts on agricultural production. Tillage-induced subsoil compaction has often been occurred in the Pannonian region related to the traffic-induced one. The reason why soil compaction has become a soil management problem during the last decade is because of the water-logging and the drought occurrence. The objective of this study was to evaluate factors connected with subsoil compaction as indicator of climate effects on arable fields. This paper based on soil condition monitoring and measuring that started 21 years ago and on short and long-term experiments initiated modelling and checking compaction extension in the soil. The investigation comprised 1020 monitoring places and 38 experimental plots. For monitoring five points were identified, that is: 1. Root zone state (to a depth of 0-50cm). 2. Occurrence of the compacted layer (referring to probable risk). 3. Extension of the compacted layer (referring to degree of damage). 4. Soil tillage effect in the long-term (soil state deterioration or improvement). 5. Tillage induced water-logging and drought damage impacts on yield loss. Main objectives in the experiments were: 1. Occurrence and extension of tillage-pan in soils are differently sensitive to compaction. 2. Water management consequences in the years. 3. Soil quality consequences. 4. Alleviation of pan-compaction by mechanical and biological methods. Both long-term field monitoring and experimental work have convincingly proved the correlation between subsoil compaction and degree of climatic damage. On the basis of the results soil tillage trends can be grouped into two categories including climate damage mitigating and climate-stress increasing. The formation and location of compacted layers provided information regarding the depth, method and type of tillage being used, and moreover the expected risk for plant production under extreme climate.

S04.K.02
Soil moisture and thermal regimes of soil cover with spatially distributed soil compacted layers

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The complex soil cover of the landscapes of Russian Plain has the special features of paleocryogenic soilscape with zones of high content of soil organic matter (loose zones) and of compacted soils. Lateral variation of soil density in arable layer are from 0.73 to 1.54 g/cm^3 and for the depth 35-40 cm - 1.0-1.68 g/cm^3, and of organic carbon content - from 1.36 to 2.98 and 0.23-4.65%, respectively. The agricultural activity reorganizes the natural soil physical properties distribution and soil cover has the compacted subsoil layers not highly correlated with soil unit distributions. Because of the soil physical properties distributions, alternating sequences of compact and loose zones the regularities of water and thermal regimes would be expected. The task of this investigation is to specify spatial distribution of water and thermal regimes of this soil cover. Water and thermal regime observations were carried out for 5 years for different time and spatial scales (from 0.01 to about 4 ha with 60-80 soil profiles studies). The series of temperature measurements proved that owing to low thermal diffusivity the loose soil layers are slowly warmed up in spring and summer and become cool later in winter. The water regimes of soilscape components also differ: during wet periods the zones of soils loose horizon accumulate and conserve water, but during the periods of drought these zones become dryer. These data illustrate spatial variability of hydrothermal field on this territory and provide understanding of the role of compacted and loose zones in soil cover. For the quantitative estimation of the regimes the pedotransfer functions were defined in the form of dependencies of water retention curve, hydraulic conductivity, thermal diffusivity upon soil density and soil organic carbon content. The model assessments of space distributions of water and thermal regimes were quite fit with experimental observations.

S04.K.03
Assessing the reversibility of soil displacement after wheeling on restored soils

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Soil compaction can cause severe damage on the soil ecosystem, but there is little knowledge about the persistence of the damage and the soil's potential to recover from mechanical impacts. This is of particular interest on restored soils after open cast mining or construction, because the improved techniques of land restoration provide loose soils that have subsequently to be treated with extensive agricultural management for several years. We investigated the influence of the age of restored soils on the amount and persistence of soil displacement caused by wheeling. We accomplished wheeling experiments with a tractor and a manure trailer on two restored soils, which had been heaped three and one year before, respectively. Vertical soil displacement was ascertained at the soil surface with digital levelling and in the soil profile at ca. 28 cm depth with a particularly developed hydrostatic soil displacement meter. After the wheeling, we determined soil subsidence of ca. 11 mm at the soil surface and of ca. 6 mm in 28 cm depth, while for the soil profile we disposed of measuring values from the three year old restoration, only. Soil displacement reformed within less than three weeks at the soil surface as well as within the soil profile. Additionally, both restorations showed the same recovering from soil displacement independently of their ages. It has to be considered, though, that we had used light vehicles to simulate a typical situation in practice. In addition, the soils were rich in sand and hence less susceptible to compaction. Based on this single experiment, we recommend not shortening the time of extensive management after soil restoration in the sense of precautionary soil protection. Further research on soil deformation as indicator of soil compaction is needed supported by our methods to assess soil displacement.

S04.K.04
Obtaining more information from soil bulk density depth function using classical soil mechanics

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Dry soil bulk density ρ_b (obtained in the laboratory from soil cores) is beside the information soil texture the most frequently given parameter regarding physical properties of soil profiles. However, the ρ_b data are commonly not further interpreted or analyzed and consequently no information about the physical state of the soil can be deduced. To allow for an evaluation of ρ_b data, we will use the classical soil mechanics concept of normal compaction NC and precompaction PC, developed for fine grained soils, to make a statement about the degree of soil compaction possible. A graph of void ratio ε (assessed via ρ_b) vs. vertical stress σ_z (log transformed, assessed via ρ_b) gives the soil packing characteristic. For soils not significantly mechanically affected by human activity (forest, non grazed grassland) a linear relationship is observed for many soil profiles, indicating NC. With increasing intensity of soil use (grazing, agriculture), in the upper part of the soil profile an increasing deviation from linearity is observed, indicating PC. Here a NC regression line and a PC regression line can be fitted. The intersection point marks the maximum depth influenced by human action. From the two regression lines the stress at rest coefficient K_0 can be calculated for each depth from the ratio of ε_{NC} and ε_{PC}. NC then is characterized by K_0 around 1, PC by $K_0>1$. In this way the physical state of the individual profile can be described and compared to other profiles.

S05 Soil Desertification and Salinisation

S05.L.KL
Soil salinity: a coin with two sides including desertification and preservation of the natural resources

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Soil salinisation is one of the main causes of desertification and if the predicted global change leads to an increase of the drought periods, an increase in salt accumulation in the soils may be expected. Also, the elevation of the saline groundwater table in coastal areas, as a consequence of the sea level rise, can increase soil salinity and the higher possibility of more intense storms and floods, due to the instability of the weather, will probably spread seawater favouring the risks of salinisation. If there is a reduction in water resources and the use of brackish and/or saline water for irrigation increases, an expansion of the agricultural lands affected by salinity will occur. This will have consequences, and changes in crop varieties and the implementation of new management techniques will be necessary. In fact, the use of drip irrigation and/or soiless culture in modern intensive agriculture exploitations permit the optimization of fertilizers and water doses, and hence the reduction of soil and water salinity damage. However, in many of these exploitations the soils are considered a mere support for plant growing and their physical properties are strongly degraded due to the intensive use.
On the other hand, saline ecosystems are considered one of the most productive systems, particularly in arid and semiarid areas, and they are valued as reservoirs for biodiversity. The knowledge of the ecology and physiology of salt tolerant plants can serve to domesticate them as alternative resources (fuel, food) since they can be irrigated with brackish and/or saline water. In addition, salt marshes develop different important environmental functions such as nutrient recycling, groundwater recharge or filtering of anthropogenic nutrients and pollutants.
Therefore a high soil salt concentration is a problem, and hence salinisation is a process of degradation which occurs at worldwide scale. However, salt marshes and salt steppes are valuable systems which should be preserved and restored. Thus, researchers should show farmers, decision makers, politicians and other sectors of society the pros and cons of salinity in order to reduce risks, to reverse the process whenever and wherever it becomes necessary and to preserve and restore the natural resources of saline ecosystems.

S05.L.01
Soil salinity in Veneto plain

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Along Veneto coastal and lagoon inland area soil salinity is an incoming problem. In fact these areas are mainly devoted to highly profitable agriculture and horticulture.
Salinity is due to inherited characteristics of soils, to salinity intrusion increasing induced by intense use of groundwater resources and to brackish water use for irrigation.
To verify soil salinity level 350 soil profiles, described within ordinary soil survey, were selected; electrical conductivity (EC1:2) was measured in samples collected at three different depths (topsoil at 0-50cm, subsoil at 50-100cm and substrate at 100-150cm).
Data analysis showed a strong correlation between salinity and soil depth. The highest EC values were found in subsoil and substrate, compared to topsoil.
A significant correlation was also found between organic carbon and salinity, particularly in the deep horizons: buried organic horizons had higher electrical conductivity values than topsoil.
Data were grouped by means of hierarchical levels (soil subregions L2, great soilscape L3 and soilscape L4) of 1:250,000 soil map of Veneto Region. The soilscape of reclaimed marshes of Adige and Po plains showed the highest EC values. Soils of these areas (Phaeozems and Histosols) were formed in morphologically depressed areas, from silty or clayey sediments and from peat. These soils have high salinity, being formed in ancient coastal areas covered by brackish water, and high acidity, due to oxidation of sulfidic material in the organic horizons, as reclaiming exposed them to aerobic conditions.
In order to assess the spatial distribution pattern of soil salinity and to map the probability to exceed reference threshold, a geostatistical approach was applied based on conditional sequential simulation, taking explicitly into account the relationships between soil salinity and soil properties highlighted in the different soilscapes.

S05.L.02
Assessment and mapping of area prone desertification processes in the saline rangelands of Southern Caspian Sea

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Desertification is a land degradation problem of major importance in the arid and semi arid regions of the world, but it one of the most urgent ecological problems in saline rangelands of southern Caspian Sea. Because of special geomorphologic, edaphic and climate condition, the area is highly suitable for desertification. So, assessment and mapping of desertification is required for combating desertification. Success in combating desertification will require an improved understanding of its processes and causes and especially the linkage between desertification and soils, land cover, climate and socio-economic factors. In this research the method used for quantitative field evaluation of desertification prone areas in the saline rangelands of southern Caspian Sea was based on the MEDALUS model. Three main indicators or processes were evaluated by using a geographic information system (GIS). These indicators of desertification including: wind erosion, vegetation destruction and salinization. Each parameter was weighted in relation to its influence on desertification process. And risks of desertification were computed by geometric mean of the parameters with help of ARCVIEW 3.1 software. Results showed that about 95 percent of the total surface is medium to high desertified. In addition to the soil salinization indicator was the most important factor affecting desertification process in the study area.

S05.L.03
Desertification and Soil Degradation in the southern forest steppe zone of Western Siberia

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Due to the global climatic change the prognosticated shift of agricultural land into the dry steppes in Western Siberia by 200 to 300 km in the next 25 years forebodes that wide ranges of steppes and forest steppes will be heavily affected by desertification and land degradation. Indicators on the process description and for the prevention of desertification are necessary. Till now they are not available in this part of Russia.
Russia joined the convention for the fight of desertification not until the year 2003. The steppes taken under culture in the 1950s in the districts Novosibirsk and Altai were protected around 1968 by a high number of hedges against deflation and soil erosion. The economic decline of the Siberian agriculture arises that the risk of recurrence of active morphological and other unwanted processes grows, which constitute today an early stage of desertification.
In our study special emphasis has been taken on the description of the geoecological indicators and land use basics in Western Siberia. Causes and indicators of desertification and land degradation are demonstrated by the example of the southern Western Siberian steppe zone. By the example of detailed pedologically investigation of the farm Ivanovskoe (ca. 20 000
ha) near Bagan in the northern Kulunda Steppe was applied. A larger set of indicators addressing desertification is analysed and evaluated in detail especially by examples of soil degradation and deflation.
The proportion of rough material on agriculturally used Chernozem increased significantly since cultivation. Deflation damage is still proven on most of these soils. The saline lakes in the area already dry up slowly. The river Bagan carries much less water up to the discharge less Kulunda depression as before steppe cultivation.

S05.L.04
Salinization of paddy fields in Northeastern Thailand

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The Northeast of Thailand, so-called Isaan in Thaï, remains the poorest region in the country and distinguishes itself by a higher degree of specialization in rice farming, a higher rate of subsistence farmers, a lower use of agrochemicals, and a low implantation of industrial units.
Isaan region is well known for its soil salinity, which is widely considered as one of the most critical environmental problems of the region. The salt source for saline water and soil is primarily from rock salt deposits occurring at variable depths (20-500 m) from the ground surface, and from tectonic stress during the Quaternary that has produced superficial domes with a high salt content. Lowland areas are salt-affected by saline groundwater flowing from regional recharge areas within underground salt deposits. During dry season, bare and diffuse saline patches occur at ground surface according variable extent. Soil salinization is also induced by human activities, namely deforestation (wood cutting), water storage (dam, pond) and groundwater abstraction for salt production (pumping). The buildup and spread of salinity have resulted in major economic and environmental impacts. High salinity levels in rain-fed rice fields, for example, affect the annual crop yields. In addition, soils in Isaan are generally poor, with low organic matter.
In a given rice farming area of Isaan region, French organization IRD and Land Development Department (LDD) from Thai Ministry of Agriculture and Cooperatives have performed from 2004 to 2007 a local field experiment involved on water and solute transfer monitoring at short-time steps, on salt-affected soil rehabilitation using improved cultural practices,and soil and water salinity survey. The present paper focused on the spatial salinity distribution at a farmer scale and the explanation of how salts reach the ground surface, namely based on hydrogeological, geophysical and geochemical data.
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S05.M.01
Risk assessment methods of salinization in Europe: a quick look

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There are numerous methodologies being used in the EU Member States (MS) for the assessment of the risk for different soil threats (erosion, salinization, organic matter decline, compaction and landslides) as defined by the Soil Thematic Strategy. We present an overview and first evaluation of the risk assessment methodologies (RAMs) utilized for salinization in the EU Member States. The assessment is based on questionnaires sent to both experts and decision makers.
It turned out that most countries affected by salinization do not have an official methodology. Among the MSs only Hungary has officially recognized assessment. Only scientists use RAMS in Slovakia and Spain, and there was information only on concepts of RAMs in Greece and Cyprus. However, salt-affected soils occur in Bulgaria, France, Italy and Romania also.
Several techniques were tested for analyzing the RAMs on salinization, such as spiderweb and tabular techniques. Although the most informative analysis was provided by the detailed analysis of the scientific papers, it also turned out to be very time-consuming.
Upon the analysis we realized that all RAMs of salinization consider soil characteristics and groundwater. In most RAMs data on soil typology, soil texture, chemical properties of irrigation water, climate, soil hydraulic properties, and land use, and in some of them pedotransfer functions, and models are also used. Our analysis provides a list of common parameters used in the RAMs of salinization in the MSs. Most RAMs were used only in case studies. Three countries use field observations combined with laboratory analysis. Two MSs use GIS as third technique and Slovakia is the only country, which has different approach, because they use remote sensing.

S05.M.02
Evaluation of an index for spatial assessment of environmental sensible areas to desertification at national scale

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An index for spatial assessment of environmental sensible areas to desertification was evaluated based on soil, terrain, climate, vegetation and crop management data. The method links in a single framework the weight-based average MEDALUS

procedure for calculating desertification risk, the indicators used in the new proposal of JRC for common criteria defining less favoured areas in Europe, and indicators for soil compaction risk assessment. The indicators included in the weight-average procedure are of three types:
(i) measured/interpolated/classes data for soil (texture, soil depth, parent material, rock fragments, salinity/sodicity/alkalinity parameters), terrain (slope, aspect), climate (temperature, rainfall, potential evapotranspiration)
(ii) static data calculated using simple algorithms (Bagnouls-Gaussen aridity index, rooting depth, soil workability limits, maximum available water, precompression stress, land use intensity) based on layers defined in (i)
(iii) dynamic data calculated simulation models running with input data as provided by (i) and (ii): number of workable days, number of growing days, crop cover
These indicators are related to the most important soil degradation processes: soil erosion, compaction, salinisation/alkalisation/sodification and to the water scarcity.
The input data are provided by the existing GIS layers available at national and/or European scale, and by simple and robust models predicting specific soil parameters (e.g. available water, precompression stress) and indicators related to soil water balance (e.g. number of workable days, crop growing days).
The index was evaluated for the agricultural land of Romania considering the recorded/interpolated climate data for the time intervals: 1901-1960, 1961-1990 and 1991-2000, and climate change projections for 2020. It was used for defining less favoured areas in Romania for agriculture.
A sensitivity analysis of the calculated index related to the uncertainities of the input parameters was performed showing that the uncertainity in rooting depth induces the highest variability.

S05.M.03
Soil salinization and alkalinization in the Lower Cheliff valley (Algeria)

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The Lower Cheliff valley, which encompasses over 60000 ha in land area, is one of the regions in Algeria most heavily affected by soil salinity problems; it is located in the extreme northern part of the Cheliff Basin in Northwest Algeria. The specific climate of the Lower Cheliff is semi-arid with very hot summers and a mean annual rainfall of 250 mm. Soil salinity is a major problem affecting the agricultural productivity in the Lower Cheliff valley. In this area, the current problem is that soil salinity which is caused by irrigation with poor quality water, which could also provoke soil sodicity and soil alcalinity.
The objective of the present study was in one hand, to improve salinity mapping by introducing exogenous information derived from remote sensing and on the other hand, to evaluate the tendencies of soil sodicity/alcalinity. The spatial variability study was carried out on a 50000 ha area using 420 topsoil electrical conductivity (EC) measurements stratified sampled.
We can show that by coupling ground measurements alone (ordinary kriging) with remote-sensing data, it is possible to establish salinity maps with greater accuracy than by use of ordinary kriging or remote-sensing data alone. The maps produced allow us to demonstrate the extent of salinisation in soils of the Lower Cheliff Valley.
By measuring the SAR (sodium adsorption ratio) and RSC (residual sodium carbonate) of 50 topsoil samples, results showed that respectively 60 % are sodic soils and 30 % showed the tendencies to soils alkalinzation, but with no significant correlation between SAR and RSC.
In perspectives, it remains necessary, besides remote sensing, to introduce geophysical approaches in order to better fallow spatio-temporel evolution of salinity and to develop predictives models of soils sodicity/alcalinity.

S05.M.04
Impact of seawater flooding caused by the 26 December 2004 tsunami disaster on physico-chemical and microbial properties of arable soils in Banda Aceh, Indonesia

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Almost 1.5 years after the 26 December 2004 tsunami disaster, soil samples (10-20 cm) were taken from four adjacent sites located in the agricultural area of Banda Aceh, Sumatera Island, Indonesia in order to investigate the impact of seawater flooding on soil physico-chemical and microbial properties. The tsunami disaster caused severe and long-lasting environmental effects by sedimentary deposits containing extremely high salt contents and salinity, as well as heavy metal pollution. The salt contents (detected as B, Na, Ca, Mg, Si and Cl), as well as the salinity levels (detected by electrical conductivity, EC) in tsunami-impacted soils still remained significantly increased compared to non-impacted soils, even after 1.5-year intrinsic bioremediation. Heavy metals such as Pb, Cd, Zn, Cu, Ni, Co, Fe and Cr were significantly higher in impacted soils than those in non-impacted soils. Furthermore, the tsunami disaster has led to an increase in contents of macronutrients such as N, P, K, and S, as well as to an increase in soil organic C content and C/N ratio. The composition of soil organic matter, as assessed by FTIR analysis, showed that the tsunami-impacted soils contained greater amounts of hydrophilic than hydrophobic organic compounds. The mean pH of soils in tsunami-impacted soils was increased to pH 7.4, while pH in non-impacted soils was 5.1.
The assay for fluorescein diacetate (FDA) hydrolytic activity indicated that microbial activity in tsunami-impacted soils was significantly lower than in non-impacted soils, whereas soil basal CO2 respiration was significantly higher in tsunami-impacted soils compared to non-impacted soils. Against this background, T-RFLP patterns of soil bacterial communities, as well as analyses of phospholipid fatty acids (PLFA) revealed differences in microbial community structure comparing impacted and non-impacted soils, which are to be discussed in context with soil chemical properties.

S05.N.01
Changes in soil physical (hydraulic and mechanical) properties of grassland soils as affected by grazing intensity at Stipa grandis steppe in Inner Mongolia

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Animal trampling can strongly affect soil physical properties. Destruction of soil structure caused by animals leads to increase in soil bulk density followed by an increase in surface runoff.
Grazing can cause changes in pore functions which affect the hydraulic properties of the soil. Stresses exerted by trampling can also lead to changes in soil mechanical strength. The effect of trampling by sheep and goats on physical (hydraulic and mechanical) properties of grassland soils at the Stipa grandis steppe in Inner Mongolia, was investigated. The samples were collected from two sites with different grazing intensities: ungrazed since 1979 (SG UG79) and continuously grazed (SG CG). The studied soils were derived from aeolian sediments above acid volcanic rocks. From each site soil samples, for measurements of soil hydraulic and mechanical properties, were taken. The soil hydraulic functions and soil mechanical properties were affected by grazing. The animal trampling

caused decrease in soil total porosity and increase in soil bulk density. The saturated hydraulic conductivity was found lower at the continuously grazed site (SG CG) in compare to ungrazed site (SG UG79). Furthermore, animal trampling affected soil sensitivity and intensity of shrinkage. Grazing had also effect on soil mechanical properties by changing the precompression stress values.

S05.N.02
Chemical degradation of soils caused by agronomic practices in a zone influenced by mining activities

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The soils studied are in the neighbourhood of an old mining site (La Unión, South-East Spain) and known to be affected by heavy metal contamination. The soils are dedicated to the cultivation of citrus trees in 300 Ha sampling zone.
The study area has geomorphological, edaphological and climatic characteristics similar to other mining areas in the Mediterranean area, with a scarce degraded vegetation.
The soils studied had been classified as haplic Luvisol (profile 1), haplic Calcisol (profile 2) and sodic Calcisol (profile 3 and profile 4).
The levels of lead and cadmium have been determined in each fraction and in the raw soils by means of ETAAS. X-ray diffractometry was used to study the complex mineralogical composition, and a semiquantitave analysis was made for the treated and untreated samples.
The use of low quality water for irrigated soils has resulted in a severe process of desertification and alkalinization in these soils. The fate and transfer pathways of heavy metals in soils are complex, requiring some knowledge of their mineralogy and the physical transport process. Transformations and transport are strongly influenced by site-specific conditions and management practices. Climatic and weather conditions other than rainfall may also influence the fate.
The mobility of both solid particles and soluble metal compounds above the argilic horizon is studied. The processes governing the transfer of heavy metals are strongly influenced by the semi-aridic climate, the presence of a high proportion of carbonates and the occasional but torrential rainfalls which, favoured by the Bt horizon´s impermeability, transport heavy metals from the upper zone of the hill to the surrounding agricultural soils.

S05.N.03
Microbial use of organic amendments in saline soils monitored by changes in the $^{13}C/^{12}C$ ratio

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An incubation experiment was conducted to investigate whether salinity at high pH has negative effects on microbial substrate use, i.e. the mineralization of the amendment to CO_2 and inorganic N and its incorporation of amendment C into microbial biomass C. In order to exploit natural differences in the $^{13}C/^{12}C$ ratio, substrate from two C_4 plants, i.e. highly decomposed and N-rich sugarcane filter cake and less decomposed N-poor maize leaf straw, were added to two alkaline Pakistani soils differing in salinity. In soil-1, the additional CO_2 evolution was equivalent to 65% of the added amount in the maize straw treatment and 35% in the filter cake treatment. In the more saline soil-2, the respective figures were 56% and 32%. The maize straw amendment led to an identical immobilization of approximately 48 µg N g^{-1} soil over the 56-day incubation in both soils compared to the control. In the filter cake treatment, the amount of inorganic N immobilized was 8.5 µg N g^{-1} higher in soil-1 than in soil-2 compared to the control. In the control treatment, the content of microbial biomass C_3-C in soil-1 was twice that in soil-2 throughout the incubation. The two amendments replaced initially similar absolute amounts of the autochthonous microbial biomass C, i.e. 50% of the original microbial biomass C in soil-1 and almost 90% in soil-2. Highest contents of microbial biomass C_4-C were equivalent to 7% (filter cake) and 11% (maize straw) of the added C. In soil-2, the corresponding values were 14% lower. Increasing salinity had no direct negative effects on microbial substrate use in the present two soils. Consequently, the differences in soil microbial biomass contents are most likely caused indirectly by a salinity-induced reduction in plant growth rather than directly by negative effects of salinity on soil microorganisms.

S05.N.04
Reducing the effect of salinity impact on two wheat cultivars using biofertilization,antioxidant and micronutrients

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Absract
A Field experiment was conducted for two growing seasons at three different sites of soil salinity levels (4.72, 7.79 and 10.86 dS/m). The experiment was designed to study the influence of biofertilization with yeast, antioxidant (ascorbic acid) and micronutrients and their interactions on mitigating the soil salinity effect on two wheat cultivars (Sakha 93 and Sakha 94). Obtained results indicated that application of biofertilization raised the shoot freshand dry weight values , although treatments using micronutrients in addition to 100 & 200 ppm antioxidant improved plant fresh weight to reach those of the positive control (100% NPK).. Biofertilization with *Candida tropicalis* increased significantly the leaf area of tested wheat cultivars under 4.72& 7.79 dS/m soil salinity levels. At high salinity level of 10.86 dS/m it has been found that all treatments together with biofertilization mitigated the adverse effect of salinity. Application of yeast produced the highest spikes number / m2 irrespective to salinity level and cultivar type that ranged from 221-323 in comparison with the non biofertilized ones (72-273). For grain yield the same previous trend was recorded at low salinity levels where biofertilized wheat yield ranged from 8 to 22 ardab/fed, while non-biofertilized plants ranged from 0.73 to 14.8 ardab/fed. As for proline content in wheat plants, the biofertilized treatments produced similar results to the positive control in the different salinity levels. For total chlorophyll, the variety Sakha 93 overcame Sakha 94. Regarding carotenoids, no significant results were recorded . As to enzymes content, no significant differences were found in polyphenol oxidase. Biofertilization of Sakha 93 enhanced enzyme content of phenylalanine ammonia lyase peroxidase in comparison with Sakha 94 grown under 4.72 & 7.79 dS/m salinity levels. For amylase activity, micronutrients together with antioxidant application increased amylase activity in both cultivars at 4.72 dS/m .

S06 Soil and Water - Theory

S06.A.KL
Hydropedology as one of „Hydro-sciences“ and important part of Soil and Water Relationship

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Very recently, the1st International Conference on Hydropedology was held in Penn State University (July 28 - 31, 2008). Around 100 abstracts have been received with many exciting and cutting-edge presentations to be given by leading scientists. More than 100 scientists from 20 countries have participated in the conference. As Henry Lin, the main organiser of the conference expressed, the large conference agenda consisted of a global alliance for *monitoring*, *mapping*, and *modelling* of the landscape-soil-water-ecosystem relationships across scales. This is in line with growing interests in international scientific communities to establish various observatory networks to monitor the ever-changing environment and to provide transformative platforms for scientific research. Rick Hooper from CUAHSI presented very interesting review about hydrologic sciences: ,,Hydrologic science, like other environmental sciences, depends on observations rather than experiments as the basis for inferring controlling processes. Stronger inferences can be made using multidisciplinary approaches, by having denser data in space and time, by having “coherent” data that link stress and response, and by having longer term and larger scale data to improve the signal to noise ratio. Significant barriers exist in cost, scale, and expertise for single investigators to acquire such data sets“.
It should not be forgotten that soils as porous media play a fundamental role for subsurface transport processes by controlling the infiltration, redistribution, drainage, storage, mixing and release of rainfall. Luisa Hopp talked about interaction between soil and topography. This interaction leads to strongly non-linear behaviour at the scale of hill slopes with threshold-like responses and hysteresis often observed in field studies. While field experiments have increased our understanding of hydropedological processes, such work is still of limited value because of the small number of places and events that have been characterized to date. The important role is played by simulation models which can be used to study different hydropedological processes and the combination of the models and field and laboratory measurements can help us to understand the processes and to evaluate the soil hydro-physical characteristics.
Many other participating scientists presented interesting results, opinions and conclusions.
This article tries to summarise and comment the future directions of hydropedology as they were discussed and presented by the World hydropedologists in the 1st International Conference on Hydropedology in Penn State University, USA, (July 28 - 31, 2008).

S06.A.01
Soils a key to understand signal propagation and dynamics in hydrological time series in changing ecosystems

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Along their path through ecosystem compartments hydrological signals are transformed in several ways, comprising changes in randomness, autocorrelation structures and smoothness. Complexity and information measures of hydrological time series are sensitive characteristic parameters of ecosystem behaviour with high potential as indicators for environmental change and disturbances. However, assessment of key factors of environmental systems by time series analysis alone is not possible. It further involves the use of deterministic analytical tools like process based simulation models in combination with sensitivity analyses and scenario techniques. The fundamental problem in this context is the necessary degree of model complexity regarding the target questions under study.
With a new approach we analyse information and complexity propagation in hydrological compart-ments and we analyse the spatial and temporal dynamics of hydrological patterns in two mountain forest ecosystems under different climatic conditions and under different degrees of disturbance.
Hydrological time series cover the sequence of hydrological signals from open precipitation, throughfall, sapflow, water fluxes in the soil compartment and system discharge. Simulations are carried out with several hydrological models differing in their degree of complexity. Model complexity is assessed by the temporal behaviour of the model output. The resulting virtual time series are analysed with the same methods as the real hydrological system. Results are compared and evaluated regarding the necessary degree of model complexity.
We find the soil as the most important compartment for signal transformation and structure building in the hydrological cycle in the ecosystem. Complexity and information measures are sensitive tools to describe ecosystems and to indicate changes in the enviromental behavior caused by natural or anthropogenetic changes.

S06.B.01
Integrated ecological modeling using pedostructure concept. Problematic and presentation of both computer models, Kamel and KamelSoil

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Modeling soil biogeochemical processes is in a deadlock due to two major limitations:
1. Since most of the biogeochemical processes occur in the soil-water film at surface of solids which compose the hierarchical and aggregated soil structure, coupling biogeochemical models with existing soil water representations is not possible at the process scale without a new paradigm that takes into consideration soil structure and its interaction with soil water.
2. Current pedological mapping and characterization methods do not provide the required soil information and data that are needed for scaling the processes from their scale within the soil to the landscape levels. Such information includes i) delineation of primary soil map units and ii) the functional characteristics which allow for modeling soil internal thermodynamic state that controls the bio and geochemical processes in soil.
The new concept of pedostructure and its thermodynamic characterization had lead to a new paradigm for soil water modeling and characterization. This new paradigm provides systematic methodologies for addressing the two challenges introduced above. The physically based soil structure water computer model, "Kamel", was built using this paradigm then offers the possibility of 1) coupling disciplinary models (e.g. the organic matter transformation, transport and mineralization) with the soil structure hydro-functioning, at the scale of processes in soil, and 2) integrating results from the local scale in the soil medium to the field scale. In this communication, we present the model "Kamel" which is available though a dedicated website, along with "KamelSoil", a translator of the easily available soil information into pedostructure parameters for "Kamel".

S06.B.02

Superhydrophobic surfaces: A model approach to predict contact angle and surface energy of soil particles

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Wettability of soil affects a wide variety of processes in soils including infiltration, preferential flow, and surface runoff. The problem of determining contact angles and surface energy of powders, such as soil particles, remains still unsolved. So far several theories and approaches have been proposed, but formulation of surface and interfacial free energy, as regards its components, is still a very debatable issue. In this work, the general problem of the interpretation of contact angles and surface free energy on chemically heterogeneous and rough soil particle surfaces are evaluated by a reformulation of the Cassie-Baxter equation assuming that the particles are attached onto a plane and rigid surface. Compared to common approaches, our model considers a roughness factor which depends on the Young's law contact angle determined by the surface chemistry. Results of the model are discussed and compared with independent contact angle measurements using the Sessile Drop Method and the Wilhelmy Plate Method. Based on contact angle data, the critical surface tension of the grains were determined by the method proposed by Zisman. Experiments were made with glass beads and three soil materials ranging from sand to clay. Soil particles were coated with different loadings of dichlorodimethylsilane to vary the wettability. Varying of the solid surface tension with dichlorodimethylsilane treatments provided pure water wetting behaviors ranging from wettable to extremely hydrophobic with contact angles >150°. Results show that the critical surface energy measured on grains with the highest silane loadings is rather similar to the surface energy measured independently on ideal silane-coated smooth glass plates, except for the clay soil. Contact angles measured on plane surfaces were related to contact angles measured on rough grain surfaces by using the new model based on the combined Cassie-Baxter Wenzel equation under consideration of the particle packing density on the sample surface.

S06.B.03

Estimating Saturated Hydraulic Conductivity In Semiarid Rangeland Using Artificial Neural Network

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With the advent of advance geographical information systems(GIS) and remote sensing technologies in recent years ,topographic(elevation, slope and aspect) and vegetation attributes are routinely available from digital elevation models(DEMs) and normalized difference vegetation index(NDVI) .Based on the correlation of the soil distribution and vegetation growth patterns across a topographically heterogeneous landscape, this study explores the use of topographic and vegetation attributes in addition to pedologic attributes to develop pedotransfer functions (PTFs) for estimating saturated hydraulic conductivity(Ks) in the semiarid rangeland of Iran .The measurement data were used to derive these functions by using artificial neural networks. Twenty models were developed to predict saturated hydraulic conductivity(Ks).The performance of the neural network models was evaluated using Spearman correlation coefficient between the observed and the predicted values and root mean square error(RMSE).Although variability exists within bootstrapped replications, improvements (of different levels of statistical significance) were achieved with certain input combinations of basic soil properties ,topography and vegetation information compared with using only the basic soil properties as inputs . Topography (DEM) and vegetation (NDVI) attributes were useful to capture the variations in the semiarid rangeland of Iran.

S06.B.04

Modelling the equivalent hydraulic properties and hydraulic functioning of a highly heterogeneous horizon

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Researchers develop predictive models always more effective on hydraulic functioning in soil. Currently, such models are based on the hypothesis that the elementary stitch, the horizon, presents constant properties in space. But some horizons are highly heterogeneous and the determination of the Representative Elementary Volume (REV) of their hydraulic properties remains difficult.
The studied Albeluvisol exhibits horizons composed by the juxtaposition of two Elementary Pedological Volumes (EPVs) that can be distinguished by their colours and classified as functional volumes. We have measured the hydraulic properties (water retention and hydraulic conductivity) of the two EPVs with experiments specifically designed for the size of these samples. We have realized, in situ, an electrical tomography of one heterogeneous horizon on a 1 m² surface. The information derived from these measurements as well images of the horizon are used to define the 3D structure of the heterogeneous horizon. Structure derived from the electrical tomography is in agreement with the arrangement of EPVs on the images of the horizon. The 3D hydraulic functioning of the heterogeneous horizon is then modelled on a volume of about 0.5 m^3 with a real annual climatic scenario. The analysis of the data helps us in identifying the minimum size of the volume of the horizon which must be taken into account to obtain the REV of the studied heterogeneous horizon. The equivalent hydraulic properties are finally calculated.

S06.B.05

Improving pedotransfer functions predictions by adding pedological information

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Soil hydraulic properties are needed for modelling hydrology at various scales. As their direct measurement is expensive and time-consuming, efforts are devoted to their prediction using more easily available information. Pedotransfer functions are tools developed for this purpose. They generally employ soil textural distribution, bulk density and organic carbon content. They are known to be only reliable when used on soils comparable to those used for their calibration. Including information about the soil structure in the predictions could improve their quality.
This study focuses on the coupling of two Belgian databases containing complementary information: the first is a dataset of some 130 soil horizons for which hydraulic properties were measured while the second holds the national pedological soil survey.
The two databases are linked through their geographical location and their soil profile classification. Pedological information constant over identically classified soil profiles, such as the CEC or the pH for example, is related to the hydraulic properties. By investigating these relations, we expect to bring some improvement to the predictions of PTFs.

S06.B.06

Confronting typical assumptions of 1-D root water uptake models with 3-D simulations

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Root water extraction from soil is controlled by the local water potential gradient between soil and roots. However taking this local effect in consideration is challenging given the lack of real data on root architecture, on the distribution of the water potential at the root-soil interface, or on the local hydraulic properties of soil and root. Therefore 1-D or 2-D models have been developed to predict root water uptake based on simple assumptions and easy-to-measure variables.
Usual assumptions made in these 1-D/2-D models are, amongst other, that 1-D sink profiles are proportional to root length density profiles; that there exist unique stress-reduction functions; that the principal direction for water flux is horizontal, and that soil affects the water uptake distribution only after its wilting point is reached.
In order to numerically investigate the water uptake processes at the plant scale, we built a 3-D model, called R-SWMS, which combines water flow in conducting vessels of a plant and within the soil matrix. The distribution of the soil-root water fluxes is calculated based on the water potential gradient and the local hydraulic properties of the root and the soil. A general scenario was built where one Maize plant extracts soil water from a homogeneous soil under a sinusoidal evaporative demand. Effective 1-D sink and water distribution profiles were then extracted from the 3-D simulations and compare with the 1-D/2-D assumptions. Results show that soil type plays a non negligible role much before wilting point is reached, that monotonic stress function can hardly be defined and that the soil water flow general direction is vertical upward.

S06.C.01

Calibration and evaluation of the soil water content sensors ECH2O EC 5 and TE for the soil moisture sensor network SoilNet

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The wireless sensor network SoilNet is a promising in situ measurement technology for the continuous and high resolution monitoring of soil moisture patterns at the catchment scale. To achieve high data accuracy, the development of an appropriate laboratory calibration methodology for the soil water content sensors ECH2O EC 5 and TE, which are used for SoilNet, is an important task. The calibration methodology is based on a standardized sensor characterization methodology, which uses 2-isopropoxyethanol and dioxane as standard liquids with known permittivity in the range between 2.2 and 41.3. The sensor response-permittivity relationship is described by an empirical model. A first evaluation using 14 liquid standards showed that the model was able to fit the measured data (rmse $\varepsilon < 1$). A sensitivity test showed that the number of standard liquids could be reduced to five, which considerably reduced the calibration time. The calibration of 100 EC 5 sensors revealed a high variability amongst the sensors. Also, one third of the 50 calibrated TE sensors showed even large variations. Therefore, it is concluded that a universal calibration curve is not applicable and an individual calibration of each sensor is necessary. To further enhance the measurement accuracy, correction functions for the effect of temperature and electrical conductivity were derived from additional laboratory experiments. The temperature effect on the EC 5 and TE sensors was investigated in the temperature range of 5 to 40°C and the permittivity range of 6.4 to 41.3 using standard liquids immersed in a temperature regulated water bath. The permittivity values were obtained with the reference network analyzer measurements. A temperature effect could not be observed up to a permittivity of 10. For higher permittivities, temperature effects were present. Furthermore, an effect of electrical conductivity was also present in the range of 0-2.5dS/m.

S06.C.02

Intrinsic hydraulic properties determination of water repellent soils using tension disc infiltrometry

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The soil's hydraulic conductivity is a property that is strongly dependent on the soil's wettability. Previous investigations showed that even subcritical hydrophobicity (contact angle < 90°) can significantly reduce the infiltration rate of water into the soil. To characterize the wettability of the soil material different methods can be used. Contact angles (CA) to measure the degree of the hydrophobicity (e. g. Wilhelmy Plate Method (WPM), Capillary Rise Method (CRM)) and the WDPT test for assessing the persistence of the hydrophobicity are well established methods on the small scale. Their relevance for infiltration processes on a larger scale remains unclear.
Due to its low surface tension ethanol is considered to form a 0° CA with the soil material, independently of the soil's surface free energy. We used water and subsequently ethanol to infiltrate into sand columns (1-D) and into packed sand blocks (3-D) at different tensions. Sand was treated with increasing amounts of dichlorodimethylsilane (DCDMS) to alter the surface free energy resulting in increasing CA. In contrast to naturally hydrophobic soils, CA resulting from treatment with DCDMS do not change with the sand's water content. They are also stable over long periods of time. Considering the different material properties of water and ethanol, congruent hydraulic conductivity functions could be measured in hydrophilic sand. Using more hydrophobic sand the differences between the water- and the ethanol conductivity function are increasing. These differences can be used to "calculate" an effective CA, i. e. the CA controlling the infiltration on a larger scale (infiltration zone). The effective CA can be compared with the CA measured on a smaller scale, so that their relevance for small-scale CA for the soils hydraulic properties on a larger scale can be quantified.

S06.C.03

Characterization of the mobile water fraction in a Beauce loamy soil

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The Beauce groundwater, one of the main groundwater resources in France with 20 billons of m3, is at risk by the use of pesticides in agriculture. The observed contaminations can only be explained by preferential flow processes, which are still poorly understood. We showed that Beauce soils were susceptible to preferential flow of the "mobile/immobile water" (MIM) type rather than of the macropore type. MIM preferential flow was evidenced by field experiments based on bromide tracing and tension infiltrometry using the Clothier et al. (1992) method. This method and other classical laboratory methods for characterizing MIM preferential flow in soils are limited to steady-state water flow regimes. Application of the MIM concept to transient water flows is still a matter of research, but significant advances have been made by Šimunek et al. (2005) and Köhne et al. (2006) through the development and test of the HYDRUS-1D model. This model allows for a variable mobile water fraction, whose evolution is linked to a convective water exchange term between the mobile and the immobile water fractions. This water exchange term may be expressed as a function of water content or water potential. Depending on this choice and on other assumptions about the mobile water fraction at the residual end of the water retention curve, the number of parameters to be specified for MIM transport modelling varies from 2 to 5. We tried to estimate some of these parameters by measuring the mobile water fraction at various water potentials between -1 and -10 cm. Our results show that the mobile water fraction is highly variable in space, and may increase or decrease with water content depending on the soil horizon.

S06.C.04
A new method to measure in-situ subsoil drainage flux

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Improving knowledge of gains and losses in water within agricultural catchments of Australia is essential to achieve sustainable water resource use. There is a great need in Australian irrigated agriculture to quantify deep drainage, because of the risk of groundwater recharge and soil salinisation.
This study presents a new method that provides in-situ estimates of sub-soil drainage flux. The method used a pair of vertically separated "tube tensiometers". This is an open-topped tube that is filled with a porous material and measures soil water potential close to saturation at two depths (1.0 and 1.2 m). These tensiometers were maintenance free and after testing were found to measure accurately. The approach used was to estimate drainage flux using Darcy's Law and the hydraulic gradient and soil hydraulic properties obtained from the measured soil water potential data. Measurements of hydraulic gradient were made over 20 months in a vineyard planted with Chardonnay grapes on a clay loam soil near Griffith, NSW Australia. At the end of this period, the soil hydraulic properties of the undisturbed soil in which the hydraulic gradient was obtained were measured using the tube tensiometer itself. A known volume of water was pumped for over 200 hours into the soil through the shallower sensor of the tube tensiometer. Continuous measurement of the soil water potential at both depths enabled numerical inversion (using the "Hydrus" model) to estimate unsaturated hydraulic properties.
The drainage flux during one season was calculated with Darcy's law using the in-situ soil hydraulic properties and the historic soil water potential data. The maximum daily averaged drainage flux was 3.2 cm h^{-1} which corresponded to 0.64 ML ha^{-1} over the vineyard for one irrigation season. These data were considered realistic and it is concluded this is an improved method to estimate drainage flux in the field.

S07 Soil and Water - Practical Applications

S07.H.KL
Soil water - storage potential, accessibility and flux as key functions for land use planning at various scales - do we need a paradigm change?

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Discussions about soil water availability become more and more important not only because of the worldwide, growing demand for water for different uses but also because of adverse land use practices, reducing the soil water storage capacity and accessibility.
Not only the pore continuity but also the intensity and directions of fluxes have to be analyzed at various scales and linked to the different water requirements for a better overview of the water controlled processes in agriculture, forestry and/or environmental protection. The lecture will cover scale dependent processes and discuss consequences for a more rational water management and water protection as an alternative to the present situation.

S07.H.01
Modeling the soil moisture regime under Mediterranean conditions

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The evaluation and prediction of the soil moisture regime is indispensable for the prognosis of processes related with the water supply to plants, soil and water degradation and derived phenomena. This becomes especially important under Mediterranean conditions, due to the predominant soil, topography and climate characteristics, and the previewed future climate changes. Under such conditions the use of empirical approaches for evaluating the soil moisture regime and derived effects has proved to be not very reliable. In this contribution there are presented the results obtained under different conditions of soils, climate and land use in NE Spain, by the integration in a simple water balance model of field measured soil hydrological properties together with climatological information. The studied aspects included the changes in soil moisture regime during the different growth stages of vines in rain fed vineyards with more or less stony soils and moderate to steep slopes. The different management practices included tillage, leveling, terracing and use of green covers and complementary irrigation. There are especially analyzed and discussed the advantages and difficulties for the field measurement of the required hydrological parameters in relation to other proposed approaches and methodologies, including laboratory measurements, use of pedotransfer functions and use of empirical models.

S07.H.02
Pedo-hydrologic indicators evaluation through pedo-hydrographic balance sheet simulation models at hydrographic basin level using georeferential data base

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Most of the spatial applications of simulation models need numerous data related to pedo-transfer functions (water retention curve, saturated and unsaturated hydraulic conductivity, and soil cohesion, angle of internal friction, precompression stress and concentration factor) in general hardly available. The application of indirect methods calculating the parameters of the pedo-transfer's functions from available information of existing data sources (databases with specific site information, soil maps) is a viable solution to this problem.
The models used are based on certain precise datasets from specific areas, and are able to combine the effects of hydraulic and mechanical properties on soil erosion processes. In this paper we present the evaluation of some soil-water indicators using mathematic simulation models at hydrographic basin level. We estimate indicators characterizing soil water infiltration (weighted integral of unsaturated hydraulic conductivity).

S07.H.03

Field scale variability of measured and estimated hydraulic properties: stochastic analysis of hydraulic behaviour sensitivity and investigation on spatial structures of the data

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Flux and storage of soil water in the unsaturated zone is adequately described by the classical Richards equation. Extrapolating the theory to a larger-scale system is ordinary practice (scale-invariant equation) but its application in modeling field-scale water flow set the following major and strictly related problems; namely (i) the characterization and parameterization of soil hydraulic properties and (ii) their variability, precisely sample and spatial variability.
In order to address (i) the characterization issue, the soil hydraulic properties are typically derived either through expensive laboratory and/or field experiments or with alternative approaches like pedotranfer functions, in order to increase cost effectiveness.
On the other side (ii) the variability of soil hydraulic properties can be treated by studying both data and spatial variability. In the former case a simple approach, considering soils in the field as an ensemble of parallel and statistically independent tubes. Then we used the Monte Carlo technique, for analyzing soil hydraulic properties probabilistic uncertainty.
Moreover the stochastic analysis of the data does not tell us anything about how soil hydraulic properties vary in space. Spatial variability was studied aiming to define spatial structure of the measured data and to perform estimates of some important hydraulic parameters. We used geostatistical approach for data analysis and applied different Kriging methods as interpolation techniques.
The goals of this work, placed at the core of the issues (i) and (ii), are the following:
- recognize the sensitivity of a Richard-based model to the measured variability of $\theta(h)$ and $k(\theta)$ parameters;
- establish the predictive capability of PTF in term of a simple comparison with measured data taking into account the results of point (i);
- establish the effectiveness of using PTF by using as data quality control an independent and spatially distributed information (NDVI).
- study the spatial variability of some hydraulic parameters and interpret their spatial patterns by means of comparison with soil and topographic characteristic of the study area.
The study area is located in the Po plain (Lodi) in Northern Italy and it has an extension of approximately 2000 hectares; most of the area has corn land use.

S07.H.04

Relevance of using soil moisture simulation for farming decision support

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Many decisions in agriculture are conditional to soil moisture. For instance in wet conditions, farming operations as soil tillage, organic waste spreading or harvesting may lead to degraded results and/or induce soil compaction. The development of a tool that allows the estimation of soil moisture is useful to help farmers to organize their field work in a context where farm size tends to increase as well as the need to optimize the use of expensive equipments.
Soil water transfer models simulate soil moisture vertical profile evolution. These models are highly sensitive to site dependant parameters. A methodology to implement the mechanistic soil water and heat flow model (the TEC model) in a context of limited information (soil texture, climatic data, soil organic carbon) is proposed. The obtained accuracy in surface soil moisture (0-30 cm) was 0.04 m3/m3. When a few soil moisture measurements are available (collected for instance by the farmer using a portable moisture sensor) a significant improvement in soil moisture accuracy is obtained by assimilating the results into the model. To meet the decision support context, we evaluated the model ability of evaluating the soil moisture level in comparison to a moisture threshold that splits soil conditions into desirable and undesirable cases. This threshold depends on soil properties, the farming operation and equipment characteristics. We evaluate the rate of making good decisions using either the TEC model with and without soil moisture measurements or an empirical algorithm that simulate the decision processes followed by farmers, currently. This later is a reference case that allows appreciating the adding value of using soil water transfer models. We found a significant improvement with a rate of success, which increases from 65% with the reference case to 90% when using the model with soil moisture assimilation.

S07.I.01

Using randomised moving plots to quantify the spatial variability of soil water dynamics in small forest areas

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Observations of the soil water status are usually restricted to few selected positions, due to the costs and equipment requirements. A common measuring design is to stratify the area under investigation into more or less homogeneous sub-areas and to measure soil moisture/tension at a “representative” position within each sub-area. This approach neglects any spatial variability of the flow dynamics within the sub-areas, caused e.g., by varying soil-hydraulic properties.
As an alternative to the stratified measuring approach, we present the concept of randomised moving plots (RMPs) which allows observing both the long-term soil moisture regime and its spatio-temporal variability. We applied the RMP concept to the mapping of the soil moisture dynamics of two forest areas (80 m × 1000 m) in Southwest Germany. The RMP concept is based on the fact that the typical seasonality of the soil moisture regime is governed by some (easily measurable) climatic driving variables. Describing the seasonality of the soil moisture by climatic variables renders it unnecessary to measure soil moisture at the same position over a long period. The thus saved measuring equipment can be beneficially used to observe the spatial variability of the soil moisture. For this, we carry out short-term continuous soil moisture measurements within an RMP with 31 FDR probes at random positions. Both, the RMP centres and the FDR positions are moved randomly in two-week intervals. Thus, within one year of measurements, 26 · 31 = 806 short soil moisture time series are obtained. These data are used to (i) relate the seasonality of the proxy variables (climate) with that of the soil moisture and (ii) to quantify the variability around the mean seasonal development.
Combining the seasonal development (derived from the proxy variables) and the spatial patterns (observed in the RMPs) results in a space-time-model of the soil moisture.

S07.I.02

Database of soil-hydraulic properties of forest soils in Baden-Württemberg/Germany

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Forest soils are under-represented throughout the existing soil databases, although they evidently differ in their hydraulic

properties from soils under agricultural use. Data on the unsaturated hydraulic conductivity of forest soils are almost completely absent in most databases. The use of the existing databases is hindered also by the numerous, individually designed experimental setups for obtaining the soil-hydraulic function.
Our work therefore focuses on

1. Generating a representative data set of both, the retention and the unsaturated conductivity characteristics of forest soils,
2. Developing an experimental setup for a fast and standardised estimation of these characteristics,
3. Developing and testing scaling approaches for the estimation of the hydraulic functions from proxy variables.

At 305 soil profiles in Baden-Württemberg, undisturbed 100 ml soil cores are sampled in 10-14 cm and 30-34 cm depth in the mineral soil (five repetitions per depth). The retention and conductivity curves are estimated from multi-step outflow (MSO) experiments by inverse optimisation.
Since many authors found a considerable dependency of the inverse parameter estimates on the experimental setup, we designed the MSO experiment such that it could be carried out with the same initial/boundary conditions for most of the soil samples. In addition, the experiment was optimised with respect to (i) the information content of the measured data for obtaining unique parameter estimates in the inverse optimisation and (ii) a shortest possible duration of the MSO experiment.
The database by now contains about 2,000 data sets. Both, the measured times series and the derived hydraulic functions were used to identify groups of hydraulically similar soils. For three pressure ranges, scaling approaches were applied in order to describe the observed variability by other soil data (texture, bulk density). We present scaling models for the different groups of hydraulically similar soils and compare them with commonly used pedotransfer functions.

S07.I.03
Electrical resistivity tomography monitoring of water deficit along pedological toposequence related to hedgerow

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In agro-ecosystems, landscape features are often enough induced by anthropogenic structures such as hedgerows, terraces and ditches located at the agricultural lands. Hedges constitute barriers to the redistribution of solid soil material through water and tillage erosion.
The aim of our study is to characterize soil water deficit related to hedgerow root system using a geophysical method combined with classical soil moisture, soil parameters and groundwater measurements. Spatio-temporal characterisation using 2D electrical resistivity tomography was conducted along a pedological toposequence. The hillslope monitored is characterized by upslope zone with a well-drained soils and a downslope zone with waterlogged soils. A hedgerow perpendicular to the slope constitutes the limit of those two contrasting domains. The results obtained show that electrical resistivity increase with soil dryness. A minor soil water content change was observed during the study because of a specially wet climate of the studied period (spring and summer 2007). The driest zones, identified with electrical resistivity tomography, are coherent with root density observed during field monitoring, and with literature.

S07.I.04
Functional parameter pedo-transfer functions of soil water characteristic curve in western Iran

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Soil hydraulic properties [soil water characteristic curve, SWCC and hydraulic conductivity, K(θ)] are of significant importance in models of vadose zone processes. This study was conducted to measure and model the SWCC, and to derive functional parameter pedotransfer functions (FP-PTFs) in Hamadan Province, western Iran. Top- and sub-soils of 63 important soil series (in total 126 soils) were samples, which were well distributed in different regions of the Province. The soil physical and chemical properties were measured by the standard methods. The SWCC was measured by the sand box and pressure plate apparatuses at matric suctions of 1, 2, 5, 10, 33, 50, 100, 200, 500, 1000 and 1500 kPa. The SWCC data were then modeled by the well-known van Genuchten-Mualem model (VG-M) using RETC program. Goodness of fit of the VG-M to the measured values of SWCC was quite well. FP-PTFs of the model parameters were derived through multiple linear regressions, in which, soil particle size distribution, bulk density, organic matter, calcium carbonate and gravel contents, their transferred values (reciprocal, root, square, and logarithm) and selected interactions were considered as independent variables. The derived FP-PTFs for the saturated water content (θ_s) were reliable but the ones for the residual water content (θ_r), shape parameter (i.e. n) and air entry value parameter (α) were not accurate. Square of bulk density and logarithm of clay content had decreasing and increasing impacts on the θ_s, respectively. The effects of logarithm of clay content and square of organic matter content on n were negative and positive, respectively. Accuracy of the FP-PTFs was highly increased when the measured θ_s and water content at matric suction of 10 kPa (θ_{10kPa}) were also included as independent variables. Prediction accuracy of FP-PTFs for θ_s was highest, for θ_r and n was lowest, and for α was intermediate.

S07.J.01
Tracing preferential flowpaths using electrical conductivity measurements: What are the constraints?

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Intensified agriculture in the mountainous regions of northern Thailand has lead to an increased application of agrochemicals. Losses of agrochemicals to aquatic systems directly affect the water quality in the lowland. To study the impacts of different land use types on the fate of agrochemicals the SWAT (Soil and Water Assessment Tool) is used. The focus of the present work is to identify preferential flow paths during rainfall events in a subcatchment of the Mae Sa watershed. The watershed is located close to Chiang Mai and has a total area of 77 km². It is characterized by steep slopes and narrow sub-basins with mainly mixed evergreen forests and deciduous forests. The cultivated areas are dominated by flower and vegetable production. Discharge is measured at three locations equipped with ultrasonic sensors. Rainfall is measured at twelve locations distributed over the whole are. Water and soil temperature is measured also.
During single events water samples were taken from stream water, soil water, surface runoff and rainfall. Electrical conductivity (EC) and temperature were measured during rising and falling limbs of the hydrograph. The water samples were

analyzed for the main ions and will form the base of a hydrograph separation. The EC values measured during peak flow showed a good reaction of the event water input, dropping by 60 µS/cm. While the EC values of rainfall were fluctuating surface runoff was more stable. With 29 µS/cm the soil water samples showed also very low EC values. This finding can be explained by a highly developed macro pore network in the upper soil layer supporting pipeflow. Using these data a hydrograph separation will be carried out to identify the subsurface flow components on the total discharge and to hereby identify the main contributor of agrochemicals to the stream.

S07.J.02
Deriving point pedo-transfer functions of water retention for important soil series in Hamadan Province, western Iran

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Soil water retention (SWR) is considered a significant subject in soil physics. It is involved in water-solute transport in soil, drainage, water uptake by plants, evapotraspiration and irrigation scheduling. Despite the great advances in the measurement methods, determination of the SWR especially on undisturbed soils is not easy. There was no database of soil hydraulic properties in Hamadan Province, therefore, this study was carried out to measure the SWR and to derive point pedotransfer functions (P-PTFs). Top- and sub-soils of 63 important soil series (in total 126 soils) were samples, which were well distributed in different regions of the Province. Soil physical and chemical properties were measured by the standard methods. The SWR was determined by the sand box and pressure plate apparatuses at matric suctions of 1, 2, 5, 10, 33, 50, 100, 200, 500, 1000 and 1500 kPa. P-PTFs were derived through multiple linear regression, in which, particle size distribution, bulk density, organic matter, calcium carbonate and gravel contents were considered as easily-available inputs. The derived P-PTFs were accurate and statistically significant (P<0.001) to predict the SWR at defined matric suctions. The absolute effect (negative for low matric suctions and positive for high matric suctions) of bulk density was decreased as matric suction increased. The effect of organic matter on SWR was positive mostly at the wet range. The effects of clay and silt on SWR were positive but the influence of gravel was always negative. Increasing impact of calcium carbonate was not considerable. To increase the accuracy of P-PTFs, saturated water content (θ_s) was also included as independent easily-available variable. The derived P-PTFs could be used in environmental management and irrigation projects in the region. It is suitable to test the validity and reliability of the P-PTFs as soon as more data becomes available in the region.

S07.J.03
Significance of tree roots to preferential flow in soils with stagnic properties

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The assumption that forests reduce discharge is in circulation for almost two centuries. Today we think that forest soils contain macropores with higher hydrological efficiency when compared with soils carrying other types of vegetation. Tree roots are important factors for the generation and conservation of macropores. In this project we explored the influence of the root geometries of spruce (*Picea abies*), white fir (*Abies alba*) and beech (*Fagus silvatica*) on preferential flow in soils with stagnic properties.

The study site was located in the Flysch region 30 km south of Bern (Switzerland) at an altitude of 1000 m. Soils were characterized by stagnic properties. The experimental set up consisted of a 1m x 1 m sprinkler device and TDR probes that were horizontally mounted from a trench into the centre of each horizon. Each plot was irrigated three times within a 24-hour interval. After irrigation, soil was sampled with a corer (10 cm diameter). Roots were extracted from the soil and analysed with the program "whinRIZO".
The application of a rivulet approach to the water content data of the tirrigations resulted in the contact length, L (m m^{-2}), per cross-sectional area and the film thickness, F (µm), between mobile water and soil. A positive correlation (r^2 = 0.77) between the maximum of L and the length of the fine roots resulted from 13 sprinkler experiments. By contrast, the correlation of the maximum of F and fine root length is negative (r^2= 0.69). Due to the fact that volume flux densities, velocity of wetting and drainage front are dependent on L and F, tree roots in stagnic soils have an effect on preferential flow.

S07.J.04
Snowmelt infiltration through frozen forest soil

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Snowmelt timing is critical for tree growth in high latitudes, but threshold conditions with respect to root-zone soil water availability in spring is not well understood. We monitored snowpack thickness, air and soil temperature (ST), as well as soil water content (SWC) in Naruska (67°09'N, 29°10'E), Finnish Lapland through 2004-2007. The site hosts premature Scots pine stand underlain by Haplic Podzol developed on sandy outwash sediments with sand silt and clay fraction contents of 60, 38, and 2%, respectively. Soil temperature probes and soil water content reflectometers were placed at 20-cm-increments starting from 10 cm and automatically logged with Campbell CR10X data-logger in 3-h-intervals. The maximum snowpack thickness varied from 45 (in 2005) to 90 cm (in 2007). We found notable rise in SWC (30-cm-depth) as early as 10 (in 2004) to 39 days (in 2007) before the final snowmelt. Notable rise in ST occurred 9 days (in 2006) to 22 days (in 2004) after the snow disappearance. Snowmelt water percolated through the frozen soil such that SWC at 10-cm-depth increased 26-58 days before ST exceeded 0°C. The shoot growth of Scots pine commenced coincidentally with the disappearance of snow except in 2007, when it was 5 days delayed. In contrast, the rise in ST (10-cm-depth) over 0°C occurred as late as 18 to 33 days after the initiation of shoot growth. We argue that soil water availability, along with air temperature, rather than soil temperature is pivotal for the start of height increment of Scots pine in subarctic conditions.

S07.J.05
The usefulness of the stable isotope ^{18}O, ^{2}H and ^{15}N for a better understanding of the soil-water-plant system.

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Improving plant water use efficiency in arid countries, where soil water resources are scarce is an important issue that can be tackled by isotope tracking. We conducted two studies with stable isotopes ^{18}O, ^{2}H and ^{15}N in the soil-water-plant studies. The first was conducted in Quebec, Canada (46° 43' 57'' N, 74° 04' 04'' W). Individual rainfalls with distinct natural isotopic signatures of ^{18}O and ^{2}H were tracked in a 80 cm loamy-sand soil profile (mixed, acid, mesic Typic Haplorthod) in a potato (*Solanum tuberosum* L.) production system from May 2005 to

May 2006 to evaluate soil water replacement rate and the impact of evapo-transpiration on the status of soil water. Nitrogen fertilizer fortified with 1.335% ^{15}N was applied at plantation. Isotopic results of ^{18}O and ^{2}H in rainfalls and soil water and of ^{15}N in the soil showed that soil water replenishment and nitrate leaching below the root zone (30-40 cm) was strongly related to the intensity of rainfall. Rainfall intensity was high (68-105 mm/day for the recorded period in spring 2005 and fall 2005) and low (0 to 40 mm/day) otherwise. Leaching occurred mostly in fall 2005 after harvest (September 12 to October 27). Nitrogen fertilizer recovery was 47 % in the harvested tuber as shown by ^{15}N. In a second study, ^{18}O-enriched irrigation water was applied to pots (44cm diam.; 30 cm height) under cultivated and controlled conditions. Isotopic signatures of ^{18}O were measured in irrigation water, soil water and in the plants (sap and dry matter). The relationship between the ^{18}O isotopic signatures of plants and the ^{18}O isotopic signatures of either the soil or the water applied was then studied all along the growing season at field capacity and at a stressed water content level.

S07.J.06
Measurement of soil hydraulic properties with a simple evaporation approach

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The measurement of unsaturated hydraulic conductivity and water retention function is a topic of crucial importance for soil hydrological research. Numerous measurement methods and simulation procedures for quantifying soil hydraulic properties have been developed over the last decades. Most of them are difficult to handle and time consuming. The aim of our study was to develop a reliable but simple approach. The evaporation method is one of the most favourable methods. Applying this method, the basic measured values - mass or water loss, respectively, and tension change over time - was analysed at 104 representative samples of varying texture and dry bulk density during evaporation. With the exception of sand, water loss per time interval was approximately constant in all other mineral and organic soils during the measuring time in the tension range between 0 and about 60 kPa. In sands, the non-linear water loss over time by evaporation can be described by a square function with high accuracy. For all other soils a linear function is sufficient. However, we recommend in general at least four weighings to decide whether to use a square or linear function for deriving fluxes. The use of evaporation functions enables extending weighing intervals. This reduces costs for the measuring equipment and increases the effectiveness of the method while maintaining the same quality of unsaturated hydraulic conductivity and water retention functions. It was confirmed that measuring with two tensiometers is sufficient for accurate hydraulic conductivity and water retention function. Reducing evaporation by screening the sample surface helps to decrease hydraulic gradients, and keeps tension distributions approximately linear with depth. This is recommended in particular for clayey soils.

S07.K.01
Shrinkage properties of clay soils of Finland

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In the Boreal climate zone of Finland, the soil experiences dry spell in summer, continuously water saturation and variable periods of freezing between autumn and spring. Consequently, clay soils with swelling properties are prone to changes in soil structure and pore size distribution. Presumably these changes are significant especially in spring, because fluctuating freezing and thawing and water saturation alter soil structure and strength.

Shrinkage properties of differently managed clay soil surfaces (Vertic Cambisol, clay 51%), including cultivated, harvested, grazed and not managed sites, were studied. The 100 cm3 cylinder samples were taken in early spring from two depths (0-5 cm and 5-10 cm), thereafter saturated in laboratory and dried stepwise. The height of sample was detected after each drying step and the volume of soil was calculated assuming isotropic shrinkage.
Total shrinkage of studied sites was 5.2-10.5% from the total volume. All sites exhibited structural shrinkage which corresponds to 18-48% of total water loss. Generally, the transition from structural to proportional shrinkage zone took place at suction around -60 hPa. At eight curvatures out of 12 the slope of proportional shrinkage zone was steeper than 1:1-line (slope up to 3.0).
The steep slope of proportional shrinkage zone indicates strong rearrangement of soil particles as it reflects the collapse of inter-aggregate pore space. The results indicate that after winter even presumably well structured soils weakly withstand forces generated by matrix suction, and that structural changes take place in rather wet soil. These changes modify soil water infiltration capacity irreversibly; the hydraulic properties of collapsed soil once dried will not revert after re-swelling. These results increase our understanding of phenomena affecting water movement during snow melt in spring, which is of great importance when soil erosion and nutrient leaching is evaluated.

S07.K.02
Evaluating single spherical aggregate (SSA) model in a saline silty clay soil

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Leaching has been the most prevailed method of saline soil reclamation. Recently Cote et al. (1999) introduced single spherical aggregate model (SSA) and through theoretical analysis deduced that in structured soils intermittent leaching would lead to a greater efficiency (F_L) than continuous leaching. The purpose of this study was to examine SSA model and compare F_L between the two leaching regimes in a saline soil (EC=18 dSm^{-1} and SAR=3.8) from Tabriz plain, northwest of Iran. Salt leaching was carried out using disturbed soil columns with 30cm length and 7.6cm diameter employing three aggregate size classes (0.5-2, 1-2 and <4 mm) and two water flux densities equivalent to 0.5 and 1 Ks under saturated conditions. In continuous leaching prepared soil columns (Db=1.16 gcm^{-3}) were steadily leached by $CaCl_2$ solution (EC =4dSm^{-1}) until EC of the leachate approached to 4 dSm^{-1}. In intermittent leaching, soil columns were leached at several cycles (4 to10). At each experiment run fractional volumes of the leachate and their EC were recorded and were used to compute F_L and breakthrough curves. Results showed that intermittent leaching, in contrast to the SSA model prediction, did not yield greater F_L compared to continuous one. Under intermittent regime, however, reducing water flux from Ks to 0.5 Ks and increase aggregates size from 1-2 to <4 mm both significantly ($p<0.05$) increased F_L, while under continuous regime they did not affect F_L. Data analyses showed that SSA model fitted experimental data more satisfactory when greater pore water velocity was established during leaching. Time required to imposing dry period in intermittent leaching increased leaching time more than twice compared to the continuous regime. Results showed that several variables such as aggregates size, flux density and soil texture affect leaching efficiency and quantifying each variable effect by SSA model needs further investigation.

S07.K.03

Discretization of spatial and temporal soil water variability into homogeneous zones based on electrical resistivity measurements at the field scale

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Since recently, the inverse modeling procedures has been introduced to obtain hydric properties in situ from a time series of soil water content determined by no destructive geophysical methods. One of these methods, the electrical resistivity is well adapted to characterise the soil subsurface and to describe soil properties, even if they are time-dependent. However the electrical resistivity depends on several chemical and physical soil variables that can interact.
We have then analysed the possibility to use spatial measurements of electrical resistivity to define zones of homogeneous resistivity that remain stable with time, to interpret them in terms of water content evolution. Our assumption was that the time variation of resistivity at the field scale was only due to the evolution of the soil moisture in the studied area.A time monitoring of the soil electrical resistivity and the soil moisture was realised during the year 2006 on a 2 ha field area. In this area, the slopes were lower than 2% and previous studies had shown that the water transfers were mainly vertical. By geostatistical analyses on the experimental data, we have defined three zones that remain homogeneous with time, both for the electrical resistivity and the water content. In a first analysis, these zones were not independent of the soil types defined on the soil map, which is not surprising. But a detailed analysis demonstrated that some homogeneous zones were not in accordance with the soil map, and that the water content could be different from what was expected from a classical model. These zones were interpreted in terms of preferential flow due to macropores and/or to lateral subsurface flows. We have then shown that the use of electrical measurements enables to directly describe the spatial and temporal evolution of the soil water content at the field scale.

S07.K.04

Optimization of the drain-Regulation in hinterlands of low Mountain ranges under the aspect of natural flood retention

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By the increasing settlement pressure or pressure of utilisation on flood-threatened surfaces and by changes of the climatic circumstances an accumulation of flood events is to be expected. That's why applicable strategies are required in practice to tone down such events or to prevent them.
The destination of the project is the production of a standardised watershed developing concept (EEK) which can be offered as a technical service to the improvement of the preventive flood control by optimization of the land use and vegetation.
According to present state of the flood models land use changes have no influence for the slow great flood events in widespread watersheds. On the contrary small quick floods in small watersheds are influenceable by land use or management changes, even in different measure according to characteristic features of the respective watershed.
So the attention of the present project is aimed on this small quick floods. However, also differentiated informations for the solution of flood problems in big watersheds can be reached by the summation of statements about small watersheds.
The development of a standardised planning procedure (incl. GIS implementing) for the optimization of the drain regularisation serves for the reduction of the flood danger. Land use and vegetation is so optimized in adaptation to soil and land management and by taking into account prevailing drain roads that an essential contribution to the regularisation of the surface run-off is performed.
The aimed procedure has to use above all the combination of parametres simply to be grasped (e.g., from atlases, available data supplies of the responsible authorities, or from easy field methods) which are valued as relevant to allow a quick and Germany-wide application.

S07.L.01

Effects of climate change on soil hydrological processes - A simple risk assessment

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Environment is influenced not only by economic activities but also by climate-change. Therefore, coping with environmental changes, such as increasing temperature, CO_2-concentrations, rainfall intensities and changes in the seasonal distribution, is a central task for decision making. Within that a risk assessment is the first step towards a reasonable management, so that risk targets can become less vulnerable to potential effects.
A qualitative and quantitative analysis on the impact of effects and stressors as well as their intensity in the environment is necessary, whereby spatial and temporal scales have to be considered. This can be obtained by the use of physically based simulation models.
Here a simple approach for integrated environmental risk assessment towards climate change effects is shown. Because soil is a central medium for storage, various transformation processes and water being the driving force for erosion, leaching, nutrient transport and many other biotic and abiotic processes, the eco-hydrologic, continuous time model SWAT was used to evaluate the effects of changes in soil aggregate structure, decomposition, the soils C-content, and particle and solute transport.
As watersheds integrate all occurring processes, a good approximation of climate-change induced impacts can be achieved. Nevertheless, in natural catchments overlay effects caused by sub-areas with different characteristics can occur, which lead to erroneous interpretation. This could be solved by the use of a simple structured artificial catchment, based on typical regional catchment characteristics.
To distinguish the qualitative effects of environmental changes and their intensity, a sensitivity analysis was carried out with regard to water quality and soil related parameters. Thereby processes and stressors exceeding relevant intensities could be identified.
The derived approach based on process-based hydrological modeling combined with a sensitivity analysis is a useful tool to estimate the effects of climate-change on erosion and stock flows to answer basic questions in risk assessment.

S07.L.02

Soil management impact on soil water status under climate change

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Soil water is influenced by climate change. Increase in speed of water evaporation, reduced snow cover amount and lower rainfall inputs have direct effect on water balance. Local effects of climate conditions on soil moisture (SM) content vary not only with the degree of climate change but also with soil properties. Soil tillage is one of the major factor influencing soil physical properties.
The influence of reduced tillage systems on SM content and penetration resistance (PR) dynamic within arable layer during

winter wheat and spring oilseed rape vegetation period was investigated in the 2 field trials at the Lithuanian Institute of Agriculture during 2005 - 2007. Overall SM content reduced and PR increased over the recommencement of the winter wheat growth until the heading stage and over oilseed rape drilling till budding stage in spite of tillage system used. During crop vegetation period in 10 - 20 cm soil layer significantly greater PR was registered under NT system compared to CT. Correlation-regression analysis shoved a conversely strong relationship (r = - 0.86**) between PR and overall SM content at 0-20 cm soil depth. It was revealed that PR increased around 0.4 MPa when SM content reduced by 1 unit percent.
RT and NT were superior to CT for oilseed rape growing during a dry year. The reason was that a higher water content was available (i.e. soil moisture content between field capacity and capillary soil moisture) for the crop in the soil under ploughless tillage application. The yield of oilseed rape during dry year was higher when RT or even NT has been used compared to CT. During wet year, the yield of oilseed rape was similar to that of CT. The study has been supported by the Lithuanian State Science and Studies Foundation and the Lithuanian Ministry of Agriculture.

S07.L.03
Impact of climate uncertainties and soil characteristics on maize irrigation requirements in South Bulgaria

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Climate change and variability of soil characteristics create uncertainties for irrigation management in South Bulgaria. To cope with them, simulations were performed for present weather conditions (1960-1990) in four experimental fields of contrastive soil hydraulic properties in Sofia plain and Stara Zagora (Thracian plain). These fields are representative for the hottest and driest (**Stara Zagora**) and coolest and wettest (**Sofia field**) agricultural regions for maize cultivation in this country. In former studies (Popova *et al*., 2001;2005; 2006), the irrigation scheduling simulation models CROPWAT (Smith, 1992) and WINISAREG (Pereira et al., 2003) were validated for maize on Chromic Luvisol, Chromic Cambic and Vertisol soils. The objective of the study was to compare the probability curves of net irrigation requirements (*NIR*) and relate them to the corresponding ones of reference evapotranspiration (*ETo*) and precipitation totals.
Comparison between *ETo* and precipitation in the representative regions showed that **in Stara Zagora**: 1) seasonal **(May-Sept.)** *ETo* was 100 mm higher, while **precipitation** were 40 mm lower over 80% of the years; 2) *ETo* sum for irrigation period (**July-Aug.**, Thrace and **15/07-15/09**, Sofia field) was 80 mm more, while precipitation totals were 20 mm less .
Comparison between ***NIR*** probability curves relative to the soils of moderate (Chromic Luvisol) and high (Vertisol) water holding capacity and similar climate background **(Stara Zagora)** indicated that *NIR* were predominantly higher (by 35-55 mm) on Chromic Luvisol in dry and average years and practically equal on both soils only in the wettest years (probability of exceedence P_i>80%). When *NIR* of maize, grown on Chromic Luvisol in regions of different climate characteristics, were compared it was found that *NIR* were 80 mm higher in 80% of the years in Stara Zagora. There was no difference only in the extremely dry (P_i=3 %) and extremely wet (P_i=97 %) years.

S07.L.04
Pedological change detection of Nile River course and its islands, Egypt

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Nile River, the longest river in the world, 6,695 km long from its remotest headstream to the Mediterranean. The current study aims at identifying the characteristics of the Nile course and its islands using remote sensing and GIS techniques in order to provide the scientific bases, which help in planning the most suitable programs of land use, soil management, conservation and recognizing the intensive agriculture system of the Nile River islands. Six MSS, eight TM and Eight ETM+ satellite images dated to 1972,1984 and 2002 respectively were used to study the changes occurred during the above-mentioned periods. The study area was divided into five sectors along the Nile River course i.e. Aswan - Qena, Qena - Assiut , Assiut - Qalubia , Qalubia - Damietta and Qalubia - Rosetta . The changes in Nile course from early seventieth to middle eighteenth were decreased by 51.34 Km^2, from middle eighteenth to the millennium were decreased by 40.30 Km^2. The overall change in Nile course area decreased by 91.64 Km^2 in the investigation period.
Belonging to the islands number and their areas in the investigation period, the changes in islands number from early seventieth to middle eighteenth were increased by 171 islands, from middle eighteenth to the millennium were decreased by 86 islands. Meanwhile, the islands areas from early seventieth to middle eighteenth were decreased by 4512.39 Feddan., from middle eighteenth to the millennium were decreased by 5446.97 Feddan. The overall change in the investigation period for the total number of the islands was increased by 85 islands, meanwhile the islands areas were decreased by 9959.36 Feddan. Conservation and management program was suggested to overcome soil limiting factors.

S07.L.05
Head balance elements evaluation of the soil and cannopy by remote sensing

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The objective of this work is to determine the radiothermal image of an agricultural test area occupied by various crops based on data from trace radiometry combined with an evaluation of the agrometeorological situation obtained by data from ground-based agrophysical measurements and agricultural observations of soils and plant status.
The methods of study include trace flights of an airplane-laboratory along several routes over the test regions and measurements of the temperature of soil and vegetation cover every 15 days during the active agricultural season by a radiometric system. On the days of trace radiometering of the area, at every 200 m along the flight traces, synchronous and quasi-synchronous measurement of the soil moisture and temperature of the surface soil layer and the soil profile, as well as of some major microclimatic elements of the field (humidity and air temperature, total solar radiation and radiation balance, wind velocity) at representative spots are carried out. Phenologic observations of the state of agricultural crops are also carried out. Soil moisture along the profile is measured with accuracy of 1.0 weight percent by an electronic soil moisture meter with gypsum blocks.
The data from the records were processed by the methods of geostatistics to obtain the map of the radiothermal image of the studied area.
The map of the thermal image reveals a qualitative difference between temperature of the wheat-planted areas, on the one hand, and the maize- and sunflower-planted areas, on the other hand.
This study advocates the performance of scheduled radiometering of definite test areas during the whole agricultural period and search for qualitative relationships between temperature and soil moisture, on the one hand, and the state of soils and crops in the test regions, on the other hand.

S07.L.06
Dynamics of redox potential and mobilisation of heavy metals in flood retention basins

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Flood retention basins play an important role within flood protection measures. During flooding sediments are deposited within the flood retention area. In case that the sediments contain heavy metals, flooding will result in their accumulation. Furthermore, flooding of the retention area causes an interruption of the soil's oxygen supply which leads to a decrease in redox potential. This can cause remobilisation of heavy metals which may then be taken up by plants or be leached into the groundwater. Against the background that many retention basins are used for agriculture it is important to know the processes that occur during flooding to avoid soil pollution and uptake of pollutants by plants.
To assess these processes a series of field experiments were carried out to simulate inundation. Flood detention basins of two catchments in Germany that are polluted to a different degree were chosen as experimental sites. The flooding experiment was performed in analogy to a double-ring infiltrometer system. pH and redox electrodes were installed in three different depths to monitor pH and redox potential during flooding. Additionally, soil solution was taken during the experiments using suction cups and analysed for Cd, Cu, Ni, Zn and Pb in the lab. First results show that in summer redox potential in 30 cm depth dropped from 190 to 50 mV within three hours of flooding. Results from autumn indicate that temperature and thus microbial activity seem to have the biggest influence on redox potential since no big changes could be observed then.
The PhreeqC model was calibrated on the field data. Scenario simulations were performed to predict the environmental fate of heavy metals in flood detention basins.

S07.M.01
The influence of irrigation on a calcic chernozem in the eastern region of Romania

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The Romanian strategy in the field of irrigations for the years of 2008 - 2011 consists in the modernization of the existing works covering about 3.1 mil. ha, and for the years of 2011 - 2025 in the irrigation of an additional area of 0.9 mil. ha.
In the climate condition of Romania, the irrigations have a complementary character over the precipitations. Because of this reason, a correct regime of irrigations needs a very good correlation between watering and precipitations in order to achieving both a favorable moisture regime for the growing plants and for the quality protection of the soil.
Using uncontrolled watering regime or inadequate quality of water, leads in many situations to inappropriate processes for the soil evolution.
A study regarding the modifications of the soil quality as result of the irrigations was carried out in the district of Bacau, in the East of Romania and its results are presented in this paper.
The research objectives were focused on a *Calcic Chernozem (FAO-UNESCO)* in three areas with different watering conditions and consisted of:
a) analyses regarding the evolutions of porosity and hydro-physical parameters;
b) analyses regarding the dynamic of soil salinity;
c) analyses regarding the dynamic of heavy metals in mobile form;
d) analyses regarding the dynamic of nitrogen in the soil;
e) analyses regarding the biologic activity of the soil.
The research method consisted in soil sampling at pre-established time periods, their laboratory studying, data processing and interpretation. The conclusions of this study bring new contributions to the development of management for the irrigated lands in Romania.

S07.M.02
Canola, *Brassica napus,* L., plant growth characteristics and productivity in response to adaptation, moisture and soil salinity

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Canola subsp., was planted in Rosseta , Nubaria and Giza. Dry farming was practiced in the first location while one, two and three supplementary irrigations were applied in the latter two. So, the influence of salinity, different climatic zones and different irrigation water treatments on growth, seedling yield, oil percentage and water conditions was studied. Other cultivation practice including fertilization were identical in all three locations.Sampling for growth studies were collected after 50, 100, 150 days and at harvest time Sandy soil of Nubaria gave the healthiest growth and yield (450kg/ha) under 120 mm precipitation. Rosseta heavy clay salty soil under 230mm precipitation gave weak plants which failed to reach maturity altogether (300kg /ha).While plants in Giza alluvial clayey soil gave profuse canopies and greater seed(550 to 620kg/ha) when treated with one ,two ,three irrigations. Oil seed percentage was lower under saline conditions (25%) and higher when more watering were applied (30-40%), a severe effect of salinity was observed .Salinity significantly reduced all growth and yield components parameters with the exception of grain protein which was significantly increased. One irrigation during the time of fruiting was not so effective as the other treatments.

S07.M.03
Improvement of Salt-affected Soils: 1-Acidify of irrigation water and soil water movement

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Salinization of well water is a significant factor that affecting not only the continuing agricultural productivity in semiarid irrigated regions but also extended reclamation projects. Treating salinity water by acid to improve its quality is investigated under salt-affected soil condition. Column experiment with loamy sand soil was conducted in greenhouse of National Research Centre, Cairo, Egypt, to study the effect of acidifying water differs in salt content on water, leachate and soil characteristics. Water salinity treatments were 2.18 (WS1), 3.30 (WS2) and 0.43 dSm^{-1} canal water (CW) as control treatment (as main effect). Sulfuric acid (H_2SO_4, 37 %) was used as acidifying material at rates 0.05 and 0.10 % (as sub-main effect). Water added to the soil column once a week and leaching requirement was take place. Soil columns were divided into 3 layers (10 cm each) and tested in lab for pH and EC and hydraulic conductivity. Results showed that some success may be achieved by acidification of salinity irrigation water to influence pH in small volumes of soil rather than trying to change pH in the entire volume. Acidification process has value in treating CW than SW1 and SW2. Increasing acid rate help in decreasing EC values and pH of water and soil column. Water movement was improved under acidification treatment except under WS2 with 0.10 % acid. Increasing acidification rate increases leached salts from soil. Hydraulic conductivity and amount increased when the water salinity and pH value decreased. Acidification of salty irrigation water has the potential to improve irrigation water quality, aid in reclamation of salt-affected soils, lower soil pH, and improve soil water movement and leachate characteristics.

S07.M.04

Soil-type impact on water and nitrogen distribution in the root zone of peach trees under drip-fertigation

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The investigation was carried out in lysimeters on soils with substantially differing physical and chemical properties: alluvial-meadow soil (*Fluvisol*) - sandy loam, cinnamonnic-forest soil (*Luvisol*) - clay loam, and smolnitsa (*Vertisol*) - clay. The investigation objectives were addressed from laboratory analyses of soil samples taken in profiles through the wetted soil volume, 20 hours after the consecutive water application. The water application efficiency was strongly dependent on the soil hydraulic properties, necessitating changes in the methodology for micro-irrigation scheduling. Root activity was found to play a substantial role in the irrigation water redistribution into the soil volume creating zones with low soil moisture values (down to the wilting point) along the skeletal roots very soon (20 hours) after the irrigation. Soil moisture in the remaining part of the root zone was close to the field capacity but this water seemed to be temporarily unavailable for roots, i.e. it might well be that trees had developed water stress soon after the irrigation. Under soil temperature of 30-32°C, urea applied with irrigation water was rapidly hydrolyzed and the obtained ammonium ions were intensively oxidized to nitrates. The easy-movable nitrate nitrogen migrated with the water flows to the periphery of the wetted soil volume where it accumulated. Two-three weeks after fertigation, the applied nitrogen was completely depleted along the skeletal roots and zones of increased nitrate content were found farther away from the main roots.

S07.N.01

Yield - water relationship of soybean

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The aim of this study is an establishment of reliability of two formulas for calculate the relation ,,Yield - water" of soybean (Biser var.), grown in region of Plovdiv (Bulgaria). The experimental work has been carry out for 5 years (2003 - 2007). Data for relative yield and relative irrigation depth, by different irrigation regime (0, 30, 50, 70 and 100 % of irrigation rate) have been used. These data have been calculated through special computer program "YIELD". The curves which we have got, interpret exactly the experimental data (R = 0.90 and over). Yield coefficient without irrigation is average 0.54. The experimental data are able to use for management of irrigation of soybean.

S07.N.02

Subsoil compaction, structure degradation under the effect of specific water regime in soil land-reclamation constructions over a period of 20 years

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The soil land reclamation constructions were created 20 years ago after open-cast ore mining. The chernozemic 60-cm layer with classical granular aggregates (1-5 mm) fine and medium shapes was applied on the thick layer of sand. This construction was in agricultural use during last 20 years. At the present time the layers of prismatic coarse peds (>50mm) bounded by flat to rounded vertical faces and columnar very thick vertically oriented blocks (>100mm) have been formed on the depths of 20-40 and 40-60 cm. The surfaces of these coarse peds and columnar blocks have lower content of silt and clay particles than the inner part: particles <0.01, <0.001 mm contents are about 47.8, 6.58 and 54.8, 9.47%, accordingly; higher content of Fe and Ca ions and homogeneous distribution of pH (8.5-8.7), the organic matter and its hydrophilic and hydrophobic components over the soil profile. Water regime researches have shown that the temporary perched water is formed on the sand during the period of the spring intensive income of water and summer heavy showers. The field experiments with soluble starch label have revealed the main role of preferential flow paths in this process. This preferential water and matter flows are generated along the faces of the peds and forms the perched water on the surface of the sandy layer. The laboratory break-through experiments with Cl and K ions as labels and physical based mathematical modeling also support this mechanism of the phenomenon. Such kind of water phenomenon with preferential flows and perched water table formation transforms the granular aggregates into columnar blocks by the temporary gleyzation process.

S07.N.03

Effect of no tillage on Vertisol hydrodynamic properties

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In Morocco, Vertisols occur throughout the semi-arid and sub-humid zones. They are highly productive, displaying characteristic physicochemical properties and are of great agricultural economic importance. However, low soil water availability is the most serious constraint to crop production on this type of soils, since drought became a characteristic of the Moroccan climate during the last decade. There is an urgent need to improve Vertisol management to conserve water. Therefore, alternative conservation practices must be employed.
This paper discuses changes in hydrodynamic properties of a Vertisol, with wheat plantation, subjected to conservation (NT) and convention (CT) tillage. Hydraulic conductivity, sorptivity and porosity at four tensions were measured by disc permeameter, soil mechanical resistance was measured by penetrometer at different crop's stage and soil water content was collected by gravimetry. Hydraulic conductivity and sorptivity values were lower in CT than NT. This is due to the type of porosity under NT and CT. Soil compaction was evaluated under NT than CT.

S07.N.04

A comparison of the effects of conventional and organic farming practices on soil physical and hydraulic properties in the UK

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In the UK, the occurrence of severe flooding has greatly increased over the last few years. There are a number of factors which contribute to this; firstly, changing climatic behaviours with different rainfall patterns altering both duration and intensity of rain storms and secondly, increasing loss of soil medium as a buffer against excess runoff. In rural areas poor soil management leading to compacted soil and reduced infiltration of rainwater has led to a 'peaky' flood hydrograph. Extreme flood events such as experienced in the UK summer 2007, maybe prevented in the future through improving soil management and attenuating the flood hydrograph.
This study investigates four pairs of farms (organic and conventional) located in southern England. These are over a range of soil textures: silty, sandy and clayey. There is also two different land uses (grass and winter wheat). The research incorporates field investigation and laboratory analysis of soil samples collected during the fieldwork. Data has been obtained on soil properties including: shear strength, aggregate stability, HOST (Hydrology of Soil Types) values, infiltration rates and soil

organic matter. This research aims to compare the effects of soil management for organic and conventional agricultural systems on soil physical and hydraulic properties. This will be related to possible impacts upon the flood hydrograph.
An initial conclusion shows that organic and conventional treatments are not significantly different from each other across all different soil textures and land uses. For example, at 95% confidence p value is 0.1375 for aggregate stability indicating no significant difference. Further soil hydraulic data is currently being analysed and results will be presented in the full paper.

S07.N.05
Nutrient movement and losses from irrigated warm climate vineyards in Australia

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Improving knowledge on the movement and losses of nutrients within an irrigated vineyard is essential to avoid polluting inland water supplies and ensuring sustainable wine grape production. There is a great need in Australian irrigated agriculture to understand and quantify nutrient pathways, because of the potential risk associated with intensive viticulture.
This paper will focus on nutrient inputs and exports from 6 vineyards over 5 growing seasons. The work was undertaken on vineyards with Chardonnay grapes that had 3 distinctly different soil types (sand, loam and clay loam), were irrigated by different methods (drip and flood) and consequently were managed differently. In-situ soil solution samples were collected with ceramic suction cups at different depths (0.25, 0.5, 0.75 and 1.0 m) after irrigation and rainfall events. Other measurements were taken including vine petioles for analysing vine nutrient status and soil moisture content. The results showed that at times nitrate concentrations that were much greater than the established water quality targets. For instance in 2006 there were nitrate concentrations measured up to 200 mg N/L at 0.5 m and 117 mg N/L at 1.0 m depth. The vine N status on most vineyards was greater than the adequate range which suggests the amount of fertiliser applied was more than necessary for the vine requirements. Therefore, reducing fertiliser rates would lower the risk of N leaching to groundwater without decreasing vineyard production or grape quality. Overall, the risk of nutrient loss was greater on flood irrigated vineyards than the drip irrigated sites, due to the different fertiliser and irrigation management. The most significant risk of nutrient loss was via drainage and run-off was found to be a minor pathway. While late spring and early autumn are the periods most at risk of nutrient loss.

S07.N.06
Modelling of water and nitrate dynamics in sandy soils in consideration of forage cropping systems - integration of dynamic plant growth for grassland and maize in a soil - plant - atmosphere - transfer model

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Nitrate leaching can be of serious environmental concern in agricultural areas with highly permeable soils and shallow groundwater. Both annual crops like silage maize and permanent grassland dominate in regions with sandy soils in northern Germany. Especially nitrate nitrogen losses can vary highly under grassland between 10 kg ha-1 (cuttings, total N - input: approx. 180 kg ha-1) and 120 kg ha-1 (rotational grazing, total N - input: 400 kg ha-1) depending on the nitrogen input, farm management and crop species. Nitrogen leaching under silage maize can increase up to 50 kg ha-1 (total N - input: 250 kg ha-1).
Detailed and long - term measurements regarding to the nitrogen dynamics under agricultural areas are far too expensive. Modelling of water and nitrogen dynamics in soil can be a valuable tool to predict nitrogen losses over longer periods. Simulations in our study were carried out with the CoupModel (Jansson & Karlberg 2004). Measurements of soil water contents, groundwater levels, nitrate concentrations in soil water and shallow groundwater and the biomass growth were taken over a period of five years at the experimental station Karkendamm in northern Germany (Büchter 2003). Furthermore, detailed farm management and dynamic plant growth were integrated to simulate a realistic crop development.
Simulations showed plausible results for soil water content in different soil depths and the groundwater level. Modelled nitrate concentrations varied highly in time and depth. The model was able to reproduce nitrate concentrations in a depth between 0.5 and 0.6 m satisfyingly with special respect to a realistic crop development. The biomass increase of silage maize was modelled closer to the measured values than for grassland. The simulation of biomass growth for grassland still needs further improvement to match the real biomass development over the whole year and the yields at fixed harvest dates.

S08 Soil Ecology - Soil as Living Space

S08.A.KL
Unravel the black box - biochemical markers provide new insight into multitrophic interactions in soil

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Soils harbour an enormous diversity of organisms in multitrophic food webs that are central to nutrient cycling and ecosystem services. The soil micro- and mesofauna, in particular the microbial grazers, are key components, and thus important determinants for the energy and carbon flow through terrestrial systems. Regardless of their significance the trophic relationships in soil are still poorly understood. Due to their small size and the cryptic habitat, feeding strategies of soil animals are difficult to address, either experimentally or by direct observation.
Over the last decade, stable isotopes have increasingly been used as biomarkers. The isotopic ratios of $\delta^{15}N$ and $\delta^{13}C$ in animal tissues were employed to reconstruct diets, with nitrogen isotopes applied to rank relative trophic levels, and carbon isotopes to assign food resource. A new approach to unravel belowground food webs is lipids analysis. Food derived fatty acids are conserved and transferred in the food chain, a fact called “dietary routing”. Several marker fatty acids have been defined for microbial-faunal interactions hitherto. To increase resolution lipid analysis was combined with stable isotope techniques. The comparison of the $\delta^{13}C$ ratio in fatty acids between consumer and diet can be used to verify trophic links.
In conclusion, the application of lipid analysis will offer new insight into feeding habits of soil animals *in situ*. The relative simplicity of chemical analysis, which uses widely available equipment, provides a high potential for food web studies. A prospect for the future is compound specific fatty acids work to assess carbon fluxes along the soil food chain.

S08.A.01

Struggling with scales in tracing diversity, distribution and expression patterns of fungal and bacterial laccase genes in soils

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Within fungal oxidative exoenzymes laccases are the most universal. They catalyze oxidation of aromatic compounds, particularly phenolic substrates and are highly involved in biodegradation of biopolymers such as lignin. We have implemented a molecular biological approach for tracing diversity, distribution and expression patterns of laccase encoding genes in fungi and bacteria in different soils and horizons.
After extraction of soil DNA and PCR amplification with specific primers, we showed that the diversity of laccase genes in soil inhabiting basidiomycota and bacteria parallels the content in soil organic matter and the total enzyme activity in different soils and horizons. A RT-PCR based approach showed however that from the detected genes, only a reduced fraction is expressed at a given time. An experimental study on ascomycota confirmed that from the diversity of the laccase like gene copies present in the genome a taxon, only a reduced part is expressed during exoenzymatic oxidative degradation.
At another scale, we investigated variations in the distribution of laccase genes along transects in forest soils. We found patchy distribution patterns reflecting the huge heterogeneity of soils. While some genes dominated in soil cores or in one of the horizons they contain, no dominancy structure was observed in other cores.
To establish relationships between large scale effects such as forest management or atmospheric element inputs on the diversity patterns of laccase genes despite their patchy distribution in soils, we coupled composite probe sampling with high throughput molecular analyses. We found correlations despite differences in the respective scales at which external effects and soil microorganisms operate. However, the gene distribution appears to be rules by diverse environmental factors some of which may play a more important hierarchical role than a given treatment such as atmospheric nitrogen input manipulation. Further molecular strategies to bridge the scales will be discussed.

S08.B.01

Substrate availability affect abundance and function of soil microorganisms in the detritusphere

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Plant litter is the major source of soil organic carbon (SOC). Its decomposition plays a pivotal role in nutrient recycling and influences ecosystem functioning and structure. SOC is decomposed in microhabitats differing in their decomposition rate due to heterogeneous distribution of microorganisms, substrates and physicochemical conditions at the small-scale. In the detritusphere, plant litter closely interacts with the soil by releasing soluble C into the adjacent soil and providing new sites for microorganisms. The abundant readily available substrates characterises the detritusphere as a hot spot of microbial activity and C turnover. This talk will address the effect of litter C transport on the spatial and temporal availability of substrates and therefore on microbial abundance and activity in the detritusphere. The results were obtained by a combination of classical soil biological methods (e.g. CFE), modern techniques (e.g. 13C PLFA, 18S rDNA sequencing) and mathematical modelling.
Based on these results, a two-phase conceptual model of litter C turnover and microbial response in the detritusphere was developed. During the initial phase mainly easily available and soluble litter compounds were transported and mineralised by bacterial r strategists and fungal pioneer colonisers belonging to the Mortierellaceae. After this initial phase, depolymerisation of complex litter compounds mainly by fungal K strategists started. The isotopic ratios of bacterial and fungal PLFAs underlined different substrate utilisation strategies with bacteria relying on the small-scale transport of substrates and fungi assimilating new C directly in the litter layer. Modelling showed that the transport rate of soluble substrates determines the spatial dimension of the detritusphere, with an enlarged detritusphere after convective versus diffusive transport and enhanced diffusive C transport at higher soil water content.
In conclusion, new insights into litter decomposition at the small-scale enabled the development of a conceptual model of litter C turnover in the detritusphere.

S08.B.02

Fate of crop residues incorporated in soil: towards linking microbial diversity and evolution of organic matter

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Among the microbial functions involved in biogeochemical cycles, those related to carbon cycle play a central role in the biological functioning of agro-ecosystems, in particular because of their involvement in soil fertility, environment quality and global changes. In spite of its major role in organic matter degradation processes, the microbial component involved is poorly documented, particularly in terms of populations and functions, and then considered as a “functional black box”. In this context, our objective was to progress in our knowledge of the microbial populations responsible for organic matter degradation in soil.
Crop residues represent one of the most important hot spots (zones of increased biological activity) and ecological niches to study microbes involved in organic matter degradation. Our objective was to characterize, in a field experiment, the dynamics of the microbial communities in the detritusphere (zone of the soil under the influence of crop residues) in relation to the biochemical quality of the residue and the evolution of the soil organic matter. For this, residues from different plant types: wheat, colza, and alfalfa were incorporated separately in different plots. From the incorporation date, soils were sample each 1 month for 1 year. The responses of microbial communities to residue supply have been assessed by using molecular methods allowing the characterization of the diversity of microorganisms (DNA fingerprinting, clone libraries). In parallel, the dynamics of the biochemical quality of the residues have been monitored (Near Infra Red Spectrometry).Results showed a strong influence of residue biochemical quality on the dynamics of microbial communities. Furthermore, most of the microbial modifications occurred in the close neighbourhood of the residue, highlighting the particular ecological significance of the detritusphere. Coupling of microbial data and organic mater biochemical data allowed linking the dynamics of microbial communities with the fate of organic matter in soil.

S08.B.03

Short term bacterial community structure dynamics in forest soil and litter: an in situ study in a CarboEurope site

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Acting as both sink and source in the terrestrial carbon cycle, soils play an important role. In forests, soils contain up to 70% of total ecosystem C and contribute to 40% to 70% of total ecosystem respiration. Therefore, in a climate change context, understanding soil microbial community dynamics and its consequences on soil functioning is a major issue.
The objective of this study was to determine if changes in the inputs of fresh litter quantity could influence the structure of bacterial communities (named BCS) and their dynamics in a forest soil. The experiment took place in Barbeau national forest (CARBOEUROPE site; Fontainebleau, France). Three treatments of fresh litter inputs were applied: 0L: no litter, 1L: litter added at the natural rate and 2L: litter added at twice the natural rate. BCS was followed every month during one year using a molecular fingerprinting (Ribosomal-Intergenic-Spacer-Analysis) technique. At the same time, intensity and isotopic composition ($\delta^{13}C$), of soil and litter CO_2 effluxes were measured as well as soil and ecosystem climatic parameters.
Soil BCS was very dynamic through the year and resilient as soon as no fresh litter was added. Litter BCS was also very dynamic but not affected by litter quantity. In all treatments, BCS during cold periods was markedly different from the rest of the year suggesting some climatic control on BCS. Last, coinertia analysis revealed a link between litter BCS and CO_2 efflux intensity and $\delta^{13}C$ in the 2L treatment. No link was observed in soil probably due to the multiplicity of CO_2 sources.
Understanding soil or litter BCS dynamics still needs more investigations, particularly concerning its climatic dependence. On the other hand, linking BCS to soil functions would help to reach a functional decomposition of the soil system and a better understanding of the climatic control of soil functions.

S08.B.04

Resource limitation of microbial decomposition: the effect of tree girdling and fertilization on belowground C and N fluxes

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In addition to temperature and moisture, the availability of labile resources (especially labile C and N) may control microbial decomposition of recalcitrant substrates such as soil organic matter. Here we report on a field experiment in which we altered the availability of labile C and N in a beech forest by tree girdling (reducing labile C input by plant roots) and N fertilization. Concentrations of dissolved organic carbon decreased strongly during the vegetation period in the girdled plots, while inorganic N increased up to ten-fold compared to control plots. In the fertilized plots the amount of inorganic N in the soil solution was roughly doubled. The altered available C and N pools significantly reduced gross N-mineralization rates and the activities of hydrolytic soil extracellular enzymes (i.e., cellulases and chitinases) during the vegetation period. The activity of oxidative enzymes (i.e., phenoloxidases and peroxidases) increased in all seasons. This may partially be explained by the fact that dead roots and mycorrhizal hyphae increased in girdled plots and may have provided an additional substrate for decomposition. The observed changes in microbial processes have been caused by shifts in the microbial community composition, as revealed by PLFA and 16S rRNA analysis of selected bacterial and archaeal taxa. Furthermore, the changes in decomposition processes translated into significant changes in ecosystem trace gas exchange (CO2, CH4 and N2O). We therefore conclude that the availability of labile C and N strongly affects soil decomposition processes and, via shifts in microbial community dynamics, may have strong impacts on ecosystem scale C and N fluxes.

S08.B.05

Resource availability and seasonal changes alter the prokaryotic community in a soil of a natural beech forest

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Changes in resource availability and seasonal changes may alter prokaryotic communities in forest soils. To test this hypothesis, a field experiment was conducted in which girdling of beech trees of a temperate forest ecosystem located in Klausenleopoldsdorf (Lower Austria) was used to alter carbon and nitrogen availability for prokaryotic decomposer communities. Tree girdling led to an increase of nitrate and a significant decrease of dissolved organic carbon concentrations compared to the controls. As such changes in resource availability may be translated into variations within the prokaryotic community; we obtained from May 2006 bimonthly soil samples to investigate girdling effects on the dynamics of the soil microflora over a period of two years. Abundance and community structure of total prokaryotic population (bacteria and archaea) and selected bacterial taxa were studied by 16S rRNA-based quantitative PCR and T-RFLP community profiling. The quantification of functional genes (*amoA, nirS, nosZ*) involved in nitrogen cycling completed our experimental set-up. Seasonal characteristics caused detectable changes in the abundance and community structure of the total bacterial/archaeal population as well as selected bacterial taxa (e.g. alpha- and beta-proteobacteria, Verrucomicrobia). Tree girdling had a major effect on the abundance and community structure of analyzed archaea. The soil bacterial community composition was particularly affected by girdling, whereas microbial abundance responded only to a minor extent. The number of bacterial and archaeal *amoA* genes (involved in nitrification) showed a clear response to season and were significantly higher in girdling plots as compared to the corresponding controls. In contrast, denitrification genes (*nirS, nosZ*) showed a clear seasonal trend, but only a minor response to girdling. In conclusion, resource availability and season are two major determinants that control the prokaryotic community composition in the studied temperate forest ecosystem. Further, such changes in community composition are followed by alterations of prokaryotic functioning.

S08.B.06

Nitrogen cycling in the Rothwald forest soil - microbial communities and effects of environmental change

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The Rothwald indigenous forest situated in a remote valley in the Eastern part of the Austrian Alps shows fast soil nutrient turnover and harbors a plentiful and highly diverse soil microbiota. Its soil bacterial community was found to be dominated by representatives of the *Acidobacteria* group, which is phylogenetically highly diverse but scarcely characterized regarding its ecological functions. Because of the undisturbed conditions prevailing in the Rothwald forest, it was selected as a model system for the study of forest nitrogen (N) cycling. High N turnover rates together with moderate losses and large pools of microbial biomass N were indicative of strong internal cycling. In the following, N processes in the Rothwald were compared with those in the Schottenwald forest, which is located within the Vienna city area and receives high atmospheric N loads. Enhanced release of radiative active N gases from forest soils is envisaged in consequence of elevated atmospheric N deposition and altered soil water and temperature regimes. To elucidate potential feedback effects induced by conditions of global change, N gas emission by nitrifying and denitrifying communities was studied in experimentally modified soil environments. N amendments as well as variations in soil water content and temperature provoked divergent responses in N gas emission from the two forest soils. Changing soil conditions specifically influenced *nirK* and bacterial and archaeal *amoA* gene copy numbers, while the structural composition of the respective communities remained widely unaffected. Finally, metagenomic analyses were performed on the Rothwald forest soil aimed at improving our understanding of the organisms involved in N gas emission and at retrieving functional information on environmentally abundant but physiologically poorly explored microbial groups.

S08.C.01
Microbial diversity affects community response to climatic changes

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A number of experimental studies suggest that microbial communities can adapt to increases in temperature but the mechanism of the adaptation is not clear. Our hypotheses were that climatic factors affect community structure leading to differences in microbial decomposition and that the diversity of the initial community affects the extent of the response to environmental changes. In soils, links between microbial diversity and ecosystem functioning are difficult to elucidate both due to the complexity of the soil habitat and to the effect of the environmental context on microbial interactions. Our aim was to measure the effect of two climatic factors, temperature and water content, on the respiratory response of soil microbial communities having different diversities in simple structured media.
Several bacterial species were isolated from soil and incubated in sand microcosms with fructose as the sole carbon source, at three different temperatures (15, 20, 25°C) and two matric water potentials (pF1, pF2), either alone or in groups of three or eight. Respiration was measured during the incubation whilst community structure was analysed after one week.
There was a positive effect of temperature on the lag phase for all communities but the effect increased with diversity between 15°C and 20°C. For single strain treatments the effect was larger when water content was high and it was the opposite for communities containing three or eight species. Temperature increased the rate of respiration for the eight species community only. On average, communities with three species consumed more carbon than single strains but at a slower rate. The consumption of the substrate by communities with eight species was lower at the high water content for all temperatures suggesting that competition lead to a reduction of decomposition. These results suggest that the extent of the community response to environmental changes increases with initial microbial diversity.

S08.C.02
Functional resilience of soil microbial communities depends on both soil structure and microbial community composition

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The effects of soil structure and microbial community composition on microbial resistance and resilience to stress were found to be inter-related in a series of experiments. The initial ability of *Pseudomonas fluorescens* to decompose added plant residues immediately following a copper or heat stress (resistance), depended significantly on which of 26 sterile soils it was inoculated into. Subsequent studies showed that both the resistance and subsequent recovery in the ability of *P. fluorescens* to decompose added plant residues over 28 days following stress (resilience) varied significantly between a sandy and a clay-loam soil. Sterile, sandy and clay-loam soil was then inoculated with a complex microbial community extracted from either of the soils. The resulting microbial community structure depended on soil type rather than the source of inoculum, while the resistance and resilience of decomposition was similarly governed by the soil and not the inoculum source. Resilience of the clay-loam soil to heat stress did not depend on the water content of the soil at the time of stress, although the physical condition of the soil when decomposition was measured did affect the outcome. The application of repeated stresses led to different reductions in function according to soil type. We propose that soil functional resilience is governed by the physico-chemical structure of the soil, through its effect on microbial community composition and microbial physiology.

S08.C.03
Bacterial spatial characteristics at the microscale in soil

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Bacterial habitats occupy 0.1% of the soil pore space, that is why bacteria in soil should be considered in spatial terms. The spatial distribution of bacteria at the microhabitat scale is a key parameter to encountering probabilities between substrates and bacteria and between bacteria, and thus to soil function. They are particularly important to bioremediation and horizontal gene transfer processes. Nervertheless, data about bacterial distribution are scarce, particularly at the relevant microscale.
Results about the spatial distribution characteristics of micro-habitats for bacterial specific groups have been previoulsly obtained suggesting that the notion of microhabitat should be revisited, as it may be ephemeral during growth. Communities in soil obviously have a spatial dimension and a way to define communities, is to look at the spatial distribution of bacteria diversity at the microscale. An experiment was carried out, using a 1400-probe16S microarray, to evaluate diversity in millimetric diameter aggregates along a 10 cm transect. Ubiquitous and rare populations could be defined, providing new data for population spatial structures in soil. The relationship between spatial and numerical dominancy was suggested.

S08.C.04
Modelling the interactions between soil structure and microbial activity

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Up to now, the soil structure models were used to study soil physical properties and they do not include microbial life. Here, we propose a geometric model for the 3D representation of pore space with active micro organisms inside. First, 3D tomography images of 11 microns resolution) of a silt loam soil are provided. The pore space is described using a minimal set of maximal balls (Delaunay spheres) recovering the shape skeleton. This set of balls provides the adjacency graph. We hypothesize that the ball is the functional unit of the pore space for the physical and biological processes. The balls may be full of water or air according to their size and location using Young-Laplace law and taking into account drainage hysteresis. Organic matter and microbial decomposers are distributed within the balls. Microbial decomposition is simulated using an offer (from organic matter)-demand (from micro organisms) approach. The decomposition is applied to micro organisms connected to organic matter through paths of water filled balls. The model produced realistic simulated results when compared with data in the literature in terms of the water retention curve and carbon mineralization. A decrease in water pressure decreased carbon mineralization, which is also in accordance with findings in the literature. From our results we showed that the influence of water pressure on decomposition is a function of organic matter distribution in the pore space. As far as we know, this is the first approach to have linked pore space geometry and biological dynamics in a formal way. Our next goal will be to compare the model with experimental data of decomposition using different soil structures.

S08.D.01
Biogeochemical transformations and response to change of soils in Antarctic dry valleys

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The Antarctic Dry Valleys are regarded as one of the harshest terrestrial habitats on the Earth because of the extremely cold and dry conditions. Despite the extreme environment and scarcity of conspicuous primary producers, the soils contain organic carbon and heterotrophic micro-organisms and invertebrates. Potential sources of organic compounds to sustain soil organisms include *in situ* primary production by micro-organisms mosses, spatial subsidies from lacustrine and marine-derived detritus, and temporal subsidies from ancient lake deposits. There is, however, little information about the biogeochemical potential of the soil communities in these soils and how they respond to additions of organic resources and nutrients. In this paper we will report recent experimental data from a 3 year field experiment on the potential biogeochemical transformations of carbon, nitrogen, phosphorus and sulphur in these soils and the way in which the soil organisms respond to resource and nutrient additions.

S08.D.02
Development of soil as a living space: the case of the Damma glacier forefield

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The chronosequence of soil along a glacier forefield presents a suitable model to investigate the formation of soil as a living space by microorganisms and plants, weathering processes and accumulation of organic matter. The forefield of the Damma glacier is currently being studied in a large interdisciplinary joint project between the ETH Zurich and the WSL Birmensdorf, with 23 common sites ranging in age from 5 to approximately 3000 years after deglaciation. Data from vegetation surveys and basic soil characteristics in 0-5 and 5-10 cm depth are already available. We measured organic and microbial C, N and P, availability of inorganic P and N and the activities of enzymes involved in C, N and P cycling. Organic matter, microbial biomass, P and N availability and enzyme activities tend to be very low at the very young sites and increase along the chronosequence, with maximum values generally found at the two oldest sites. Using additions of phosphatase enzymes, we investigated the release of P from organic P in soil water extracts and soil suspensions. A possible effect of C-C hydrolases and oxidoreductases on P release was also explored. The results are interpreted in terms of the potential benefit for bacteria, fungi and plants to secrete extracellular enzymes at different locations along the chronosequence.

S08.D.03
Tree species control nitrification?

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We studied how tree species affect N nitrification at a site where five tree species (*Picea abies*, *Abies nordmanniana, Pinus nigra, Pseudotsuga menziesii, Fagus sylvatica*) were planted 30 years ago in a clear cut within an old (150 years) beech and oak coppice (TSF). Net nitrification was very low in TSF, Nordmann fir and Spruce stands and high in Douglas fir, Pine and Beech stands. Two experiments were started in 2006: (i) exchange of 180 soil cores (O + A horizons, 8cm diameter and 15cm depth) between all stands and (ii) exchange of 12 O layer subplots between the TSF and Douglas fir stands. After 18 months, soil cores were collected from all plots, and incubated *in vitro* to measure the net N nitrification. Subsamples were used to extract DNA followed by quantitative PCR of Nitrite-Oxidizing Bacteria (NOB).

Soil cores from highly nitrifying stands transferred to highly nitrifying stands nitrified. Soil cores from highly nitrifying stands transferred to poorly nitrifying stands continued to nitrify. Soil cores from poorly nitrifying stands transferred to highly nitrifying stands nitrified strongly. Finally, nitrification remained poor in soil cores from poorly nitrifying stands transferred among each other. Quantitative PCR of NOB was correlated to net nitrification.

Therefore, we demonstrated that Beech, Pine and Douglas fir stands quickly promote the activity of NOB. Conversely, rapid inhibition of nitrification by Nordmann fir, Spruce and TSF stands was not found.

The transfer of the TSF O layer in the Douglas fir stand increased nitrate concentration in the soil of Douglas fir while the O layer of the Douglas fir transferred to the TSF stand did not affect the nitrate concentration in the TSF soil. As the nitrification process did not seem to be controlled by the humus layer alone, we suggest an additional control by root exudates.

S08.D.04
N-dynamic and microbial community structure depending on vegetation patterns in agricultural soils

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Vegetation patterns in agricultural soils might have profound effects on the structure of the soil microbial community and on nitrogen dynamics in soils. Especially in agricultural management systems with fallow periods within crop rotations vegetation patterns change frequently. Plant diversity, plant species composition, plant genotype as well as management practices like fertilisation and ploughing can influence the microbial community composition and nutrient cycling rates in soils.
The objective of the project was to assess the dynamic of soil organic matter mineralisation depending on changes due to season and agricultural management practices in a sandy Cambisol with site conditions typical of NE-Saxony, Germany. A special focus was on the influence of the dominant plant species (Rumex acetosa, Cirsium arvense, Agropyron repens, Secale cereale) on nitrogen dynamics and the structure of the soil microbial community (phospholipid fatty acid analysis, PLFA). A former arable site with natural succession vegetation (“Fallow”) was compared to a site under intensive agricultural management (“Intensive”).
The influence of management on most examined parameters was less pronounced than seasonal changes. However, differences in PLFA profiles between bulk soils of Fallow and Intensive plots were visible. They were reflected in PLFA profiles of rhizosphere soil originating from typical plant species of the Fallow (Rumex acetosa, Cirsium arvense, Agropyron repens) and rhizosphere soil of Secale cereale grown on the Intensive plots. Rhizosphere soil of the leguminous plant species Vicia villosa had the most distinct and diverse PLFA profiles. Net nitrification and gross nitrate transformation rates indicated a higher microbial activity in Vicia villosa rhizosphere soil compared to rhizosphere soil of the other plant species. Generally, the potential to release N as indicated by higher gross N mineralisation rates was higher in the Fallow soil than in the Intensive managed arable soil.

S08.D.05
Effects of organic and conventional farming practices on biological soil quality parameters: Evolution during the experimental period of the long-term DOK field trial

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In the long-term DOK field trial at Therwil, Switzerland, the following agricultural farming systems were compared since 1978: CONFYM (mineral and organic fertilisers, synthetic pesticides), BIOORG (organic fertilisers, mechanical weeding and biological disease and pest control) and BIODYN (with composted manure and bio-dynamic preparations). These three systems were performed at two fertiliser intensities of 0.7 and 1.4 livestock units ha^{-1}, respectively. They were compared with CONMIN (conventionally managed, exclusively minerally fertilised) and NON (unfertilised control). The seven year crop rotation, including two to three years of grass-clover, green manuring, the removal of cereal straw from the harvest plots and soil tillage were identical for all systems. CONFYM and CONMIN were limed with 2.7 t $CaCO_3$ ha^{-1} in 1999, CONMIN with additional 2 t $CaCO_3$ ha^{-1} in 2005 since pH values had dropped below officially recommended values.
Soils were sampled from 0 to 20 cm depth in spring at the end of the 3rd (1998) and 4th (2006) crop rotation period and subsequently, soil microbial biomass (substrate induced respiration- and chloroform fumigation extraction-method), soil respiration and dehydrogenase activity were analysed.
Manure influenced most soil microbial parameters positively compared to the non-manured treatments. At both fertiliser intensities, BIODYN showed the highest values, but as a result of liming the differences between the organic and conventional farming systems were narrowed. In particular microbial biomass and dehydrogenase activity increased and qCO_2 decreased in CONFYM and CONMIN after liming. This result underlines the importance of pH-management for maintaining and improving microbial soil quality. We conclude that the lack of organic fertilisers in CONMIN decreases microbial activity, whereas the use of composted manure may have additional benefits in BIODYN. The predominant farming systems in Switzerland, CONFYM and BIOORG were thanks to their use of organic fertilizers and residues equally beneficial for microbial soil quality.

S08.D.06
Seasonal dynamics of microbial communities in two alpine soils: a molecular approach

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Understanding the functioning of soils (i.e. carbon and nitrogen pools) requires a description of the local microorganisms and their metabolism. We characterized the soil microbial communities and their dynamics of two contrasted alpine meadows, snowbed combs and wind-exposed ridges. These weakly anthropized, high altitude ecosytems (2400 m) differ in snow cover duration. Snowbed combs show an 8-10 week delay in snowmelt and spring soil warming. This snow cover maintains soil around 0°C during winter (allowing microbial activity and thus, litter decomposition), whereas wind-exposed ridge soils, without snow cover, undergo -5 to -10°C freezing. Consequently, plant communities of these two ecosystems are entirely different, dominated by fast growing species in the first ecosystem, and by stress tolerant species in the second one. The seasonal successions of microbial communities are therefore shaped by markedly contrasted biotic and abiotic factors.
Soils samples were harvested at different seasons, and DNA sample pools were used to amplify a polymorphic segment of the conserved ribosomal DNA using kingdom specific primers. We improved the SSCP method and used it as a fast, high-throughput way of community fingerprinting. Microbial communities' fingerprints were analyzed by computing pairwise distances between normalized electrophoregrams and generating NJ trees. Tree analysis revealed good sampling reproducibility, a seasonal structure of microbial communities, and notable divergences between the two ecosystems at all seasons, except in spring. We then cloned and sequenced rDNA PCR products to ascribe a phylogenetic basis to these variations, and confirmed the large differences in microbial community structure between the two ecosystems. We also were able to identify several microbial clusters that vary widely along the seasonal successions.
High-throughput taxonomic sequencing, mesocosm experiments, and metatrancriptomic approaches are now under way to understand the kinetics, extent and biochemical processes of litter degradation in periodically snow covered soils.

S08.E.01
Metaproteomics: a new approach for studying functional microbial ecology

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Establishing the link between microbial diversity and ecosystem functioning constitutes one of the fundamental questions in microbial ecology. However, microbial biodiversity cannot be resolved in a single manner and the question arises about which of the genetic and/or taxonomic and/or functional components of biodiversity are the most relevant in such a problematic. To date, most researches in this field has focused on genetic diversity and few investigations have examined functional diversity, resulting in a poor understanding of the manner in which genetic and taxonomic diversity affect functional diversity or ecosystem properties. This can be explained by paucity of methods allowing an *in situ* and without *a priori* functional analysis of indigenous microbial communities. This statement recently stimulated the development of new approaches allowing the characterization of microbial metaproteome (i.e. all the proteins synthesized at the scale of the community at a given moment) extracted from environmental samples. Since proteins, and more precisely enzymes, are involved in biotransformation processes, metaproteome analysis constitutes a suitable way to characterize the dynamics of microbial functions in a holistic way.
Our presentation deals with interest and expected outcomes of the development of the metaproteomic approach for the functional analysis of microbial communities in their habitat. Different applications will be presented, highlighting the specificity and the sensitivity of the approach to characterize modifications of the functional structure and of the physiology of indigenous bacterial communities in response to metallic pollutions or organic matter inputs. Results presented show that, depending on soil characteristics, bacterial communities with similar genetic structures can harbour different functional structures and thus be potentially of different ecological significance for soil functioning. However, since they do not necessarily evolve in the same way, the simultaneous characterisation of genetic and the functional structures appears warranted to highlight fine and qualitative modifications in bacterial communities induced by variations in surrounding environmental conditions.

S08.E.02
Iron reducing bacterial activities and communities in paddy soils: impact of salinity and of organic matter

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Processes of oxydo-reduction occurring in the availability of iron and of associated trace elements, as well as their consequences on the functioning of soil in permanent or in temporary hydromorphic soils have already been studied. The originality of this work is built on a study of these processes in paddy fields which presented salinity zones and organic matter addition performed to limit the negative effect of the salinity on rice production.
Specific techniques have been used to study the cultivable rhizospheric and non rhizospheric bacterial communities, involved in these processes and to measure their activity which could control soil functioning and/or could be determined by soil parameters.We observed, that independently of the salinity, the paddy plots amended in organic matter presented the highest reducing conditions and the higher anaerobic ferri-reducing activity but the higher rice production. On the other hand, whatever was the studied plot, the cultivable bacterial communities always presented halotolerant even hyper - halophilic characteristics.
To better defined the bacterial communities involved, four cultivable bacterial consortiums (S1 ; S2 ; S6 et S8) isolated respectively from a paddy salty and organic amended plot (L25S), a paddy salty and not amended plot (L14S) and a paddy not salty and amended plot (L14NS) were selected for further studies. Their capacity to dissolve iron oxides according to the salinity, the evolution of the chemical parameters (pH, Eh,) and the production of fermentation métabolites were measured. Tools of molecular biology (PCR-TTGE then sequencing) allowed to characterize *Shewanella putrefaciens*, *Enterobacter Rpfp* and *Enterobacter cloacae* in saline and non saline environment. The bacteria *Clostridium beijerinckii* and *Clostridium acetobutylicum* were observed in non saline environment and the bacteria *Clostridium saccharobutylicum* and *Bacillus megaterium* only in saline environment. The fermentative bacteria appear of major interest in these environments.

S08.E.03
How alternative agricultural practices affect the soil biota and soil function - the case of the denitrification process

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To counter the loss of soil fertility due to conventional agriculture, alternative practices like Direct seeding Mulch-based Cropping systems (DMC) has been adopted in different countries (USA, Brazil, Madagascar). These alternative systems aim to conserve, improve and make more efficient the use of natural resources. The principle of DMC is to keep the soil permanently covered by mulch in absence of tillage. The aim of this work was to investigate to what extent DMC modifies soil biota and its activities, taking the denitrification process as a bacterial model function. The experimental field was located in Madagascar on a clayey ferrallitic soil where conventional tillage (CT) was compared to DMC along a soybean-rice rotation including a fertilization gradient. The soil biota studied included, total macrofauna, nematofauna, bacteria and and key functional denitrifiers communities. All these communities were studied in terms of density, structure and potential activities for the denitrifiers communities. Compared to CT, DMC positively affected the biomass of all the soil biota. However, for the soil fauna, high fertilization inputs (organic + NPK) diminished the difference between these two practices. In DMC plot, earthworm biomass was dominant while Coleoptera larvae dominated in CT plot. Nematode densities and microbial biomass increased significantly under DMC practices. Nevertheless, the fertilization levels seem to have a higher impact than culture practices on the nematode and bacterial diversities. Co-inertia analysis confirmed that cultural practices and fertilization have the same influence on bacterial and nematode diversities. DMC significantly affected the different parameters (potential activity-density-structure) of the bacterial community involved in N20 emission, but they did not changed in situ N20 emissions compared to CT. At last The direct or indirect effect of the modification of the soil fauna by agriculture practices on the denitrification process is discussed

S08.E.04
Denitrifying activity and fungal growth in the fresh cast of *Aporrectodea caliginosa*

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Earthworm activity leads to intensification of nitrogen turnover in soils. As a rule it increases nitrogen losses in that bacteria are responsible. Fungi contrary play key role in nitrogen immobilization. There are observations that soils with higher ratio fungal to bacterial biomass have lower denitrifying potential. In this work the interrelation between intensity of fungal growth and activity of denitrification in earthworm casts was studied.

The incubation experiments (12 days at 20°C) were done with fresh casts of *Aporrectodea caliginosa* from soddy-podzolic soil. Inorganic nitrogen was determined by colorimetric methods, denitrification - acetylene inhibition method, biomass - luminescent microscopy with fluorescein diacetate. Intensity of fungal growth in the casts was inhibited by cycloheximide (16 mg/g).
Rates of nitrification and denitrification were much higher in the casts than in the soil. Denitrification in the casts decreased on 30% at the end of incubation and it became close to activity in the soil.
Significant elevation of fungal biomass in the cast (around 5 times) was observed already after 3 days. Antibiotic inhibited mycelium growth completely during first 3 days and fungal biomass increased in 2 times only after a week. Amount of immobilized N in the biomass declined from 135-195 µg N/g in control up to 40-107 µg N/g in the treatment with cycloheximide. At the same time the casts with antibiotic have significantly higher content of ammonium, nitrates and rate of denitrification (on 10-15%) than control cast. So, there is interrelation between intensity of fungal growth, decline of pool of inorganic nitrogen and activity of denitrification in the casts. Most possible mechanism lies in the competition of fungi and denitrifying bacteria for available nitrogen and carbon. Amendment of plant polymer substrates that improve of fungal growth can be recommended for maintain nitrogen in soils with abundant population of earthworms.

S08.F.01
Endogeic engineering: Soil ecological processes related to endogeic earthworms - A summary of lab incubations

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We summarize a number of published and unpublished incubation experiments with endogeic earthworms from our group. Some specific characteristics for endogeic earthworm species in the functions of litter breakdown, microbial biomass regulation, nutrient turnover and soil formation will be worked out. All the incubation experiments compare treatments related to the factors endogeic earthworms (yes/no) and substrate addition (yes/no). The substrate added always represents crop residues. Aporrectodea caliginosa or Octolasion lacteum were used in the experiments. Our results support the view that endogeic earthworms feed on microorganisms to a large extent. Endogeic earthworms reduced the soil microbial biomass in all experiments. This reduction was persistent even after removal of earthworms and application of a drying and rewetting cycle. Using stable isotope techniques, we are able to show that the uptake of microbial biomass does not only account for the digestion of microorganisms from ingested soil particles, but also by a selective grazing on litter colonizing microorganisms. Comparing different size classes of particular organic matter, it turned out that even small particles do not decrease in the presence of earthworms. This indicates again a selective preference for microbial tissue. According to the ergosterol contents, soil fungi were ingested at higher rates. Moreover, focusing on the nutrient turnover, we are able to show that endogeic earthworms have different impacts in relation to tillage practices than anecic earthworms. In addition we will report on an experiment drawn to the question whether the rate of soil ingestion and aggregate formation by endogeic earthworms depends on the amount of litter related microorganisms or other factors like content of humified soil organic matter.

S08.F.02
Functional impact of earthworm biostructures on soil bacterial community: A field approach in agricultural soils

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It is widely accepted that earthworm activities participate greatly to soil processes by the bioturbation of large volumes of soil. Their activity affects primarily the soil bacteria communities by their gut transit. However, while earthworm cast biostructures deviate from surrounding soil in term of morphology and availability of organic compound, little is know about the persistence of a functional discrimination of microbial biota within soil biostructures. In this work, we have considered that the bacterial communities could vary according to the aged of cast deposition, to the location of cast and also to the nature of organic matter initially ingested by earthworm.
Based on the classification of soil structures observable on soil profile, we sampled soil cores corresponding to physicogenic soil structures (e.g. S- Surrounding soil and Ag- granular plough structure) and to biogenic structures (e.g. B3g and B3i that represent respectively some recent granular and welded packing of cast deposition). So, soil material was collected at different depths and under contrasted soil management (experimental plots at Kerguéhennec, France) allowing to compare the impact of different fertilisations (mineral fertilisation vs poultry manure) combined to different tillage practices.
On each soil core, total concentrations of carbon and nitrogen were measured. Moreover, we analysed the diversity of bacterial community by performing diversity signatures of the 16S rRNA gene fragment using terminal restriction fragment length polymorphism (T-RFLP) from environmental DNA extracts.
The first results demonstrated that the manure input enhanced the total C concentration in the first centimetres for both physicogenic and biogenic soil structures. Interestingly, differences clearly appeared with the depth: biogenic structures significantly concentrated Ctot below 20 cm.
The variability of bacterial communities will be discussed in relation to (i) the spatial modifications in concentrations of carbon and nitrogen, and (ii) the different fertilisation treatments.

S08.F.03
Root, mycorrhiza, and earthworm interactions: their combined effects on plant biomass, nutrition and soil structure

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Biotic interactions in soils are known to influence aboveground plant communities and furthermore soil fertility, i.e. its nutrient status and structural stability. Earthworms, arbuscular mycorrhiza fungi (AMF) and roots are especially important components of the belowground ecosystem. While AMF have mainly mechanical and chemical roles (soil particles enmeshment into bigger aggregates and glomalin secretion), earthworms structure the soil by their burial and feeding-casting activities. Furthermore, earthworms are able to disrupt the mycelium network, which could lead to either a decrease of AMF root colonization rate, and/or an enhancement of the dispersion of root/mycelium networks. However, little is known about their effects on plant growth or soil chemical and physical properties. Therefore, the objectives of this study are to assess separately or in combination, in phosphorous limited conditions, the effects of earthworms (Allolobophora chlorotica, Savigny), AMF (Glomus intraradices, Schenk and Smith), plant roots (Allium porrum, L.) and time on i) soil structure and ii) available nutrients (mainly phosphorous) in bulk soil as well as in both rhizosphere

and drilosphere soils. In addition, investigations focus on the combined effects of earthworms and AMF on plant growth.
Our results point up that earthworms decrease water-stable macroaggregates. Moreover, available phosphorous decreases in bulk soil whereas it increases in the drilosphere soil. Regarding plant growth, AMF enhance shoot and root biomass and decrease N:P ratio in shoots. Earthworms do not increase plant biomass. This study shows that under phosphorous limitation, AMF enhance plant growth via available phosphorous acquisition from the soil. Earthworms have no direct effect on plant growth but drilosphere soil may serve as nutrient storage that can be later mobilized. This study supports the idea that complex interactions occur at the rhizophere level that may affect soil structure and fertility.

S08.F.04
Impact of root growth, fungi and earthworms on soil physical properties as assessed by shrinkage analysis

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The impact of soil life on soil physical properties is a hot issue for nowadays concerns such as soil erosion, soil preservation and restoration, or greenhouse effect. Although soil life is well known to interact with soil physical properties, its quantitative impact is poorly described due to difficulties in accurately assessing small changes in soil physical properties. As the recent developments in shrinkage analysis are assumed to overcome this limitation, the working hypothesis of this study was to quantify with shrinkage analysis the changes induced by root and fungi growth, earthworms, and the combination of these living organisms on soil.
The experiment was performed in climate chamber with homogenized soil columns. The control was a sterile soil and the different treatments were (1) earthworms, (2) mycorrhizae, and (3) plant (Allium porrum), plus combinations of the treatments. After 35 weeks, the soil was sampled for analysis. The roots, mycorrhizae, and earthworms mass and volume distributions were measured. The shrinkage analysis allowed calculating the plasma and structural pore volume of the samples, the pore size distribution of the structural pores, the hydro-structural stability, the bulk density and the available water in the soils of the different treatments.
The short term impact of soil biota on soil physical properties was accurately assessed with the shrinkage analysis. The roots induced an increase in the bulk soil volume, an increase in the structural pore volume and hydro-structural stability, resulting in an increase in available water. A similar effect was induced by mycorrhizae and cumulated with roots effects. The comparison between the structural pore volumes and the fungi and root volumes and sizes supported the theory of a “self-organization” of the soil-life system. The earthworms compacted the soil and decreased the soil plasma swelling, as already observed in similarly structured soils.

S08.F.05
Ecological forest management, soil faunal communities and soil processes: a case study in the Black Forest (Germany)

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In Europe, afforestation policies led to the replacement of native deciduous tree species forests by coniferous stands. The idea of re-establishing mixed forests that are better adapted to site conditions has attracted increasing attention over the last decades. These mixed forests are assumed to be ecologically more stable, more resilient and to fulfil demands for multi-functional forestry. But so far, few investigations have been carried out to survey topical aspects in this regard, namely soil biodiversity conservation and ecosystem processes. We, thus, decided to investigate the consequences of mixing stands on soil processes and invertebrate communities. Within three forestry districts in the southern Black Forest (Germany), we selected 12 stands representing four common stages of forest conversion, starting from even-aged pure spruce stand (P), through two intermediary stages (called species enrichment stage (SE) and structuring stage (SP)), and finally to a diverse continuous cover forest (CC). Changes of environmental parameters between the stages indicated a significant alteration of the soil environment. While pH increased during conversion process, C/N ratio and water content had an opposite trend. Surprisingly neither microbial parameters nor soil respiration were influenced by the factor “conversion”. Our results, however, revealed major changes of soil invertebrate assemblages’ structure. Based on densities a group-specific response emerged with several groups (e.g Collembola, Isopod, Chilopod) profiting from the conversion process. At the species level, mean species richness of Collembola largely reflects the enrichment of the community along the conversion process with a strong increase of approx. 47% from P to CC. Replacement of species were also depicted. Major conclusions of this study are the strong modifications encountered by soil faunal communities during ecological forest conversion. Improvement of basic communities’ parameters of several groups (abundance, species richness, diversity indices) along the conversion process pleads with such management according to biological conservation goals.

S08.F.06
Pedotransfer functions for soil biodiversity

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Indicating changes in soil biodiversity is generally considered a difficult task due to the complexity of soil biota. Current attempts to open the black box of the microbial community uncover an immense diversity at the local scale. At regional or landscape scales, however, the challenge is to define indicators describing the below-ground system as a whole. It is argued that soil organisms such as earthworms, having a strong metabiotic impact on other soil organisms, can be regarded as system indicators that allow to predict overall characteristics of a specific soil biota system. System indicators are commonly used in soil monitoring programmes to assess changes in soil biodiversity (e.g. within the EU project ENVASSO).
Data from some 50 soil monitoring sites in Germany, which have been investigated during 20 years, will be used to relate biological parameters, such as species composition and abundance of earthworms and enchytraeids, to soil variables such as pH, soil moisture, soil texture, humus form and land use. The emerging patterns serve as a basis for defining pedotransfer functions which allow to predict the characteristics of soil biota, where direct measurements are not feasible. Pedotransfer functions are the tool for upscaling soil biodiversity data up to the landscape scale and for mapping soil biota related soil functions. They may also be used to define the benchmarks for assessing decline in soil biodiversity caused by soil contamination, soil compaction and other soil threats. Examples will be discussed using data from German pilot sites.

S08.G.01
The contribution of fungi and bacteria to the microbial biomass in soil

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Soil microorganisms encompass archea, bacteria, fungi, and protozoa. They maintain the majority of enzymatic processes in soil and preserve energy and nutrients in their biomass. The assessment of the microbial community structure can be divided into two main approaches: The first approach is the differentiation of the microbial biomass into a small number of large functional subgroups such as fungi and bacteria. The second approach is to measure the large diversity on a genotype, phenotype or functional level. The knowledge about the diversity of the soil microbial community has much increased over the past years, but the contribution of fungi and bacteria to the soil microbial biomass is still controversial. This is especially due to the strong focus on soil bacteria in the new molecular and physiological methods for characterizing microbial diversity. The repertoire of methods for differentiating between fungal and bacterial biomass has remained essentially unchanged over the past decade. Three different approaches can be distinguished (1) microscopic methods, (2) selective inhibition (3) biomarkers (ergosterol, PLFA, glucosamine, muramic acid). Data obtained from the literature were compiled for these three methodological approaches. The advantages and disadvantages of the different methodological approaches are highlighted and discussed. In the majority of experiments, a fungal dominance has been observed, with a proportion ranging from 60 to 80% fungi of the total soil microbial biomass in comparison with 40 to 20% bacteria.

S08.G.02

Influence of pH-heterogeneity of fertiliser effects on microbial biomass in a long-term field trial of ecological agriculture

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This research project focuses on the comparison of mineral (MIN), organic (CM) and organic fertiliser with biodynamic preparation (CMBD) in terms of microbial biomass in a long-term field experiment of organic agriculture. The data showed a high variation in the pH values, which are not caused by different fertiliser but influenced by the heterogeneity of the fluviatile sandy sediments. This influence of the highly varying pH values was reduced by the geostatistical methods to improve the comparison of microbial biomass in the different treatments. The organic treatments were characterized by nearly 10.7% higher contents of Cmic (CM: 149 mg kg-1; CMBD: 152 mg kg-1) and Nmic (CM: 18 mg kg-1; CMBD: 22 mg kg 1) compared with the mineral ones (136 mg Cmic kg-1; 17 mg Nmic kg-1). These results were consistent with the significant ($P < 0.05$) lower Cmic/Nmic-ratios (MIN: 9.2; CM: 8.4; CMBD: 7.5) of the treatments with organic fertiliser addition. Furthermore, the Pmic contents showed 25% higher values (6.5 mg kg-1) in the CM treatment and 44 % in the field with CMBD addition (7.5 mg kg-1) than in the mineral treated soil (5.2 mg kg-1). The Cmic/Pmic-ratio was 26 with mineral fertilisation compared with 23 (CM) and 20 (CMBD) in the organic treatments. This points to a higher P-availability in the soils with organic fertilisation. This suggests that the addition of organic fertiliser generates higher microbial biomass and higher nutrient availability of nitrogen and phosphorus in comparison with the addition of mineral fertiliser. Microbial sulphur (Smic) will be determined to give additional information about the role of microbial sulphur transformation in soil with mineral and organic fertilisation.

S08.G.03

Soil microbial community structure, diversity and functionality in integrated livestock-corp production systems compared to continuous cotton

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Many regions of the world are facing soil quality and sustainability problems due to monoculture. In the Texas High Plains of US, cotton (*Gossypium hirsutum*) production under continuous monoculture and conventional tillage (since the 1940's) has contributed to wind-induced soil erosion and organic matter reduction. This study is part of a larger project to develop and evaluate integrated crop and livestock systems that reduce dependence on underground water while optimizing productivity and enhancing soil quality. A clay soil (Fine, mixed, thermic Torrertic Paleustolls) was studied during the first 10 years under continuous cotton compared to an integrated livestock-crop system with a perennial warm-season grass pasture (*Bothriochloa bladhii*) and two stages of a rotation (wheat *(Triticum aestivum)*-fallow-rye (*Secale cereale*)-cotton). After 5 years, total C (0-5 cm) was only higher under perennial pasture, but total C (avg: 17.3 g kg^{-1} soil) and total N (avg: 1.5 g kg^{-1} soil) were higher in all the integrated crop-livestock systems compared to continuous cotton (11.4 g C kg^{-1} and 1.1 g N kg^{-1} soil) after 10 years. After 5 years, soil microbial biomass C (MBC) was greater in perennial pasture (193 mg kg^{-1} soil) and in the rotation when sampled under rye or cotton (237 mg kg^{-1} soil) compared to continuous cotton (124 mg kg^{-1} soil), but MBC became significantly higher in all the alternative systems after 7 years. Similar trends were found for enzyme activities of C (β-glucosidase, α-galactosidase), P (alkaline phosphatase, phosphodiesterase), N (β-glucosaminidase), and S (arylsulfatase) cycling. The integrated crop-livestock systems had higher protozoa (20:4ω6c=1.98%) and fungi (18:3ω9c=1.30%) than continuous cotton (20:4ω6c =1.09%; 18:3ω9c= 0.76%) after 5 yrs. Higher mycorrhizal fungal fatty acids (18:1ω9c, 16:1ω5c) were detected under ungrazed areas compared to grazed areas in pasture at 0-5 cm. Bacterial diversity as affected by the integrated-crop livestock systems will be discussed.

S08.G.04

Microbial-biogeography of France by the use of molecular tools applied to the French soil quality monitoring network (RMQS)

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Although microorganisms are the most diverse and abundant type of organisms on earth, the determinism of microbial diversification and the distribution of microbial diversity from small to large scale are poorly documented. Ecologists studying macroorganisms have long recognized that beta-diversity (how community composition changes across a landscape) is central for understanding the environmental factors driving the magnitude and the variability of biodiversity. However, this conceptual vision is also relevant for microorganisms since patterns of beta-diversity can offer valuable insights into the relative influence of dispersal limitations, environmental heterogeneity, and environmental and evolutionary changes in shaping the structure of ecological communities. Despite the statement that spatial patterning of microbial diversity can have important consequences regarding to plant community structure and ecosystem functioning, microbial beta-diversity patterns have been poorly investigated and remain largely unknown. In this context, we have investigated the characterisation of the indigenous bacterial communities from soils sampled at a broad scale. This goal was achieved by characterising density, diversity and genetic structure of bacterial communities by using molecular tools directly on the DNA extracted from the soil library of RMQS ("Réseau de Mesures de la Qualité des Sols" = French soil quality monitoring network) which cross-rules all the French territory with about 2200 soils sampled. In this library, soil physico-chemical characteristics, climatic factors, floristic composition and land use were recorded. Specific statistical tools were developed to confront microbiological, pedo-climatics data and geographic distance to i) characterise the bio-geographical patterning of soil bacterial diversity in French soils, ii) deduce the contribution of edaphic, climatic and land use factors on soil bacterial diversity and composition, and iii) identify bacterial bio-descriptors of specific environments and anthropogenic activities. Moreover, such an approach will allow to validate one of the oldest concept in microbial ecology "*everything is everywhere*, but, *the environment selects*" (Beïjerinck, 1913).

S09 Forest Management and Soils

S09.H.KL
Climate - vegetation - soil interactions: Changes in forest soil properties and function in a changing environment

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Soil scientists have long been aware of the continuous feedback between vegetation cover and soil properties. On a broad scale, climate influences the distribution and productivity of vegetation types, with local variations in vegetation due to differences in edaphic soil conditions. Within a given region, soil microclimate generally reflects ambient climatic regimes, but vegetation cover induces local variations in soil water and temperature patterns by influencing rainfall interception, snow accumulation, shading, or insulating the soil with accumulated litter material. Different vegetation types further cause differences in the rate, quality, and mode of annual organic matter input via foliar litter fall and root turnover. As a consequence, distinct climate-vegetation combinations result in distinct sets of physical, chemical and biological soil properties and pedogenic processes. In extreme environments, this may be reflected in persistent tree or shrub islands that influence and in turn are influenced by resource availability.
A change in this climate-vegetation complex - whether due to land use shifts, forest manipulations, global climate changes, or a combination thereof - will cascade into a complex set of changes in organic matter storage and dynamic, physico-chemical soil properties, soil formation, nutrient cycling, and soil biological processes, that may fundamentally change ecosystem function and soil productive capacity. While we conceptually understand the interactions between soils, plants, and the surrounding environment; the complexity of the climate-vegetation-soil feedbacks often mar our ability to accurately model or predict future ecosystem responses.

S09.H.01
Impact of tree species on the release from forest floor of organic and inorganic carbon and nitrogen

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The impact of tree species on soil is ruled by strong soil-plant feedbacks and interactions with climate. Using forest stands involving different tree species in homogeneous soil and climate conditions is thus a prerequisite to understand the specific effect of tree on soil properties and processes.
Here, we study the release of organic and inorganic carbon (CO_2, DOC) and nitrogen (DON, DIN (NH_4^+, NO_3^-)) from forest floors from 30 year old monospecific pure stands of spruce (*Picea abies* Karst.), Douglas (*Pseudostuga menziesii* Franco), beech (*Fagus sylvatica* L.) and oak (*Quercus sessiflora* Smith) grown on the same soil (Alocrisol) (Morvan Plateau, France). The forest floor leachates were collected after laboratory incubation under controlled conditions.
The forest floor (Ol, Of and Oh horizons) was the thickest under spruce (40 mm), and the thinnest under oak (15 mm). The thickest Ah horizon occurred under oak (30-50 mm), and was only 10-20 mm thick under the other stands.
As inferred from CO_2 and DOC release, C mineralization was the largest in the oak forest, but did not significantly differ between the three other species.
The nitrification degree (NO_3^-/DIN) was the largest in the Douglas forest floor, and the smallest in the spruce forest floor. Accordingly, the leachates from Douglas forest floor exhibited the lowest pH values (pH<3.8). The release of dissolved organic carbon (DOC) and nitrogen (DON) were smallest in the Douglas forest floor.
We studied the correlation between these observations and the composition of specific litterfall. We did not observed correlation between lignin content or C/N ratio of litterfall and forest floor properties. However, oak litterfall exhibited the largest Mg and Mn contents, which could promote lignin degradation.

S09.H.02
Nitrogen mineralization pathways in the humic epipedon along chronosequences of a pure beech and a mixed oak-hornbeam even-high forests

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Studies focusing on organic matter recycling at the scale of forest ecosystem dynamics are scare and often based on indirect measures such as humus forms. Besides, relationships between humus form changes and important soil functional processes as nitrogen (N) cycle are lacking. In this study, space-for-time substitution procedure and laboratory incubation method for 28 days at 28°C were used in order to assess potential N mineralization (PM) and nitrification (PN) within the forest floor (FF) and the five first centimeters (5FC) along two even-high forest chronosequences: a pure beech one about 130 years and a oak-hornbeam mixed one about 100 years. Selective inhibitors were used to distinguish autotrophic versus heterotrophic nitrification pathways. Results have shown that PM in the FF increased with forest maturation in both chronosequences whereas 5FC potential nitrification significantly decreased. Along pure beech forest maturation, PN was exclusively autotrophic and decreased with age in both horizons while in mixed forest, selective inhibitors have revealed a temporal as well as spatial segregation of nitrifiers group activity, i.e. PN was mainly under an autotrophic control in the 5FC while it appeared under a heterotrophic one within the FF. Moreover, within the FF, PN seemed to be a bacterial process in young stands and a fungal process within mature stands. In conclusion, N mineralization pathways as well as associated decomposers vary greatly along forest chronosequences. These temporal changes in soil functioning corroborate with humus forms changes during forest maturation. French humus form classification may thus constitute a great indicator tool of N mineralization efficiency and decomposers implicated, especially through extensive descriptions (OH layer thickness, fine organic matter abundance in OF or OFm structure).

S09.H.03
Decomposition and nutrient loss of bilberry litter under three different dominant tree species

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The study stands were adjacent 70-year-old stands in Kivalo, northern Finland dominated by silver birch (Betula pendula Roth.), Scots pine (Pinus sylvestris L.) and Norway spruce (Picea abies (L.) Karst.). The soil type was podzol and the organic layer was mor. Originally the whole study site has been a homogenous Norway spruce stand, which was clear-cut and prescribed burned in 1926. Three study plots (25 m x 25 m) were placed in each stand and abundance of the understorey vegetation was studied by estimating visually the species-specific coverage in percentages. Bilberry (Vaccinium myrtillus) was the most common dwarf-shrub at all sites. The biomass of bilberry represented more than half of the total aboveground biomass of the understorey vegetation at all sites. Decomposition of bilberry leaves and stems was studied using litter bags placed beneath the humus layer at all study plots for a two year period.
The decomposition rate of bilberry was highest under birch which is in agreement with results of mineralization measurements obtained from the same sites. The rates of carbon and the net nitrogen mineralization measured in laboratory incubation experiments were highest in soils taken from the birch plots. The mass loss of the leaves of bilberry was higher (52-61%) than that of the stems (33-46 %). There were no clear differences in nutrient loss rates between sites of different tree species.

S09.H.04
Structure, functioning and impact of young teak (*Tectona grandis*) plantation on coal mine spoil in a dry tropical environment, India

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Present study conducted on the ecological aspects of rehabilitation of coal mine spoil through dense plantations of *Tectona grandis*. Teak is indigenous and possesses high economical value in terms of high-grade timber production in most of the country. The objective of the present study was to quantify growth, biomass, net primary production and nutrient dynamics, and to assess the impact of plantation on restoration of biological fertility of coal mine spoils.
Growth in height and diameter, accumulation of biomass, net primary production, N and P storage, and N and P deposition and release were measured up to 6 yr age of plantation. Impact of this species on soil redevelopment as indicated by physico-chemical characters viz. concentration of organic C, N and total P, levels of mineral N and PO_4^--P, and rate of N-mineralization was monitored. Development of soil microbial biomass and levels of microbial nutrients were also determined. Results indicated that, biomass accretion; NPP and nutrient storage increased with age of plantation, and redevelopment of soil biological fertility on mine spoil was evidently influenced with increasing plant growth and nutrient cycling tended to become tighter with age of plantation. The study further indicates that the ecological restoration of teak *plantation* on mine spoils is a feasible land use option, which might be more beneficial in the long term.

S09.I.01
Influence of six European tree species on soil respiration, rates of carbon turnover and carbon stocks in a common garden experiment

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The knowledge of tree species effects on soil carbon pools and carbon dynamics is limited, particularly for a range of European deciduous tree species. We studied soil respiration, rates of C turnover and soil C stocks in six European tree species in a 30-yr-old common garden experiment replicated at three sites in Denmark. Soil respiration was assessed monthly in the field, and rates of C turnover were estimated by i) the ratio of soil respiration to C stock in forest floor and top mineral soil assuming a similar ratio between root and microbial respiration among tree species, ii) decomposition constants based on the ratio of litterfall C to forest floor C, iii) foliar mass loss in litterbags, and iv) mineral soil basal respiration in the laboratory.
Soil respiration differed significantly among species and increased in the order beech<lime<Norway spruce=oak=maple<<ash. Soil respiration was mainly temperature limited with no significant species difference in Q_{10}. Norway spruce soils were significantly driest and soil respiration was also weakly positively related to soil moisture. Forest floor C stocks increased in the order ash=lime=maple<oak=beech<<spruce, but mineral soil C stocks did not differ significantly. The estimates of soil C turnover were largely consistent. Carbon turnover rates based on the ratio between soil respiration and C stock increased from spruce and beech over oak and lime to maple and ash. A similar influence of tree species on C turnover was indicated by the litterfall C/forest floor C ratio and by foliar mass loss; rates of C turnover increased in the order spruce<beech=oak<ash=lime=maple. Mineral soil C turnover during laboratory incubation was also highest for ash, maple and oak, but there were no significant differences. The results suggest that the six common European tree species had developed consistently different profiles in terms of soil C dynamics three decades after planting.

S09.I.02
Are soil organic carbon stocks affected by forest management?

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Soil organic carbon (SOC) stocks are particularly sensitive to landuse management and site conditions. We studied the relation between forest management intensity and SOC-storage in the framework of the German Biodiversity Exploratories initiative.
The study was conducted in the Hainich region in Thuringia/Germany with a total of 500 sampling points along a landuse gradient including unmanaged forests, selection forests and age-class forests. We recorded relief parameter, texture and soil type at each sampling point. The forest floor was sampled by means of a metal frame and the mineral soil with a soil column cylinder auger to obtain undisturbed samples at six depth increments. After sample preparation, the OC-concentrations were determined and the OC-stocks calculated.
The analysis of the first 90 sampling points by Anova showed that the OC-stock in the forest floor was significantly higher

(p<0.0001) in unmanaged and selection forest (0.8 and 0.7 kg m^{-2}) than in age-class forest (0.4-0.5 kg m^{-2}). In contrast, the OC-stocks in the mineral soil were not significantly affected by landuse intensity. However, the results revealed significant differences (p<0.0001) among the OC-stocks of the major soil types, Luvisols (9.2 kg m^{-2}) and Cambisols (10.8 kg m^{-2}). Cambisols contained the highest OC-stocks at all soil depth increments.
There were no effects of forest management intensity on OC-stocks in the mineral soil at a sample size of n=90. However, we expect that a higher number of soil samples (n=500) will enhance the propability of significant effects of forest management intensity, particularly in the topsoil. Additionally, we are planning to isolate the light fraction of soil organic matter (SOM) from selected samples to test the hypothesis that the labile fraction of SOM is more sensitive to forest management than total OC-stocks.

S09.I.03
Effects of thinning and clear-felling on greenhouse gas fluxes in Japanese cedar forest on Brown Forest soils

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Carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) are major greenhouse gasses (GHGs).Temperate forest soil is a source of CO_2 and N_2O, and a sink of CH_4, but the effects of thinning and clear-felling on dynamics of these GHGs are not well understood. Japanese cedar accounts for 20% of the forest area, and Brown Forest soils cover 70% of the total forest area in Japan. Five sites of Japanese cedar forests on Brown Forest soils were selected from northern to southern Japan for this study. Monthly measurement of GHG fluxes from soil surface after thinning and clear-felling was carried out for two years using a closed chamber method. The annual mean soil temperature at the clear-felling plots (14.7 ^{o}C) was significantly higher (P < 0.05) than that at the control (13.0 ^{o}C) and thinning (13.5 ^{o}C) plots. The annual mean soil moisture was not significantly different among the managements. The annual mean CO_2 flux at the clear-felling plots (80 mg C m^{-2} hr^{-1}) was significantly higher (P < 0.05) than that at the control plots (58 mg C m^{-2} hr^{-1}) (P < 0.05). The difference in CO_2 flux between the control and clear-felling plots at south-facing sites was relatively higher than that at north-facing sites where the difference in soil temperature was small or negligible. This result suggests that the impact of clear-felling on CO_2 flux may vary with slope direction. Although many studies reported that a decrease in CH_4 uptake rate (negative CH_4 flux) and an increase in N_2O flux by clear-felling were due to an increase in soil moisture, CH_4 and N_2O fluxes in this study were not significantly different among the managements.

S09.I.04
Soil carbon and nitrogen pools after clear-cutting and scarification

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Carbon (C) and nitrogen (N) pools in different soil horizons after logging following by scarification with disk plower were studied in eastern Finland three (in 2001) and eight (in 2006) years after operations. Soil samples were taken in the ridges, furrows and undisturbed microsites and from organic (O), elluvial (E) and illuvial (B) horizons of podzolic soil to the thickness of 20 cm measured from mineral soil surface. The organic horizon in the ridges was the thickest, since it was formed from two humus layer and logging residues with disk plower. Also the amounts of C and N were 2.6 and 2.9 times, respectively, higher in the O-horizon of the ridges compared to undisturbed microsite in 2001. However, in the E-horizon of the ridge the amount of C and N were smaller than those of the furrow or undisturbed microsite. Nevertheless, in the B-horizon of the ridges C and N amounts were the highest. In the whole soil profile the ridge had 1.6 times more N and 1.8 times more C and the furrow had 40 % less N and 51 % less C than the undisturbed microsite. In 2006 the differences between microsite types were smaller. The areas of the ridges, furrows and undisturbed microsite were 25 %, 30 % and 45 %, respectively, for the whole scarified area. When calculating the C and N amounts for the whole area it can be concluded that scarification increased the amount of C 4.5 % and amount of N 6 % in soil profile, at least temporarily.

S09.J.KL
Element budgets for silvicultural management schemes - a tool for preserving ecosystem sustainability

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Silviculture implies patterns of harvest in space and time, and thus defines closeness of element cycles. Management-strategies with clear-cut phase tend to unbalanced element budget, whereas continuous-cover treatment creates more closed element cycles. It is an important task for silvicultural management strategies to keep element budgets of forest ecosystems closed, reflecting actual environmental conditions. For that purpose element budgets should refer to whole life-cycles of stands.
In the Convent forest ecosystem study, 18 km east of Freiburg (South-West Germany), element- and water budgets of forest ecosystems are examined since 1991. The silvicultural treatments have more or less identical site conditions, acidified Cambisols on dark Paragneis bedrock with high base content.
The measurements from 50 different structure units and silvicultural treatments served as a basis for calculating individual element fluxes and -budgets for mixed and monocultured stands of the case study. Those were considered as phases in the stand development. They have been re-arranged on a virtual model time axis to generate the element budget of the whole rotation period. The course of element fluxes in the individual structure units was parameterized by means of non-linear regression models. These long-term element budgets have been calculated for five different silvicultural management regimes: monocultured stands of spruce and beech after clear-cut regeneration, beech stands with gap-oriented regeneration with and without pre-regeneration in the femel phases and finally beech/silver-fir/spruce mixed stand with continuous cover management. Harvesting intensities could be distinguished through differentiation between element pools of biomass compartments. The two examples with clear-cut regeneration caused a net loss in the Mb-cation balance up to 7-8 $kmol_c ha^{-1} a^{-1}$ during the clear-cut phase. In the beech mono-cultured stand the balance for Mb-cations was equalized 25 years after clear-cutting. The beech/silver-fir/spruce stand with continuous cover was the most cautious strategy causing no longer lasting periods of Mb-cation loss.

S09.J.01
Synthesis of research on the nutritional sustainability of variable-retention harvesting as an alternative to clearcutting in northern forests

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The productivity of most temperate and boreal forests is primarily limited by low soil nitrogen (N) availability. Early work in Scandinavia and the eastern US suggested that clearcut harvesting could lead to increased loss of N through leaching from sites. Concerns were therefore raised about the potential for clearcutting to result in decreased site productivity because of leaching losses, and in environmental and health problems. Public and market-driven concerns over the potential environmental impacts of clearcut harvesting led to the introduction of alternative silvicultural systems, or variable retention (VR) harvesting in the 1990s. These harvesting techniques are now used, or are being considered for use, in many ecosystems and it is usually assumed that loss of N following clearcutting would be mitigated by using variable retention harvesting. We synthesized long-term results from VR as well as clearcutting silvicultural trials to determine the effect of different harvesting methods on nitrogen cycling processes. Clearcutting, overall, increased availability of nitrate and the rate of net nitrification, total N capital remained unchanged. Deciduous and coniferous forests showed different temporal patterns of the postharvest N dynamics. Single-tree selection usually caused smaller changes in N cycling than clearcutting or group-selection harvesting. However, in forests that showed no response or very small responses to harvesting, partial-cut treatments did not differ either from the clearcuts or uncut forest. Higher levels of nitrate and nitrification and N mineralization rates at clearcut sites were usually associated with higher values at the control sites. So, VR harvesting systems may be preferable to clearcutting (in regards to N availability and losses) in forests with higher nitrate availability and net nitrification rates, but would not be beneficial in forests with more conservative N cycling.

S09.J.02
Effects of different soil preparations methods on the foliage N dynamics in Finnish boreal forests; 15N natural abundance isotopic method approach

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Abstract
In this paper, we report on the impacts of clear cutting and soil preparation methods on the foliage N dynamics. We used natural ^{15}N abundance method to study this. The clear cutting is a common silvicultural practice in Finland and half of forest cuttings are regenerated from seeds. In order to provide better seed bed conditions and to improve environmental conditions for seedling growth, site preparation methods such as ploughing, burning, fertilization etc. are commonly used, but their effects on the on the foliage N dynamics, especially on long-term basis, have rarely been studied. This study concerns on the study about the impacts of the different site preparation methods on the foliage N concentrations and ^{15}N. The different methods of site preparations studied were i). slash burning, ii). ploughing, iii) ploughing and fertilizer and iv). Fertilizer alone and, v). control (no treatment). $\delta^{15}N$ values of plant foliage N closely reflected the management practices (fertilization, burning and ploughing) of different boreal forests in the medium term (20-25 years). Furthermore, the foliage N dynamics related to management practices are explained in this study in more details. Finally, from our study we conclude that the long-term effects of different management practices can be studied through the natural abundance of ^{15}N isotopes in foliage of boreal forests, provided that there is no significant atmospheric N deposition.
Key-words: boreal forest, clear-cut, foliage, nitrogen, ^{15}N natural abundance, isotope, firing, fertilizer, ploughing

S09.J.03
Aspects of the nutritional sustainability of forest management in Bavaria, Southern Germany

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The possibilities of modern harvesting technologies, precautions against insect calamities, and the renewed interest in forest biomass as an energy source initiated lively discussions about intensifying forest production and the utilisation of crown material. However, a responsible forest management demands to consider not only the economic gains of an intensified production but also the associated nutrient exports. In order to avoid losses in yield and site quality, a nutritional sustainability of forest management has to compare the site specific nutrient availability (deposition, weathering, overall and exchangeable nutrient pools) and the nutrient losses via biomass export (harvesting) and seepage output. This approach is currently realised for the state forests in Bavaria, Southern Germany, financed by the BAYSF (Bayerische Staatsforsten). Units of comparable site conditions are identified using soil profile data from different sources and national soil and geo-scientific maps. Specific chemical and physical information is derived from typical soil profiles. Growing stock, increment, and harvesting is calculated with the forest growth simulator SILVA for 69 growth districts throughout Bavaria, considering the tree species Fagus sylvatica, Quercus robur, Picea abies, and Pinus sylvestris. The biomass of wood, bark, branches, and needles is calculated based on dbh, height, and crown length. To estimate nutrient exports with harvesting, biomass is multiplied by specific nutrient contents. Regional deposition rates are derived from measured deposition at level II plots, critical loads assessments and emission inventories. Weathering rates are calculated with the soil chemical model PROFILE using geological and soil physical information as well as approximations for the mineral composition. Nutrient losses with seepage are estimated via mass balance approaches and measured data from scientific projects. The appraisal of nutritional sustainability is based on the comparison of nutrient exports with the following three different references: rates of nutrient supply, easy available (exchangeable) nutrients, and total nutrient store.

S09.J.04
Sustainable site productivity - is the expertise derived from agricultural long-term field experiments relevant to (intensively) managed forests?

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Long-term data sets from agricultural field experiments provide extensive information about the productivity of a site. Crop yields, nutrient balances and changes in soil parameters (e.g. nutrients and soil organic matter) at different sites are indicators to sustainability of production. Wood biomass production on former agricultural sites - especially in short rotation forests - may rise questions regarding the sustainability of these intensively managed forests. In spite of differences in the management of agricultural and forest sites some principles may be derived from the results of agricultural field experiments. This comprises questions of plant nutrition, the effects of harvest

residues' removal and soil cultivation practices. Nutrient dynamics (especially caused by harvest removals) of different agricultural crop rotations are compared to those of managed forests. The removal of total above-ground biomass may lead to heavy losses of nutrients and soil organic matter, but varies with the main crop species. Effects of frequent tillage are considered.
It is discussed, if results of long-term agricultural field experiments at different sites (climate and soils), carried out to define sustainable agricultural production, may help to communicate principles of sustainable long-term productivity of (intensively) managed forests.

S09.K.01
Dynamic modelling of forest management effects on N retention and output at three catchments at the Harz Mountains, Germany

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High atmospheric inputs of nitrogen (N) have caused an increase in nitrate leaching from forest soils in many regions of Europe. The effect of atmospheric N deposition on N leaching can be delayed by N retention in forest floor or topsoil. For simplified models the C/N ratio of the forest floor or mineral topsoil may be used to estimate the immobilisation of N and the risk of nitrate leaching with seepage water.
The aim of this study was to assess the influence of forest management on N turnover in three small catchments in the upper Harz Mountains with contrasting management activities in the past. All catchments are stocked with spruce plantations. Lange Bramke catchment was replanted with spruce after a complete clear-cut in 1948. At Steile Bramke an ameliorative dosage (16 t/ha) of dolomitic lime was applied in 1989 and the adjacent Dicke Bramke is the control catchment. Model calculations are based on a simple mass balance for total N at stand level. Input parameters were calculated dynamically from spatial information on forest stands, soil distribution, and deposition. N immobilization was estimated as a function of the C/N ratio of the forest floor. Simulations were run for management scenarios with different biomass utilization intensities. Modelled N output time series agreed satisfyingly with observed trends in stream water and helped to explain the differences between the three catchments. We thus conclude that the parameterization of implemented N processes is in a plausible range and that the simple mass balance approach in combination with dynamic parameterization of input parameters is able to simulate the dynamics of N retention and N output during forest succession and the effects of forest management.

S09.K.02
Evaluation of forest sites with regard to nutrient export by whole tree harvesting in Lower Saxony, Germany, using a nutrient depletion index

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In recent years, high price of fuel wood has increased the volume of fuel extracted from the forest sites in Germany. Fuel wood includes many nutrient rich logging residues like tree tops, branches and even needles and leaves. Nutrient exports by full-tree harvesting are several times higher than by the stem-only harvesting. Thus the evaluation of nutrient transfers is necessary to achieve conservation of site productivity. Here we provide a method of evaluating forest sites by relating the pool of plant available cations of different site index classes with the amount of nutrient extracted by different harvesting operations.
The nutrient depletion index, which is the ratio of soil nutrient content to nutrient extraction, when calculated for one full rotation, was compared for forest sites in Lower Saxony, northwest Germany. The lower the value of the nutrient depletion index the lower are the sustainability and the level of elasticity in the system. For assessing soil nutrient content amounts of exchangeable K, Ca and Mg contents of soil profiles, which have been classified into site mapping units, were used. Nutrient extraction rates were assessed by the growth model BWIN for Scots pine, Norway spruce and European beech stands.
According to the nutrient depletion index, on less fertile sites of pine stands full tree harvesting resulted in less exhaustive nutrient removal than from beech stands of more fertile sites. Critical nutrient depletion indexes were defined by conventional means due to lack of empirical data. This index may provide a useful measure of classifying forest sites for sustainable amount of forest fuel extraction. Such information is readily required and attainable.

S09.K.03
Reduction of ungulate density in mixed mountain forests of the Bavarian Limestone Alps results in improved soil fertility

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Long-term effects of reduced ungulate populations (Red deer Cervus elaphus L., chamois Rupicapra rupicapra L., roe deer Capreolus capreolus L.) on stand regeneration, soil quality, and tree nutrition were assessed at four forested sites in the Bavarian Alps with calcareous bedrock (Hauptdolomite) and soils. The sites comprise steep (25-30°) slopes with different aspect, which are loosely stocked with mature mixed mountain forest, mainly consisting of Norway spruce (Picea abies), European Beech (Fagus sylvatica), Silver fir (Abies alba), and Sycamore maple (Acer pseudoplatanus). At each site, two rectangular plots (size: 11 m * 22 m), located inside and outside 30-40 year-old exclosures, respectively, were compared. On the plots outside the exclosures, natural tree regeneration and particularly seedling and sapling growth were strongly impeded by ungulate browsing. Inside the exclosures, the natural regeneration has developed well, seedling and sapling biomass was up to 2500 times larger than outside. The increased tree biomass inside the exclosures reduced snow-gliding significantly. Due to reduced topsoil erosion and increased litter input, the forest floor of the soils inside the exclosures had larger organic C and N pools than the soils outside the exclosures. Moreover, the N concentration of the forest floor was increased, and its C/N ratio was smaller. The carbonate content of the forest floor inside the exclosures was also strongly reduced, resulting in an increased availability of P, K, Mn, Cu, and Fe to the trees. Consequently, Norway spruce and European beech saplings inside the exclosures had a better nutritional status. In summary, 30 years of strongly reduced ungulate impact have resulted in (i) highly diverse regeneration of considerable growth, (ii) reduced topsoil erosion, (iii) significant changes of the chemical status of the topsoil, and (iv) an improved nutritional status of the natural forest regeneration.

S09.K.04
Does Cd promote the effects of wood ash on enchytraeids in coniferous forest soil?

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The use of wood ash as a fertilizer in forestry has often been questioned because it may strongly affect soil biota through changes in soil chemistry. In addition, ash may contain harmful metals, especially cadmium (Cd). We studied the effects of wood ash and Cd on one functionally very important decomposer animal group in boreal coniferous forest soils, enchytraeids. In a field experiment, replicated plots were fertilized (except the controls) with wood ash (3000 kg ha^{-1}, containing 15 mg Cd kg^{-1} dry soil) or with the same ash spiked with additional Cd (400 mg Cd kg^{-1}). Samples for enchytraeids were taken two and three years after the treatments. In the microcosm experiments in the laboratory, different levels of wood ash and Cd were applied to the forest soil to find out specific responses of enchytraeids to both ash and Cd. Different application methods of ash (spread to the soil surface or mixing to the whole soil profile) were tested, too. In the field, the numbers of enchytraeids decreased due to the ash fertilization while the additional Cd in the ash did not induce any further responses. In the laboratory, already the lowest dose, corresponding to 750 kg ash ha^{-1} and increasing soil pH by one unit, decreased enchytraeid numbers in the ash and ash+Cd soils compared to the controls. Cd added to the soil in pumice (an inert carrying material) also affected enchytraeids, but no clear dose-response relation was observed. Ash applied evenly to the soil surface seemed to decrease enchytraeids more than the ash mixed to the whole soil profile. Cd was not found in enchytraeids in measurable amounts in any treatment. Together, changes in soil pH due to wood ash fertilization but not Cd in the ash significantly reduces enchytraeids in the forest soil.

S09.L.KL

Excursion in South Moravia - Lack and surplus of water in floodplain forests and its impact on physiological processes and tree survival

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Floodplain forests are rather specific when considering their environmental situation. Underground water (which may represent up to 70% of tree transpiration) is usually not a limiting factor under natural situations, having enough water they develop rather small root systems. In contrast, excess of water can be harmful for trees, if flooding water after snowmelt in spring or even more after extraordinary precipitation during summer remains for a long time in stand, causing lack of soil aeration and following root hypoxia. Oak is especially vulnerable to permanent overwatering longer than 2-3 weeks, while ash is a little more resistant. However, even drought can occur in situations, when the natural regime is changed artificially during water management measures causing drop of underground water down to 2-4 meters, as it happened in late seventies and remained for almost 20 years. There was relatively still enough water in soils, but the water cannot penetrate fast enough to root surfaces in heavy soils, when soil water content decreases close around roots during periods of high transpiration (and high root water absorption). Drop of soil water content by $4\%_{vol}$ means drop of its hydraulic conductivity by 100 times. Therefore trees can start to decline under seemingly sufficient soil water content. Rapid mortality could occur especially in trees with low root/sunlit leaf area ratio.

S09.L.01

Soil water budget and sap flow measurements of a 9-yr-old short rotation poplar plantation in Saxony (Germany)

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Short rotation forestry is a worldwide established management system in order to accommodate demand of raw material for timber and pulp industry or to supply a renewable energy resource. Especially in Europe the interest in fast growing tree species like willow (Salix spec.) and poplar (Populus spec.) is increasing. However, in many environmental conditions water availability is a main growth limiting factor. Furthermore, there exist concerns, that the high water use of extensive short rotation forests could reduce stream flow and aquifer recharge. In order to exploit the high yield potential of short-rotation forests but simultaneously minimise negative effects of the high water demand during the growing season it is necessary to carefully select adequate sites for short rotation plantations. Hence, a precise evaluation of water balance and interaction on biomass production is needed.

In the growing season 2007, a 9-yr-old hybrid poplar plantation (Populus maximowiczii x nigra) at Methau in the hilly loess region in the Free State of Saxony, Germany (51°05`N, 12°49`O, 210m) was amongst others monitored by TDR (soil water status), sap flow technique (stand transpiration) and climate sensors.

The transpiration rate reached 2.6 mm/day during the whole growing season (April until October) with a maximum of 5.7 mm/day on 8th June. Total transpiration reached 480 mm which corresponds to approximately 85 % of Penman-Monteith-evapotranspiration in reference grassland.

Modelled canopy conductance shows a significant decrease with cumulative soil water depletion in the main root habit. Also the increment of stem diameter is reduced with increasing soil drought. Furthermore, measured data and model calculations show, that no deep infiltration and no runoff occur during the growing season.

We assume that even on high productive arable land in Saxony with moderate rainfall and high water storage capacity limited water availability inhibits higher yields of short rotation forests.

S09.L.02

Soil moisture regime of Silver birch (Betula pendula) and Norway spruce (Picea abies (L.) Karst.) during variable weather conditions

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Water demand is a key factor to tree survival. Tree species whose roots are able to tap lower soil layers in case of drought have a big advantage. Climate change may increase the number and the length of drought periods. So it will become more and more important to use tree species for a forest which can fully use the soil water reserves of a given site.

We studied the differences in the water consumption of Norway spruce (Picea abies (L.) Karst) and of Silver birch (Betula pendula) in relation to soil water content. We recorded soil moisture using registering FDR-sensors supplemented by manual TDR-measurements on a grid as well as by measuring several other parameters (meteorological parameters, sap flow, soil temperature). The registered data (FDR-sensors) were used to estimate the soil moisture conditions in the course of time, whereas the manually collected data were used to draw soil water content maps for the stand.

Differences in soil moisture under spruce and birch can be seen in summer but also the effects of transpiration of Norway spruce in winter gets visible. The data also show the high water demand of birch during the period of sprouting. The study period includes the very hot and dry summer of 2003 when transpiration of Norway spruce was almost reduced to zero during the peak of the drought. Correspondingly the data of the measurement grid (topsoil only) showed uniformly extremely low soil moisture values during this time period. On the other hand, the spatial data showed pronounced patterns in soil moisture even during very humid periods.

S09.L.03
Spatial distribution of temperatures and water dynamics in the soil of a small clear fell

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Small scale clear felling of 1 to 4 ha size, surrounded by the remaining mature stand, create a special "meso-environment" with respect to energy-, and water input. The aim of our study was to describe the spatial distribution of these inputs and their effects on temperatures and water status of the soil, which subsequently might alter soil biological processes, the establishment of herbaceous plants and the development of the next tree generation.
In a mature spruce stand of 30 m height we formed a clear cut of 2 ha. Over the period of two years, we continuously measured and modelled the energy input, measured the soil temperatures in 10 cm depth along two transects, and the matric potentials and water contents at three locations. The parameters also were detected under the closed canopy of the spruce stand.
It was found that all parameters showed very dynamic pattern over the year and also differed between the two years. It also became obvious, that the effects of the surrounding trees con not be neglected for small clear cuts.
We will present the results of our study and discuss the consequences with respect to the topics mentioned above.

S09.M.01
Mapping of soil water regime of forest sites based on spatially distributed process modeling

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For a sustainable forest management, detailed knowledge on the site-specific soil water dynamics is indispensable. In Central Europe, the mapping approach to characterize the water supply conditions traditionally has been based on overlaying relief and soil information. This relative system refers to an (hypothetical) equilibrium between static site conditions and natural stocking (potential natural forest association). Accordingly, the climatic settings are supposed to be constant and are mostly based on long-term means of precipitation and air temperature (whole year and/or growing season). However, long-term climate changes as well as infrequent climatic extremes have not been considered in an adequate way. Furthermore, the feedback of forest management itself (e.g. tree species different to natural stocking) on available soil water cannot be addressed, so far.
To overcome such short-comings, we integrated the 1D-SVAT model BROOK90 and a radiation model in a GIS frame to simulate the spatially distributed components of water balance of forest sites. In our paper, we present the model concept and show an approach to describe the influence of a complex terrain on parameters controlling the spatial distribution of energy and water fluxes. The overall goal is to produce forest site maps that provide a more objective description of variable soil water conditions. The testing area is located in the foothills of the Ore Mountains, Saxony, Germany. Existing forest soil maps are used to parameterize the soil module of the model. BROOK90 is calibrated based on energy and water flux measurements in two spruce and beech stands. Finally, the paper discusses future strategies to derive a novel eco-hydrological classification scheme based on statistical analysis of model results (occurrence and duration of periods with limited soil water supply: ‘drought stress’; and in contrast of periods with a surplus of water in the rooting zone: ‘water stress’) and related growth-physiological responses.

S09.M.02
Climatic water balance and available soil water storage capacity as indicators for possible climate change effects on forest ecosystems

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According to the current knowledge on global climate change higher temperature and lower precipita-tion during the growing season are expected for most regions of Central Europe for the coming 50 to 100 years. Furthermore, an extension of the growing season will enhance the evaporative demand of forest trees. Hence, an increase of the length and intensity of drought periods and an increased risk of drought stress for forest stands can be expected. Because of its adaptation to cold humid climate, its shallow root system, and its high sensitivity to infestation with biotic agents Norway spruce is in par-ticular vulnerable to reduced soil water availability.
Based on climatic water balance for the growing season, i.e. precipitation minus potential evapotran-spiration and available soil water storage capacity the risk of continuing cultivation of Norway spruce with respect to climatic change has been evaluated for Northwest Germany. Climatic projections for 2050 are based on the IPCC-SRES scenario A1B and have been regionalized with the statistical model WETTREG. Information on soil water storage capacity has been obtained from the soil map (BÜK 1:50,000) which is available for the whole forested area.
If climatic and soil hydrologic limits for sustainable Norway spruce cultivation of currently used silvi-cultural guidelines in Northwest Germany are applied on the projections on climatic conditions in 2050 the area suitable for Norway spruce cultivation will decrease vigorously. Remaining areas are sites with a high available soil water storage capacity and large rainfall amounts. Possible adaptation strategies comprise selection of drought tolerant tree species and silvicultural techniques to reduce evapotranspiration.

S09.M.03
Influence of management on soil moisture content and soil solution quality in the forests in the Dinaric karst

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The influence of different management practices on soil moisture content and soil solution quality in the silver-fir beech forests was investigated. In the managed forest 3 plots with different management regimes were established: the closed stand, extremely large gap (diameter ca. 45 m), and a small gap (diameter ca. 30 m). Both gaps were established in winter 2000, representing nontraditional “clear-cut management”. In the virgin forest remnant 2 plots were selected: the closed stand and the large gap as a result of natural disturbance.
On all plots, the prevailing soil units and soil properties (soil depth, morphology, composition, thicknesses of horizons, humus forms etc.) were examined. Soil samples were analyzed for soil acidity, contents of Ctot, SOM, carbonates, Ntot, CEC, soil texture, plant available nutrients, etc. On all plots soil solution was collected using ceramic suction-cup lysimeters. Bulk density and soil hydraulic parameters (field capacity, permanent wilting point, pF curve) were determined. In the growing season 2003-2004 soil moisture content was measured with TDR.
In the first year after gap formation, faster decomposition of the SOM and mineralization of N in the gaps caused strongly increased concentrations of nitrates in the soil solution. The creation of gaps resulted in higher soil moisture contents during the measurement period compared to the forest stands.In the extremely dry summer 2003 the soil moisture contents of the upper soil in the gaps in the managed forest reached values below the permanent wilting point.

In order to avoid nitrogen leaching and water supply stress related to harvesting, it is suggested that gaps created by harvesting be small and they be made to better imitate the stand structure and regeneration patterns observed in the virgin forest remnant.Regeneration under canopy shelter, followed by formation of smaller gaps (silvicultural techniques, currently in practice), is most appropriate.

S09.M.04
Reliability of field tests for ferrous iron (FeII) to identify compaction damages in forest soils

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Redoximorphic patterns in the top soil are a typical delayed symptom of heavy machine impact on forest soils and serves as a field indicator of deformation intensity. However, this visual assessment fails when the initial soil colour is very intensive, e.g. due to hematitic iron oxides. In this study we investigate whether the established 2,2'-dipyridyl field test for ferrous iron used for assessment of reductive processes in the subsoil is also a reliable test for deformed topsoils. Bleached and rust-coated soil material was sampled separately from four skid trails 1, 1.5, 2.5 and 6.5 years after the compaction . After the field test for FeII the samples were analyzed in the lab for organic carbon, the oxalate-soluble, and the dithionite soluble Fe fraction. No rust-coated sample revealed a positive dipyridin FeII reaction. Of the 60 bleached samples 18% responded negatively, independently from the time since compaction. A cluster analysis based on the contents of amorphous iron oxides, crystalized iron oxides, and organic carbon yielded 4 distinct groups. All negative results were in the statistical cluster revealing both low iron oxide concentration and low organic carbon content; however, even in this cluster 60% of the results remained positive.
We conclude that the dipyridil test works in dependence of the content of soil organic carbon and of iron oxides. Surprisingly the depletion of organic carbon and iron in the bleached topsoil material was independent of the age of the skid trail. Because of the high portion of microsites where the test failed in an unreproducible way, this limits its practical usability in assessing soil deformations in forest soils.

S09.N.01
Soil moisture influence on carbon and nitrogen mineralization in two adjacent coniferous forest types on northern Vancouver Island

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Conifers regenerating on cutovers of cedar-hemlock (CH) forests exhibit slow growth and nutrient deficiencies (N and P) which are not observed on adjacent cutovers of hemlock-amabilis fir (HA) forests. Our field investigations indicate that CH soils are wetter, oxygen-limited and potentially more anoxic than HA sites. We hypothesize that these conditions will be associated with lower mineralization of C and N, changes in prevalent N forms and lower forest productivity. Forest floor and mineral soil from 5 CH and 5 HA sites were incubated for 4 weeks in the laboratory at four moisture levels (field moisture and three levels up to saturation), and total N and C, dissolved inorganic and organic N (DIN and DON), microbial biomass and CO2 flux were measured.
Total N, DON, DIN, NH_4^+ and C mineralization were lower in CH forest floor than in HA. The majority of the available N in forest floors was in the form of DIN (60%) in HA sites and DON (70%) in CH sites, regardless of moisture level. The patterns were different in the mineral soil. DON was the most prevalent form in mineral soils at all moisture levels (90%), was higher in CH than HA soils, and increased with increasing moisture. In CH forest floors, NH_4^+ and DIN decreased with increasing moisture above 350% (dry-weight basis); in HA forest floors DIN and DON both increased up to saturation level. Microbial biomass decreased with increasing moisture in both forest types and was not different between the two sites. The findings thus far are largely consistent with the hypothesis that differences in nutrient supply among the two site-types can be attributed to differences in moisture levels. Findings will be incorporated into the ecosystem-based models, ForWaDy and FORECAST, to predict the responses of the two ecosystems to differences in soil moisture conditions.

S09.N.02
DOC properties of forest floor solutions under Norway spruce and Douglas fir on a Cambisol (Morvan, France)

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The impact of forest tree on soil fertility can be assessed by the experimental plantation of monospecific stands on a homogeneous soil. Six different monospecific stands were installed in 1976 on a Cambisol in the experimental site of Breuil (Morvan, France). Available data show that forest floor properties strongly differ between Douglas fir and Norway spruce. Here, we compare the compositions of soil solutions collected *in-situ* under these stands.
Solutions were collected by low-tension (pF 1.3) fibreglass-wick lysimeters, and automatically transferred every 3 hours to three separate containers in storage devices: a freezer (-10°C), an ice-refrigerated box (0.1°C) and a covered pit. The pH value, the specific absorbance at 280 nm and the concentrations of inorganic anions (Ionic chromatography) and cation (ICP-AES) were measured in all samples. The density of carboxylic functions (NaOH titration) and the aluminium complexing capacity were assessed on the samples stored at 0.1°C and frozen samples were considered for the concentrations of low-molecular weight organic acids (Ionic chromatography).
The pH values ranged between 3.8 and 4.5, and were generally smaller in spruce solutions except between May to September. The main sources of protons were nitric acid under Douglas fir, and organic acids under spruce.
DOC concentrations were larger under spruce (6 mM) than under Douglas fir (2 mM). Furthermore, the larger values of specific absorbance at 280 nm under spruce suggested a larger relative contribution of hydrophobic DOC, likely balanced by a relatively small contribution of low-molecular weight organic acids. Despite these differences in DOC composition, similar values of the density of carboxylic functions (0.1 $eq.molC^{-1}$) and of Al-complexation capacity (0.05 $molAl.molC^{-1}$) of DOC were measured under both forest stands.
The solutions thus did not differ in DOC reactivity whatever the species. However, the relatively large DOC concentration and acidity under spruce likely promote mineral weathering.

S09.N.03
Evaluation of silicon stocks and uptake in five forest stands on an acid brown soil

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Plants can take up considerable quantities of aqueous Si in soil, and return biogenic opal-A particles (phytoliths) to soil within organic residues. The Si soil-tree cycle is, however, poorly known in forest ecosystems.
Here, we quantify the stocks and uptake of Si in five monospecific forest stands (beech, oak, spruce, douglas and pine) grown on an acid brown soil within a unique 32 year old planting site under humid temperate climate (Morvan Plateau, France). Si concentrations were measured in living and dead

organic pools. Phytoliths were quantitatively extracted from soil horizons. Allometric relationship between tree circumference (C_{130}) and biomass was used to evaluate Si stocks and uptake.
Leaves and needles accumulated the largest quantities of Si relatively to other tree parts, thus making Si largely mobile in the soil-tree cycle through litter fall. Leaf/needle Si content significantly decreased in the sequence beech (0.82%) > oak (0.66%) > douglas (0.53%) > spruce (0.46%) > pine (0.02%). The content of biogenic Si in humus layers was below 4% of total Si content. The latter content was controlled by biological activity, which mixes up silicate minerals from horizons beneath into humus layers. The morphology of phytolith particles largely differed between tree species. The annual Si uptake by oak and beech stands was 16.5 and 17 kg ha^{-1} yr^{-1}, respectively. Pine had a weak biological turnover (0.8 kg ha^{-1} yr^{-1}) as compared to spruce (14 kg ha^{-1} yr^{-1}) and douglas (18 kg ha^{-1} yr^{-1}). Consequently, the residence times of biogenic Si in soil were much shorter under beech and douglas (2.5 years) than under pine (80 years).
The uptake, storage and release of Si by trees were species-dependent since tree species strongly influenced the recycling of Si in the soil-tree system.

S09.N.04
Weathering state of coarse soil fragments affects nutrient uptake by tree seedlings

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Rock fragments are proven to be a sufficient nutrient source for tree seedlings. The question whether biological weathering (irreversible decomposition of silicate structures) is an important tool for tree seedlings to obtain nutrients from rocks remains. The hypothesis that fine earth infillings, with high CEC and base saturation, in weathering cracks within rock fragments are the dominant nutrient source, was tested in a microcosm experiment.
Norway spruce seedlings were grown on a substrate of gneiss fragments (2-6 mm diameter, weathered or unweathered) and inert quartz. A deficient nutrient solution was added so that the substrate was the only source for Mg and Ca. Four treatments were assigned: weathered gneiss with and without spruce seedlings, and unweathered gneiss with and without seedlings. Nutrient budgets were calculated to determine nutrient fluxes from gneiss and the nutrient solution into seepage and seedling biomass.
First results showed that seedlings survived well on both substrates, increasing significantly in biomass and nutrient content. The unweathered gneiss started with high ion fluxes in the seepage but after 6 weeks these declined rapidly. Weathered gneiss showed a more stable ion flux into the seepage. Mg and Ca in seepage of weathered gneiss were lower for treatment with seedlings.
The different fluxes imply that cation exchange is the most important nutrient source in coarse soil. The unweathered gneiss can only provide exchangeable cations directly after sample preparation where large blocks were crushed to the desired diameter. The weathered gneiss, sieved directly from the soil in the appropiate size, can provide a constant nutrient release presumably from fine earth infillings in weathering cracks. Thus nutrient uptake from weathered gneiss by seedlings is dominated by cation exchange. Seedlings on unweathered gneiss may use additional weathering since the amount of exchangeable cations in seepage cannot explain healthy seedling growth.

S09.N.05
Hidden fluxes of organic matter- the importance of canopy-derived particulate organic matter (POM) in forest ecosystems

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The canopy is the second largest source for organic matter in forests. In contrast to dissolved organic matter (DOM), throughfall fluxes of particulate OM (0.45µm < POM < 500 µm) have not been taken into account for routine sampling and element budgeting. To date, it is largely unknown to what extent the input of POM may affect soil processes or be altered by climate change and corresponding biotic feedback processes such as pronounced herbivore insect pests.
Over the course of 2.5 years we followed the concentrations and fluxes of DOM and POM along different ecosystem compartments at the Level-II-monitoring B1 and F1 (mature beech and spruce) sites in the Solling area, Germany. In fortnightly intervals, we took solution samples from bulk and throughfall precipitation, from forest floor layers and from the Ah and Bv horizon.
In addition to annual throughfall fluxes of DOC amounting to 99 kg C ha-1 at the spruce and 34 kg C ha-1 at the beech site, 15% (+16 kg C ha-1 a-1, spruce) and 40% (+14 kg C ha-1 a-1, beech) more organic carbon was transported as POC from the canopy to the ground. For particulate bound nitrogen (PON) corresponding values were 11% (+ 3 kg N ha-1, spruce) and 23% (3.5 kg N ha-1, beech). In the forest floor layers at both sites the additional contribution of POC was 13 to 18% and the one of PON 6 to 15%, with decreasing proportions of < 5% in the mineral soil horizons.
Including particulate organic matter fluxes in element budgeting approaches might contribute to fill budgeting gabs in terrestrial C and N cycling.

S09.N.06
Calcium and magnesium content in throughfall and seepage waters under Norway spruce stands in a mountain area affected by liming

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The content of calcium and magnesium in throughfall and seepage waters was evaluated in a liming experiment in research stands with Norway spruce (*Picea abies* L. Karst.) monoculture (2nd generation) within 2002 - 2006. Sampling was carried out in a two-week interval. The research plots are situated in the Moravian-Silesian Beskids, the Czech Republic, at an altitude of 908 m with annual precipitation 1000-1400 mm. Dolomitic limestone was applied on chosen plots in the total dose of 9 t per ha in the 80s of the last century. The annual mean concentrations of Ca during the studied period were 1.1-1.5 $mg.l^{-1}$; the annual mean concentrations of Mg were 0.3 - 0.5 $mg.l^{-1}$. The bulk depositions of these elements under crowns representing the input from precipitation were 14 - 17 kg of Ca and 2.9 - 5.5 kg of Mg per ha and year. The concentrations of calcium and magnesium in seepage waters sampled from limed and unlimed plots were compared. The concentrations of Ca and Mg were significantly higher in seepage waters from the limed plot than in seepage waters from the unlimed plot (t-test). The mean annual concentrations of Ca were 1.1-2.2 $mg.l^{-1}$in seepage waters from the limed plot and 0.6-1.2 $mg.l^{-1}$in seepage waters from the unlimed plot. More distinctive differences were found between the mean annual concentrations of Mg in seepage waters from limed (2.0 - 3.3 $mg.l^{-1}$) and unlimed plots (0.2-0.7 $mg.l^{-1}$). No significant difference was noted between the nitrate concentrations in seepage waters from limed and unlimed plots (evaluation with t-test).Significantly higher contents of Ca and Mg were found in current spruce needles sampled from trees on the limed plot than in needles sampled from trees on the unlimed plot 19 years after the last liming event.

S10 Advances in Soil Monitoring

S10.H.KL
Recent advances in soil monitoring and unsolved issues

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Soil monitoring is the systematic determination of soil variables so as to record their temporal and spatial changes. Soil monitoring is essential for the early detection of changes in soil quality both negative and positive. As such, it is an important tool for the assessment of soil protection policies. However, in numerous countries, the national monitoring sites have been sampled only once, and therefore, the monitoring scheme is still an inventory.
Several scientific issues are related to soil inventory and monitoring: choice of relevant indicators (what should we monitor ?), sampling strategy both in space and time, data processing, estimation of background values…
This keynote presentation will review recent advances in soil monitoring in Europe and highlight theoretical and/or case studies (from plot to broad scales) providing novel scientific insight on methodological issues and/or changes in soil parameters.

S10.H.01
Soil monitoring - a basic tool for protection of soils and land use

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EU member countries have established monitoring programmes for soil. Slovakia has a soil monitoring system covering agricultural soils and mountainous areas. Ecological principle in soil monitoring network construction has been accepted (all main soil types, substrates, climatic regions, polluted and non-polluted areas are included on 318 monitoring sites). Main quantitative and qualitative parameters according to threats to soil (soil contamination, soil acidification and sodification of soils, decline in soil organic matter, soil compaction and erosion) are permanently monitored in 5 years repetitions. On the basis of obtained results it may be said that significant soil changes have been indicated in soil organic matter and available nutrients decline as well as in some parameters of physical degradation of soil (soil compaction and erosion). Soil monitoring in Slovakia is an integrated part of environmental monitoring with integrated information system. One of the important initiatives of European Strategy on soil monitoring is a stimulation of national strategies on soil protection and their evaluation. In effort of European Commission is an approximation of such soil monitoring process which will be helpful for management of all activities on soil including soil protection and functions of soil in a transparent way in all EU countries.
In relation to our professional knowledge resulting from soil monitoring system in Slovakia, document on Methodical Instructions for Application of some measures relating to soil protection and land use has been elaborated at present time. So, in this manner soil monitoring system becomes a basic tool especially for decision sphere with regard to protection and sustainable land use, as well.

S10.H.02
Harmonization of Risk Assessment Methodologies for Soil Threats in Europe

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For five soil threats, viz. erosion, compaction, salinization, soil organic matter decline and landslides, an EU wide inventory was made of risk assessment methods (RAMs). This paper presents the results of the inventory and discusses the options for harmonization of RAMs.
In total, 26 main RAMs have been identified. In practice, more RAMS are used, but the additional RAMs differ only in details from the main ones. For instance, for compaction, most EU member states use various deterministic models, which differ only in the level of detail, but risk indicators and the associated threshold values (i.e. risk perception) vary greatly. Some countries use a minimum saturated hydraulic conductivity (ranging from 10 to 24 cm d^{-1}), whereas others used a maximum penetrometer value (ranging from 2 to 6 Mpa). In most cases there is a sound scientific basis to use different indicators and threshold values, but the validation of RAMs with field data is often poor, which makes it difficult to evaluate the appropriateness of indicators and threshold values.
The implementation of RAMs in practice not only depends on the scientific basis, but also on the acceptability and the flexibility of the RAM. Harmonization of risk perception can be achieved through various activities ranging from synchronizing output data to prescribing complete RAMs. The first possibility is relatively easy but demands for extensive calibration and is therefore expensive. The latter option is relatively cheap but looses on geographical precision and public acceptance. Options for harmonization differ per soil threat, as is the maximum level of harmonization that can be achieved. In conclusions, there are various options for harmonization of RAMs, the choice of which depends on the scientific soundness, economic costs, flexibility and acceptability.

S10.H.03
European soil monitoring versus mapping - the importance of scale

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The European Geological Surveys have long experience with large, up to continental-scale, cross-border international cooperation projects in geological and geochemical mapping. These projects have convincingly demonstrated that earth scientists need to be acutely aware of the issue of scale in their research. Most of our research is carried out at a very detailed scale. However, there also exist natural processes that involve enormous volumes of the earth's surface.
When mapping (or monitoring) a continent we do no longer deal with some centimetres or a couple of square metres. Europe comprises more than 5 million square kilometres. Scale becomes an exceedingly important issue when setting up soil monitoring networks, among others it is directly related to price. For cost-effective monitoring of the chemical quality of soils, experience gained during geochemical mapping projects carried out at widely differing scales and sample densities (from hundreds of sample sites per km^2 to 1 site per 5000 km^2) during the last 25 years teaches that baseline mapping of the whole

continent should be carried out at a low density (1 site per 2,500 - 5,000 km^2) before establishing monitoring sites. Monitoring requires a different and much more detailed scale than continental mapping. Only once the regional importance and distribution of the key geochemical processes (or environmental threats) is characterised the optimally localised monitoring sites can be established.
Maps in the recently published Geochemical Atlas of Europe demonstrate, that at the European scale neither bedrock geology, nor soil types, nor anthropogenic contamination dominate the geochemical patterns. Geochemistry or background values for chemical elements cannot be predicted based on existing knowledge. Processes driving the continental scale geochemical patterns must be documented and understood before a monitoring network is established.

S10.H.04
Correcting temporal instabilities of chemical measurements in long-term forest soil monitoring

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In large parts of the Swiss Plateau, atmospheric deposition of nitrogen compounds exceeds the critical loads. Excessive N-input into forests may accelerate soil acidification. The soil protection agency of canton Zurich, therefore, monitors soil acidity at some 180 forest sites in the canton. Soil samples were collected for a first time between 1995-1999. The sites were re-sampled 5 years later. The pH, exchangeable cations and soluble heavy metals were measured by accredited analytical laboratories. For quality control, each batch of samples sent to a lab contained specimens of up to 3 standard soils and some randomly chosen customary soil samples that had been analysed before. To see how stable the chemical analyses were, we plotted the repeatedly measured concentrations against the date of analysis. The temporal fluctuations were non-negligible for most attributes and correlated among different samples. Systematic differences between laboratories seemed less important than fluctuations within labs. Thus, we modelled the fluctuations by a robust one-way analysis of variance with the date of analysis as grouping variable. The estimated effects of the dates of analysis did not change smoothly with time, but fluctuated erratically. This suggests that there was no genuine change of the samples, as one would then expect more gradual variation. We corrected the data by the estimated effects, and this removed any visible temporal trend. However, the correction did not (strongly) reduce the variance of the measurements. For many dates of analysis, the effects were not estimated very precisely: There were too few repeated measurements, most of them from samples analysed only twice. Increasing the number of standard soils and analysing them all in each batch, might be more effective than our quality control design with the randomly chosen customary soil samples, mostly analysed just twice.

S10.I.01
Project ,,Development of the Croatian soil monitoring programme with a pilot project“ LIFE05 TCY/CRO/000105

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Project ,,Development of the Croatian soil monitoring programme with a pilot project“ is in implementation with the financial support of the LIFE Third Countries programme of the European Community. Croatian Environment Agency is the beneficiary of the Project and partner is Faculty of Agriculture, University of Zagreb. Project started in January 2006 and it will end in January 2009.
The final objective of the Project is development of the Soil Monitoring Program (SMP) by taking into consideration specific Croatian agro-ecology conditions and EU guidelines and experiences.
The SMP will include proposition of harmonized methods, standards, time frame and dynamics for soil sampling, analysis, display and dissemination of data, proposition of locations for soil monitoring stations and points at agricultural, forestry and contaminated sites and proposition of financial structure for future development and maintenance of the Soil Monitoring System, already recognized by National environment Strategy and National Environment Action Plan (Official Gazette No 46/02) as important source of information for Government bodies to plan Soil Protection Strategy and linked legislation measures at the national level.
Data provided by soil monitoring will be used for Croatian Soil Information System, as a part of the Environment Information System, seated at Croatian Environment Agency.
The Project has already delivered The Croatian Soil Monitoring Manual which includes category parameters for monitoring of the agricultural, forestry and contaminated sites.
The soil monitoring procedures proposed by The Manual are being tested by the Pilot projects on agricultural, forestry and contaminated sites, in order to correct eventual wrong steps and approaches during development of the Soil Monitoring Programme.
The Soil Monitoring Programme, a final result of the Project, will be presented by the December 2008.
Detailed information about the Project is available at www.azo.hr/smp_life_tcy

S10.I.02
Options for a UK Soil Monitoring Network to assess status and change in soil indicators

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This presentation will review a recent UK government-funded project to evaluate design options for a UK soil monitoring network using indicators of soil function identified by previous UKSIC (UK Soil Indicators Consortium) projects. The ultimate objective is that soils information collected by a UK soil monitoring scheme will be used to assess the status of soil, and changes over time, at a UK and devolved administration level. The information will also be used to inform the development of evidence-based policy and guidance to help ensure the sustainability of the soil resource in the UK. Our project's objectives were to develop and assess a range of options for a monitoring scheme using robust statistical approaches that included model and design-based methods. The options had to accommodate the specific requirements of the UK stakeholders, so, a detailed checklist was complied, in consultation with these stakeholders, to capture the various end-user requirements. The checklist was used to design and test different options, critically evaluate the performance of each option and estimate deployment costs based on our practical experiences. Consultations were carried out with the UK stakeholders at various stages to progress decision-making towards a recommended monitoring network. We will discuss the different options, how they were developed, their relative performances, along with constraints, uncertainties and assumptions and, finally, what recommendations were achieved.

S10.I.03
Advances in long-term chemical soil monitoring of Switzerland

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The Swiss soil monitoring network (NABO) was started in 1984 and comprises currently 105 observation sites covering all characteristic land use types across Switzerland. So far, the sampling periodicity was 5 years and we perform at the moment our fifth sampling campaign. For each observation site four composite soil samples (0-20cm) are taken and archived. We measured soil concentrations of Cd, Zn, Pb, Cu, Hg, Ni, Cr, Co and F. The presentation will provide an overview of the results and our experience to improve soil monitoring:
• Even in remote areas top soils of the observation sites were to some extend affected by anthropogenic supply, mainly with Pb, Cu and Cd. However, elevated soil concentrations can also be of natural origin, e.g. for F, Ni, Cr, and Cd.
• Land use is often a rather unreliable indicator to discriminate soil pollution.
• Positive, negative or no temporal changes of metal concentrations were found after the 2nd campaign. From the 3rd campaign onwards positive and negative changes alternate frequently at the same site. Therefore no verified trends can be stated so far.
• The causes for temporal changes of soil concentration are complex and result from (1) natural processes, (2) anthropogenic processes, and (3) methodological artefacts. Hence, not all measured temporal concentration changes in soil monitoring are due to anthropogenic inputs.
The experiences result into some basic methodological requirements which are essential to improve the quality of soil monitoring. Firstly, for early detection of concentration changes the best possible measurement precision must be performed, and secondly it is crucial to control the long-term stability of the measurement system (bias). In contrast to other soil monitoring networks we propose to intensify the measurement periodicity with respect to time series analysis, in order to discriminate noise from real change as soon as possible.

S10.I.04
An Issues and Goals of Development of a Soil Monitoring for Bulgaria

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The system for soil monitoring in Bulgaria should meet today's objectives and requirements of society for sustainable use of soils and for general environmental control policies. Since the Republic of Bulgaria is a Member State of the European Union, the latest developments concerning the soil monitoring policy and legislation and the latest development of measures against uncontrolled soil damages are to foster methodological approaches for those who are interested in keeping soil multifunctional as a public interest. Therefore, the decision to develop and implement a soil monitoring system and the available national database of land use, conditions, and early changes detection in soil quality are in order to be able to regulate soil processes related to soil conservation and soil protection practices based on scientific understanding of current status of the soils.
The paper presents results of the development of the National "Land and Soil" Monitoring System (NLSMS). The main goal is to assess current status of soils at the national monitoring network based on the knowledge in relation with the soil threats according to the European Soil Thematic Strategy 2002. This study is based on the Level I of the National monitoring network (16*16km grid) for the territory of Bulgaria.

S10.J.01
National Soil properties monitoring by means of the French soil test database

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About 250,000 soil-tests are performed each year in France at farmers' request. The number and diversity of origin of the samples make these soil-test results an interesting and original source of information regarding the variability of cultivated topsoil. Moreover, these soil-test results relate to several parameters strongly influenced by human activity (macronutrient contents, pH...), for which existing cartographic information is not very relevant.
The soil-test results were gathered in a unique database with continuous data collection called the French Soil Test Database (FSTD). All results recorded have been generated by commercial soil testing laboratories certified by the French Ministry of Agriculture, using standardized protocols. After the initial quality control stage, soil-test results from more than 1,110,000 samples were available in the database. The anonymity of the landholders seeking soil analyses is perfectly preserved, as the only identifying information recorded is the location of the nearest administrative city to the sample site
Taking into account statistical and sampling bias, the FSTD appears to be a relevant tool to analyze the evolution over successive time periods of soil properties and to test the potential of soil test databases for soil dynamic monitoring. Several examples are shown about spatial-temporal variability of soil nutriments status like organic carbon content, available P content and K content at regional and national scales. Nevertheless, only chemical properties are considered and only topsoil horizons of cultivated land have been sampled, providing therefore a partial view of the soil cover. Consequently, FSTD must be thought as one piece of a more exhaustive program of soil survey and monitoring.

S10.J.02
Detecting changes in Scotland's soil resource

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Soils are under threat from economic, social and biophysical drivers. Soil monitoring schemes are being designed to determine the magnitude and direction of any change in order to more effectively manage the soil resource. However, detection of change is not straight forward. In Scotland, we intend to use an existing national scale sampling scheme to test aspects of soil monitoring systems and determine soil indicators.
From 1978-1988, the soil profile at 721 sites (10km intervals) were described, sampled and analysed for a wide range of soil properties. This National Soil Inventory of Scotland (NSIS) provides an objective sampling scheme over a wide range of Scottish soil types and habitats and is ideal for testing methods to determine changes in soil properties over time. In particular we aim to:
1. determine evidence of change in C content and nutrients
2. compare sampling methods such as:
a. fixed sample depth vs soil horizon
b. point vs composite sampling over an defined area.
3. measure new attributes to test their suitability as indicators of soil quality
4. develop and test new methods for assessing soil quality
We have devised a sampling scheme to resample 25% of the original inventory based on a 20km grid pattern and verified that there was no significant bias inherent prior to implementation.

At each site we have also implemented a sample design which examines short range variability in soil properties. This will help determine if detected changes are real or simply due to the inherent variation in soils and therefore to determine limits to the detection of change.
Land use may have changed at some sites and the soil samples from both the previous and the new sampling schemes will be used to test methods to detect land use changes.

S10.J.03
The Collection of Improved Soil Datasets for Soil Quality Monitoring

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Soil and environmental protection activities and the design of sustainable agricultural practices are implemented at the local scale, for which reliable and accurate soil and related environmental information is required. Soil data collection is a time, labour, and cost intensive task. Soil mapping and field data collection are nowadays, in comparison to the past, relatively rare activities. Often when soil is monitored, soil quality and soil threats are assessed from incomplete or outdated datasets. Once in the field an exhaustive dataset can be collected which can be used to develop multipurpose datasets linked to contemporary GIS databases.
The article presents soil data collection activities carried out within several national projects in Slovenia. During a soil sampling campaign an extended dataset is collected at representative locations. The soil dataset consists of relevant physical and mechanical properties, a complete profile description, and, subsequently, the essential chemical parameters.
Two devices for soil data collection developed at AIS will be presented: a computerised hydraulic measuring device for measuring soil penetration resistance and vane shear strength with 10 cm increments, and circular shear plates for measuring cohesion and internal friction angle and circular plates for measuring the parameters of vertical bearing capacity. A hydraulic-driven soil coring system was constructed for collecting large undisturbed soil monoliths with diameters of 20 cm of up to 130 cm in depth.
The measuring and sampling AIS activities are the basis for the improvement of the Slovene GIS soil data sets in order to meet quantitative and qualitative requirements. They will present a firm basis for soil quality monitoring and various activities, such as the adaptation of existing agricultural practices towards more sustainable use of soil - especially managing the threat of soil compaction, supporting local scale soil protection activities, state-wide groundwater protection, or soil information processing for military applications.

S10.J.04
Elaboration of the soil monitoring module of the Hungarian Agro-Environmental Program

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The National Agri-Environmental Program (NAEP) started in 2000 in Hungary. The Monitoring System of NAEP aims at the demonstration of improving influences of the various agri-environmental target projects on the state of the environment. The expected positive regional effects can be proven by appropriate spatio-temporal analysis of permanently expanding and suitably linked thematic databases. The two main environmental targets of the programs are biodiversity and soil. As a consequence there are strong expectations on adequate and continuous soil state evaluation, which can support the verification of the realized objectives. The Soil Monitoring System of NAEP represents the framework of the related activities. In our paper we present the pursuits carried out for the elaboration of the system, which involved the followings:
- Definition of soil state features, soil functions, soil processes, soil threats and degradation processes which can be related to the presumable improving effects of the various agri-environmental target projects in order to be monitored.
- Working out of a complex, hierarchic sampling strategy (definition and designation of sampling units representing multipurpose spatial representativity; determination of their number and spatial distribution).
- Selection of appropriate soil indicators.
- Elaboration of protocols for the measurement parameters of the selected indicators.
- Spatio-temporal redistribution of measurements along the predefined sampling units and over time.
- Estimation of financial aspects of the actuation of the system.

S10.J.05
The estimation of heavy metal mobility in soil monitoring

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The system of estimation of heavy metal mobility in soil monitoring was offered. It allows revealing the mechanisms of metal compounds transformation in soil under contamination. It is shown the direction of processes of zinc and lead transformation in chernozem.
The estimation of heavy metals (HM) mobility system includes the following stages:
1) *HM forms determination and calculation.* The mobile forms of heavy metals were extracted from soil by ammonium acetate buffer solution NH_4OAc (exchangeable forms), pH 4,8. The amount of complex-bound forms was calculated as a difference between the metal contents in the extracts of 1% EDTA in NH_4OAc and NH_4OAc. The amount of specifically adsorbed forms was calculated as a difference between the metal contents in the extracts of 1N HCl and NH_4OAc. Metal contents in all solutions were analyzed by AAS.
2) *HM forms grouping*. The difference between the total HMs and their weakly bound group demonstrates the amount of metals within group of strongly bound compounds. Soil contamination by zinc and lead is accompanied increasing to their mobility. The share of weakly bound group increased in 2-3 times.
3) *Calculation of metal groups ratios are Êm indexes.* Êm presents a ratio of weakly bound metal compounds (WB) to strongly bound ones (SB): Êm = WB/SB. These ratios as part of ecological monitoring can be used to give an indication of soil contamination. In contamination the share of Zn and Pb weakly bound compounds and mobility indexes Êm increase.
4) *Calculation of metal forms in percent from group*. This calculation allows to estimate of their contribute in the changing of total metal mobility. Within present groups of compounds in forms ratio is happened under HM addition changing. There are changes of forms ratio within this group: exchangeable and complex forms increase at reduction their specifically adsorbed forms.

S10.K.01
Topsoil-structure damages in forest soils - a survey based on the Level I - soil monitoring in Baden-Wuerttemberg

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A lot of soil functions like the gas exchange, the rooting capacity as well as the habitat function are closely linked to an intact secondary pore system. In the actual EU-wide and national monitoring scheme no attention has yet been paid to get an overview on soil structure damages caused by increasing machine impact during forest operations.
Numerous investigations showed the long lasting negative effects of soil structure deformation on soil aeration status and fine rooting after trafficking with heavy forest machinery. As a consequence of these findings preservation strategies for forest soils recommend a strict binding of vehicle movement on regular skid trail systems.
Until now data on soil disturbances have been gathered in scientific field experiments. These were cause-effect studies describing the processes leading to ecological soil damage through machine impact. No data describing the relevance of compaction phenomena on higher spatial scale than small patches of forest stands are available.
During the ongoing soil monitoring survey in Baden-Wuerttemberg data on the physical status of the top soils are gained on 308 evenly distributed grid points. At each point 8 satellites located on a circle with a radius of 10 m around a central soil pit were investigated. Beneath an intense humus form description soil structure and also the appearance of hydromorphic phenomena were recorded for the top soil as indicators for structural disturbance. Further more the samples were classified into deformation classes reaching from 0 (no indications of deformation) to 4 (extreme deformation).
Irregular machine passage on unprotected forest soils is still a widely spread problem in Middle Europe. Representative data on this item that are collected within regular soil surveys will raise the awareness for this problem and emphasize the need for soil protection strategies.

S10.K.02
Relevance of different soil fauna and microflora groups in the monitoring of soil biodiversity: RMQS-Biodiv, a french Pilote area experience

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Soil biota play essential roles in delivering key ecosystem goods and services, and are both directly and indirectly responsible for acting in many important functions (nutrient release, soil structure maintain, contribution to water storage). It is thus essential to characterize both the species diversity and the biological functions.
In order to monitor soil biodiversity (species and function) in relation to land use (mainly agricultural practices) and pedoclimatic parameters, a French program « RMQS-biodiv » was developed at a wide regional scale (Brittany). An important national research collaboration (12 research teams) supported the program, that undertook the study of several biological parameters such as macrofauna diversity (earthworms, total macro-invertebrates), mesofauna diversity (acarina and collembola), microorganisms (nematodes diversity, microbial biomass, bacterial and fungal diversity), as well as functional biological parameters (soil respiration, humus index, macrofauna and mesofauna activity: biogenic structure, feeding activity).
This program was connected to a larger soil monitoring network developed at national scale (Soil Quality Measurement Network-RMQS) which monitored soil parameters (chemistry, physic) and agricultural management using a regular grid (16 X 16 km) covering the whole national territory. The link between these two programs allowed the study of biological parameters in the light of soil and agricultural characteristics, and thus the definition of biological indicators.
The results obtained from the analysis of 115 sites sampled in 2006 and 2007, will be discussed in terms of relevance of these biological criteria as indicators, and in fine of their transfer to field actors (technicians) who are in charge of new tool implementation on agronomical management assistance.
Furthermore, the results will also be discussed with respect to propositions and recommendations made by the ENVASSO project (Environmental Assessment of Soil for Monitoring), especially the biological criteria proposed by the European project and the hierarchy of these criteria.

S10.K.03
Comparison of soil organic matter and microbial respiration measurements at different scale

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Decline of soil organic matter and soil biodiversity are among the eight threats defined in the 2002 Communication ,,Towards a Thematic Strategy on Soil Protection" by the EC. In the frame of the ENVASSO (Environmental Assessment of Soil for Monitoring) Project, that targeted the development of the principles of a harmonized European monitoring system, organic matter content, bulk density and microbial respiration were among the selected and tested indicators to record the temporal and spatial changes for these two soil threats. Measurement of these indicators have been in practice in the frame of the Hungarian Soil Information and Monitoring System (TIM), which provides basic chemical, physical and biological data, since 1992 on 1237 sampling sites. The testing of the indicators with the recommended ENVASSO methodology was carried out on the Szent István University Experimental Farm pilot area. The pilot area is a catena, representative of the Eastern Central European loess areas with high organic matter content. It experienced decline in organic matter content and soil biodiversity due to natural and tillage erosion. The results of the field scale measurements with the national ones were compared. Strong correlation between organic matter content, soil types and microbial respiration was found on national and field scale as well. Based on the TIM data national threshold values were determined. The data from the Hungarian monitoring system are compatible with ENVASSO suggested methodology. The TIM data fit to the targeted EU monitoring of the studied parameters.

S10.K.04
Perspectives for regional monitoring of soil organic matter in mineral soils

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The (draft) European Soil Strategy (EUSS), which was rejected by the EU parlement in december 2007, identified loss of SOM as a major threat for soil quality. Main arguments against it relate to aspects of subsidiarity and proportionality, and not the relevance of a soil policy as such. Several Member States are actively developing a national policy for the conservation of SOM, i.e. the U.K., France, Germany, and the Netherlands. One of the major effort is the inclusion of SOM in monitoring schemes for soil quality. In the Netherlands, major experience on monitoring SOM had been gained from routine soil analyses over 30 years and more. For sandy soils it has been shown that there is no univocal trend in SOM changes within regions and cropping systems; available evidence suggests a similar result for clay soils. To improve our understanding of SOM changes at field level, detailed analysis at field level (as opposed to regional scale) is required. We present results of an analysis of changes of SOM with information on SOM quality, geology, hydrology, weather, soil type at field level. We developed a monitoring system for SOM in mineral soils in the Netherlands that combines the economic merits of routine analysis of SOM (monitoring base) with detailed soil and management data from a representative selection of fields (benchmark). Features of the system are *i)* meets requirements of both monitoring authorities and stakeholders, *ii)* enables resources and efforts to be proportional to the level of risk identified and *iii)* a scientific approach for the selection processes involved. Criteria have been identified for both the monitoring base and the benchmark, e.g. soil stratification, selection of indicators (early signalling, sensitivity, individual indicator vs. indicator set, target ranges), reliability of data (sampling, registration). The added value of modelling and geostatistics is also discussed.

S11 Management of Contaminated Soils (1): practical applications

S11.A.KL
Management of local and diffuse soil contamination on a heavily contaminated region (seen from the point of view of the feasibility and possibility of technical implications of technologies)

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In the last few decades subsurface contaminations by chemicals (mostly organic) and heavy metals has become a widespread problem for soil and groundwater quality. The most severe contamination problems are due to point sources which frequently involve organic solvents (chlorinated derivatives of methane ethane and ethane, aromatic hydrocarbons etc.) gasoline, diesel oil, lubricants, as well as coal tars from manufactured gas plants and cookeries, wood preservatives (e.g. creosote), transformer fluids (polychlorinated biphenyls) and plasticizers (phthalates). Diffuse sources which causes usually much lover contaminant concentrations than point sources, result from the application of pesticides and fertilisers in agriculture or the deposition of a wide variety of air-borne anthropogenic compounds.
The proper analysis and identification of the contamination problem, both its exact nature and extent, should be the first step in any remediation process.
In general, soil remediation, which is rather a complex process, consists of several stages including:
§ Preparatory activities including site characterization, health and environment risk assessment for both workers doing soil cleaning and further users of the site, selection and design the most suitable remediation technique,
§ soil cleaning itself
§ conducting aftercare activities.
Remediation procedures and techniques are becoming increasingly more specialized and more costly.
Estimated number of contaminated sites in Europe is app. 300.000 either industrial sites or landfills or other local sources posing significant risk to human health or to the environment. The UE spent several billion Euros each year on the remediation of land affected by contamination. It is rather obvious that total clean-up of these sites is neither economically nor technically feasible. However, many of today's remediation costs can be minimized by gaining a better understanding of remediation procedures and the various options available at the different stages in the process.
Generally, a sustainable approaches including e.g. risk based land management, land use requirements, and/or natural attenuation, are ones of emerging solutions.
Some of them, dealing with:
§ detection, transport and evaluation of contaminants,
§ accumulation, bioavailability of contaminants
§ phytoremediation
§ remediation and natural attenuation
are presented at the symposium.

S11.A.01
Copper and Zn labile pools changes in intermittently flooded soils evaluated using isotopic dilution techniques

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Under reducing conditions soils may release contaminants as a consequence of the dissolution of iron and manganese oxides and hydroxides.
An Oxisol and an Inceptisol, either unamended (control) or amended 5 years previously with soluble Cu (as CuSO4) or biosolid Cu, were submerged with de-aired 0.001 M CaCl2 and kept in an anaerobic chamber. They were maintained flooded for two weeks and then drained, dried and re-submerged. A set of soils was also maintained at field capacity in an oxic environment throughout the experiment. Up to three wet & dry cycles were conducted, and the release of Fe2+, Mn, dissolved organic carbon, Cu, Zn in the soil solution as well as the trends of pH and Eh were monitored at the end of each cycle. Labile pools (E-values) of Cu and Zn were determined at the end of each cycle using stable (63/65Cu) and radioactive (65Zn) isotopic dilution techniques, respectively. A resin purification step was included to avoid colloidal interferences in labile pool determinations.
Little change in Cu and Zn was detected in the soil solutions at the end of each wet/dry cycle, but significant changes in the isotopically exchangeable pools were observed. Zinc E-values decreased with each wet/dry cycle, while labile Cu generally increased. The highly Cu-contaminated soil did not show any changes in pH or Eh after submersion, likely due to lack of microbial activity as a result of the high Cu concentration. An increase of colloidal forms of metals in soil solution was observed with each wet/dry cycle, particularly evident in the case of Zn, suggesting the importance of colloidal mediated transport of metals in intermittently flooded soils.

S11.B.01
Enrichment of Pd, Pt, Au, and Hg from aqua regia soil digests

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In ICP-MS, direct determination of Pd, Pt, and Au is positively interfered from oxides of Sr, Y, Hf, and Ta, respectively. As dissolution and stabilization of Hf and Ta needs hydrofluoric

acid, rapid and reliable separations could be achieved by selective dissolution of Pt and Au by reverse aqua regia with 20 µl of elemental bromine added. These solutions were stable for at least 5 months, but unconsumed nitric acid and elemental bromine in the digests, however destroy organic reagents needed for appropriate separation techniques. There was still too much Sr and Y in real samples to achieve proper corrections on Pd in the ICP-MS.
After addition of excess ascorbic acid in 5% aqueous solution, separation of Pd, Pt, Au, and Hg from the matrix solution has been successfully achieved by coprecipitation as dithizonates from strong acid solution (1-2 M) with an excess of reagent, and sorption upon active carbon. Dithizone addition in dilute ammonia was preferred over addition in 1+1 acetone. After filtration, recovery of the analytes from the active carbon was achieved by microwave -assisted pressure digestion with a solution of KClO3 in dilute nitric acid. Digestion with nitric acid was less satisfactory. The active carbon has to be checked for blanks, particularly of Pt and Hg, and platinum spatulas should not be used in the entire procedure.
Whereas Pd, Pt, Au and Hg were recovered at more than 90%, other common ions and Ir were less than 3%, and Bi was variable. Removal of the salt matrix improved the performance of the ICP-MS. The method was checked with Certified Reference Material BCR-723 (road dust), and applied to soil and road dust samples.

S11.B.02
Health-based action levels for metals and organic pollutants in Norwegian soils

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The Geological Survey of Norway has in collaboration with the National Institute of Public Health and the City of Oslo prepared a set of action level concentrations for a selection of pollutants in soil for different land use. Based on risk assessments of the possible influence on human health, pollutants such as heavy metals, PCBs, DDT, PAHs, benzo(a)pyrene, aliphatic components, dioxins, furans, phenol, benzene, and triclorethene were classified into five categories of land use. The land uses are:
1.
All land uses, except agricultural soils
2.
Residential areas, day care centers, playgrounds, parks, and beaches
3.
Urban areas except residential, including streets, squares, business areas
4.
Industrial areas, railways, main roads
5.
Active and closed landfills
Considerations regarding residence/occupational time for humans within the different categories were taken into account. The exposure from food and drinking water is probably much more important than the contribution from soils in most cases. However, to small children harmful substances in soil may represent a significant but unnecessary source of exposure. In this study, recommendations on proper use of the action levels are proposed and how deep into the soils the action levels should apply. The main use of these action levels is the development of a simplified system for the management and disposal of polluted urban soil based on scientific health based criteria.

S11.B.03
Cr(VI) transport in typical soils of the North of Portugal

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Heavy metals are being added to the environment by atmospheric deposition and by fertilizers, sludge and sewage sludge application to the soil. The fate and movement of these contaminants depend on the physical and chemical properties of the solid and liquid phases that are in contact with each other. Generally, batch experiments are used to obtain equilibrium adsorption isotherms and to evaluate the soil sorption capacity of any given contaminant in an aqueous phase. However, in addition to adsorption, advection and dispersion may occur in dynamic systems justifying the need of flow experiments. Due to its mobility in the environment, its harmful effects on humans and its large usage among Portuguese industry, the behaviour and transport of hexavalent chromium, at different pH values of the aqueous solution, have been the aim of this study. A sample of a loamy sand soil collected in Oporto, Portugal (41º25'15.58''N and 8º45'58.27''O), was submitted to batch experiments and to flow experiments in column tests, at pH values of 2, 5 and 7. Kinetic, equilibrium adsorption and hydrodynamic parameters were evaluated and compared between systems. Sorption of hexavalent chromium was described using Freundlich and Linear isotherms, whereas transport was described as a convection - dispersion process, and characterized by a retardation factor. A nonreactive tracer was used to evaluate the dispersion coefficient independently. The kinetic rate coefficient was also evaluated for batch and dynamic systems. The retardation value, *R*, showed that hexavalent chromium is less mobile when the contaminant solution pH is higher. Moreover it has been found that the *R* values obtained by the convective-dispersive equation fitting are lower than those determined by the linear isotherm and very similar to those obtained by the Freundlich isotherm.

S11.B.04
The use of earthworms to test the efficiency of remediation of oil-polluted soil in tropical Mexico

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In many countries where petroleum exploration is done, soils are contaminated with crude oil on a nearly a monthly basis, due to the use of old exploration technologies. Determining the efficiency of restoration of soils contaminated with hydrocarbons has only looked at soil chemical parameters, i.e. hydrocarbon content after restoration. However, no information has been required concerning soil restoration as far as soil's function as a habitat for fauna and flora.
Therefore, this study focuses on the medium-term effects of soil bioremediation on mortality and reproduction rates of *Eisenia fetida* (laboratory experiment*)* and of the tropical earthworm *Polypheretima elongata* (field experiment) in tropical Mexico. We compared soils restored with the two bioremediation technologies landfarming (LF) and compost-bioremediation (BI) with control soils and with soils contaminated with 1 and 2 % of petroleum. Control and restored soils both were fertile and showed low hydrocarbon contents. The mortality of *Eisenia fetida* was not influenced by soil restoration and by contamination with 1% petroleum; it only increased in soils contaminated with 2 % petroleum. However, the reproduction rate of *Eisenia fetida* was significantly lower in the soils restored with LF and in those contaminated with 1% crude oil and significantly higher in the soils restored with BI. *.Polyphretima*

elongata showed the same reaction as *Eisenia fetida*. The stimulation of the reproduction rates in the soils restored with BI was probably due to the fact that allochtonous microorganisms were introduced which stimulated the earthworms. We conclude that it is important to include reproduction or other subletal tests for earthworms when estimating the efficiency of restoration techniques.

S11.B.05
Sorption behavior of cadmium on zeolite and bentonite

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Sorption and release reactions of metal ions play a key role in toxicity, bioavailability and mobility of these elements in soils and sediments. The release of Cd into the environment is a potential threat to water and soil quality as well as to plant, animal and human health. Thus, a number of technologies for the removal of Cd have been developed over the years. Among all the methods, ion exchange /sorption using clay minerals is highly effective, easy to adapt and economical. The objectives of this study were to determine i) Cadmium sorption (removal) capacity of bentonite and a zeolite minerals ii) sorption kinetics and mechanisms of Cd^{2+} on the clay minerals. Experimental data obtained from batch equilibrium tests have been analyzed by Freundlich, Langmuir and Koble-Corrigan isotherm models, and kinetic models including the pseudo-first order, the pseudo-second order equations using nonlinear regression technique. Koble-Corrigan isotherm was the best to describe the experimental data. Maximum experimental sorption capacity was found to be 6.5 and 12 mg/g for zeolite and bentonite, respectively. The time-dependent Cd^{2+} sorption data were well-described by pseudo second-order (r^2 = 0.99) kinetic model. The results also showed that the sorption process was relatively fast and equilibrium was reached after about 120 min. Uptake of Cd^{2+} ions on the sorbents showed a pH-dependent profile. The results also show that Cd^{2+}can be adsorbed successfully in significant amounts on bentonite and zeolite, indicating that the natural sorbents from Iran are good sorbents for the removal of Cd^{2+} from the aqueous solutions.

S11.B.06
A strategy for efficient surveying and mapping of soil pollution around a metal smelter

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A few kilometres south of Basel, Switzerland, a metal smelter operates since 1895 and produces alloys for the manufacturing industries. Until 1972 metal dust containing mainly copper, zinc and cadmium was emitted into the atmosphere without filtering. In the 1980s a first survey revealed elevated metal concentrations over an area of a few square kilometres. The survey data provided evidence that both the clean-up and trigger values of the Swiss soil protection ordinance were exceeded. Therefore, the soil protection agencies of the concerned cantons started a new survey with to delimit legally binding pollution zones. To select the sampling locations we analysed the data of the old surveys geostatistically and predicted the mean topsoil copper and cadmium content of some 8000 parcels of land by Gaussian conditional simulations. This gave us the mostly likely level of contamination of every parcel and a quantitative description of the uncertainty of the predictions. Based on this and the restrictions imposed by limited resources, we selected new sampling sites in that part of the study area where the pollution was likely to be severe but uncertainty was large. In a first round, soil was then sampled at some 220 sites, the samples were chemically analysed and the new data was merged with the measurements of the old surveys. These steps were iterated twice, resulting at the end in data from some 480 new sites. In our presentation we shall sketch the geostatistical procedure that was used for prediction and selection of the new sites, we shall discuss in some detail its validity based on the comparison of the predicted with the measured metal content of the soil, and we shall show how the uncertainty about the pollution could be reduced in the most strongly contaminated part of the study area.

S11.C.01
Soil and Water Contamination in an Agro Industrial Region in Tropical Mexico

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Pesticide use in agro industrial regions may cause an accumulation of pesticides and/or their metabolites in the environment. In tropical Mexico, we studied the effects of a weekly application of the fungicide Mancozeb against *Sigatoca negra* in drained banana plantations. The yearly application of the fungicide is about 100 kg ha^{-1} carried out since 1995. In 2006, we took soil (0-30 cm), drain sediment (0-10 cm), drain and well water samples of six banana sites and two control areas. We analyzed the content of ETU (first metabolite of Mancozeb) and of Zn and Mn (accompanying heavy metals, 2.6 % Zn, 20 % Mn).
We did not find any accumulation of ETU in soil or sediment samples. The ETU content was near the detection limit of 0.01 mg kg^{-1}. However, we found extremely high ETU concentration in superficial drain water up to a maximum of 50 µg L^{-1} due to its high water solubility. Furthermore, in some wells the concentration exceeded the EU trigger value for drinking water of 0.1 µg L^{-1} with maximum values of 8.5 µg L^{-1}
We observed an accumulation of Mn in soils and sediments with values significantly higher than in control soils. In sediments the accumulation was partly extremely high with a maximum content of 20,000 mg kg^{-1}. Zn was not accumulated in soil or sediment due to its lower content in Mancozeb.
We conclude that the actual accumulation of ETU in superficial and well water causes negative effects on aquatic fauna and human beings using the well water as drinking water. We suggest changing the production way of bananas in the region.

S11.C.02
Mine tailings as adsorbent for lead in contaminated soil

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Lead (Pb) is toxic to living organisms, and if dissolved to the soil water it may end up in food chain and harm the ecosystem. Thus, soils contaminated with lead (Pb), e.g. shooting ranges and old gas stations, cause a notable environmental risk. In the late 1990's, there were approximately 2000-2500 open-air shooting ranges in Finland, with 60% of them still in operation.
Remediation of Pb contaminated sites is complex and costly. However, biotite, referring here to a mixture of minerals processed from the tailings produced in apatite ore benefication, may function as an environmentally sound, cost-effective Pb sorbent owing to its versatile mineralogical and chemical properties. The main component of biotite is phlogopite associated with carbonates and apatite. Phlogopite is a silicate mineral rich in Al and Fe. Weathering of the mineral generates reactive Fe and Al (oxy)hydroxides which offer specific sorption sites for heavy metals. Carbonates, to some extent, function as Pb sorbents and promote the retention through precipitation or, in mineral soils, through raising soil pH. Furthermore, poorly

soluble compounds are formed between apatite ore residues and Pb, which contributes to decreased Pb leaching.
The suitability of biotite to remediation of contaminated sites was studied in laboratory by incubating Pb-contaminated soil with and without untreated or artificially weathered biotite of various particle sizes. The impact of biotite addition on the distribution of Pb between various pools was examined by sequential chemical extractions. The results showed that untreated biotite efficiently decreased bioavailable (i.e. water soluble and exchangeable) Pb in soil, whereas the low pH of the artificially weathered biotite promoted Pb dissolution into water. Biotite particles of different sizes vary in their chemical properties and, thus, they retained Pb differently. In fact, the unsieved material containing all particle sizes proved to be the most efficient sorbent.

S11.C.03
Mass balance and distribution of zinc, lead, and cadmium in sludge-amended soils developed on diorite saprolites (Limousin, France)

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Two main sources of Metallic Trace Elements (MTE) are currently recognized in the soil: (i) the natural pedo-geochemical background and (ii) the anthropogenic contamination by sludge spreading and/or diffuse atmospheric deposition. Concentrations as well as solubility and mobility of MTE contaminants in soils depend on the chemical reactions during weathering processes. Recent studies demonstrated that these chemical changes and their associated metal release operated in specific soil microsystems with their own solid and solution chemical properties. Consequently, the budget and the fate of a given contaminant in a soil needs bulk analyses of soil and microsystems. This dual analytical approach was planned to estimate the effects of long-term sewage sludge application upon Zn, Pb, and Cd distribution and movement in two inceptisols (control and amended soil) from Limousin (France), composed of the typical A, Bw, and C horizon sequence and developed on dioritic parent-rock The clay minerals occur both as weathering of primary minerals (amphibole, plagioclase and biotite) or as fissure infillings throughout the soil profile. The bulk clayey fraction is a mixture of smectite, kaolinite and kaolinte/smectite mixed layer. The bulk Cd content in the control soil is under the detection limit, whereas Zn and Pb are respectively depleted or accumulated in the upper horizons. Same behaviour is observed in the amended soil, except for cadmium that shows significant concentrations ranging from 0.13 to 0.33 $mg.kg^{-1}$, well below the contamination threshold (2 $mg.kg^{-1}$). However, microsites analyses indicate that high local Cd concentrations exist and are located in clayey plasma of A and Bw horizons and in fissural clayey infillings of C horizon.
This analytical approach demonstrates that, although bulk soil could be considered as unpolluted, local high concentrations exist and are associated with clay minerals, the most active phases in the plant-soil reactions.

S11.C.04
Accumulation of some heavy metals in wheat grown on sludge treated on sandy soil

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Disposal of sewage sludge has been practical in Egypt for 100years and longer. Sludge compost application to agriculture in Egypt became a vital issue particularly, in the new cultivated areas in the desert (approx...96%total area of Egypt) . However, the potential for excessive uptake of heavy metal by plant corps continues to be of concern. A number of principal issues or questions about the environmental acceptability of sewage sludge compost and its use on cropland have been raised. Recently, in Egypt, research has concentrated in the conditioning effect of sludge in sandy soil with respect to their physical and hydrological properties in addition to its productivity where as the fate of heavy metals and their availability to the growing plants have found little attention. The object of the present study was to evaluate the effect of sewage sludge application to sandy soil on dry matter, seed production and heavy metals distribution of wheat plant part (*Triticum valgare*) cv skha8. Results indicated that sewage sludge is available organic fertilizer particularly for poor sandy soil. As expected the accumulation of heavy metals in wheat leaves, stem, and seed was recoded. Stems tend to accumulate Fe, Mn and Co than leaves.
Surprisingly, seed samples accumulated Zn, Cu, Cd and Ni more than samples of other plant parts, which may suggest a potential hazard through food chain at high sewage sludge application. It could be concluded that the application of sludge to Egyptian sandy soil has beneficial effect on the growing crops. However, the elevated concentration of heavy metals in sludge amended soil should be considered to avoid potential impact on human health through the food chain.

S11.D.01
Binding of organochlorine pesticides in agricultural soils and a phytoavailability assessment

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Organochlorine pesticides (OCP) were once applied world wide but are banned nowadays in most countries because of their ecotoxicity, bioaccumulation and persistence. However, residues can still be present in soils and taken up by *Cucurbitaceae* plants (cucumbers, pumpkin etc.), even many years after applications have been stopped. In order to address the problem, we proposed to test the binding of OCP residues in soils by activated charcoal (AC) to prevent further uptake in plants. The sorption of OCP was assessed by Tenax® beads added to soil samples as a predictor for the phytoavailability to a target plant.
We performed two pot experiments growing cucumber (*Cucumis sativus* L.) in soil with bound residues of dieldrin (67 µg/kg). In the first experiment, cucumbers were grown for 13 weeks in soil into which AC had been mixed at concentrations of 200, 400, and 800 mg/kg and in untreated controls. In the second experiment, Tenax® beads were added to the soil and cucumbers, grown with and without AC amendment (800 mg/kg soil), were harvested after 4, 8, 10, 11, 12, and 13 weeks.
Dieldrin concentrations in cucumber fruits were significantly reduced in all AC treatments. Also significantly less dieldrin was sorbed by Tenax from the soil amended with 800 mg/kg AC over time sections than from the untreated control soil. More dieldrin was found to be sorbed by Tenax in the last 3-4 weeks of the experiment, particularly in the control soil, but this trend was not significant. The correlation between the amounts of Tenax-sorbed dieldrin and dieldrin accumulation in the cucumbers was not significant.
Hence, charcoal amended to soil can reduce the accumulation of dieldrin in cucumbers. Further, Tenax appeared to be suited for the assessment of dieldrin solubility in soil and to become a valuable tool to assess the phytoavailability to cucumbers.

S11.D.02
Growing of Crops on Contaminated Soils

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The man's activity has caused environmental changes ever since his beginnings on the earth. Over millions of years of development of mankind these changes have been slow and slight, however, after industrialisation, such changes have become more adverse. One of the most environmentally harmful products of men's activity is waste. What is waste? The answer to this question varies depending on who gives the answer. Waste can be considered as a fundamental issue for the survival of civilization on this planet. As defined in the Framework waste legislation of European Union it means substances and items categorized under the said Framework implementing regulations, which the owner disposes of, intends to or has to dispose of. One of the outcomes of drilling for oil is waste i.e. oil contaminated solid consisting of cuttings and a number of waste fluids used in the drilling process. The said solid contains various chemical compounds, including those that can be classified as environmentally harmful or toxic substances. In order to determine the environmental harmfulness of this matter, in particular potential harmfulness for the soil and water, and also crops, knowing that contaminants - pollutants enter animal and human food chain via soil, this issue has been addressed. In spring 2006 a stationary field experiment was set up. Trial variants are: control; soil contaminated by petroleum hydrocarbons at three levels (8; 4 and 2 l m^{-2}) and soil contaminated by oil solidificate, also at three levels (30; 20 and 10 kg m^{-2}). During research in chemical compositions of the soil changes are recorded (soil reaction, organic matter content, total petroleum hydrocarbons, heavy metals, polycyclic aromatic hydrocarbon), also achieved crop yield, crop establishment, and the ratio of heavy metal transport from the soil via the plant and to the grain.

S11.D.03
Comparing Kd, repetitive extractions and DGT as means of assessing heavy metal bioavailability

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In recent years, considerable efforts have been made to reduce the effect of heavy metals in soils in regard of their availability to living organisms. Especially plants have been the target of experiments to limit HM uptake due to their role in the food chain. However, to infer the actual HM bioavailability from their concentration in soil extracts has been shown to be inaccurate. Relatively new approaches - Sequential Extractions and DGT - are combined with Kd and used to more accurately assess the bioavailability and therefore the imminent danger to biota. 10 different soils varying in HM contamination were used. The experiments are being aimed at providing sufficient information to apply suitable remediation techniques.
For Kd experiments, concentrations of Cd and Zn in Ca(NO3)2 extracts (soil:solution ratio 1:5) and EDTA (0,1 M) extracts were assessed in relation to their total (aqua regia digestion) concentrations. Concentrations and equilibration times for Ca(NO3)2 extracts were adjusted to the individual soils. Two different kinds of Kd were defined, one reflecting the labile pool (EDTA), the other a mobile pool (Ca(NO3)2). Diffusive Gradient in Thin Films (DGT) was used and as a third approach, 20 repeated extractions (0,1 M CaCl2) were carried out for each soil to simulate long term behavior.
Results for Kd show that the various soils differed greatly in their total HM concentrations, as well as their mobile and labile pools. For example, one soil (PR1) showed a low (18) mobile Kd for Cd with a high total concentration (49.16 mg/kg), another soil (CZ) showed the opposite (Kd: 413; concentration: 4.93 mg/kg). Hence, CZ is assumed to release lower concentrations of Cd than PR1. Ongoing research will show if the other methods will show similar pictures and will be available at the conference.

S11.D.04
Simulation of the pytoextraction process by repeated extraction of soil with neutral salt solution and determination of resupply processes

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Several investigations have been conducted in the past to predict the phytoextraction of heavy metals from contaminated soils by using single extraction with neutral solution but no method could successfully predict the metal removal efficiency and/or explain the effects of resupply of metals to the bioavailable metal pool. Therefore, the total amount of extractable Zn and Cd, a surrogate for the target fraction to be removed by phytoextraction, was determined by repeated removal of extractable metals of four contaminated soils. Additionally, the resupply of metals was determined in a parallel experiment where two extractions of the same soil sample were done with one week interval. Among the four selected soils, two were calcareous and two were non-calcareous. In this study, we used two neutral salt solutions (NH4NO3 and CaCl2) as single extracting agents which are generally used for extraction of metals from soils. 25 ml of the extractants were added to 0.5 g of air dried soils and shaken for one hour. After centrifugation for 10 minutes, the supernatant was filtered through 0.45µm filter. The process was repeated for 20 times for each soil. The amount of extractable Zn and Cd rapidly decreased until the 10th extraction steps, afterwards a very slow depletion was found for non- calcareous soils. In contrast, the amount of extractable Zn and Cd decreased slowly until the 20th extraction step in calcareous soils. The more pronounced decrease in non calcareous soil corresponded to low Kd values. The resupply was determined by two extraction steps with 1 week time inbetween. Very different rates of resupply were found, ranging from 0 - 44 %. A relation between known soil parameters and amount of resupply was not found so far. It is assumed, that a high amount of resupply supports a fast phytoremediation process.

S11.D.05
Minimizing the environmental risks of Lettuce cultivated in heavy metals affected Soils

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1. abstract
Heavy metal HM cations can be introduced into agricultural soils by application of fertilizers, conditioner materials, sewage sludge, composts, and other industrial and urban waste materials. Therefore, heavy metal adsorption reactions, in a competitive system, are important to determine heavy metal availability to plants and their mobility throughout the soil. This study was conducted to evaluate the selectivity sequence and to estimate the competitive bioavailability of several heavy metals Lead (Pb), Cadmium (Cd), Nickel (Ni), and Iron (Fe) as affected by Cobalt (Co) applied at different rates. The uptake of these metals by Lettuce plant (*Lactuca Sativa*) as an indicator grown in two light texture soils having different chemical and mineralogical characteristics as affected by these conditions was investigated.
The obtained results indicated that addition of Co in the studied soils, led to increase both fresh (FW) and dry weight (DW) of lettuce until 12.5 ppm Co application rate, where both parameters were decreased in higher concentrations applied. In addition, all Macronutrients (N, P and K) contents were increased by applying the same abovementioned Co concentration. In some cases, however, increasing of Co concentration, led to extra increase in nutrient content like P. Concerning the HM content, results indicated that Pb, Cd, Ni and even Fe contents were decreased by increasing Co at any

concentration applied without any exceptions. However, a reverse trend was observed for other nutritive HM like Co. From the obtained results we assumed that application of 10 to 12.5 ppm Co for contaminated soils are the best concentrations to have healthy plants and elevate HM hazardous, the remediation effects of Co through competition phenomenon takes place were discussed.

S11.D.06
Bioremediation and phytoremediation of copper and herbicides coming from vineyard soil

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Despite more sustainable practices in agriculture, it seems illusory, however, to expect that such practices will quantitatively prevent pesticide leakage from agrosystems. Significant quantities escape agrosystems at the outlet of watersheds. In vineyards in particular, runoff may cause erosion during storm events accompanied by leakage of pesticides *via* both water and soil particles. One part of contaminants accumulates in sediments of storm basins, the other part only passes in transit. Biological pesticide mitigation has been observed and related to the role of natural macrophyte colonizers together with their associated microflora. Nevertheless, pesticide mitigation requires optimization in most cases since pesticide concentrations at the outlet of storm basins, including copper, usually exceeds legal threshold limits for natural water. In addition, storm basins flow rates can change very quickly, i.e., close to zero in a few hours after a storm event while they are very high during storm events with lower hydraulic retention times than the time needed for biological treatment.
In this study performed in laboratory conditions, adsorbing materials like vermiculite, beet pulp, were selected for their ability to both increase the retention time of copper and herbicides, i.e., diuron, glyphosate and to serve as carriers for a bacterial consortium. Besides 208 clones out of 563 isolated from sediment accumulated in a storm basin at the outlet of a vineyard were selected first on the basis of (i) their resistance to contaminants, (ii) their genetic differences by using Ribosomal Intergenic Spacer Analysis (RISA) and then Restriction Fragment Length Polymorphism (RFLP), and (iii) their ability to either mineralize glyphosate or diuron, or to enhance copper availability for macrophyte extraction. Results of batch and continuous experiments associating together adsorbing materials and bacterial consortia will be presented.

S11.E.01
Variability of edaphic conditions in metal-contaminated sites at multiple scales. A temperate and a tropical situations.

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In numerous places, mining and ore treatment activities have generated environmental contaminations which endanger ecosystem viability and/or human health. In some places, the ecological pressure induced by the metal contaminations allowed the development a specific flora, fromwhich candidates for phytoremediation may be selected. A survey of edaphic conditions prevailing for plant growing in contaminated areas around metal smelters has been conducted in belgian calaminary sites (Zn, Pb, Cd contaminations) and in the Katanga province of RDC (Cu contaminations).
As the processes generated by the modifications of the soil environment may affect the form of a trace element, that is its distribution through various pools, we investigated physical and chemical fractionation of some metallic trace elements (Cu, Zn, Pb, and Cd) in soils and compared temperate and tropical cases.
The results stress the need of a typology of the contaminations that takes into account the classical pedological parameters, even if contaminated sites are far from classical soil environment. The variability of edaphic properties that can occur within small distances is also an important point to consider when planning rehabilitation operations.

S11.E.02
Remediation of total petroleum hydrocarbons (TPHS) in a long-term contaminated soil using phytostimulation technique

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Total petroleum hydrocarbons (TPHs) are important sources of environmental pollution especially around oil refineries. The presence of these pollutants in soil can contaminate ground waters and food chine thus, its remediation is vital. In order to find environmentally and economically acceptable options, biological methods such as phytostimulation have been investigated. In this study, first the germination and subsequent growth of seven plants was tested in three soils with different petroleum contamination levels. Contamination treatments consisted of C_0 (uncontaminated soil), C1 and C2(1:1 and 1:3 w/w, uncontaminated: contaminated soil, respectively). Then, the best plant genotypes were selected for phytoremediation trails. The results showed the presence of TPHs in soil had no effect on seed germination of agropyron, white clover, sunflower and safflower. In contrast, there were 52 and 56% decrease in germination of tall fescue and puccinellia seeds in C_2 treatment, respectively. Canola and white clover seedlings were sensitive to petroleum contaminations and failed to produce dry yield matter (DYM) at the end of trial period. Thus, tall fescue, agropyron, safflower and sunflower were selected for phytoremediation trails. In the phytoremediation studies, DYM was significantly reduced by the presence of TPHs at all the contamination levels. Microbial respiration in the rhizosphere of agropyron was more than tall fescue in C_2 treatment. However, there were no significant differences in microbial respiration in the rhizosphere of sunflower and safflower with control. TPHs concentration decreased 71 and 69% in C_1 treatment, and 45 and 42% in C_2 treatment using agropyron and tall fescue, respectively. Sunflower had no effect on TPHs concentration reduction at the end of the trail period. Although, advanced studies for assessing the suitability of plant species and improving phytoremediation efficiency is necessary, some species like agropyron showed to be a suitable choice for phytoremediation of the investigated long-term petroleum contaminated soils.

S11.E.03
Phytomanagement of metal-contaminated agricultural land using crop species

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In Witzwil, Switzerland, high levels of heavy metals occur in agricultural land because of previous city waste disposal. The contamination limits the use of the land for crop production. Phytomanagement uses plants to reduce the negative environmental effects of contamination. Phytomanagement aims to combine the reduction of risks arising from the pollution with the utilization of the soil for the production of crops with economic value.

In a long term field experiment over six years, we investigated the use of high biomass plants (maize, tobacco, sunflower) combined with soil conditioners, which enhance plant heavy metal uptake, to produce valuable biomass and simultaneously extract metal contaminants. Our treatments were: elemental sulphur, nitrolotriacetic acid (NTA), ammonium sulphate fertilizer, and a control treatment.
Managing the soil pH by the elemental sulphur treatment was an effective means of controlling metal uptake by crop plants. Sulphur is a low-cost soil amendment that, in this study, increased the Cd and Zn content of some crops by up to 25%. It would still take unacceptably long time for exclusive remediation operations. However, the combination of phytoremediation with the production of biomass that could be used for biofuel or other purposes and thus produces a profit would render the cleanup time less important. Sunflower and maize could be used as fodder crops, since their heavy metal content was low enough not to harm any ruminant animal. On the contrary, the sulphur treatment increased the nutritional quality by increasing the Zn-to-Cd ratio of both crops and also increased the concentrations of other essential trace elements. We could thus phytomanage our experimental site to reduce risk of metals spreading into surrounding areas and metal leaching into deeper layers of soil profiles or into ground water. Repeated cropping would, over the long term, reduce the soil metal burden.

S11.E.04
Remediation of soils polluted with heavy metals by using of biosolid and supported zeolite

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In order to evaluate remediation possibilities of soils polluted with heavy metals, two materials were used: a biosolid, prepared by treatment of sludge from municipal waste water treatment of Timisoara, and a clinoptilolitic zeolite supported with polynuclear aluminium salts. An experimental zone of agricultural soil (cernozem) was polluted with mining waste, 20 kg/m^2, from a copper ore processing, having the following composition: Cu = 669 mg/kg d.s., Zn= 610 mg/kg d.s., Mn = 676 mg/Kg s.u., Pb =110 mg/Kg d.s.
To establish the efficiency of metals immobilization, the experimental zone was cultivated with 2 plants, Medicago sativa and Festuca arundinaceea, 4 parcels for each plant: blank parcel (1), polluted parcel with mining waste (2), polluted parcel with mining waste and treated with biosolid (3), polluted parcel with mining waste, treated with biosolid and supported zeolite (4). The surface of one parcel was 3 m^2, and the quantities of used materials were 8 kg/m^2 biosolid and 1 Kg/m^2 supported zeolite.
Both plants had a well growing and development, with a good covering of cultivated soil. The greatest quantity of total phytomass was produced in polluted parcels, amended with biosolid and supported zeolite. Metal concentrations in the aerial part of plants cultivated on polluted parcels with mining waste, from the second harvesting, had the greatest values: Zn = 63.7 and 74.5 mg/Kg d.s., Cu = 56.3 and 65.7 mg/Kg d.s., Mn= 59.8 and 137.4 mg/kg d.s., Pb = 63.7 and 49.6 mg/kg d.s., for Festuca arundinaceea and Medicago sativa, respectively.
These values were about 2-5 times greater than those determined in plants harvested from blank parcels or polluted parcels amended with biosolid and supported zeolite. By combined using of the two prepared materials, a synergic effect on heavy metals immobilization from soil, was recorded.

S11.F.01
Remediation of PAH-polluted soils by in-situ-injection of vegetable oil

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This contribution gives an overview about a project that was started with the objective to develop an in-situ-remediation method for soils polluted by organic contaminants, especially polycyclic aromatic hydrocarbons (PAH). Soils from former gasworks locations or tar oil production sites may be contaminated with hydrocarbons from spills, leaky storage containers or transport lines. PAH may occur in such soils at concentrations exceeding 1 g.kg-1. To avoid the necessity of extensive soil excavation, an innovative in-situ-treatment method is being developed that deploys subsurface injections of vegetable oil as solvent for PAH with subsequent recovery by skimming migrated vegetable oil from groundwater. The recovered oil may be cleaned by active charcoal-filtration and can be used for further re-injections. Remaining vegetable oil and not-desorbed PAH will be degraded microbiologically. The method can be used for contaminations beneath buildings or sealed surfaces because the injection probe will allow for lateral or three-dimensional oil injection. In the case of open surfaces a plant cover may support the microbial degradation of residual oil or pollutants.
Column experiments at lab scale have analysed the PAH-removal capacity of vegetable oil in soils of different water content and different soil compaction levels. After the application and gravitational oil recovery up to 30 % (w/w) of vegetable oil remained in the soil, with the higher residual concentrations in drier material.
Lysimeter experiments were started with materials of different textures and PAH-concentrations to test the injection technique, injection probes, the distribution of vegetable oil and to calculate lysimeter-scale oil budgets. Soils from original contaminated sites are being used to study the extraction efficiency as preparation for field pilot-scale tests.
Complementary studies have analysed the development of bacterial communities, degradation and ecotoxicological characteristics during the remediation process and will be presented in separate contributions.

S11.F.02
The possible use of soluble humic substances for remediation of heavy metal polluted soils

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Polluted soil is a common and serious environmental problem. While reliable methods exist for cleaning soil contaminated by organic compounds through degradation, remediation of heavy metal polluted soils awaits an appropriate solution. This is because heavy metals are nondegradable and generally strongly bonded in soils. Consequently, removal of heavy metals by extraction is difficult and requires harsh chemicals such as ethylenediaminetetraacetic acid (EDTA) and acids. However, use of EDTA is environmentally problematic because of persistence, toxicity and deterioration of soil structure. Therefore, the potential of soluble natural humic substances (HS) to extract heavy metals from contaminated soils is tested as an environmental friendly substitute for EDTA. A strongly polluted urban soil and a moderately polluted agricultural soil were extracted at neutral pH in batch mode by three HS solutions from beech and Norway spruce litter and processed cow slurry, all containing 25 mM dissolved organic carbon (DOC). After 10 weeks, 8 % to 39 % of the total Cd, Cu, Ni and Pb soil contents were extracted. Increasing the DOC concentration to 100 mM resulted in markedly increased heavy metals extraction. Heavy metal extraction with dissolved HS is compared with EDTA at the same concentration and sequential extraction has been performed to identify extracted pools. The results indicate a clear potential of using HS solutions for remediation of heavy metal polluted soils, which is fortunate, especially if organic waste products such as sewage sludge and animal slurry after proper processing can be turned into soluble HS as preliminary investigations indicate.

S11.F.03

The effect of biotic and abiotic factors on Pb, Zn and Cd accessibility and mobility in soil after remediation with EDTA soil leaching

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Soil washing remediation techniques remove only the labile heavy metal (HM) species from the soil, leaving the residual ones in less accessible/mobile forms. Remediation processes thus disturb the chemical equilibrium among different species of HM in the soil. Re-establishing of such equilibrium and shifting HM back to more accessible/mobile chemical forms should be expected after exposing the remediated soil to environmental biotic and abiotic factors. Earthworms and soil temperature/moisture changes affect the soil characteristics in time, leading to possible changes in HM accessibility/mobility. They were used as model biotic and abiotic factors acting on residual HM after chelant leaching remediation.
Contaminated soil from a smelter site (Pb 4600 mg/kg, Zn 1800 mg/kg, Cd 30 mg/kg) was washed with increasing EDTA concentrations (2.5, 5.0, 10.0, 20.0, 40.0 and 4-times with 40.0 mmol kg-1 EDTA). Fractionation with a 6-step sequential extraction, mobility, plant accessibility of Pb, Zn and Cd and Pb oral bioavailability were determined for the soil, for soil processed by earthworms (Eisenia fetida) and for soil exposed to different temperature and moisture regimes.
A gradient of removed HM was reached: from 6 to 73% of initial Pb, from 3 to 23% of initial Zn and from 17 to 74% of initial Cd were removed. Temperature and moisture consistently lowered HM accessibility in original (non-washed) and all treated (chelant-washed) soils. Earthworm activity increased Pb, Zn and Cd mobility in all soil treatments, while temperature and moisture increased Pb, but decreased Cd mobility.
Results indicate that both biotic and abiotic processes change the accessibility/mobility of residual HM in all leaching treatments and should thus be considered in remediation successfulness evaluation.

S11.F.04

Soil redox changes enhance metal fixation into Fe (hydr)oxides

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In-situ remediation, based on fixation of metals by iron rich co-products, represents a low-impact and low-cost alternative for soils contaminated by toxic elements. It is well known and established that Fe (hydr)oxides have the capacity to adsorb metals and other elements, but in order to reduce remobilization risks, an occlusion of sorbed metals into the oxide structure would be desirable. This could be obtained trough solubilization/precipitation cycles of Fe induced by redox fluctuations of soil, similarly to what normally happens in paddy fields.
This treatment was tested on a grassland soil, from Carpiano (Milan, Italy), highly contaminated with toxic trace elements by prolonged irrigation with polluted water. The soil was incubated waterlogged for 40 days, under anaerobic conditions, with and without addition of Fe oxides and Fe oxides plus fresh organic matter to accelerate and intensify the reduction processes. Then, the soil was drained and air-dried. This treatment was repeated for 3 successive cycles. Phyto-availability was evaluated by $Ca(NO_3)_2$ and DTPA extraction, whereas human hazard from direct soil ingestion was tested by the physiologically based extraction test (PBET). Metals were chemically speciated by a 7-steps sequential selective extraction procedure.
Results showed that redox fluctuations alone were unable to reduce metal mobility of most elements in this soil, but when Fe, or Fe plus organic matter had been added before incubation significant reductions in $Ca(NO_3)_2$ and DTPA-extractable metals were observed. The sequential extraction showed a marked decrease of metals concentration into the exchangeable, carbonate and Mn oxide fractions, with a corresponding increase into amorphous Fe oxides fraction, and in crystalline Fe oxide fraction for Cd, Pb and Zn. As expected the most relevant changes were observed after addition of Fe oxides, whereas only small changes were evident in control soil.

S11.F.05

Monitored Natural Attenuation of nutrients at river basin scale - the case of Evrotas river basin

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Monitored Natural Attenuation (MNA) is a remediation technology based on understanding and quantitatively documenting naturally occurring processes that “destroy” or immobilize contaminants at a contaminated site in order to protect humans and ecological receptors from unacceptable risks of exposure to hazardous contaminants. Although uncertainty existed regarding its application, MNA is now widely accepted as a viable remedial option for the remediation of contaminated soils and groundwater at a plume scale.
This paper presents an approach of applying MNA at a river basin scale. The study area is Evrotas river basin, located on the south-east of Peloponnesus of Laconia Prefecture, Greece. The pollutants studied are nutrients, organic load and total phenols due to the main activities (intense agriculture, olive oil mills and orange juices factories) undertaken at the area. To this end, a methodology was developed based on the three “lines of evidences” approach as proposed by EPA. The three lines of evidence are documented loss of contaminants, documented Natural Attenuation process and documented microbial activity. The methodology is comprised of three basic steps each of which includes specific actions.
Up to now the first step has been completed providing sufficient and documented evidence that mechanisms of natural attenuation exist. This paper is mainly focused on the application of the first step which includes evaluation of the site characteristics, analysis of historical data, analysis of data from five field campaigns conducted in the study area and modeling with MONERIS for the estimation of nutrient fate and transport through various diffuse pathways.

S11.F.06

An innovative, biologically based *in situ* remediation procedure for chlorinated solvent-contaminated sites: first steps of establishment in Austria

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Chlorinated solvents are amongst the most widespread organic soil and groundwater pollutants in Austria. As opposed to conventional decontamination measures such as excavation or hydraulic containment, biological treatment of contaminated sites offers a number of advantages such as sustainability, efficiency and minor effort in terms of finance and construction. Presently, bioremediation of chlorinated solvents contaminated sites is not being implemented in Austria.
Although the principles of biodegradation of chlorinates have been elucidated in the recent years, research need exists to deal with a number of difficulties in order to establish an environmentally, economically and legally acceptable microbiological remediation method. In the present project, technology development has been focused on a hands-on, genuinely applicable bioremediation procedure that will be well-documented and publicly available to stakeholders in Austria.
The procedure is based on the addition of non-toxic, biodegradable hydrogen sources that exert a minimum influence on soil and groundwater chemistry, porosity and other relevant aquifer parameters. Such an amendment was specially developed and optimized according to these premises using small- to medium-scale laboratory experiments. The assessment of issues such as subsurface distribution, amendment and pollutant degradation rates, release of intermediate products and groundwater well grid was performed using hydro-geologic data collected from the two hydraulically contained test sites in Upper Austria. Based on these findings, the procedure was implemented, validated and optimized *in situ* in two variants.
Certain issues of Austrian law to be considered before and in the course of field validation were found to exert major influence on the process design and implementation, such as specific easements as well as certain environmental regulations.
First results from *in situ* validation are indicating the great potential of *in situ* bioremediation of chlorinated solvents, aside a range of impediments, and allow for the prediction of the future success of such remediation technologies.

S11.G.01

Soil solution composition as a criterion of soil remediation

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Soil solution analysis allows us to understand metal migration, to predict toxic effect on plants and biota and possibilities of groundwater pollution. Thus it enables easily testify effectiveness of different sorbents in heavy metal immobilization and can be helpful in soil remediation control. The aim is evaluation of Cleansoil technology in remediation of contaminated soils under existing infrastructure in the surroundings of a copper-nickel smelter in the Kola Peninsula, north-western Russia. Sorbent (vermiculite) was located in perforated horizontal pipes and as an entire layer at 0.5 m depth. Water, hydrochloric and citric acid additions were applied in order to mobilize heavy metals in topsoil and increase their flow to sorbent. Soil solutions were extracted with Rhizon samplers tested already in the polluted soils in the Kola region. Data indicate that both acids were highly effective in mobilizing the heavy metals studied, but the potential of soil acidification and nutrient leaching was extremely higher in HCl treatment. Water as a mobilizing agent was less effective. A considerable part of metals remained in solution and did not adsorb to vermiculite, even if the entire layer of it was placed in soil. This increases the risk of metal leaching to the groundwaters. Therefore, careful management of remediation process and exact evaluation of soil and soil solution parameters seems highly desirable to determine whether chelate- or acid-enhanced remediation can be used safely without creating new problems related to groundwater pollution and ecosystem disturbance.
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S11.G.02

Anaerobic biodegradation of organic pollutants in groundwater: a novel, low-cost in-situ bioremediation approach

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Organic compounds such as polycyclic aromatic (PAH) and petroleum hydrocarbons (TPH) are widespread contaminants in the environment, posing a serious risk to the ecosystem via contamination of soil and groundwater. Biological in-situ remediation methods are innovative, promising alternatives to conventional management methods (extraction, excavation) of contaminated soil and groundwater. However, the amount of oxygen required for the aerobic, microbial contaminant breakdown exceeds its solubility in groundwater (10mgl-1). The deficit in oxygen supply in the saturated zone thus states an essential limitation for the efficient biological turnover of organic compounds.
By contrast, supporting anaerobic biodegradation processes offers the possibility to circumvent this limitation. Biodegradation of organic contaminants without oxygen is the result of anaerobic bacterial respiration, occurring at a slightly to strongly negative redox potential. Therefore, a substitute of oxygen, an alternative electron acceptor (AEA) is required. Several naturally occurring substances qualify as AEA, and their application offers the potential of promoting and enhancing natural degradation processes.
However, despite the fact that the ability of some bacteria to metabolise hydrocarbons in the absence of molecular oxygen was recently recognised, the need for in-depth investigations on the fate of organic contaminants under anaerobic conditions remains.
The aim of this work is to characterise the conditions favouring the anaerobic biodegradation of organic hydrocarbons. Special focus is given towards the assessment of the efficiency of various AEAs, the characterisation of degradation performance and rates under different redox conditions as well as toxicity monitoring. Consequently, a series of investigations to prove applicability and predict remediation performance are being performed. Various preliminary tests include degradation experiments in shaking flasks and soil columns, followed by in-situ validation.
Based on these results, an estimation of applicability, duration and success of low-cost anaerobic bioremediation approaches at field conditions will be given.

S11.G.03

Effect of Canola Oil addition on the degradation behaviour of polycyclic aromatic hydrocarbons in soil

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Polycyclic aromatic hydrocarbons (PAH) are environmental contaminants of great interest due to their toxicity, carcinogenic potential and world wide occurrence. Under natural conditions many PAHs are microbially biodegradable in the subsurface. Well-bioavailable compounds are degraded preferentially, a process associated with the relative enrichment of less

degradable and available compounds over time. The potential of canola oil as an *in situ* extracting agent for less available PAH as well as a facilitator for microbial degradation was investigated in the present study.
A historically contaminated soil from a former gas plant was used for PAH biodegradation and bioavailability assessment. Contamination was approximately 300 ppm (16 EPA PAHs), with about 50% the sum of Naphthalene, Phenanthrene, Fluoranthene and Pyrene.
Biodegradation experiments (2 months) revealed no significant biologically related contaminant depletion both with and without canola oil (0,1%) amendment. In accordance, PAH bioavailability from soil was determined to be nil from parallel experiments using specially designed, matrix-coated containers. However, canola oil was biodegraded from day 4 on, with 98% degradation at the end of the experiment. This was correlated in time and extent with a slight but significant increase of PAH in the water phase in the same, biologically active and canola oil amended microcosms. On that account the observed mobilization of PAH to the water phase is attributed to microbial processes related to canola oil degradation.
The present study gives evidence on the positive influence of canola oil on PAH mobilization from soil to water phase. Presently, this effect was limited to a relatively low amount of PAH. Presumably this can be attributed to the low concentration of oil applied (0,1%). From these results an increase in biodegradability of PAH due to an elevated bioavailable contaminant fraction can be expected, provided an excess canola oil dose is applied.

S11.G.04
Effectiveness of CLEANSOIL system in remediation of heavy metal polluted soils

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Remediation of contaminated soils beneath infrastructures has numerous problems and identifies limitations in the use of current cleaning tools and technologies. The CLEANSOIL method consists on the insertion of several chords connecting a multitude of sockets inside parallel horizontal holes drilled in the ground. The sockets serve as holders for appropriate sorbents that absorb the pollutants. After a period of time sufficient to attain the desired decontamination effect, the system is removed and the sorbent regenerated for further application. Performance of the CLEANSOIL system for remediation of heavy metal polluted soils was assessed in the field-scale experiments in surroundings of a large copper-nickel smelter in the Kola Peninsula, Russia. Test monitoring programme included analysis of soil, soil solution, lysimeter water, and sorbent state. Effectiveness of the system in soil remediation was assessed with the developed empirical model describing the cleaning process in result of release of heavy metals from soil.
Addition of dilute acid and chelating agents had significant effect on solubility of nickel and copper; however, fractions of metals released from topsoil under enhancing treatments were not very high. Though hydrochloric acid was effective in mobilization and redistribution of heavy metals, the potential of soil acidification and nutrients leaching was extremely high. Citric acid can be recommended as a more environmentally-friendly extractant for removal of heavy metals from contaminated soils. Vermiculite was found to be appropriate for binding of heavy metals. The CLEANSOIL system should work more efficiently in situations when simultaneously concentrations of pollutants at pipe locations are high and when transport of pollutants with water is minor, so that diffusion mechanism of pollutant movement will come on first place. Effective application requires a sound understanding of soil chemistry and hydrogeology at a site.The study was supported by FP6 EC (INCO-CT-2005-013420) and RFBR (05-04-48460).

S12 Management of Contaminated Soils (2): concepts and policy developement

S12.L.KL
European policy developments for the management of contaminated land

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Introduction
The Millennium Ecosystem assessment (2005) stated that over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history. The services these ecosystems provide are likely to decline with direct and indirect effects on human health and welfare. Soil does play a central role in ecosystem services, soil formation is mentioned as a most important support function for many them.
Many threats to soil have been identified. In the EU Soil communication (2002) eight threats were considered important enough to undertake action: Erosion, Organic matter decline, Soil biodiversity loss, Contamination, Soil sealing, Soil compaction, Salinization and Floods and landslides. The soil communication was followed by a well-organized discussion with experts from the EU member states and stakeholder organisations. The reports of this discussion have now resulted in a new EU soil communication, a proposal for a Soil Framework Directive and an extended impact assessment of various policy options. Soil is now high on the political agenda of the EU and ought to be so in the rest of the world according to the Millennium ecosystem assessment. However compared to other areas of environmental policy soil protection policy has been developed only recently, much later in most countries than policies for water and air.
The status of soil and soil contamination
Contamination refers to the present or past introduction (either direct through leakages, spills and applications of contaminated products or indirect through atmospheric deposition or contaminated surface waters) of chemical substances in the soil system by human activities that may lead to adverse effects on soil uses and functions and/or adverse effects in other parts of the environment. Older publications used to make distinctions between contamination (concentration above background value) and pollution (concentration above background value with adverse effects on soil uses and functions or on other parts of the environment). Contamination and pollution are nowadays used more or less as synonyms.
The invisibility of soil contamination, the heterogeneity of soils, and the fact that land is often privately owned makes it very difficult to make systematic quantitative assessments of the status of contamination in soils in Europe or worldwide. Real spatially representative information is lacking. Even in countries were a contaminated site remediation program is in place, only rough estimates exist about the number of sites that may need remediation. In view of the differences in national approaches even these data cannot be compared. The Working group contamination, one of the technical working groups established under the EU Thematic strategy for soil protection, considered

that a general qualitative description of the status of soil contamination is possible, which is good enough to serve as a starting point for policy making.
The general picture that emerges from the characterisations above is that soils in agricultural and natural areas are still in an acceptable state with respect to contamination but are under pressure. Taking into account average land use distributions in EU, it may be generally concluded that approximately 70% of EU soils are still in reasonable shape, with the exclusion of problems occurring in localised areas. However if pressures continue at the current level, as it is already evident in some problem areas, impacts will start to occur on a larger scale. Because the negative effects on the quality of soils are hard to remediate, these pressures should be addressed in time. On the other hand many urban soils and sediments are already heavily affected. Prevention should stop further deterioration and the risks of the currently contaminated land should be adequately managed. There is enough sound scientific information about the socio-economic drivers, the pressures on landuse by human activities and the impacts of a bad soil status to justify the development of a soil protection policy.
In view of the consideration mentioned above the working group proposed four specific policy strategies concerning respectively:

- Local sources of contamination,
- Agricultural soil uses,
- Management of contaminated land
- Large-scale diffuse pollution.

The strategies are related to the way the land is used and identify the owner/user of the land as the primarily responsible party for soil protection, recognizing of course that large-scale contamination from diffuse sources is beyond the control of the individual owner of the land. These must be brought under control at larger special scale by regional of national resource management policies.
For contaminated land the owner of the land should be made responsible for managing and improving the situation, in the case that the polluter cannot be legally addressed. In many contaminated land situations resulting from past industrial activities it may be impossible to apply the “polluters pay principle”. Management and remediation of contaminated land can be based on risk-assessment and risk-management approaches described in the reports of the CARACAS and CLARINET concerted actions. These concerted actions showed the benefits of the long tradition of European and international networks of national policy makers and scientific advisors. In good cooperative discussions with industry led networks like NICOLE a state of the art contaminated land management practice has now evolved.
Current developments in EU soil policy
A new policy package has been proposed in 2006 which consists of:

- A proposal for a Framework Directive for the protection of soil (SFD).
- A Communication laying down the way forward and addressing issues not tackled in the SFD
- An Extended Impact assessment (economic and environmental) based on the recommendations of the working groups

The proposed Soil Framework Directive tries to establish a common systematic approach for assessment and remediation of contaminated sites in EU. Harmonisation of some natural scientific aspects of contaminated land risk assessment in EU may be possible, but a uniform contaminated land policy will be much harder to achieve, given the different national situations in the Member states and the different evolution of national contaminated land approaches. Most national approaches have already evolved from sectoral soil-oriented and chemical substances-oriented policies to more system-oriented and adaptive management approaches under headings like “revitalisation of brownfields” “sustainable urban development” and “Riverbasin management”. These integrated approaches are supported by results of many EU funded research projects. Integration means that “pollution” is only one of the many aspects that have to be addressed. Integrated approaches are more complex, but this can be an advantage because more stakeholders are involved that can contribute to the solution and gain benefits from it, and different policy goals, like attractive urban landscapes and job creation, can be reached simultaneously.
The main elements of the policy regime concerning contaminated land imposed by the proposed Soil Framework Directive are:
1] A systematic inventory of contaminated sites
2] A remediation program for those sites according to (risk based) priorities
3] A soil status report has to be produced when a suspect site is sold. The report is made available to the other parties (buyer or seller) and the public authorities.
The way the contaminated sites problem is presented in the draft Soil Framework Directive does reflect a classical sectoral soil oriented contaminated land policy approach. This is understandable because it is a directive aiming to protect the soil environment. It is quite difficult to make regulations that need to integrate with many other policies and regulations already in place, in a directive, which deals exclusively with the environmental aspects of Soil. The classical soil oriented approach may be a good starting point for those countries which still have to start a national policy. However in other countries, which have dealt with contaminated land for thirty years, political attention has shifted from command and control regulation to policies facilitating and stimulating brownfield regeneration. Many INTERREG (EU funded regional development) projects have put this integrated approach into practice. Trying to solve a soil contamination problem first without addressing the wider socio-economic context may lead to conflicts with other wishes of society and tends to be very expensive, as several experiences have shown. Replacing an integrated national approach which is adapted to the national situation by some “EU averaged approach for soil contamination only” is likely to lead to less effective ways of dealing with contaminated land problems. This is the dilemma the current discussion about the contaminated land part of the proposed a Soil Framework Directive has to face: How to promote a common approach which integrates soil protection, spatial planning, management of water resources and sustainable socio-economic development with sectoral soil oriented regulation.

S12.L.01
Management of contaminated soils in Turkey: Legal framework and national programme development

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Contaminated land management in Turkey is regulated by the Soil Pollution Control Regulation. The regulation covers indicative and target values for some inorganic and organic pollutants. However, there is no specific document, which establishes principles and standard procedures for the identification, investigation, monitoring and remediation of contaminated sites. Consequently, contaminated land management in Turkey is not based on a systematic approach. Sites are mostly identified after some potential problems become obvious and public, like the toxic barrels found in Tuzla Orhanli and the BOTAS pipeline leakage near Atatürk Dam. Illegal dumping, temporal disposal of industrial wastes and metal ore processing residues, oil leakage from pipelines and storage tanks are the main sources of soil contamination. An inventory for contaminated sites does not exist. However, the expected number of contaminated sites is reported to be in the range of 1000-1500, of which 5-10 % is believed to require remediation. Remedial measures taken are generally based on removal of contaminated soil from area followed by incineration or sanitary landfilling. Soil contaminated by hazardous substances is mostly

incinerated at the IZAYDAS incineration plant. For the remediation of petroleum contaminated soil, bioremediation is also considered.
The development of a national programme for the management of contaminated soils is in the planning phase. This programme will enable the development of methods and techniques for the identification, investigation, classification and remediation of contaminated soil. Another project on "The Development of a Management System for Point Source Contaminated Sites," is currently carried out by the Ministry of Environment and Forestry together with the Middle East Technical University. The project aims to adopt specific soil quality standards based on land use, to develop a contaminated sites identification and registration system, an evaluation system, a computer software for the contaminated sites information system and several technical guidelines.

S12.L.02
Development of a decision making tool for remediation of contaminated sites in Austria

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In Austria remediation of contaminated sites is currently based on a number of laws that were not originally created for the management of contaminated sites. In the past and even today protection of the groundwater is the major rationale for performance of remediation actions. Considerations regarding protection of the soil (and the vadose zone) and the current and future use of a site still remain to a big part in the responsibility of the experts at the responsible authority.
On this background a group of scientists from the Austrian Research Centers Seibersdorf and the University of Natural Resources and Applied Life Sciences, Vienna performed a study supported by the Austrian Environmental Protection Agency leading into a concept paper for the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. This concept paper shall provide a possible frame for an amendment of the so called ALSAG (= Altlastensanierungs[[Unsupported Character - Codename]]gesetz = law for remediation of contaminated sites). This law currently regulates mainly the governmental funding of remediation actions, whereas the basis for a decision about (remediation)-measures is scattered among a number of other laws.
In the concept paper the authors suggest a tiered approach, with refined risk assessment in every step based on additional investigations. The risk assessment should be receptor specific and should depend on the site use ("fitness for use"). Based on the investigations and risk assessment in every tier a decision can be made, if measures (including various remediation measures, but also access restrictions etc.) shall be taken, or if proceeding to the next step makes sense.
The content of the concept paper and ongoing activities will be presented.

S12.L.03
Sustainable management of trace element contaminated soils - The SUMATECS project

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The development of "gentle", in-situ remediation technologies (i.e. phytoremediation, in situ immobilisation, etc.) has been under intensive research over the last few decades (see Figure 1). A great deal of progress has been achieved at the experimental level, but the application of these technologies as practical solutions is still at its early stage. On the one hand, methods for determination of the trace element (metals and non-metals) fractions relevant for their ecotoxicology (i.e., the bioavailable fraction) still have their limitations since they may insufficiently reflect the potential risks. On the other hand, a number of in-situ remediation options are available and thus a decision tool system has to be developed allowing to choose the most suitable technique. TECS (trace element contaminated soils) management moved into a new century where environmental decisions must be 'socially-robust' within a context of sustainable development & is a part of the conceptual framework "Risk-based land management". All efforts need to ensure management and/or remediation is affordable, feasible, effective & sustainable.
The aim of this project is to make a literature and project-based review (including country specific state of the art and current procedures) to identify the current status of research and application in Europe and to (i) derive decision tool systems, remediation scenarios including the potential impacts on the local environment and (ii) define further research needs.
This project was launched under the umbrella of SNOWMAN, which is a network of national funding organisations and administrations providing the research funding platform for soil and groundwater bridging the gap between knowledge demand and supply. SNOWMAN is one amongst more than 70 ERA-Nets (European Research Area - Networks) being funded by the European Commission's 6th Framework Programme for Research and Technological development. Further information is available at http://www.snowman-era.net and http://www.rhizo.at/Sumatecs.

S12.L.04
The detection of outliers in trace element content in soils based on the French Soil Quality Monitoring Network

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Knowledge about natural pedogeochimical background and diffuse contamination of the soil is essential to soil remediation stakeholders to manage soil pollution at best. Our study tends to overcome the lack of information concerning these two issues in France.
Thus we measured the content of nine trace elements (Cd, Co, Cr, Cu, Mo, Ni, Pb, Tl, Zn) in the French topsoil (0 to 30 cm) and subsoil (30 to 50 cm) from the Soil Quality Monitoring Net-work (RMQS) programme. The network is based on a 16 km x 16 km systematic grid covering the whole French territory (about 2,140 sampling sites) and has several goals: (1) to set up a na-tional assessment of the soil quality, (2) to detect evolutions and (3) to show gradients in the French territory.
For each trace element, we computed a statistical indicator taking into account the distribution of the trace element content in order to define and map regional threshold for outlier values: the fences are defined in terms of the hinges. To aggregate the data considering the local distribution, we calculated for each cell of the 16 km x 16 km grid the value of the upper fence from the data located in a 50 km radius
The maps of the threshold values highlight some areas of high contamination due to urban or in-dustrial activities or due to agricultural spreading like the copper contaminations in the French vineyards. Some areas of high natural geochemical background content are also pointed out.

The maps will be published soon and they will be available to remediation stakeholders but also to the general public via the Internet. For this purpose, the maps will be added to the INDIQUASOL (Soil Quality Indicators Database) map server, which gathers more than a hundred environmental indicators for the French soil quality.

S12.M.01
Advancing Innovative Remediation Technologies in Europe through Networking

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Market uptake of innovative soil and groundwater remediation technologies is disappointingly low throughout Europe because of stakeholder confidence issues. Technology demonstration is a vital component to improve confidence levels and therewith to provide better access to European or global markets.
To address this issue, the European Commission has launched the Coordination Action EURODEMO within the 6th Framework Program for Research and Technology Development, and in accompanying support to the Environmental Technologies Action plan (ETAP).
Between 2005 and 2007, EURODEMO has supported innovative remediation technologies by providing comprehensive information through reports, databases and promotional workshops. The information provided has been targeted on the defined needs of end-users who have been involved in an influential role since 2005. Within the project the first European network for demonstrating innovative remediation technologies has been established, and interesting national developments and knowledge sources for individual technologies, applications and processes have been identified and generated.
A continuation of these activities is a vital component of the multi-strand approach that is needed to challenge entrenched market barriers and to support the expansion of field implementation of technology innovation throughout Europe. An ongoing and dynamic European technology demonstration platform can actively and specifically support national remediation activities as well as pan-European co-operations for transferring innovative remediation technologies towards field application and routine use. Thereby, a shift to sustainable approaches for contaminated site remediation projects can be triggered.
In this presentation, some results of EURODEMO shall be illustrated, and the new technology platform EURODEMO+ shall be introduced.

S12.M.02
Feasibility in Application of Different Remediation Methods of Petroleum Pollutants in soil and its Algorithm in Industrial Case

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Pollution of soil and water resources with petroleum compositions is potent to damage our Environment. Petroleum Hydrocarbons which have solubility, volatility and ability to harm environment by releasing from refineries, streams or leakage from underground storage tanks (USTs) will penetrate into soil and underground water and negatively affect on their quality, as a result human health will be threatened. In a country like Iran which has many petroleum resources, soil pollution with petroleum components is not a new matter. After production of crude oil in last century, unfortunately this problem wasn't seen seriously, until by the passage of time, pollution has caused changes in balanced condition of basic resources, specially soil and water, reducing in production, and making critical situation for environment. Hence, now more than any other time, it feels the necessity of enacting compatible policies and rational solutions for cleaning environment in a course which is adaptable to environmental limitations. In this research, first environmental standards and acceptable ranges, which were announced by Environmental Protection Agency, were considered. Afterwards, various methods of remediation (Physical, Chemical, and Biological), which will be used in the world, were investigated and its algorithm was offered. The suitable method of cleaning, that is function of cleaning rate, investigation of in-situ remediation possibility, time, how to affect on close regions, and mixed application of remediation methods possibility, is necessary for optimization of efficiency and economic. Therefore, Feasibility of different cleaning methods and finally applying the proper method was advised. However, to apply that in industrial case, it should be considered economically. Results have shown that biological regeneration methods although have ability to compete with other methods, they also include lower cost than others and is compatible with universal environmental protection evaluation.

S12.M.03
Former/present and future risks of excess heavy metal input to terrestrial ecosystems

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Long-term deposition of heavy metals and sulphur due to emissions of the nickel processing industry in the Kola Peninsula, Russia, has caused a severe damage to terrestrial ecosystems. To evaluate ecotoxicological effects, a recently developed methodology to calculate critical loads for heavy metals was applied. To estimate former/present risks, critical metal contents in soil solid phase can be calculated and compared with the observed metal contents. For management of contaminated soils future risks are to be calculated; the latter can be expressed as long-term acceptable deposition loads, or critical loads of metals. The critical limit for ecosystem was defined as a critical free metal ion concentration in soil solution. To assess the critical leaching the total metal concentration in solution was calculated from the critical free metal ion concentration using a chemical speciation model. The results do indicate current and potential threats to soil functioning from high heavy metal depositions in the surroundings of the smelters. Critical contents for Ni and Cu are exceeded (for more than 30x for Cu in organic layer) over large areas around the smelters showing the necessity of soil remediation measures. Despite notable recent decreases in emissions, critical loads of heavy metals are still exceeded in the vicinity of the smelters, especially for Cu (>10x for organic layers and 100x for illuvial layers). The patchiness and relatively high Ni and Cu contents even in the background regions leads to the conclusion that combined effects of simultaneous heavy metal and sulphur depositions in combination with severe climatic stress is necessary to consider.
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S12.M.04
Effect of endophytic fungi on Cd tolerance of *Festuca arundinacea* and *Festuca Peratensis* grown in a hydroponic system

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Fungal endophytes are world wide distributed in graminoid species of Poaceae family. Endophytic fungi from genus

Neotyphodium have been found in many cool-season grasses such as Festuca species. The presence of the fungi has been associated with superior qualities in the host plant such as various biotic and abiotic stresses tolerance which may help using the plants in phytoremediation of heavey metal contaminated soils. . A greenhouse study was established to test the hypothesis that plants infected with endophytic fungi may be able to tolerate high concentrations of cadmium. Two infected and non-infected with endophytic fungi species (*Festuca arundinacea* and *Festuca Peratensis*) were grown in a hydroponic system with different levels of Cd^{2+} (0, 5, 10 and 20 mg L^{-1}) for 2 months. Metal-toxicity symptoms were only observed at 20 mg L^{-1} Cd^{2+} level. *Festuca Peratensis* had more biomass and Cd uptake in all treatments in comparison with *Festuca arundinacea*. Results showed that endophytic fungi can help the plant to tolerate high concentration of Cd and this depends on plant species.

S13 Buffering Function of Soils

S13.D.KL
From Atom to Pedon: Linking Processes to Phenomena and Function

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Soil is vital for the production of food and fibre for the provision of the Earth's primary renewable resources. It is the focal and connecting link between the information, matter and energy cycles of the hydrogeosphere and the atmosphere and plays a central role as a transformer, buffer, accumulator and filter of water, dissolved and dispersed particles. Its unique ability to process and accumulate inputs of energy and matter is the direct consequence of *the interplay and interaction of the diverse organic, inorganic and biological components which define a complex and hierarchically structured and extremely large biogeochemical interface.* Organic chemicals enter soil as dissolved species, attached to colloidal and suspended particles, and might be transported to deeper soil horizons, the vadose zone or even to the aquifer. The major amount, however, will react and interact with the biogeochemical interfaces, the ultimate causes of the phenomena of *dispersion, retardation* and *elimination.* Until recently, soils opaque nature limited our ability to explicitly characterize soils architecture and made impossible to explore in-situ the processes and properties which control bioavailability, bioaccessability and finally biodegradation, metabolisation and effect. Yet, the utilization of novel spectro-microscopic and spectro-tomographic characterisation and probing techniques in combination with advanced approaches in computational chemistry allows unravelling soils "interior". The joint application of those with sophisticated experiments and techniques from molecular biology and analytical-chemistry delivers insight into the reactions and interactions at biogeochemical interfaces, both in situ and in real-time over ranges of concentration, composition and environmental conditions. This ultimately holds the promise to link phenomena in and functioning of soils at the pedon scale to processes at the local "atomic" scale within a general mechanistic framework. The application of this approach, which is fundamental to the priority program "Biogeochemical Interfaces in Soil", will be demonstrated by the example of hydrophobic organic contaminants in soils.

S13.D.01
Fate of pesticides in soil porosity using Lattice Boltzmann and X-ray computed tomography

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Retention of pesticides in cultivated soils is mainly influenced by soil organic carbon content. In some cases, clay content can also affect sorption of pesticides. Heterogeneities of physical (structure of soil), physico-chemical (adsorption/desorption) and biological origins contribute to the fate of pesticides in soil. Heterogeneities are implicitly described in macroscopic transport models of solutes in soils by the use of non-equilibrium transport models: two-porosity, multiple-permeability, kinetic sorption. In this work, we used the discrete Lattice Boltzmann modeling approach to explicitly describe the flow and transport in the presence of real soil heterogeneities. Structure of soil was obtained by 3D X-ray computed tomographic images of a clay-loam soil (68 microns resolution). The soil samples contained fresh organic matter residues (wheat straws). Resolution of the images was of 68 microns. The tomograms were studied to detect different levels of density indicating different nature of soil constituents such as particulate organic matter, organo-mineral phase and void. The high quality of the tomographic images allowed to distinguish particulate organic matter from porosity and organo-mineral phases. Reactive sites governing retention of pesticides were thus localized in the 3D pore space and introduced in the model. Heterogeneity of reactivity of pesticides was further modeled by ascribing different reaction kinetic laws (adsorption/desorption and degradation of pesticides by laws of first-order) to the particulate organic matter and organo-mineral phase. The impact of adsorption/desorption heterogeneities has been tested by simulation of advection-diffusion, retention and degradation processes in Stokes flow in the 3D soil images.

S13.D.02
Surface properties of hydrous iron oxides: a model study

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Hydrous iron oxides like goethite, ferrihydrite or lepidocrocite represent a large class of minerals with a considerable geochemical relevance. They are common minerals found as weathering products in soils. They are characteristic by a high specific surface area what determines their large sorption capacities and their importance in sorption processes in soils. Their composition and surface structure have a crucial importance for their chemical behavior in aqueous systems, driving sorption, dissolution and precipitation processes as well as redox reactions. Therefore, it is of great interest to understand the surface structure and related properties of these minerals at an atomic level.
In this work a model study of the mineral goethite is presented using a density functional theory. Acid-base properties of different surface sites of the (110) goethite surface represented by hydroxyl groups (-OH, μ-OH, μ_3-OH) are calculated. Obtained proton affinity constants, pK_a, are compared with results from the multisite complexation model (MUSIC). The computed pK_a values for all sites of the modeled goethite surface were used in the prediction of the pristine point of zero charge, pH_{PPZN}. The obtained value of 9.1 fits well with published experimental values of 7.0-9.5.
Several experiments have shown that goethite plays an important role in the sorption of polycyclic aromatic

hydrocarbons (PAHs) in soils. Benzene, naphthalene and three PAHs (anthracene, phenanthrene and pyrene) are used in the systematic theoretical study of their interaction with the (110) goethite surface. The highest sorption affinity has anthracene since its linear structure better fits with the arrangement of the surface OH groups than in case of phenanthrene and pyrene.

S13.D.03
Estimation of heavy metal sorption in German soils using artificial neural networks

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Over the last decades, there has been a continuous increase in heavy metal concentrations in the environment as a result of human activities. The soil has been known to be the most important sink for heavy metals, while sorption is a major buffering process in soil. A reliable prediction of sorption of heavy metals in soil is therefore needed to understand the fate of heavy metals in the environment and properly assess the risks associated with their occurrence. The present study was conducted to parameterize an extended Freundlich isotherm as a function of basic soil properties using artificial neural networks (ANN). In the study we used soil data collected from 133 agricultural sites across Germany. Results were compared with those based on multiple linear regression (MLR). Artificial neural network models were derived for 9 heavy metals (Cd, Cr, Cu, Mo, Ni, Pb, Sn, Tl, and Zn) using between 9 and 11 soil properties as well as solution phase concentrations as inputs and sorbed phase concentrations as output. The performance of the models was assessed by the root mean square error (RMSE) and modeling efficiency (EF). Comparisons were made based on EF. For the ANN model, RMSE ranged from 0.04 (Cd) to 0.1 (Cr) while EF ranged from 0.80 (Cr) to 0.95 (Cd). The ANN models outperformed the MLR approach in all cases with differences ranging from 0.03 to 0.14. Improvements were most pronounced for Cr (0.14) and Cu (0.11). Dividing the data into top- and subsoil samples showed that ANN performance was generally better in topsoil. Our study shows that ANN is a versatile tool for the estimation of heavy metal sorption when data is in abundance.

S13.D.04
The role of hydrogen bonds and cation-bridges on the thermodynamic stability of humic acids: modeling study

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Humic substances (HSs) constitute a major fraction of the dissolved and particulate organic matter in natural ecosystems and provide numerous sites for adsorption and chemical reactions. They are generally recognized as large macromolecular, amorphous species of variable size, structure and chemical composition making its modeling a complicated task. The most active sites in humic acids (HAs) are carboxyl groups therefore, oligomers of polyacrylic acid with different length have been chosen as model compounds for HAs in the present work. The capability of them to form hydrogen-bonded complexes is demonstrated through the interaction with acetic acid, the herbicide (4-chloro-2-methylphenoxy) acetic acid (MCPA). Moreover, deprotoned carboxyl groups are able to form very stable cation-bridged complexes. This is investigated as well. All calculations were done by means of density functional theory. Solvation effects, as an important phenomenon, were computed by means of a combination of microsolvation (explicit insertion of water molecules) and global solvation (polarizable continuum approach). The stability of hydrogen bonded complexes in solution is characterized by a strong competition between solute and solvent molecules. The cation-bridged complexes of the negatively charged (deprotonated) ligands were found to be strongly favored explaining the capability of humic acids to fixate anionic species from soil solutions and the ability to form cross-linking structures within the humic acid macromolecules.

S13.E.01
The three-dimensional structure of soil organic matter

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One of the most valuable ecological potentials of soil organic matter (SOM) is based on its highly dynamic nature enabling flexible reactions on a variety of environmental conditions. SOM controls large part of the processes occurring at biogeochemical interfaces in soil and may contribute to sequestration of organic chemicals. This presentation focuses on understanding of these dynamics in SOM from a new viewpoint regarding SOM as amorphous matrix. The dynamics addressed in this view are mainly based on "weak" intermolecular interactions rather than covalent binding.
Our central hypothesis is that physicochemical SOM matrix aging, driven by dynamics in intermolecular cross-linking via bridges of water molecules and multivalent cations, is responsible for sequestration of heavy metals and organic chemicals and for the dynamics of water repellency. In our study, we artificially induced various states of cross-linking in soil samples and investigated the thermal characteristics, desorption kinetics of representative chemicals in various stages of aging, as well as the wettability of the modified samples. This presentation gives an overview on experimental significance of cross-linking via water or cation bridges for sorption characteristics as well as for the development of water repellency in soils.

S13.E.02
Effect of soil moisture status on sorption processes of xenobiotics in soils

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Previous studies show high variability of soil sorptive properties with variations of soil moisture content. In this study, the influence of water-induced alteration of soil organic matter (SOM) matrix rigidity and sorbate chemical properties on contaminant sorption to natural soils is investigated. The effects of soil water content, structure of SOM, and molecular properties of sorbates on contaminant sorption processes are elucidated in batch experiments. We use naphthalene (NAP), naphthalene-2,7-diol (27-NOL), 2-hydroxynaphthalene (2-NOL) and 2-methylnaphthalene (2-NME) as model xenobiotics. Sorption is investigated on a peat and a gley soil under varying water content at different time steps. SOM rigidity at the particular water content is characterized by techniques such as Differential Scanning Calorimetry (DSC), while computational chemistry is used to model interactions of the sorbates' functional groups with the SOM matrix. Sorption results will be presented in dependence on the sorbate and sorbent properties. Small differences between the molecular properties of the model compounds, such as molecular weight and functional groups, will significantly influence sorption behaviour. Additionally, sorption rates are expected to vary at low and intermediate soil moisture contents depending on plasticizing or crosslinking effects of water and decrease at high water contents due to competitive effects. First DSC results show that, at room temperature, SOM in the air-dry peat soil shows high matrix rigidity, presumably due to crosslinking of polar humic and fulvic acids by water molecules. Highly non-linear isotherms of NAP and 27-NOL sorption to this soil also indicate such a "glassy" structure. Sorption of 27-NOL to the investigated peat is stronger than sorption of NAP. Apparent Freundlich sorption coefficients decline with water content from 149 to 111 for NAP and from 250 to 169 for 27-NOL. The combination of data from sorption experiments with results from computational chemistry will establish new insights into contaminant sorption research.

S13.E.03
Influence of soil properties on solute and extractable Trace Metal in French forest soils

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Critical loads for Trace Metal (TM) aim at limiting air pollutant emissions for ecosystem protection. A critical load of a substance is defined as the rate of deposition of a harmful substance below which damage to sensitive components in the environment will not occur, according to current knowledge. Indeed, TM (Cd, Cu, Co, Cr, Ni, Pb, and Zn) availability and potential toxicity to sensitive sensor is governed by their concentration in soil solution, since soil solution is a vector of available metal to plant, microorganism and soil invertebrates. Consequently, to assess critical loads for TM in forest ecosystems, TM concentration in soil solution must be known for different soil conditions. However, these concentrations are hardly measured and therefore only few data are available in the literature. On the opposite, total metal content and some other soil parameters are frequently measured and much more data are available. This study aims at determining and evaluating the possibility of defining pedotransfert functions linking soil parameters, such as total metal content, soil pH or organic matter content to TM concentration in soil solutions. This will allow assessing ecosystem sensitivity to atmospheric pollution at regional and national scale.
Twelve soil profiles from six French forest sites were sampled and analysed for total TM content, TM available fraction (0.01M $CaCl_2$ extraction) and a range of soil properties including pH, soil organic matter, CEC and texture. Moreover, soil solutions were extracted from fresh soil centrifugation.
Regression analyses are performed to determine the most significant parameters to predict TM concentration in soil solutions. pH is found to be the most significant parameter to estimate TM extractability in soils (accounts for up to 81% of the extractability variance for Cd). Total metal content, soil pH and soil organic matter efficiently predict TM concentrations in soil solution.

S13.F.01
The impact of soil organic matter loss on the soil's filtering capacity of the herbicide 2,4-D

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Recently, the loss of soil organic carbon (SOC) has been reported for some soils in New Zealand. Our objective was to investigate the impact of SOC loss on the soil's filtering capacity using 2,4-D as an example.
Our hypothesis was that the topsoil's filtering capacity depends on physical, chemical and biological properties at the aggregate scale and that they are related to SOC.
We selected two pairs of sites in New Zealand. The sites within each pair had the same soil type, texture, land-use and climatic conditions, but they had significantly different SOC contents.
The first pair of sites was soils under the tree rows of apple orchards. One site was an integrated and the other an organic fruit production system. The second pair of sites consisted of soils under a camp and a non-camp site of a permanent pasture. The water-stable aggregate size distributions of the silt loam soils of the sites were dominated with 83% and 91% by macroaggregates. The SOC contents of the aggregates ranged from 1.8 to 3.9% for the orchard and from 4.6 to 9.2% for the pastoral sites. Higher SOC contents tended to have a positive impact on biological, but a negative impact on the physical filtering-related aggregate properties. For example, the pastoral soil with the highest SOC had the highest C-mineralization rates but also extremely small water sorptivities due to the occurrence of hydrophobicity. The sorption for 2,4-D acid was positively correlated with the SOC contents. We will also present the impact of the SOC contents on the degradation rates of 2,4-D.
Currently we are measuring the leaching of a conservative tracer and 2,4-D acid at the various sites under dry initial conditions. We will present the analysis of the breakthrough curves and discuss their relation to the aggregate-scale SOC contents and properties.

S13.F.02
PAH leaching at the laboratory scale - Comparison between saturated and unsaturated flow

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PAHs (polycyclic aromatic hydrocarbons) are major soil pollutants, since they are present in former industrial soils, and particularly in former coking plant locations. Their behaviour in the soil needs to be investigated, to evaluate their possible migration to the water table. At the laboratory scale, three leaching experiments were carried out using a stainless steel column (i.d. = 9.4 cm, h = 20 cm) containing a contaminated soil from a former coking plant. Two experiments were run under saturated conditions (one with a 140 µm stainless steel filter and one with a 0.5 µm stainless steel filter) at 3.5 mL/min. The third experiment was conducted under unsaturated conditions at 3 mL/min with a suction of 30 cm at the bottom of the soil column. PAH concentrations, pH and total organic carbon (TOC) were monitored in the collected fractions.
Both experiments carried out under saturated conditions showed that PAHs could be divided into two groups : the ones with the lowest molecular weights (three rings, in addition to fluoranthene and pyrene with four rings), which migrated in the dissolved state, and the ones with the highest molecular weights, transported in association with colloids bigger than 0.5 µm. Almost no PAH was detected at the column outlet under unsaturated conditions.
In addition, the curves representing the total organic carbon versus the leached pore volume showed exactly the same shape. They strongly decreased during 5 pore volumes and reached a low value that remained constant to the end of the leaching test. During the first leached pore volumes, the TOC concentration was a little higher under unsaturated conditions, than under saturated conditions. These results tend to prove that PAH transport was not completely correlated to organic matter transport.
Experiments at the field scale are in progress, in order to validate laboratory results.

S13.F.03
Influence of progressing pedogenesis on the buffer function of floodplain soils

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In the course of pedogenesis, soil properties undergo significant changes caused by a variety of processes that operate on different time scales, such as accumulation and transformation of organic matter, formation of secondary clay minerals and oxides as well as acidification. Consequently, progressing pedogenic development alters a soil's retention capacity for plant nutrients as well as organic and inorganic pollutants. Soils of river floodplains are in an early stage of pedogenesis and are strongly influenced by the nature of the deposited sediments (e.g., igneous or calcareous parent material, degree of pre-weathering, particle size distribution) and by their alterations through soil forming processes with increasing soil age. In order to quantify changes of the soils' buffer capacity over time, we analysed soil profiles from lower (younger) river terraces to higher (older) terraces from the Rivers Ebro/Spain, Elbe/Germany and Danube/Austria. Age gradients of the studied soils covered up to 3000 years and revealed significant changes in soil properties. Sorption capacity analysis included adsorption and desorption experiments with heavy metals (Cu, Cd), phosphorus as well as selected organic compounds (naphthalene, naphthylamine, naphthol). Our study showed an increasing binding capacity for Cu and Cd and a decreasing desorbability with progressing soil development. In the Danube soils, retention of phosphorus was strongly related to dithionite-extractable Fe, Al and Mn as well as the soils' particle size distribution, but showed little response to 500 years of pedogenesis. The sorption behaviour of organic model substances was significantly affected by pH and organic matter content, which both change with soil age and development.

S13.F.04
Leaching of glyphosate on partly sealed urban areas

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As the herbicide Roundup (a.i. glyphosate) is not only used in agriculture but also for weed control on partly sealed urban areas, the transport behaviour of glyphosate thereon was investigated in order to see if a risk of leaching of the substance into lower layers of the pavement bed or into the ground water exists. Therefore batch-sorption, column and field experiments with simple lysimeters were conducted.
For the field experiment three lysimeters (5m x 1.4m, height of 0.3m, 4 outlets) with different pavement coverings were built according to construction guidelines for pavements. As the walls overtopped the surface no runoff was possible, causing unnatural conditions.
Roundup Ultra (a.i. glyphosate) was applied with the roller wiper "Rotofix" according to common practice. 24hours after the application the areas were artificially irrigated. Thereafter no artificial irrigation occurred. The experiment lasted 5 months. At the end of the experiment the lysimeters were digged up in layers. For information about flow characteristics two tracer studies with bromide and brilliant blue were included. Depending of the surface covering 0.3 to 15% of glyphosate and 2 to 58% of the equivalent of the applied active ingredient were leached out within this time. For all coverings preferential flow was observed. A Kd-value of 5 was determined via batch sorption experiments for the fill material.
In column experiments with the fill material of the field experiment, leaching of glyphosate with the matrix flux was observed. More than 30% of the applied radioactivity was leached. This supports the finding of glyphosate leaching with matrix flux in lysimeter experiments. For columns filled with materials with higher Kd-values for glyphosate no leaching occured and an accumulation in the upper layer was observed.
The obtained results will be analysed with the numerical model HYDRUS 1D/2D.

S13.F.05
Transport of Reactive Anions and Cations in a Volcanic Soil: Experiments and Modelling

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Agricultural crop fields are commonly amended with nitrogen and heavy metals, such as using rich pig manure, which can lead to soil and groundwater pollution. The ability to predict accurately water flow and solute transport into and through the soil is essential for an effective management of such fields.
To study the impacts of a pig manure amendment on the retention and flux of chemical elements in the soil from the Reunion Island, we constructed three large columns (85 x 40 cm) from a Nitisol in a laboratory. Over a 120-days period one untreated column and two amended with pig manure received regular amounts of water of 200 mm a week (tropical conditions). Soil moisture regimes of the soil were continuously monitored at four depths (17.5, 30, 55 and 85 cm). Hydrodynamics functions, exchange properties of the soil and mineralization of the spread pig manure were also measured.
The hydrobiogeochemical program HP1 was selected for the study to simulate variably-saturated water flow and transport of chemical elements in the soil columns. The HP1 model couples the previously separate HYDRUS-1D software package accounting for variably-saturated flow and solute transport with the PHREEQC code simulating equilibrium and kinetic biogeochemical reactions.
Experimental and modelling results showed that there was an interaction between anions and cations in the soil exchangeable phase. While all copper and zinc were retained in the first horizon of the soil, nitrate, calcium and potassium also interacted with anion and cation exchange complexes, chloride and sodium were less adsorbed and thus more mobile. The rapid manure nitrification led to an acidification of the soil solution mainly in the surface soil horizon.
These results present evidence of the specific mechanistic exchange properties of a volcanic soil under tropical conditions.

S13.F.06
Oxidation of anoxic soils and sediments: how can we evaluate the risk of heavy metal release?

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The understanding of the behaviour and fate of contaminants in soils, sediments and dredged materials is essential to deal with their management. In the present study, heavy-metal contaminated anoxic soils and sediments originating from different locations in Flanders were exposed to oxidizing conditions during 20 weeks. The possibility to predict and quantify the evolution of sediment properties and porewater composition during sediment ripening, based on relevant physico-chemical properties and based on the results of leaching tests and/or rapid oxidation tests ('resuspension experiment'), was assessed.
In general, for all the samples studied, pH was the most important factor explaining heavy metal release during oxidation. Clay-rich samples mostly displayed a higher acid neutralizing capacity than sandy samples, which resulted in a less important pH-decrease during oxidation and a more limited release of heavy metals. Surprisingly, the most important release of Zn was measured in the sediment with the lowest total Zn-concentrations.
Additionally, other factors, such as the precipitation of Fe-(hydr)oxides or the formation of secondary minerals influenced heavy metal concentrations measured in the porewater.

In the resuspension test, the oxidation rate increased with a factor of 4 to 10 compared to the 'normal' oxidation. Nevertheless, the patterns of metal release and the evolution of soil or sediment properties (e.g. pH) were similar in both types of oxidation experiments, so that the resuspension test can be used to predict heavy metal release from contaminated soils and sediments.

S13.G.01
Wastewater irrigation affects soils' filtering of atrazine: A laboratory study

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Land application of wastewater is a popular alternative to direct wastewater discharge into water bodies. While soils and crops benefit of the added nutrients and organic matter (OM), long-term risks such as potential aquifer contamination by wastewater-borne chemicals and pesticides mobilised in the irrigated soils are not fully assessed. Wastewater irrigation changes soil properties: Soil pH, OM content, biomass and degradability of OM tend to increase. Results of experiments that examined the effect of wastewater irrigation on pesticide sorption, however, are inconsistent. In the Mezquital Valley, Mexico, crops have been irrigated with untreated municipal wastewater for 100 years. Our objectives were to analyse (1) how wastewater irrigation affects the filtering of atrazine, and (2) if this effect is related to the length of irrigation. We compared atrazine sorption to soils that have been irrigated with wastewater for 40 and 100 years with sorption to freshwater-irrigated soils. The use of inert water tracers in column experiments and the subsequent analysis of the tracers' breakthrough curves allowed the calibration of the hydrodynamic parameters of a mobile-immobile convection dispersion model. Sorption and desorption isotherms, determined in batch and column experiments, showed enhanced atrazine sorption in wastewater-irrigated soils, while desorption was decreased and slowed down. The analysis of the soils' clays with X ray diffraction and OM fractions (obtained through chemical dissolution) with FTIR will help to investigate the role of various sorbents on pesticide transport in irrigated soils as our soils have the same soil type and climate but different wastewater irrigation history.

S13.G.02
Release of Cd, Pb and Zn from substrates of a former Pb smelter site

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The release characteristics of Cd, Pb and Zn from two highly contaminated ash-like substrates from a former Pb smelter site were studied by various approaches to estimate possible contaminant export. We carried out soil extractions (soil saturation extract (SSE) and S4 extracts with a soil:solution ratio of 1:10) and column experiments with two flow velocities and four flow interruptions (4 h to 21 d). The eluates were analysed for metals and pH. The breakthrough curves were inversely modelled by fitting the concentration data to the advection-dispersion equation by using the numerical code RICHY considering rate-limited desorption. Several physical and chemical soil properties were determined including sequential metal extraction, total element contents, soil texture, C and pH. High total contents of Cd (104 mg kg^{-1}), Pb (19 g kg^{-1}) and Zn (27 g kg^{-1}) were detected. The substrates were weakly acidic (pH 6.3) and contained approx. 160 g total C kg^{-1}. The column experiments indicated rate-limited release of the studied metals due to pronounced effects of the flow velocities and the flow interruptions with increased concentrations after restoring the flow. In the column experiments, release of Cd, Pb and Zn was very slow (k approx. 10^{-3} min^{-1}), but high maximum concentrations were found (Cd 282 µg l^{-1}, Pb 435 µg l^{-1} and Zn 34.4 mg l^{-1}) in spite of the relatively high pH. The amounts of metals extracted by the S4 procedure were much higher than those extracted by the SSE method (e.g. S4: Pb 5.7 µg g^{-1}; SSE: Pb 0.4 µg g^{-1}). Concentrations of metals detected in S4 extracts are very similar to those of the column eluates. Additional studies will characterise the mineral phases governing metal release.

S13.G.03
Modifications of pH-dependent heavy metal solubility through mineral and organic amendments

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Soils in residential areas of the Rhine-Ruhr area generally contain elevated concentrations of heavy metals. In-situ immobilization would be an attractive option to reduce risks and enable a continuation of the current land-use. In order to test the sustainability of such measures, laboratory sorption and soil acidification experiments were conducted with amended and control soils. The total metal contents of the soils were Pb: 400-1000 mg kg-1, Cd: 2-12 mg kg-1, Zn: 300-1500 mg kg-1. The most promising materials were phosphate (TSP), iron oxide (precipitates from ground¬water aeration for processing drinking water), Metasorb (commercial product), synthetic zeolite and TMT (Trimercaptotriazin, an organic sulphur compound used in industrial wastewater treatment). These were incorporated at rates of 0.5 to 2% w/w into the soils and then incubated at field capacity for 8 weeks.
Most additives increased the acid buffering capacity of the soils, except for TSP which caused slight acidification and therefore was also combined with lime. However, at a given acid addition, all treatments decreased Cd and Zn solubility. Here, the acidifying agents TSP and its combination with TMT were even most effective in reducing Cd solubility, while zeolite and Fe-oxide had the strongest effects on Zn solubility. When metal solubility was assessed at a given pH in these experiments, it became evident that the effects of most amendments was mainly caused by providing increased acid buffering capacity. When acidified to pH 5.5, Cd and Zn solubility in zeolite amended soil increased by a factor of 2 compared to the untreated control. Only the amendments containing phosphates and TMT reduced the solubility of the two metals at this pH. Similar results obtained with sorption isotherms show that phosphates, and Fe-oxides increase metal immobilization, most likely through a combination of precipitation and sorption mechanisms.

S13.G.04
Influence of pig slurry on sorption and transport of medicinal sulfonamide antibiotics in soil systems

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Sulfonamides are one of the mostly used substance classes of veterinary antibiotics, used for treatment of infectious diseases. After excretion from the treated animal, sulfonamides reach agricultural soils through the use of contaminated slurries and manures as fertilizers and may be dislocated to other environmental compartments. According to standardized test systems for risk-assessment of xenobiotics in the environment, the application of these organic chemicals to soils is carried out in water solution and therefore they do not respect the real entry path of sulfonamides to agricultural soils. In prior batch trials a higher mobility of sulfonamides in presence of manure was observed. Here the transferability of this effect to other experimental conditions was examined in sorption and breakthrough experiments in soil columns. The contribution of manure on mobility and depth distribution of sulfonamides was determined after application of four sulfonamides in slurry and water solution to soils, respectively. The distribution of sulfonamides in disturbed soil columns and soil leachates of different topsoils was examined and determined by LC-MS/MS after application of artificial rain over periods of 48 and 120 h, respectively. Sorption coefficients were modelled from breakthrough curves of sulfonamides using Hydrus-1D. Furthermore changes in distribution and composition of selected soil parameters and constituents of soils and soil leachates were determined. Selected physico-chemical properties of the soils and substances were related to sulfonamides distribution in soils. The results imply that sulfonamides mobility is highly affected by addition of liquid manure to soils, depending on soil type, sulfonamide and properties of soil organic matter.

S14 Organo-mineral Interactions

S14.L.KL
Mineral-organic associations in soil: a riddle wrapped in a conundrum inside an enigma ?

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Minerals and organic compounds interact intimately in the soil environment, resulting in mineral-organic associations that largely determine a soil's properties. The recently most highlighted aspect of mineral-organic associations is the stabilization of the organic component involved. Despite the research efforts of the last years, much of the nature of mineral-organic associations, their pathways of formation and their stability are poorly understood or still under debate. Although conceptual models have been developed, none so far is fully convincing.
Here, we summarize major findings and discuss them in the light of proposed concepts and with emphasis on open questions. These include (i) the formation and (ii) the stability of mineral-organic associations over time in different climatic and pedological settings.
Adsorption and (co)precipitation reactions of OM with minerals may lead to mineral-organic associations that differ in their physical and chemical properties, and thus in their reactivity. Surface area/nanoporosity studies suggest that pores <10 nm in diameter are preferred places to host and stabilize associated OM. Yet, the 'size exclusion concept' alone is insufficient to explain the stabilization. Strong multiple bonds, in combination with nanoscale agglomeration-aggregation, seem more relevant. The aging of soil minerals might also be closely linked to the turnover and composition of associated OM, pointing to a need for integrative approaches to assess the (co)evolution of mineral and organic matter in mineral-organic associations over pedological time scales. Mineral-organic associations, either formed in laboratory experiments or separated from soil, indicate that interactions of reactive minerals and OM can result in compounds where the volume of the organic component is dominant. Concepts explaining that propose either multilayer formation or coagulation effects. Finally, we highlight the decomposition of mineral-organic associations, which affects soil structure and is essential for the bioavailability of many elements.

S14.L.01
Stabilization of dissolved organic matter by sorption to amorphous Al hydroxide

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Amorphous Al hydroxides are strong sorbents of dissolved organic matter (DOM) in soils. However, their contribution to long-term C stabilization against microbial decay was not quantified so far. We carried out different sorption experiments with DOM from Oi and Oa horizons of two forest soils and quantified its contribution to C stabilization by incubating sorbed and non-sorbed organic matter (OM) in comparison to the original DOM samples. We covered a medium to high level of organic C loadings of the Al hydroxide for each DOM sample ranging from 0.2 to 1.2 mg C/m2. At a low availability of mineral surfaces, only small proportions of DOM were removed from solution by sorption. This small fraction of OM can be even better degradable than the original DOM despite its sorption to Al hydroxide. Probably, it consisted of compounds being rich in N and we assume that these compounds were bound to Al hydroxide by phosphate bridges. At a high availability of mineral surfaces aromatic compounds were sorbed preferentially and stabilized. From our results we conclude that the pool of sorbed OM consisted of two fractions; a small fraction being highly degradable and a large fraction being highly stable. Total C mineralization comprising sorbed and non-sorbed OM decreased by up to 50% after sorption. Sorbed OM contributed only minor to this total mineralization. Increasing the availability of mineral surfaces resulted in increasing stabilization. The organic C loading of the mineral surface was not decisive for OM stabilization. In turn, the percentage of C removal by sorption was the crucial parameter to predict the stabilizing effect of sorption. More than 30% of C should be removed from soil solution by the sorbent for efficient stabilization. The proportion of C removal increased with increasing aromatic contents of DOM resulting finally in larger stabilization.

S14.L.02
Precipitation or co-precipitation of organic matter by Al - controls and impacts

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The interaction between dissolved organic matter (DOM) and metal cations (e.g. Al, Fe) can remove substantial amounts of DOM from acidic soil solutions. These organo-metal associations were highly stable against microbial decay. However, it is unclear if the removal can be attributed to precipitation of DOM with metal cations or co-precipitation of Al hydroxides together with organic matter (OM). We studied precipitation/co-precipitation in four highly different DOM solutions at pH 3.8 and 4.5 under varying Al/C ratios (0.05, 0.1 and 0.3). At pH 3.8 the precipitated/co-precipitated OM had an almost constant Al/C ratio of 0.05 in all samples. This value can be explained if 10% of the C represents carboxylic groups of which on average two were bound by one Al cation. Thus, at pH 3.8 we have no indication for co-precipitation of OM. In contrast, Al/C ratios of OM precipitated/co-precipitated at pH 4.5 were clearly larger (0.06-0.29) and reflected the Al/C ratio in solution. We assume that at pH 4.5 Al hydroxide must have been formed, indicating co-precipitation of OM. This observation is in accordance with modelling results. Elemental analysis, ^{13}C and ^{1}H NMR and FTIR analysis showed that precipitated and co-precipitated OM had a similar composition. FTIR spectra further indicated that the type of bonds between OM and Al was similar in all samples, probably formed by ligand exchange. Laser scanning microscopy revealed that cross-linking of organic molecules by Al led to a very porous floc structure and increasing floc sizes with increasing pH, being of importance for OM mobility in the soil profile. About 2-5 times more Al was needed at pH 4.5 than at pH 3.8 to stabilize equal amounts of OM against microbial decay. In soils with only small Al concentrations this could be decisive for OM stabilization.

S14.L.03
Humic substances adsorption to iron oxides and its effects on adsorption of cations and anions

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Humic substances are major components in natural organic matter. Adsorption of humics to minerals is considered an important mechanism that stabilizes carbon in the terrestrial system. In this work, an advanced heterogeneous particle adsorption model, the LCD (Ligand and Charge Distribution) model was developed. The improved LCD model can describe the pH, ionic strength and loading dependency of both fulvic acids and humic acids adsorption to goethite. Interactions of humics with mineral surfaces influence strongly the adsorption of cations and anions. The strength of the effects of fulvic acids on Ca2+ adsorption is stronger than that on Cu2+ adsorption to goethite. This difference can be explained with the LCD model, and it is attributed to the differences in the charge distribution of these cations at goethite surfaces. At relatively high cation loading, the effects are largely due to electrostatic interactions for both Ca and Cu. But at low Cu loading, the formation of cation bridging type ternary complexes is required for good description. The LCD model can also give good prediction of the adsorption of phosphate and arsenate in the presence of fulvic acids or humic acids. This is very promising considering the fact that good prediction for this complex system requires correct handling of the distribution in space of the charge and of site competition for both the humic particles and ions.

S14.L.04
Sorption of Cr(III) on mixed montmorillonite Al-Fe humic acid complexes

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Although soil pollution by chromium(III) presents only a low health risk, a potentially significant toxicological hazard can result from Cr(III) oxidation to Cr(VI) by different oxidizing agents in soil. Hydroxy precipitates of Cr(III) are particularly important because appreciable mobilisation of hydrolysed Cr(III) from montmorillonite occurs in interlamellar space. In our study we used organo-mineral complexes formed from montmorillonites intercalated with Al and Fe polymers and complexed with humic acid (HA). The organo-mineral complexes were characterized by X-ray diffractometry (DRX), FTIR, TEM and SEM-EDS for elementary analysis and surface area determination. The adsorption trends of Cr(III) on the organo-mineral complexes were investigated separately and in all combinations in order to distinguish the effects based on the interactions of the components. Significant alteration of surface characteristics were observed with TEM and SEM, indicating the differential influence of Fe and Al on the organo-mineral complexes surface properties. The coprecipitated Al or Fe markedly decreased the sorption of Cr(III) in binary systems whereas the strength of Cr intercalation increased in Mt-Al-HA complexes. After Cr(III) adsorption, an alteration of surface complexes was observed by SEM, along with a significant increase in d(001) spacing by XRD patterns. The basal spacing of montmorillonite Al-Fe humic acid complexes was increased after Cr(III) adsorption, showing its intercalation. SEM images of the complexes after Cr(III) adsorption point to some important micromorphologic modifications. In particular, SEM observation showed that the Mt-Fe-HA complexes behaved as a non-oriented network, the ferrihydrite suspension was formed from particles of various shapes and dimensions, and the HA exhibited a sponge-like structure. The micromorphology of the ferrihydrite-HA association was close to that of pure ferrihydrite, while the Mt-Al-HA associations were similar to the basic structure of smectite. Data presented here, however, show that appreciable immobilisation of adsorbed hydrolysed Cr occurs in the organo-mineral complexes.

S14.M.01
Monte Carlo simulation of TPP+ arrangements in the interlayer space and at the external surface of Na-montmorillonite

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Unlike natural clay, organically modified montmorillonite is able to sorb anions, which makes it suitable for waste storage and sewage purposes. Currently applied experimental methods provide only partial information about its structure. To get more structural information, Na-montmorillonite modified with tretaphenylphosphonium (TPP^+) chloride was simulated using the Metropolis Monte Carlo method. The simulated interlayer content of TPP^+ varied between 8% and 100% of CEC. Two different initial arrangements of TPP^+ were considered taking into account experimentally derived suggestions: 1) three of the phenyl groups of all TPP^+ aligned to the same basal surface, and 2) half of TPP^+ rotated by 180° to reach a uniform distribution of phenyl groups between the two opposite basal surfaces of the montmorillonite. Pressure, temperature and number of particles were kept constant whereas the layer spacing was allowed to vary during the simulations.
The layer spacings, determined for the first arrangement, are between 17.4 Å for the lowest and 19.4 Å for the highest TPP^+ contents and show a very good agreement with experimental values. For this arrangement, a segregation of organic (TPP^+) and inorganic (Na^+, Cl^- and H_2O) phases is observed. On the contrary, the simulated layer spacings for the second arrangement agree with the experimental data only for lower contents of TPP^+. For higher contents of TPP^+, the experimental values are overestimated by 2-3 Å.
In a second series of simulations, TPP^+ ions up to content of 200% CEC are considered in aqueous solution at the external surface of montmorillonite. Experimental studies of organically modified montmorillonite show increase of the surface charge up to positive values for TPP^+ contents higher than 100 % of CEC, which suggests a possible aggregation of TPP^+ at the mineral surface. Simulations should give more information about the aqueous structure and TPP^+ arrangement at the water-montmorillonite interface.

S14.M.02
Adsorption of HDPy+ to muscovite- and montmorillonite-aqueous solution interface: A Monte Carlo study

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Structural issues of surfactant adsorption to mineral-aqueous solution interface remain largely unresolved despite the

considerable progress of experimental techniques. This contribution presents the results of a Monte Carlo study of hexadecylpyridinium ($HDPy^+$) chloride adsorption to the interface between aqueous solution and the external surface of muscovite and Na-montmorillonite. $HDPy^+$ contents of up to 300% CEC for montmorillonite and up to 100% CEC for muscovite are considered. OPLS-AA force field is used to describe interactions between atoms in the mineral-HDPy-Cl-water system.
This study shows that $HDPy^+$ ions are adsorbed directly to the basal surface for montmorillonite and to the first water layer hydrating the basal surface for muscovite. This is due to strong water interaction with the substituted tetrahedrons, which surface concentration is much higher for muscovite as compared to montmorillonite. The competition between $HDPy^+$ ions and exchangeable K^+ (muscovite) or Na^+ (montmorillonite) leads to an increasing detachment of inorganic cations from mineral surface with increasing $HDPy^+$ content within the first self-assembled monolayer. This detachment is accompanied with the movement of Cl^- ions away from the positively charged head groups of $HDPy^+$ ions adsorbed to the basal surface and appears to be facilitated through the formation of K^+-Cl^- contact pairs as compared to the case of Na^+-Cl^- pairs. However, it is only at the $HDPy^+$ content of ~100% CEC of muscovite that a K^+-Cl^- pair leaves the adsorbed $HDPy^+$ monolayer. On the contrary, in the case of bilayer arrangement of the adsorbed $HDPy^+$ ions, the concentration of Cl^- ions strongly increases at the upper boundary of bilayer with increasing $HDPy^+$ content, whereas inorganic cations remain near the mineral surface. Further discussion will give attention to the changes in the water structure, the structure of adsorbed $HDPy^+$ monolayer(s) and the conformational order of the alkyl chains of $HDPy^+$ ions.

S14.M.03
Increasing pH drives the release of organic matter in wetlands soils under reductive conditions

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Water saturation of the uppermost organic-rich soil horizons in wetland involves dissolved organic matter (DOM) release into the soil solution. Positive correlation between DOM, Fe(II) and Mn(II) concentration suggests that the establishment of conditions able to reduce Mn and Fe could be a key factor in enhancing DOM release . However, during soil bio-reduction, three mechanisms may account for DOM release i) release of organic matter (OM) bound to reductively dissolved Mn- and Fe-oxyhydroxides ii) desorption of OM from soil minerals due to pH change linked to reduction and iii) production of organic metabolites by soil biomass. Incubation experiments of wetland soil were conducted to assess the respective roles of each mechanism. Soil anaerobic incubation released 2.5% of the total soil OM as DOM. This release was accompanied by a pH increase (from 5.5 to 7.4) and by Mn- and Fe- reduction. Here, all mechanisms occurred simultaneously and mobilize DOM. Soil anaerobic incubation at a constant soil pH of 5.5 preventing OM desorption due to pH increase, released 0.5% of the total soil OM as DOM. Soil aerobic incubation at pH 7.4 preventing Mn- and Fe-reduction released 1.6% of the total soil OM as DOM. Finally, soil aerobic incubation at pH 5.5, preventing both Mn- and Fe-reduction and pH increase, did not release DOM.
Released DOM exhibits the geochemical characteristics of humic substances, thereby ruling out any significant role of metabolite production by microbes. Thus, the results show that reduction of wetland soils significantly release DOM to the soil solution. However, the dominant mechanism by far is OM desorption from soil minerals due to pH increase (>67% of the total amount of released DOM in the present study) and not the reductive dissolution of Mn- and Fe-oxyhydroxides.

S14.N.01
Bradford reactive soil protein, glomalin, accounts for a large proportion of organic matter in forest soils of Martinique, French West Indies

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Glomalin, first reported in 1996 by Wright & Upadhyaya (1996), is a glycoprotein produced by the hyphae of arbuscular mycorrhizal fungi and secreted into the soil where it may accumulate. In some soils, glomalin may account for a large proportion of soil carbon, and on a global scale may represent an important carbon sink. Oxides of iron and aluminium are thought to protect glomalin and decrease its turnover time. In addition, it has been suggested that, in common with fungal polysaccharides, glomalin may play an important role in the stability of soil aggregates.
We have studied the glomalin contents of soils sampled from A and B horizons of forest soils of Martinique, French West Indies. Both easily extracted (one short autoclave extraction in 20 mM sodium citrate solution at pH 7) and total (five 1-hour extractions in 50 mM sodium citrate solution at pH 8) glomalin contents were measured as Bradford reactive BSA-equivalent protein.
Glomalin contents ranged from about 1 to 36 g kg^{-1} accounting for up to 10% soil organic carbon. Such levels of glomalin are high although even larger levels have been reported for Chilian andosols. Glomalin contents were strongly correlated with organic carbon and allophane contents for surface soils. For sub-soils, glomalin content followed the same trend with organic C content as surface soils, but showed no significant relationship with allophane content. About half the soil glomalin was easily extractable in surface soils, whereas the fraction was smaller and more variable for B-horizon soils. This contrast between glomalin in surface and deeper horizons suggests that glomalin is transformed with time in contact with the solid phase.

S14.N.02
Characterization of organo-mineral associations by sequential density fractionation of two contrasting soils

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The degree of association of soil organic matter with the mineral matrix is considered a major control on organic matter stability. Fractionation of soils by density separation separates organic matter more or less associated with mineral matter, where the lighter fractions have generally been found to be more C-enriched with higher C/N ratios while heavier fractions have less C and narrower C/N ratios. The objective of this study was to fractionate two contrasting soils (an Alfisol and a Mollisol, separated geographically by ~100 km) under similar management regimes. Bulk soil samples (< 2 mm) were dispersed prior to a sequential density fractionation using a series of solutions of sodium polytungstate with increasing density. We recovered six density fractions ranging from < 1.6 g cm-3 to > 2.6 g cm-3, which were subsequently characterized for mineralogy and organic matter quality. Fraction mass, organic C and total N distributions differed significantly between the two studied soils. Thermal analysis of the density fractions showed that the organic matter associated with different density fractions differed within one soil type, as well as between soils. Our results indicate the importance of soil genesis and the major role of mineralogy in organic matter stabilization in the form of organo-mineral complexes.

S14.N.03
Weathering of ferric-oxyhydroxides in the humid tropics : a story of interactions between bacteria-organic matter and mineral

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The redistribution (solubilization-accumulation) of iron and weathering of ferric oxyhydroxides is a major process in soils of humid tropics. It leads to fundamental changes in soil properties. Formerly in such soils, the weathering and evolution were considered as based mainly on geochemical processes. Now biological parameters are considered through interactions between microbial, chemical, and physical phenomenons. Field studies and laboratory experiments have been performed to determine the main processes and the parameters involved, considering different soil sequences located in Brazil, Cameroon and New Caledonia.
Field measurements in soil waters, ground waters and swamps (pH, Eh, NH_4^+, NO_3^-, Fe^{2+}, metals, DOC…, screening of microorganims), suggest redox mediated processes and the occurrence of aero-anaerobic and anaerobic bacterial activities. Results of laboratory experiments simulating different environmental conditions and using soil samples originating from the different sites, underline the involvement of iron reducing bacteria both in the biodegradation of soil organic matter (SOM) and the weathering of ferric oxyhydroxides. Fermentative and non fermentative bacteria appear to be concerned. Calculation of weathering coefficients shows that, the bacterial mineralization of one organic carbon allows to solubilise from 0.06 to 1.29 iron.
The bacterial activities, located at the redox interfaces of the hill-side sequences and under the dependence of water movement, organic matter and iron availability, is the major agent of these weathering processes. However further characterization of bacterial communities and of the factors of control is required and is in progress to aid our understanding of their functioning.

S14.N.04
The hydromechanical response of soils with different clay mineralogy to biological exudates

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Plant and microbial exudates are critical to the formation and stabilization of soil structure. From research dominated by studies on the stability of aggregates, it has been postulated that exudates act as flocculating agents and glues that bind soil particles. When produced, exudates may wet up soil and the mechanical response under this condition will be critical to the subsequent formation of soil structure. In this study, rheological measurements quantified the viscoelastic behaviour of a range of soils following amendment with root or microbial exudates. Root exudates were simulated with polygalacturonic acid (PGA) and the microbial exudate was Scleroglucan produced by the fungus *Sclerotium rofsii*. Soils had contrasting clay mineralogy (2:1 vs 1:1) and textures. Viscoelastic behaviour was measured on wet soils over a range of water contents using a parallel plate rheometer.
Our results showed that biological exudates significantly increased viscosity in soils dominated by 2:1 clay minerals. In these soils, root exudates had a greater impact than fungal exudates. In 1:1 dominated soils the viscoelastic response was less clear. One 1:1 soil showed no impact from biological exudates. Another 1:1 soil showed that fungal exudates increased viscosity more than root exudates. Resilience tests were also conducted, defined by the mechanical stability and recovery following the application of a shear stress. If root and fungal exudates increased viscosity of a soil, they also improved resistance and recovery to stress. This suggests that the formation of the rhizosphere could be strongly controlled by the interaction between mechanical deformation by the root and improved mechanical resilience caused by the interaction between exudates and mineral particles.

S14.N.05
Pouloud, a model to predict the soil aggregate stability dynamics after the input of an organic product

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Soil aggregate stability is a keystone in the matter of soil fertility and erosion. One of the agricultural practices that can have an effect on aggregate stability is the input of organic products, like crop residues or manures. However, our ability to predict the effects of various organic amendments on soil aggregate stability is limited due to the complexity of the biological, chemical, and physical mechanisms involved. Based on previous experimental results, this study developed a model (Pouloud) to predict the dynamics of aggregate stability following the incorporation of various organic residues under field conditions. Following Monnier's conceptual model and previously published data, a lognormal function is first used to describe changes in aggregate stability after organic inputs under laboratory conditions. Using principal component analysis, the parameters of the lognormal function are associated with the biochemical characteristics of the organic products such as water-extractable polysaccharide, cellulose and hemicellulose, and lignin contents. To simulate aggregate stability dynamics under field conditions, the effects of soil moisture, soil temperature, and N availability are taken into account by specific functions obtained from the literature. When model simulations were compared with experimental results under field conditions, variations in aggregate stability were generally well reproduced. The sensitivity of the model to climate variations and organic residue characteristics was tested. Soil N availability and the substrate lignin content are major factors that influence the prediction of aggregate stability dynamics. Our results suggest that prediction of aggregate stability dynamics under field conditions using organic substrate characteristics and simple climatic data is possible. More work is required to test the model and broaden its applicability to other soil and climatic conditions.

S15 Soil Information Systems, Regionalisation of Soil Data including Soil Associations

S15.L.KL
Soil Information Systems - as an unifying factor in Soil Science

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Soil Scenice is a scientific discipline with a very broad scope. I tis based on soil data gained directly, measured (field, laboratory), or derived from indirect sources (remote sensing,

modelling). Data from different fields of soil science are usually complementary to each other.
It became a necesary tool for such applications as sol produktivity and fertility evaluation, land evaluation and land use planning, soil sustainability models, hydrological balance, flood alert systems.
The practical application of proposed ,,Soil directive“ of EU will be based on fully functioning soil information system. Delination of areas of soil threats (erosion, contamination, landslides, acidification, organic carbon loss ets) will need not only reliable measurement, but also reliable models.
In the frame of Europe big eford is belg paid to building of European Soil Information System, and European Soil Data Centre.
The future soil information system will more and more rely on digital soil mapping technologies.
At European scale the very important problem is not only the soil classification, but also the classification of soil combination patterns and regions. Soil associations are defined in term of soil combintions of dominant, condominant, accompanying and accessory soil units. They are characterized by following attributes: - combination pattern, - extrinsic characteristics(geomprphology, climate, vegetation-current, reconstructed), - land use, - soil rating,- limiting factors, - erosion hazards, management conditions.
Development Trends
The expected future trend in the field of pedology involves:
- completing the soil diabase at scale 1:250.000 and the modified SOTER system for the soil map of Europe, with a pedon database;
- joining on international programs, concerning soil survey interpretations;
- making use of the middle-scale maps for planning and the development of concepts of land use, management, soi conservation and protection;
- development of the innovative soil surveys at large scale, based on the synthesi s of existing soil maps, remote sensing and investigations into the heterogenity of selected sites and soil-geomorphic transects..

S15.L.01
Towards the European Soil Data Centre

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In order to ensure the provision of robust data and information on the state of the environment for the development of environmental policies at European Union level, the European Commission’s DG Environment (ENV), DG Joint Research Centre (JRC) and Eurostat, together with the European Environment Agency (EEA), together called “Group of four” (Go4), have decided at the end of 2005 on the establishment of “Environmental Data Centres”. These data centres will work in support of DG ENV, which will formulate its data requirements.
As part of a joint system and covering the thematic aspects of soil and soil related applications within the EU, the Environmental Soil Data Centre (ESDAC) will be established within the JRC. ESDAC will constitute the primary focal point for DG ENV for data and information on soil related issues, fulfilling DG ENV’s data and information needs. The role and features of ESDAC will evolve over time in line with the ongoing development and implementation of the envisaged Shared Environmental Information System (SEIS) for Europe.
This paper describes the importance of ESDAC for the European soil community, its founding priniples, its development plan for the coming years and the current state of afairs.

S15.L.02
Development of the Croatian Soil Information System

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Croatian Environment Agency (CEA) has started the development of the Croatian Soil Information System (CROSIS), as part of the central national Environment Information System (EIS).
CROSIS was designed as a distributed integrated hybrid information system that offers relational database data management functionality combined with spatial analysis, query and visualization features of the enterprise GIS solution available through thick client or web-based interface. Building the system required resolving a number of technical and non technical issues, like enabling inventory and monitoring data entry through the same user interface, providing access to different spatial thematic layers, building user friendly web-based interface for reporting, spatial analysis and presentation of results and responding to different user requirements from public to government agencies level, enabling use of the system in locations with different speed and availability of communication network.
One of the key requirements was the integration with the other relevant databases and/or systems. The integration was designed and implemented on three levels: on metadata level through the catalogue, on data exchange level through the central CEA’s EIS database and on user interface level through the standard CEA’s EIS web GIS portal. So far, the integration was made between the Landfill Cadastre, the Register of hazardous and potentially hazardous industrial facilities and the Potentially polluted and polluted sites database (GEOL).During the CROSIS design as a necessary data repository, the emphasis is given to data standardisation as well. With the EC contribution via Life Third Countries Program, CEA and Faculty of Agriculture have started the Project “Development of the Croatian Soil Monitoring Programme with a Pilot”. The main objective is to provide the basis for the development of Soil Monitoring System, with proscribed harmonized methods and standards for soil sampling, analysis, display and dissemination. Such system will ensure data integrity on national and EU level.

S15.L.03
A database for the monitoring of forest soils over Europe: data management for the Biosoil Project

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The Biosoil project carried under the scope of the Forest Focus EC regulation aims to constitute a European-wide database in order to monitor forest soil condition, and feed the Soil Profile Analytical Database of Europe (SPADE-M) with measured soil profiles. The final database will gather information on approximately 5000 plots dealing with soil classification, profile description and soil sample analysis over 2 survey rounds. This huge amount of data of different nature and of different origin has to be stored in a single database in order to be manipulated, retrieved for analysis and shared. Besides, soil related databases have to face two critical issues: the need to store properly not only the data but also the method used to obtain it; and the ability to check the data for errors, as many inputs are entered manually.
With these considerations in mind, we have designed a generic software architecture that comprises:

(1) the central relational database that favours generic tables because they are more suitable for analytical menu changes;
(2) a metadata base that describes data formats, data units and codes and analytical methods;
(3) a validation database that stores checking SQL queries that generate warnings when data seems suspicious, and also a record of such data and the follow up of its validation so as to assure a quality assurance/quality control (QA/QC) procedure. Furthermore this allows testing the validation relevance.
(4) Data input is made via a web application that betters the interaction between data input and database managers.
The system described here manages the data workflow from its initial spreadsheet format to data checked for errors and arranged in a self-descriptive database that will be stored by the European Commission Joint Research Centre. Concepts developed may be generalised to any soil database to better data quality management and assessment.

S15.L.04
A high-resolution digital conceptual soil mapsoil map based on soil-relief relationships

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Disaggregation of soil survey maps and processing conceptual soil maps represents a field of current research in soil science. This is caused at large by missing human resources which is permitting to provide only overview information. On the other hand, there is a need of further particularization and localization of soils for many tasks in soil landscape research, but also for soil and land use and protection.
A case study from the northeast German young moraine region is presented. Based on an investigation area with relatively high sampling density, the combination of soil and relief is analyzed in order to create a large-scale digital conceptual soil map. On this basis transfers to similar areas should be possible.
Data base:
- Medium-scale agricultural site map (MMK) 1: 25,000
- 800 soil observations by drilling
- 94 analyzed soil profiles
- DEM 5, remote sensing, other maps (geology)
Result
The Topographic Position and Landform Analysis according to Weiss (2001) combining near and far distance zones to derive landforms is used.
Characterized are the relief - landform - slope position and curvature.
The conceptual map generated at the scale 1: 5,000 (12 km²) covers a representative part of the soils of the ground moraine landscape of the Pomeranian Stage. By comparison with drilling points it was possible to assess the accuracy.
The result is reproducible and can be regarded as a basis for developing large-scale digital conceptual soil maps in the young moraine area.
Detailed resolution of soil information is of importance for example:
- to specify and localize soil data for process -relevant investigations and/or models,
- to classify results of non-invasive procedures in regional context,
- as a contribution to develop field cards e. g. for precision farming.

S15.M.KL
Where is the information from 100 years soil surveying and research in Europe?

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Easy access to seamless, interoperable and harmonised soil data are key requirements when building structures for storage and processing of soil information. For example, today, new technical solutions are available for web-based solutions, which are already proposed in policies like INSPIRE, or the building of a geodata infrastructure for GEOSS. On the other hand, very specific data storage systems are being built and used nationally and in Europe which are very tightly constructed around a specific data assessment scheme (for example forest soil condition monitoring, national monitoring systems). It is also well-known that especially in European countries, a multitude of soil data has been collected over the last century and today, but this information is not available. At the same time, the personnel needed to update, digitize and harmonize soil information becomes gradually reduced in many countries, which prevents that an increasing amount of archived and quality-controlled data are being made available. For example, a fundamental limitation for data availability is the right of land owners to prevent publication of raw data, and that the data are gathered for a single purpose, but used in a multi-purpose manner. Reporting schemes such as the recently proposed EU soil directive, EU agricultural policy, Kyoto Protocol, UN/ECE LRTAP, are mostly met by using existing data. The collection of new data is expensive, and often limited to individual research projects.
By using modern GIS and data management methods, soil information systems (SIS) can be developed to become the key option to meet these requirements efficiently. Up until now, for the internet user, existing SIS are a mix of small clearing houses for national or local information (reports, links, general thematic information) without data access, coupled with operationality of an internet portal. There, users are guided to access printed, sometimes digital maps. In some few cases, a viewer is also available which visualizes some of the map data available. For the internal user, the SIS provides the umbrella to access a variety of soil information (profile data, digital and printed maps, reports, method bases). However, this is not public, and very exceptionally, these different kinds of information are dynamically linked to allow applications. That is done again on the project level, prohibiting easy repetitions of evaluations with different, improved data.
While local DBMS can still be individually constructed, data communication principles need to be developed which are able to link the information produced in the field with the large variety of reporting schemes and users. Thus, an extremely high level flexibility at the output side of a soil information system must be facilitated using modern GIS and OGC techniques. Examples will be presented.

S15.M.01
Mapping of trace element contents and enrichment factors in topsoils in the Nord-Pas de Calais region (France)

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Nord-Pas-de-Calais constitutes a densely-populated region which has been deeply affected by heavy industries, coal mining and intensive agriculture.
A large dataset was built by gathering data collected in the framework of different soil surveys carried out throughout the region.
Maps of topsoil concentrations of Cd, Cu, Cr, Ni, Hg, Pb and Zn were drawn up by ordinary kriging interpolation using nearly 4000 analyses. These clearly show that there are some “hot spots” linked with well-known point sources of pollution but the rural areas are not particularly contaminated by metals.
Enrichment factors (EF) were calculated for 18 trace elements and 250 soil pits using total aluminium as a geochemical reference element and a deep layer supposed not to be contaminated by human activities (a deep horizon or parent material).

As a first step, mapping of EF required a variography analysis. Only eight trace metals are spatially correlated allowing us to use the turning bands simulation technique. The results obtained in this way are both striking and highly consistent relative to the diverse sources of contamination. Cadmium shows a very marked enrichment (EF from 2 to 5) in the whole regional area, including the farmlands, while zinc and lead exhibit strong local enrichments (EF from 3 to 30) in the near vicinity of factories or urban areas. Bismuth, copper and tin display moderate enrichments (from 1.5 to 3) in one-half of the regional territory, mainly around the largest towns and industrial estates. Indium shows similar levels of enrichment close to a zinc smelter. There was no evidence of thallium enrichment anywhere.
Such clear results were achieved because of the adequate sampling scheme (samples sufficiently numerous, rather well distributed in space, taken in soil pits from identified horizons) and the analysis strategy (determination of total concentrations of 21 elements, including aluminium and iron).

S15.M.02
Study of the surface soil geochemistry in the Neretva River Valley (Croatia) using GIS and geostatistics

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Neretva River Valley is located in the Mediterranean part of Croatia. The upper river flows swiftly through a mountainous landscape, while the last 30 km spreads into an alluvial delta before emptying into the Adriatic Sea. The lower river course and delta were shaped by high waters that periodically washed down from the mountains, bringing dissolved organic substrate and creating a fertile soil. Due to special interest of the region from both environmental and agricultural point of view, a multi-element pedo-geochemical survey was carried out as a part of a national geochemical mapping project covering agricultural land. The aims of this study were (i) to measure the spatial variability of elements in soil, mainly according the different reclamation patterns undertaken in the recent history to increase the agricultural land and (ii) to identify the main inputs affecting element contents. Topsoil samples were collected from 152 locations. Total element contents (Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Zn) were determined using ICP-OES after aqua regia extraction. A geospatial database was compiled in GIS, and after applying statistics and geostatistics, the maps of element distribution were produced. The variations of element concentrations have both natural and anthropogenic sources. Three main problems regarding the soil quality have been identified. The decline in availability of fresh water for irrigation resulted in the intensive use of saline or brackish water. The use of such water caused an increase of soil salinity, with the sodium accumulation in topsoil up to 2590 mg kg^{-1}. The main source of metals to the estuary of the Neretva River, including its catchment area, has been the industry in the higher part of the river area. Total metal metal concentrations, especially Cu and Zn, depend also on the on the manner of land use and cultivation.

S15.N.01
A digital soil mapping application for delineating landscape pattern in France

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The knowledge about landscape pattern is essential for the elaboration of soil environmental indicators for the protection of soil resources. Therefore, a Digital soil mapping technology is used for the automatic delineation of valid environmental functional units at the French national scale. A non supervised classification combining an Isodata method (Iterative Self Organizing data) and a maximum of likelihood method is used within a Geographical Information System. Several input parameters are used: land cover taken from the CORINE Land cover dataset (scale 1:100,000), altitude assessed from DEMs (Digital Elevation Models), soil units from French soil databases and lithology from the 1:1,000,000 geological map of France.
The objectives of this study are first to obtain a delineation of functional environmental units at national sacle, and second to understand how this delineation can be influenced by the initial data integrated in the algorithm. As this second objective is rather prospective, the study focuses on one region where different input parameters are tested to assess the influence of the landscape evolution in time and the geographical resolution of the input data:
- two land cover scenarios (1990 or 2000),
- two Digital Elevation Models differing in accuracy : IGN (French Geographical Institute) DEM, with a pixel resolution of 250 m x 250 m, or SRTM (Shuttle Radar Topography Mission) DEM, with a pixel resolution of 90 m x 90 m and,
- two soil databases with different scales (1:1 million scale and 1:250,000 scale).

To explain the discrepancies between the different delineations obtained, expert validation and several assessment tools at different levels are used: at the variable level (histogram, scatter plot, PCA), at the landscape classes level (signature files, dendrogram) and, at the classified image level (confusion matrix, uncertainty image).

S15.N.02
Dynamic soil data management facilitating harmonisation, access and communication of soil data in web-based distributed systems

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Future EU-wide information on soils and changes of soil state require new approaches to data storage, harmonisation, evaluation and presentation. Subsidiarity as the basic principle in EU legislation (e.g. INSPIRE) asks for data maintenance on the lowest administrative level possible. We propose an internet-based system of interlinked distributed databases, a XML structure for soil data exchange, and Web Soil Services (WSS) providing data evaluation procedures accessible via common internet browsers.
The relational soil data model SoDa is intended to be used to build a local to national soil database. It allows for management of site, soil profile and analytical data from inventories as well as from monitoring. These soil data can dynamically be linked to map units of various scales. Soil data of varying provenances and obtained according to various mapping guides and classifications can be recorded, considering the huge variety of existing European soil data. SoDa also includes extensive facilities for storing meta-information essential for scientifically sound data processing. An implementation of the model has been tested in the FP 6 project ENVASSO with data from eight EU countries. The software produces XML-encoded text files for data transfer to other databases of any technical platform or to web-based services like Web Soil Services (WSS).
WSS have been developed as a flexible tool of the German Federal Institute for Geosciences and Natural Resources, providing data evaluation procedures agreed between all 16 federal states. In the future, WSS hosted by various European or national institutions could offer procedures needed for reporting on soil tasks to the European Commission, reducing national effort. Trans-boundary calculation of soil indicators could easily be done with the same procedures. It became obvious, however, that soil data harmonisation as a prerequisite for the use of existing soil data is an oncoming challenge to soil science.

S15.N.03

Web municipal SIS for evaluation of human health risk due to soil pollution and urban soil management

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Contamination, local or diffuse, is one of the main recognised threats to soil. It is important to gain sufficient knowledge about the effects of different types of land use on soil properties and on the capacities of the soils to perform certain functions. A better understanding of urban soils functions, focussing on the information needed for soil management is needed. Environmental-soil datasets show, in particular in urban environments, a high complexity. Planners and decision makers lack understandable and reliable information on the effects of soil contamination and the management options they may reconsider. Environmental modelling and its application into GIS environment in urban areas are important to support decision-making process.
The aim of the work was to design and to set up a simple yet effective web-based Municipal Soil Information System (MuSIS) for municipalities and local authorities in order to include the evaluation of human health risk and soil quality management into the municipal land use planning processes. The MuSIS has to i) make complex scientific data available in daily planning processes, ii) be simple to maintain and update and iii) be cost affordable.
The information system was created using open-source software: i) a soil database designed to comply with special requirements of urban soil evaluation, ii) a web interface to spatially present and query data and iii) a simple tool for the calculation of the health risk at different sites.
The results showed that with little economical effort a municipal soil information system can be set up and make available interpreted information for planners through the visualisation of soil and health risk data.

S15.N.04

Development of a bottom-up approach for soil indicators: organic carbon and soil loss assessment for the Italian territory

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Many EU policy areas are dealing with soils. The comparability of information on soils in Europe is limited since it is based on data collected over a long time span using different methodologies. A more harmonised monitoring approach and methodology is envisaged in the Thematic Strategy for Soil Protection (COM 2006, 231).
A new approach that exploits soil data and expertise available at local level, has been developed in a pilot project that involves the National Environmental Protection Agency, Regional Soil Survey Services and European Soil Bureau. The project is the first experiment at National level to develop a Multi-Scale European Soil Information System (MEUSIS). The most accurate and up-to-date soil data are used directly by institutions and experts involved in soil survey at local level to assess soil status indicators (organic carbon content in soils and soil loss). To simplify harmonization problems and in order to set up a common infrastructure for data sharing, output data were represented by means of a reference grid (1km pixels), built following the recommendations of the 1st Workshop on European Reference Grids in the context of the INSPIRE Directive. Furthermore an exchange format for storing data and metadata information has been set up jointly by the working group. For assessment, local experts can use the most adequate procedures, following their judgement, for instance to cope with different levels of data availability and/or reliability. Record of all this, procedures and kind of input data, is stored in another section of the format, that collects metadata. Great effort has been set in the definition of shared data quality indicators, both as quantitative indexes of data availability and specific confidence levels.

S16 Soil Indicators

S16.D.KL

The Soil Framework Directive: State of play on the debate and the importance of soil information in its implementation

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The Soil Thematic Strategy, which includes a proposal for a Directive establishing a framework for the protection of soil (Soil Framework Directive) (COM(2006)232), was adopted by the Commission on 22 September 2006. The objective of the Commission proposal is to set out common principles, objectives and actions. It requires Member States to adopt a systematic approach to identifying and combating soil degradation, tackling precautionary measures and integrating soils protection into other policies. However, it allows for a high degree of flexibility, as it is for the Member States to decide the level of ambition, specific targets and the measures to reach those. Member States are required to identify areas where there is a risk of erosion, organic matter decline, compaction, salinisation and landslides. They will have to set risk reduction targets for those areas and establish programmes of measures to achieve them. They will also have to prevent further contamination, establish an inventory of contaminated sites on their territory and draw up national remediation strategies. Finally, the Member States are required to limit or mitigate the effects of sealing, for instance by rehabilitating brownfield sites
The European Parliament adopted its first reading in November 2007 endorsing the proposal with a large support. Although the text adopted by the European Parliament gives more flexibility and more margin of manoeuvre to the Member States in several parts of the text, all the key elements of the Commission proposal have been maintained. Moreover, the European Parliament has introduced few provisions that strengthen the proposal..
The Portuguese Presidency made enormous efforts to reach a political agreement in the Environment Council of 20 December 2007. Despite all the efforts of the Presidency as well as the very strong support and call for legislation from 22 Member States, there were five Member States (FR, DE, NL, AT, UK), constituting a blocking minority, which voted against the compromise text and prevented reaching a political agreement.
The Commission considers the current *impasse* on the soil file as a temporary situation and has done and will do its outmost to ensure that the proposal comes back on the Council agenda. The Commission is ready to work with the Presidency to move forward in a satisfactory manner while not jeopardising the environmental value added of the proposal. The presentation will provide an update on the actual political situation.
One of the key elements in the approach taken by the Commission is a knowledge based assessment of the situation as regards soil degradation before taking any action. This is specified in articles 6 and 7 (identification and methodology) and Article 10 (inventory of contaminated sites) of the proposed Framework Directive. The main reason for this approach is the fact that EU-wide systematic information on the state of soil (degradation) is virtually non-existing. The importance of this

approach is recognized by the European Parliament which by amendment voted for the introduction of a specific monitoring requirement in Article 7. The presentation will provide more details on the views of the Commission as regards soil monitoring.

S16.D.01
The core-set of environmental indicators of the European Environment Agency

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The European Environment Agency (EEA) aims to help achieve significant and measurable improvement in Europe's environment through the provision of timely, targeted, relevant and reliable information to policy makers and the public.
The EEA launched a *core-set* of priority environmental indicators in 2004. This exercise has been guided by the need to identify a small number of policy-relevant indicators that are stable and that give answers to selected priority policy questions. The *core-set* has three main objectives:

- Provide a manageable and stable basis for indicator-based assessments of progress against environmental policy priorities;
- Prioritise improvements in the quality and coverage of European data flows - improvements that will enhance comparability and reduce the uncertainty of information and assessments;
- Streamline contributions to other indicator initiatives in Europe and beyond.

The *core-set* currently comprises 37 indicators covering six environmental themes (air pollution, climate change, waste, water, biodiversity and soil) and four economic sectors (agriculture, energy, transport and fisheries).
These indicators were selected from a larger set, on the basis of criteria widely used elsewhere in Europe and by the OECD. Particular attention was given to the relevance for policy priorities, objectives and targets, the availability of high-quality data over both time and space, and the application of well-founded methods for indicator calculation.
The *core-set* is structured around the DPSIR analytical framework (Driving forces, Pressures, State, Trends and Responses) and is supported by a large information base containing expert knowledge, as well as qualitative and quantitative information. This currently includes about 500 other indicators and other information tools to facilitate the use of environmental information.
The *core-set* indicators are populated and periodically updated using mostly data provided by the European Information and Observation Network (Eionet) through specific data flows.
The *core-set* is published on the EEA web site:
http://themes.eea.europa.eu/IMS/CSI

S16.D.02
Indicators for soil monitoring in Europe

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The ENVironmental ASsessment of Soil for mOnitoring - ENVASSO - Project, funded by the European Commission's Sixth Framework Programme, has identified 290 indicators for 188 key issues that focus on threats to soil in Europe. Twenty-seven priority indicators that address nine threats to soil - erosion (by water, wind & tillage), decline in organic matter content, contamination (local & diffuse), sealing, compaction, decline in biodiversity, salinisation, landslides, and desertification - have been selected and tested in the majority of EU Member States. The testing involved assessing the suitability of these indicators for inclusion in a forthcoming soil monitoring system. This presentation reports the results of the testing process, which has identified those soil indicators that could be applied with immediate effect.

S16.D.03
Environmental Indicators - a German Approach

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Environmental Indicators are a tool to recognise positive or negative trends in environmental policy. They may show the success of environment protection measures.
The Federal Environment Agency developed a system of environmental core indicators (KIS) to help politicians, scientists and the public to be informed about the roadmap to the sustainable development in Germany. The core indicator system is a supplement to the national approach of sustainable indicators with more than 50 indicators to show causes and effects of environmental burdens. So the system helps to evaluate where Germany is on the way to a sustainable future reaching the environmental goals.
In four main topics
- climate change,
- biodiversity, nature and landscape,
- environment, public health, quality of life, and
- resources and waste
with 16 subtopics the more than 50 indicators are divided.
The elaboration of the indicators is done by comparison with the DPSIR-approach by several national authorities and institutions.
As far as possible the trends were compared to quantitative environmental goals e.g. from the Germany strategy on sustainable development or from the strategy on biodiversity.
It is difficult to develop direct soil related indicators in this system due to two main reasons:

1. The long term changes in soil properties (concentrations of dangerous substances in soil) and
2. The lack of quantitative soil quality aims (especially in threats like erosion and compaction)

For the system of environmental core indicators are up till now four soil-related indicators developed:
- the erosion risk caused by water in arable soils
- changes in land use to settlement and traffic area
- number of contaminated sites
- impact of heavy metals on soils
Research work is done to find further indicators for soil biodiversity and the influence of climate change to soils.

S16.D.04
Proposal for a Soil Indicator Set in Austria

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At the international level soil indicators have been proposed for soil assessment and some of them are used in environmental reporting. Also at national level selected soil indicators are integrated in indicator sets for reporting on achievements towards sustainability. In Austria a working group within the Austrian Soil Science Society developed a concept for a comprehensive soil indicator set which will be presented.
The objective was to compile a national set of indicators for comprehensive soil protection in order to support environmental policies at different administrative levels and to improve efficiency of future soil investigations.
Different indicator concepts were analysed and evaluated for national purposes. In a consultation process themes of interest were identified, such as soil quality, soil erosion, land consumption or soil contamination. For selected themes relevant

questions were defined and corresponding indicators were proposed.
Furthermore data requirements related to the indicators were identified and analysed as well as compared with data availability. This comparison was the basis for the evaluation of the feasibility of implementation of the proposed indicators. Another output was the identification of further data needs and areas of future research.
Towards the implementation of the proposed indicators a fact sheet describing the main features of the indicator was developed and filled in for several indicators of selected themes in order to give practical examples. The proposed soil indicator set should help to assess the status of soil and the effectiveness of soil protection measures in Austria. Furthermore it facilitates an efficient soil monitoring and can stimulate harmonised data collection.

S16.E.01
The complex indicators reflecting soil functioning activity

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The complex soil indicators for Estonian pedo-ecological conditions were primarily elaborated for characterizing soil humus status and for evaluation of soil cover environment protection ability. The humus cover type (analogue to widely known “humus form”) characterizes soil humus status from the qualitative aspect. The humus cover type is not only a good indicator of carbon input into and output from the soil, as it also reflects the morpho-genetic fabric of the topsoil. The humus cover acting as interface between plants and soils (or biotic and abiotic components of ecosystem) integrates the character of both components and as well connected with them soil edaphon composition and activity. With land use change from natural status into arable, the drastic changes (activity of processes, decreasing of diversity) are taking place and the leading role goes to the anthropogenic factor (tillage technology, external subsidence). As a complex soil indicator may be treated also the soil environment protection ability. In this case the soils are treated not only as medium, which needs in some cases protection form degradation, but as active superficial layer of landscape, which, thanks for its valuable functions, acts as natural body determining environmental status of the area. The integrated environment protective value of soil (very good to very weak) is determined by the soil cover (or solum) biological activity (based on its productivity level), physical properties (based on clay and humus pools in solum) and soil climate (integrated soil regimes and red-ox conditions), and by subsoil composition and thickness (as protective layer under the soil cover). In the presentation the correlation of humus cover types with both plant and soil covers, and concordance of humus cover types with soil environmental protection ability will be analyzed on the background of post- and synlithogenic soil matrixes.

S16.E.02
Indicators and Thresholds for Desertification, Soil Quality, and Remediation - INDEX

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INDEX, a STREP funded within the 6th Framework of the EC had the objective to develop indicators, with which the dynamic state of land degradation as well as its remediation can be assessed, and which reflect ecological quality at the soil level rather than at the field and catchment levels.
Soil samples were taken from sites across Europe, where a variation of influencing factors (“pressures” according to the DPSIR concept) related to soil deterioration and desertification could be observed either because of a natural variation along a catena or because of different treatments applied during past experiments. Analysis included
- soil microbiological parameters (bulk functions such as microbial biomass carbon or soil respiration, enzymatic activities and molecular biological parameters)
- humus parameters (bulk humus, humo-enzymes and available humus)
- physical parameters (such as particle size stability, hydraulic parameters, pore size distribution, etc.)

Parameters were selected for their ability to differentiate various pressure levels, for their temporal stability and for their transferability to other sites. Finally some practical aspects were considered. After a factor analysis INDEX came up with three indices, which are well suited to indicate differences of soil degradation according to the prevalent type of pressure:
1. lack of vegetation as the result of desertification processes;
2. soil erosion;
3. agricultural practice.

7 indicators, mainly bulk microbial and enzymatic, were found to be suitable for pressure type 1; one, based on particle size, for type 2; and 2 enzymatic ones for type 3. It could be demonstratet that the index for pressure type 1 was also applicable to monitor the effects of soil remediation.
As a shortcoming the fact has to be mentioned, that no universal thresholds may be established but measurements have to be made against local reference plots.

S16.E.03
How to monitor decline in soil biodiversity across Europe?

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The soil biota have important fundamental roles in soil processes and contribute both directly and indirectly to many important ecosystem functions such as nutrient cycling, decomposition of organic matter etc. It is essential to understand the importance of biodiversity in soil and their impact upon soil quality and function.
The EU project ENVASSO (Environmental Assessment of Soil for Monitoring) addressed the 8 threats to soil identified by the Commission (CEC, 2002). The aim of the project was to design and test a single, integrated and operational set of EU-wide criteria and indicators that will provide a basis for a harmonised comprehensive soil and land information system for monitoring in Europe. To identify suitable indicators for monitoring the decline in soil biodiversity, indicators were selected from current national monitoring programmes. For monitoring application it was considered that only 3 key indicators per soil stress were practical, however this was considered a difficult task for indicating biodiversity decline due to the complexity of soil biota and multi-functionality in soils. Therefore stringent criteria were applied to the selection process to evaluate: 1) methodology standardisation, 2) complementarity to other indicators, and 3) interpretation at both scientific and policy levels. The key indicators selected were chosen as representative of 3 functional levels in soil: a) abundance, biomass and species diversity of Earthworms - macrofauna, b) abundance and species diversity of Collembola - mesofauna and c) microbial respiration. Procedures and protocols were written based upon current ISO standards and adapted for assessment at a European scale.

Pilot sites were established in 3 countries (France, Ireland and Hungary) to test the ease of measurement of the selected indicators. The effectiveness of each indicator and their sensitivity to detect change across a range of land-use categories at a European scale will be discussed using data from these sites.

S16.E.04

An ecosystem-services based approach to selecting biological indicators of soil quality for national-scale soil monitoring

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A limited set of biological indicators of soil quality that would be suitable for deployment in national-scale soil monitoring schemes, and that specifically aim to meet a range of UK policy objectives, have been identified. The basis of the approach was the selection of indicators that could provide information on the ecological processes which underpin soil function and therefore support ecosystem services. We developed a semi-quantitative framework to systematically capture both the wealth of information in the literature and from expert knowledge. A total of 183 indicators were numerically scored against scientific and technical criteria relating to soil functions, their ability to discriminate between ecosystems or soils, and technical issues relating to methods, costs, timescales and quality assurance. The relative performance of each indicator was assessed by calculating final scores from these criteria for each soil function and all functions combined. The 20 top-ranking indicators (9 microbial, 4 faunal, 6 process and one other) are presented and discussed with respect to the soil functions. Thirteen of these indicators are now undergoing intensive field trialling across the UK and we will present the first results from two studies, firstly to assess the temporal sensitivity of these biological indicators to key environmental pressures over one year, and secondly the ability of these indicators to discriminate between different soil:land use combinations.

S16.F.01

Soil quality indicators and risk assessment methodologies for subsoil compaction

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Subsoil compaction is one of the soil threats addressed in the ENVASSO project (**ENV**ironmental **AS**sessment of **S**oil for m**O**nitoring). A key objective of this project was the selection of a set of indicators for each soil threat, as identified in the Soil Communication (EC, 2002). The indicators selected are the result of an expert consultation process within the ENVASSO Project and a literature review. Threshold values are proposed for several selected indicators. A top 3 of subsoil compaction indicators was selected: (1) CP01 Density (bulk density, packing density, total pore volume), (2) CP02 Air Capacity (volume of air-filled pore at a suction of 5 kPa) and (3) CP06 Estimated Vulnerability to Compaction (based on texture, density, climate and land use).
The proposed indicators served as basis for test runs in selected European pilot areas to gain experience concerning the monitoring of soil threats in the European Union. The Romanian Soil Database was used to analyze and compare direct and indirect estimates of the top 3 subsoil compaction indicators for Romanian arable and grass lands. For the indicators CP01 and CP02 this can be considered as a first step to determine Risk Areas (priority areas) for subsoil compaction. The indicator CP06 is in fact a risk assessment methodology for the determination of Risk Areas. This ENVASSO method to calculate the vulnerability to compaction was compared with a risk assessment method based on soil mechanical properties (pre-compression stress) developed in the European SIDASS project. For the dry-climate areas of Romania the ENVASSO method gives lower estimates of vulnerability than the SIDASS method based on effective soil loads. For wetter areas the ENVASSO method predicts higher vulnerability than the SIDASS method. Strengths and weaknesses of both methods are discussed.

S16.F.02

Using expert knowledge to assess soil compaction

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With this presentation, we contribute to the discussion about the definition of thresholds for soil quality indicators. Although soil compaction is well known to cause severe damage on the soil ecosystem and soil protection legislation of many countries prescribes the avoidance of compaction, there is lack of indicators and thresholds to assess soil compaction. Nevertheless, many soil experts have to judge on soil compaction in their daily work and have gained experience in this. We present the results of a Delphi-survey among 24 soil experts from Switzerland, where they were asked to judge 21 data records of physical soil parameters from real soil cores. We asked them to group the data records in different classes of severity for the state of and the susceptibility to compaction. The survey revealed the following findings: once the experts were given quantitative parameters, they relied rather on them than on qualitative ones, although they had stated in an open question to weigh qualitative parameters stronger. We determined the means of the values for the different classes for single parameters like bulk density, coarse pore content and precompression stress. The mean thresholds indicating critical states after the experts' judgements coincided with thresholds cited in literature. However, most experts stated to have considered several parameters parallel. Hence, their judgements were better retraceable with composite parameters like packing density and a with fuzzy membership model allowing for the three most important parameters. We will discuss the strengths and weaknesses of using expert experience to define soil quality standards.

S16.F.03

Putting together measures of soil physical quality

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The search for indicators of soil physical quality that are applicable across different soil types, land uses and scales continues. Adding to traditional indicators, such as bulk density and plant available water are recent measures, such as the least limiting water range and S theory, that aim to incorporate several soil features. Until recently calculation of the different indicators has rarely been determined on the same sample. The use of multiple samples rather than the same sample may be due to constraints of time and equipment needed for processing of samples, because samples were used for other purposes or the destructive nature of some measurements. We report multiple indicators determined on individual core samples.
The partial resampling of the National Soils Inventory for Scotland (NSIS) on a 20km grid is providing an opportunity to determine physical indicators on soil cores collected in a systematic and unbiased way from a wide range of soil types and habitats across Scotland. Soil classification of sites from which the samples were collected and traditional measures of

chemical and mineralogical properties provides a wealth of data against which indicators can be tested. Comparisons are also made with water stable aggregation of soil collected at the same time and immediately adjacent to where cores were collected.

S16.F.04

Assessment and monitoring of soil conditions using indexes based on near infrared reflectance (NIR) spectroscopy

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Assessing the health of European soils is becoming a major issue in the framework of the Soil Thematic Strategy of the European Union. However, this issue remains mostly unsolved because of the lack of standard and economically realistic diagnostic tools for screening soil conditions. Despite intensive research programs over the last decade, no generalized accepted indicators of soil quality exist. Such indicators should incorporate minimum datasets built with suites of physical, chemical and biological properties suitable for monitoring the eight main threats to soils identified by the European Commission.
NIR spectroscopy is a rapid and robust technique, and the development of portable sensors now allows *in-situ* and airborne measurements. Soil NIR spectra contain information related to many soil properties, especially soil organic matter content and quality, but also texture, elemental composition (C, N, P, K, etc.), concentration in contaminant metals (Ni, Cr, Cu, etc.), biological activity (microbial biomass, basal respiration, enzyme activity, etc.); NIR spectroscopy can also detect changes in soil properties due to human practices (tillage, fertilization, etc.) or extreme events (e.g. wildfires).
Most uses of NIR data concern the prediction of soil properties on unknown samples. We claim for another promising approach: summarizing NIR data into categorical indexes of soil quality that would address specifically each of the main threats to soils. Indeed, some minimum datasets dedicated to the evaluation of soil quality relate to properties that can be predicted by NIR spectroscopy, which could thus provide soil quality indexes directly. To be operable, such indexes should be calibrated on large sample sets representative of the diversity of European soils and uses, collected through soil monitoring networks. Moreover, indexes of soil quality using NIR hyperspectral remote sensing data could provide soil property maps useful for soil carbon accounting, soil degradation, soil contamination and global change studies.

S16.F.05

Novel approaches for assessing properties and limitations of soils for cropping and grazing

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The aim of our study was to test the diagnostic value of visual methods of assessing soil quality (SQ) of farmland for cropping and grazing.
Different field methods of SQ evaluation have been tested along with measurements of physical SQ (density, strength, permeability) on agricultural plots in Germany, New Zealand, Russia, Canada and China. Novel multi-indicator methods under study were the New Zealand Visual Soil Assessment (VSA) and the Muencheberg Soil Quality Rating (SQR). Additionally some traditional single-indicator methods like the Peerlkamp soil structure test and its latest modification have been applied.
Results showed correlations between indicators of visual methods and measured soil physical parameters. Shape and size of aggregates had highest diagnostic value in most methods focusing on soil structure (VSA, Peerlkamp). The conditions of the soil in terms of favourable, medium or poor could be clearly indicated by visual methods. On sites in Germany and Canada, effects of traffic and tillage on soil structure were detected and quantified both by measurements and visual methods.
Soil texture and soil water balance were the most important SQR indicators, focusing on inherent SQ for cropping. SQR ratings were adequately correlated to crop yields. On pastoral grassland, the effective crop yield (edible plants only) was also significantly correlated with the Muencheberg SQR. It may be concluded that both novel methods of VSA and SQR, and also single-indicator methods like the modified Peerlkamp test are useful diagnostic tools for identifying soil properties and limitations for cropping and grazing, and may indicate aspects of SQ clearly, soil structure in particular.

S16.F.06

Organic nitrogen as a potential indicator of livestock grazing impacts on Mediterranean soil quality

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A compilation of literature data concerning the ratio of dissolved organic nitrogen to total dissolved nitrogen (DON/TDN) revealed that Mediterranean rivers exhibit higher concentrations of DON and DON/TDN ratios (even in major agricultural basins -very high DIN concentrations) compared to rivers of North-western Europe and America. Furthermore, a land use load apportionment analysis for four Greek mixed land use types river watersheds indicated that the river export load of DON is linearly correlated with the livestock derived input of DON (normalized to watershed area). These observations constitute evidence that intensive livestock grazing in Mediterranean geonvironments might be related with the quality of soil organic matter (SOM) and eventually with the fate of DON. In order to test the theory of the previous hypothesis, a methodology (SOM characterization, UV-Vis analysis of leachates) was applied on soil samples from Crete, corresponding to different land uses. The C:N ratio of SOM and microbial activity, in terms of soil microbial biomass C and N and dehydrogenase activity, exhibited the first evidence of the different origin and quality of SOM among the different groups of soil samples. UV-Vis analysis of soil leaching eluent supported the hypothesis and a new index based on DON was developed. The results of this work suggested that DON can be used as an indicator to assess livestock grazing impacts and the resulting deterioration in the quality of soils.

S16.G.01

Soil indicators for chemical soil pollution in Switzerland - a critical review and proposal for future soil indicators

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There is an increasing demand for indicators in present and future environmental assessment studies. Indicators are

generally expected to be simple, comprehensive, significant and cheap. Fully aware of the complexity, soil indicators are of vital importance for decision makers to gain understandable knowledge about soil quality. In order to communicate the results of the Swiss soil monitoring network (NABO) we critically reviewed the soil indicators implemented in the Swiss environmental reporting. Regarding future soil indicators the following aspects have to be taken into account:
- The spatial and temporal aggregation of soil indicators
- Robustness of soil indicators in an area of conflict between temporal an spatial variation of soil properties and the sensitivity to detect changes
- Measurement uncertainty of the soil samples
- Comparability of the monitoring sites.

Because one single soil indicator cannot cover all information provided by the soil monitoring network, we propose to develop three complementary soil indicators addressing (1) state, (2) temporal trend, and (3) the risk potential of the measured soil pollution.

S17 Land Use and Soil Protection

S17.H.KL
Land Use and Soil Protection in Europe

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The adoption of the EU Thematic Strategy for Soil Protection by the European Commission has given formal recognition of the severity of the soil and land degradation processes within the European Union and its bordering countries. The thematic strategy underlines that soil degradation processes or threats or a combination of some of the threats can ultimately lead to desertification. The Strategy includes an extended impact assessment that has quantified soil degradation in Europe, both in environmental and economic terms. Available information suggests that, over recent decades, there has been a significant increase in soil degradation processes, and there is evidence that these processes will further increase if no action is taken. Soil degradation processes are driven or exacerbated by human activity. Climate change, together with individual extreme weather events, which are becoming more frequent, will also have negative effects on soil. Soil degradation processes occurring in the European Union include erosion, organic matter decline, compaction, salinisation, landslides, contamination, sealing and biodiversity decline. All this processes are strictly related to unsustainable land use practices that cause in many cases irreversible soil loss. Reversing this negative trend can be achieved through the right combination of obligatory measures (the proposed Soil Framework Directive), integration in existing legal frameworks of soil protection aspects, awareness raising initiatives and increased investment in soil research. The 7th Framework Programme for Research of the European Community is addressing the need to increase soil research activities both through indirect actions (specific calls for proposals) and direct research activities of the Joint Research Centre. Of particular importance will be the increased effort of the European Commission towards the collection of soil data and information on a regular basis through the establishment of the European Soil Data Centre (ESDAC). Jointly with the other European institutions operating the Shared Environmental Information System (SEIS), namely the European Environment Agency, EUROSTAT and with the coordination of DG ENVIRONMENT, there will be an increased effort towards the collection of soil data through soil monitoring initiatives like BIOSOIL and the LUCAS-soil programmes. Integrating updated soil data with land use/land cover information provided by other EU initiatives like GMES, will allow making a more in-depth assessment of the interlinkages between land use and soil protection in Europe, paving the way for more effective soil protection strategies in the future.

S17.H.01
Land use and landscape effects on carbon sequestration in cultivated and pasture soils

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Organic carbon sequestration in soils is important to the mitigation of increasing atmospheric concentration of CO2. The objective of this study were to investigate the impacts of land use (wheat cropping and pasture) and slope on soil organic C accumulation and on distribution within aggregate-size fractions in a Chaharmahal & Bakhtiariy (Southwest of Iran) soils at the end of 50 years of treatment imposition. The soil was silty clay in both summit and footslope and a silty clay loam in backslope in cultivated soil only. Combined samples were collected during May of 2007 at 0-5 cm depth in two landscape plots adjacent to each other on the same topography positions. Aggregate separation was done by wet sieving to obtain three aggregate sizes (4.75-2mm, 2-0.25mm and 0.25-0.053mm) in order to measure C concentration within the aggregates or associated with particle size fractions. Soil organic carbon considerably was greater under pasture than cultivated soils. Large aggregate(4.75-2mm) and medium aggregates (2-0.25mm) size fractions exhibited the majority of SOC storage under pasture and cultivated land respectively, the effect of land use and aggregate C concentration was most significant in the footslope and backslope position, the most and least stable landscape positions. Land use treatments significantly influenced particle size fractions (clay, silt and sand). Soil C is enriched in the clay and silt compared to sand fractions. The most notable findings were that cultivation decreased C, whereas pasture enhanced C concentration in soils.

S17.H.02
Land degradation as affected by deforestation in northern Jordan

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In northern Jordan, deforestation is taking place to establish olive and fruit trees orchards. A study was conducted to evaluate the effects of deforestation on physical and chemical properties of soils under native forest (Querus coccifera, Pistachio atlantica, Querus aegilops, Callliprious, Querus infectoria) in the semi-arid to sub-humid area of Ajloun in northwestern Jordan.
The study sites were under, i) native forest; and ii) completely deforested (cultivated land) and currently utilized for cereal, forage and fruit-nut crops.
The objective of the study is to evaluate the effects of deforestation on soil characteristics and sustainable land use.
Soil characteristics that were analyzed include, soil texture, bulk density, organic matter, total nitrogen, pH, cation exchange capacity, phosphorous and potassium.
The analyses indicated that the conversion of forest to cultivated areas had adverse effects on the studied physical and chemical properties. Among those mostly affected distribution of texture, bulk density of surface soil and subsoil. Organic matter decreased on cultivated land, cation exchange capacity also decreased, while the soil pH increased in surface and subsurface soil of cultivated land as compared to the forest soil. Deforestation and clear cutting of the forests in Ajloun area resulted in a lower soil quality, and contributed to land degradation in northern Jordan.

S17.H.03
Land suitability and crop distribution in an irrigation district of the Ebro valley (Spain)

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The degree of agreement between evaluation results and actual crop spatial distribution is usually unknown. The present research aims to obtain a better insight into this agreement by comparing biophysical land suitability with different crop frequency parameters (occurrence, frequency and typical location) and with crop rotations derived from multi-year crop maps. The research was carried out in the Flumen district (33,000 ha), which is located in the Ebro Valley (northeast Spain). Land evaluation was based on a 1:100,000 soil survey according to the FAO (1976) framework for the main crops in the study area (alfalfa, cereals, maize, rice and sunflower). Three crop frequency maps (crop occurrence, crop frequency and typical crop location) and a crop rotation map, derived from a time-series of Landsat TM and ETM+ images of the period 1993-2000 were used for comparison with land suitability maps (crop-specific, average for all crops and average for all crops except rice). The relationships between the two types of variables were analyzed by means of statistical tests (Pearson chi-square ($\chi 2$), Cramer´s V, Gamma and Somers´ D). The results show the existence of a significant relationship between crops' location and land suitability, except for opportunist crops as sunflower, which is very much influenced by subsidies. Regarding crop rotations, the alfalfa-based show the highest distribution percentages on the land most suitable for agriculture in the area. In comparison with other land evaluation assessments, the present approach offers more information than a static year crop map in assessing the degree of agreement of land evaluation recommendations with crops actually cultivated by farmers. Furthermore, it overcomes masking problems due to opportunist crops in regions where agriculture is highly influenced by subsidies, and political decisions can lead to rapid changes in the crop pattern.

S17.H.04
Factors influencing land use and public perception of land use changes in Slovenia

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The land use could be a result of several environmental, economical, social and governmental factors or driving forces. Theirs dynamic interactions which not necessarily led to equilibrium, provoke land use changes. They may appear slowly and also as unexpected and unfavourable side effects of policies of different sectors. Land use that could be followed in a time span is evidenced in official state statistic and cadastral data base. These data could be or not to be in accordance with public perception of this phenomena.
More than 60 % of Slovenia is covered by forest and is still growing, mainly on account of abandoned areas of less intensive agricultural land. The pressure for changing land use for new housing and infrastructure is enormous in lowland, where the best crop land is. Slovenia has just 18% of lowlands, where majority of population is living and soil sealing become political, economical and social problem. In the past, political system with its politics has significantly determined the land use structure. In the last few years European common agriculture policy has brought new dimension into this process. Additionally, globalisation especially in terms of economic forces significantly influenced local land use.
Available statistical and cadastral data were used to analyse directions and dynamics of land use in the last few decades in Slovenia, additionally supported by the analysis of politics and important political and socio-economical turnovers. Furthermore in order to assess public perception of land use changes in the country structured interviews with 576 individuals of both genders, aged 15 to 80 years, of different education, working status, from all over Slovenia were carried out and their answers analysed.

S17.I.01
Organic C storage and organic fractions in carbonate-rich semi-arid soils after 20 years of continuous irrigation in NE Spain

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Inventories on soil organic C (SOC) stocks have been done in many areas of the planet in the last decade. Although large-scale estimations on the effect of different agricultural practices in SOC have been compiled to asses the relationship between such practices and soil quality and C sequestration ability, the effect of irrigation on the SOC stock and organic fractions remains scarcely studied. Similarly, SOC dynamics in carbonated, agricultural soils have been much less studied than for other soil types.
In this study we selected two mid-sized agricultural areas (703 and 1160 ha) in a semi-arid area in NE Spain, and studied the total SOC stocks and different organic fractions (particulate organic matter (POM) and the mineral-associated fraction (MC)) after 20 years of irrigation (1987-2007). Most soils in the area were carbonate-rich. We studied the different soils units separately, and used soil data from 1987 as a reference. Our results indicate that the gain in SOC was not homogeneous among the different soil units, and that differences in the POM-to-MC ratio exist at present also depending on the type of soil. The response of the soil organic fraction to irrigation was thus different depending on the type of soil. Soil genesis seems to be related to the response of SOC dynamics to increased water content and organic inputs in this semi-arid area.

S17.I.02
Research of soil and water conservation measures for land use planning

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Land use planning process in the Czech Republic creates space for soil and water conservation measures realization, directed especially on wind and water erosion control, flood control, soil degradation reduction, surface and underground water quality and quantity conservation. Parameters of the measures are usually dimensioned by the models of erosion soil loss and maximum outflows in a profile. Empiric data of influence of real protective arrangements are rare. For this reason research of efficiency of soil and water conservation measures has been running for 4 years in 2 small basins, 1 drinking water basin and 1 site with small experimental plots. There were built gauging profiles in the experimental basins, which are equipped with weirs, ultrasonic probes and automatic water samplers. Precipitations, discharges, concentrations of insoluble matter, phosphates and nitrates are monitored during extreme rainfall - runoff events. The results are interpreted in time and in the relations to the actual natural and anthropic conditions. There were realized various erosion control measures (grassing, baulks, intercepting ponds) thanks to complex land use adjustment in several cadastres in our experimental areas. Comparison of the suspended load content in water proves key role of growth density in the soil loss control. Longer data row evaluation shows slight slow trend to water quality improving in the drinking water basin by virtue of realized soil and water conservation measures. Synthetic results should enable evaluation of efficiency observed measures and create methodics for erosion and flood control measures designing in complex land use planning. Next aim is to contribute to differentiation of types and parameters of protective elements for advancement of non-productive functions of the agricultural countryside.

S17.I.03
Identifying risk area for soil degradation of rural area in Wysokomazowiecka Upland - Poland

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Soil is subject to a series of degradation processes or threats. Soil degradation is a serious problem only in some parts of Poland. The main degradation proce -sses identified in polish soils besides of soil erosion in some part of Poland are acidification, decreasing of organic carbon and in some rural areas soil compac -tion and growing land consumption by new transport network and soil sealing. It is driven or exacerbated by different human activities. In rural area, inadequate agricultural practices can pose a threat to soil and result in deterioration the quality . Crop production systems, operators skills and management practices directly can affect soil quality, fertility of soils, condition and quality of environment.
The aim of this work is to present the main threats to soil in the rural region of Wysokomazowiecka Upland. Analyzed region is known for soils developed from boulder loam with high content of clay and intensive agriculture. Southern part covers sandy parent material with more extensive agricultural practices . To identify the area for risk we have collected the data from the period of soil cartography (1970) for agriculture purposes and from research conducted in the period 2003 - 2005. The soil data base contains information about land use, topography, parent material, water regime, the physical and chemical properties of soil units like acidity, content of clay, SOM, plant available macronutrients - like magnesium phosphorus, potassium and heavy metal content in different soil utility complexes as well. Identification socioeconomic factors, like type, size of farm, management practices, land use, cadastral aspects of agricultural use area etc. were analyzed as well.
The risk area according to main soil threats (SOM decline, compaction, acidification) of the investigated region is presented on a digital soils-agricultural map at the scale of 1:25 000.

S17.I.04
Categorizing European soils according to the ability to retain or transmit diffuse source pollutants

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Within the EU-funded FOOTPRINT project, a methodology has been developed for defining a large number of generic scenarios that characterise the complete spectrum of European agricultural environments. Each scenario represents a unique combination of those agronomic practices, soil and subsoil hydrological characteristics and climates that determine the fate of agriculturally-applied pesticides within Europe. A key component of the scenarios is the grouping of European soil types into a limited number of FOOTPRINT Soil Types (FSTs) based on their hydrological, textural and sorption potential characteristics. A total of 373 FSTs have been defined and each is characterized by a set of land use specific soil properties.
The FST hydrological component encompasses a suite of conceptual models (Flow Pathway Categories, FPCs) of contaminant flow pathways and lower boundary conditions based on an integration of the Hydrology Of Soil Types (HOST) and French CORPEN systems. The FPCs differentiate soils according to their different potential for rapid transfer of water from the land surface to the surface water network by various fast or intermediate rainfall/runoff response mechanisms. The sorption potential component is based on a combination of soil texture and broad differences in the magnitude and distribution pattern of organic matter within the soil profile. The 373 FSTs thus represent a first attempt to group European soils according to their ability to retain or transmit various potential pollutants, especially agriculturally applied pesticides.
Derivation of the FOOTPRINT Soil Types from pan-European databases will be described, their hydrological and sorption potential components defined and their potential for identifying route-specific mitigation measures for reducing the rapid transfer of pollutants will be discussed.

S17.J.01
Fertilization Loads of Less Common Elements to Arable Soils in Austria

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Sustainable soil management means to supply nutrient and essential element loads close to crop consumption by fertilization. The main plant nutrients N-P-K can either be supplied by recycling manures and slurries from animal production as well as treated biowastes like composts or digestates from agricultural biogas plants, or by addition of inorganic salt mixtures, the mineral fertilizers. Apart from main constituents N-P-K, their composition is highly variable among fertilizer types. Due to valid regulations, the quality of fertilizers is usually controlled via their N-P-K-S contents and additional essential trace elements labelled at the bag (e.g. B, Co, Cu, Fe, Mo, Zn). Unwanted element contents, like Pb, Cd, Cr, Ni and Hg, are regulated by threshold values of the fertilizer ordinance in Austria. Additionally, other potential toxicants like As, Ba, Be, and V as well as physiologically less active elements like Li and Sr, were simultaneously read by ICP-OES multi- element spectroscopy for about 1600 samples from 2001 to 2006. The investigated fertilizer samples were taken from the official fertilizer quality control.
According to good fertilization practice, fertilizer dosage is primarily coupled to the nitrogen content of the fertilizer, to achieve an optimum load of nitrogen per area. Total nitrogen was determined after combustion of the sample due to the method of Dumas. Regional differences in animal farming result in different animal waste (from cattle, pigs, chicken, none) and mineral fertilizer substitution, and thus to regionally different loads of accessory elements.
Median loads of accessory elements per kg N resp. kg P have been evaluated in order to detect possible accumulations of toxic elements in soils indicative for certain fertilizer types. This should lead to strategies to avoid excess loads of unwanted accessory elements. Fertilization loads are discussed with respect to regional soil composition and atmospheric deposition data.

S17.J.02
Biological methods of fertility reproduction of antropogene degraded irrigated soils in Azerbaijan dry subtropics

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Degradation of soils as slow death of the planet threatens all the mankind! The reasons for degradation of soils are natural factors and agricultural human activity. Many world regions including Azerbaijan have faced this process. Azerbaijan territories of dry subtropical climate -Absheron peninsula, Kura-Araksin lowland involved in agricultural industry are especially exposed to degradation.
In order to establish the degree of degradation of the irrigated meadow-like-serozem soils in Shirvan steppe, physico-chemical

and biochemical analyses of the indices determining soil fertility were conducted in 1988.
The results testify to considerable decrease in soil fertility for the last 30 years. Biological activity and the content of humus in the soil decreased to 20-30%, which affected the other indices of soil fertility. Thereby, under the existing system of agriculture soil will lose its potential fertility in 150-200 years. In connection with that, reproduction and increase in fertility of the irrigated meadow-like-serozem soils are possible on the basis of employing biological methods.
It was established (1998-2007) that reproduction of degraded soils is possible by means of planting lucerne, sainfoin, and winter mixed grass crop (rye + vetch + rape) leaving after fodder harvesting vegetative residuals containing nitrogen - 1.92-2.5%, phosphorus - 0.49-0.58%, potassium - 1.30%. It allows for enriching soil with vegetative residuals (kg/ha) containing nitrogen - 340, 310, 225, phosphorus - 103, 100, 102, potassium - 160, 153, 150 which is 49-60 kg/ha more than when taken out with harvest. These sowings decreased the volume weight of soil from 1.70 to 1.01%, increased humus by 0.88- 1.00%, nitrogen - by 0.30-0.37%, narrowed the ratio C:N, increased nitrification capability - to 100-130 mg of NO_3, the content of Ca in the sum of absorbed bases, the quantity of 1mm aggregates, biological activity and soil productivity 2 times as much.

S17.J.03

Trace elements in the soil of some specific localities on Mt. Medvednica

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Over most of the area the mountain massif of Medvednica is a nature park surrounded by settlements with more than one million inhabitants. It is a large forest complex covering about 20,000 ha and containing several grassland enclaves intended for recreation, and grasslands and pastures used for cattle breeding purposes. The forest area is sporadically broken up by quarries, whereas old medieval mines are completely covered by forests.
Research was conducted in four specific localities. The first locality refers to recreational areas - grasslands whose top parts are converted into skiing and sledging grounds in winter months. The second locality is grasslands used for grazing and producing hay in experimental cattle breeding programmes (cows, bulls and sheep). The third and the fourth localities are areas of medieval mines (lead-zinc ore). Soil analysis aimed at detecting trace elements was made for the topsoil layer 5 cm deep.
The results of research reveal high values of Pb, Zn, Mn and Se in the “Zrinski” mining site. Pb concentrations reach over 20,000 mg/kg, those of Zn over 3,000, of Mn more than 7,000, of Cd 27, and of Se 1.2 mg/kg. High values of Pb (up to 500 mg/kg) and Mn (up to 2,500 mg/kg) were found in the “French” mine locality. Extremely high lead and zinc concentrations were to be expected since these are lead-zinc mines dominated by the minerals galenite (PbS) and sphalerite (ZnS) with considerable portions of silver, which was the reason for mining. High copper (230 mg/kg) and arsenic (100 mg/kg) values were also registered in this locality.
The invariably increased values of arsenic in livestock pastures and mine localities are indicative; in contrast, the skiing grass area manifests considerably lower values. Increased manganese values are the consequence of the geochemical composition of the bedrock.

S17.J.04

Effect of conventional and reduced tillage systems on some physical and microbiological properties of silt loam and heavy loamy sand soils

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The aim of this research was to determine the effects of different tillage systems on changes of chosen parameters of soil properties: physical (bulk density, water content and stability) and microbiological (soil enzymatic activity, microbial biomass C and N content). Analyses of physical and microbiological properties of soil were performed on the long-term field experiment on a private farm in Rogow (Lublin voivodeship) on silt-loam soil and at the IUNG-PIB Experimental Station in Grabów (Mazowieckie voivodeship) on heavy loamy sand in 2006 and 2007. At both experimental sites winter wheat was grown under two tillage systems: conventional tillage (CT) based on the mouldboard plough and traditional soil tillage equipment with the field surface mulched with chopped wheat straw, and reduced tillage (RT) with the surface mulched with chopped wheat straw based on soil crushing-loosening equipment and a rigid-tyne cultivator.
The significant effects of different tillage systems on the values of physical and microbiological properties of studied soils were observed at $P<0,05$. The results showed that the RT system in comparison to the CT system, created a more-friendly environment for improvement of soil physical properties - particularly soil stability, which increased in response to the increased activity of native groups of soil microorganisms.

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S17.J.05

Nutrient balances as required by the EC Nitrates Directive and national Fertiliser Ordinances. How to get from a farm level to a regional approach?

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Fertiliser Ordinances implement the EC Directive 91/676/EEC, commonly known as Nitrates Directive, into national legislation. They regulate agricultural fertilizer application on the farm level. The objective of this study is to examine the impacts of the farm level regulations as required by the German Fertiliser Ordinance, particularly on phosphorous in regions with different agricultural practices in North-western Germany. Regions with predominant arable farming and usually low to medium soil phosphorous contents are compared to regions with intensive egg, poultry and livestock production where more manure nutrients are accumulated than needed for fertilization of the agricultural land. As a result of long-term excessive manure application soil phosphorous contents are often comparatively high. Basis of the modelled scenarios are the Fertiliser Ordinance’s requirements, statistical, empirical and expert data on animal husbandry, acreage, mean harvest potential of common crop rotations, typical feeding and housing strategies, type and composition of manure produced, and further impacting parameters. Calculations are carried out on the district level. We consider the Fertiliser Ordinance being an effective land management instrument in respect of phosphorous in arable farming regions. However, it is not an appropriate tool in areas with intensive animal agriculture because it allows a maximum tolerable phosphorous surplus of 20 kg P_2O_5 ha^{-1} a^{-1} on the farm level regardless of soil phosphorous content. Although the allowed surplus is comparatively small, the Fertiliser Ordinance's regulations will not be able to prevent leaching of manure-borne phosphorous in areas where intense animal farming has resulted in phosphorous rich soils. Consistent and extensive material flow management could help to avoid additional phosphorous enrichment in these regions.

S17.J.06

The undercutter method of dryland wheat farming to control wind erosion in the western United States

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Wind erosion is a major problem in the dryland winter wheat (*Triticum aestivum* L.) - summer fallow production region of the Columbia Plateau in eastern Washington and north-central Oregon. Several locations within the Columbia Plateau have failed to meet federal clean air standards for PM_{10} emissions during windstorms. Alternatives to traditional intensive tillage during summer fallow were evaluated over a 15-year period at Lind, Washington. The undercutter method of dryland wheat farming employs a wide-blade V-sweep for primary spring tillage plus fertilizer injection, followed by as few as one non-inversion weeding operation. Tillage is reduced from the traditional eight operations to as few as two operations using the undercutter method. Averaged over years, there were never any differences between treatments in precipitation storage efficiency in the soil or in wheat grain yield. The undercutter method consistently increased surface residue, surface clod mass, and surface roughness compared to traditional tillage. The undercutter method reduces soil loss and PM_{10} emissions during high wind events by up to 70% compared to traditional tillage practices. Due to the recent surge in the cost of diesel fuel and decline in the cost of glyphosate herbicide, the undercutter method of farming provides significantly higher net returns to farmers compared to traditional tillage. The Federal Government feels so strongly about this farming method that they recently awarded a US$ 1.8 million grant to cost share undercutter implements with farmers. The undercutter method of dryland wheat farming provides a 'win-win' for farmers and the environment.

S17.K.01

A qualitative multi-attribute model for assessing the impact of management options on soil sustainability

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Understanding the drivers of soil sustainability is complicated by a wide range of chemical, physical and biological processes. However, most work to date has focused on a limited number of parameters, making it difficult to detect the major drivers of sustainability or how processes interact. A large-scale collaborative project was established to quantify a wide-range of soil processes at two sites: one to investigate the impact of carbon addition in the form of slurry or municipal compost and one soil properties at different phases of a traditional crop rotation.
A wide range of biological, physical and chemical parameters have been sampled in a co-ordinated design on 5 occasions in 2006 - 2007. Individual results processed so far indicate marked effects of the management options (e.g. large shifts in microbial community structure due to compost addition; different shifts due to slurry addition; changes in microbial community structure and microarthropod abundances between the ley and arable phases of the rotation; changes in air-permeability and pore structure following compost addition and during the rotation).
However, an overall answer on soil sustainability is not always obvious because of the conflicting nature of and interactions between many of the parameters. To overcome this, an expert-based, multi-attribute model is one way to calculate the overall effects on soil sustainability and the underlying reasons for those changes. The multi-attribute and decision support approaches rely on experience gained from applying a similar food web approach to determine the effects of genetically modified crops on soil sustainability.
The design of a qualitative, multi-attribute model with which to assemble the data and the overall scores for the changes in soil sustainability resulting from the management options, will be presented and discussed.

S17.K.02

What would we like our soils to do and how do we decide?

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The concept of soil functions is now well established and forms the framework around which a number of national protection strategies and the proposed EU Soil Framework Directive have been developed. However because of the multifunctional aspects of soil and their interaction with water and air quality, in some contexts there will be complementarity between the different soil functions and in others, a degree of incompatibility. In some situations, this incompatibility could lead to a serious loss of soil function or at least a reduction in the future flexibility of land use.
Soil and other environmental datasets were compiled for three catchments in Scotland and England and a large number of environmental models representing the six high level soil functions were applied to those data. This demonstrated explicitly and spatially that different soils were better at performing some functions than others.
The main output from the project was the development of a high level prototype Evaluation Framework. This allows the functional capacity of land to be interrogated and utilises the outputs from the different soil models and allows users to review whether positive or negative interactions will occur between soil sub-functions as a response to changing land use. Tentative rankings have been placed on the changes in soil function that result and it demonstrates that some land uses can have profound negative impacts on future land use options. These rankings were based on the collective expertise of the project team and require additional input from other perspectives. Nonetheless the Evaluation Framework offers significant potential to assist decision-making for land use planners and policy-makers in the context of spatial planning
The application of this approach is highly dependant upon the availability of suitable models and input data; this project has highlighted some of the constraints currently associated with both of these.

S17.K.03

The loss of fertile land due to urbanisation process in the last decade - the case of slovenian cities

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Human activities have always been connected with the land, the soil, which has remained at the foundations of human life.

Nowadays, the need for sustainable land management and soil protection is becoming more and more important all over the world. In order to ensure sustainable spatial development, state and local authorities developed instruments to regulate urbanisation. Slovenia has a long tradition in land planning. When looking at the fast growing cities the question arises: does building control consider the protection of the best soil, fertile land? In the paper, the results of the study of urbanisation process for two bigger Slovenian cities, Maribor and Kranj, are presented. On the base of orthophotos, the building border in nineties and current building border was determined for the test areas. The urbanisation process and compromise land planning was further studied and discussed, based on available cartographic material, where the soil quality was determined by soil data from the Soil information System of Slovenia. The results of the analyses showed that the sealed area has increased evidently in the study areas in the last decades. It has been shown that flat land near urban periphery and main roads regardless of the soil quality has been strongly affected by the process of land urbanisation. The results confirmed the anticipation that location is the major factor which is reflected in the urbanisation process and soil sealing consequently. The earlier, compact cities have spread out over the surroundings district with suburbs, single-family housing estates, shopping centres and so on. The demand for both new construction due to increased urban sprawl and transport infrastructures continues to rise, which requests to better legal framework of the land planning and management in the future.

S17.K.04
Implementation of the concept of reference soils (RefeSols)

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The study of the soil quality and the fate of chemicals and their effects to soil properties is an objective of environmental assessment strategies. Within this context soil tests are performed which for reasons of quality assurance are validated and crosschecked with soil reference material. In case of assessing the fate of chemicals and their adverse effects to soils legally binding test schemes require specific tests with a set of different soils.
Since the behaviour of the substances in soils and their bioavailability is strongly dependent on the soil properties reference soils should be defined for such tests. These soils should represent the range of important soil properties within agricultural soils and should be applicable for different kinds of tests. The use of well defined reference soils (RefeSols) will gain comparability and reproducibility.
In the first part of the project 12 reference soils were characterized, where in this part a methodology was developed for the preparation of bulk material of soils and for the storage under outdoor conditions. With this material also stability tests are performed.
The material was sieved after drying to 2 mm by using a cement mixer equipped with an appropriate sieve on top. The use of the cement mixer is a cost-effective way to sieve large amount of dry material. Depending on the soil texture of the material up to 400 kg of soil can be sieved daily. The sieved lots were combined and deposited as bulk material in a stainless steel container with a perforated ground plate and a drainage layer.
The results of the study proved the homogeneity of the stored bulk material. Also, no changes of soil parameters could be observed within the storage period with the exception of the pH-value. That means a long-term storage under outdoor conditions is possible.

S18 Urban and Anthropogenic Soils

S18.H.KL1
Services from Soils in Urban Areas

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From high diversity of urban land use follow new soil properties, demands to soils and capacities for services from soils. Additional demands occure from climate, land scape water household and habitat changes.
Hazards from soil pollution are discussed in many papers. But soils contribute also to reduction of hazards by acting as adsorption, immobilization, decay and dillution medium. An import role have acid neutralization capacity and sequences of layers in soil profiles with very diverse properties.
A second source of hazards for health is dust. One can assume benefits from soils by dillution effects and change of particle size composition. A third threat in urban areas is the overheating. It can be mitigated by heat storage of soil water.
To avoid both floodings and expensive drainage constructions storm water can be infiltrated in soils. Many benefits for life quality can be established by a high green volume which needs soils of high quality.Young soils in urban areas have due to no or a low content of organic matter a high potential for carbon sequestration. Due to the occurence and combination of diverse and in part extreme properties of soils in urban areas unique and very valuable habitats can develop. But soils can be also sources of pathogenic organisms.
Soils of urban areas contribute in manifold ways to quality of urban life, social problems and economy. For this it will be necessary to keep soils in urban areas. Strong restrictions of soil services exist from sealing. Therefore we must learn to use soils underneath sealed areas, so for storm water infiltration and urban green. The biggest threat for soils is the large extend of soil excavation. It must be reduced. More proposals about sealing and soils of urban areas contains the 'Soil Thematic Strategy of the Euopean Commission (2004, EUR21319 EN/6)'.

S18.H.KL2
Anthropogenic soils, what they are, their properties, behaviour and functionality

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Anthropogenic soils have been considered since the early days of modern pedology, at least since 1847. However, these soils have been recognized for a long period only with respect to their potential threat to human health. Today, the dynamics and functionality of anthropogenic soils are highlighted more. Typical properties of anthropogenic will be summarized and the meaning of these properties in regard to the consequences of their interaction to the bio- and hydrosphere will be analyzed. Such properties which influence the behavior of anthropogenic soils could be followed, e.g. the content of artefacts and fragments, the pH, the content of technical as well as natural organic carbon. Furthermore, the nutrient content, the occurrence of contaminants or a very high/low bulk density, an increased soil temperature and decreased soil moisture can be included in set of anthropogenic properties. As an ongoing process of anthropogenic soils introducing into the soil taxonomy is in progress, this is documented in the contribution. Especially the artefact-concept for the WRB-Technosol is set in relation to other national concepts for the classification of anthropogenic soils. The national concepts focus on soil development, the kind of disturbance of soils, and the origin of the substrate or on the functionality of anthropogenic soils. The overlap of the terms urban soils and soils changed by strong anthropogenic or by agricultural impact will be clarified. In detail, anthropogenic impacts cover urban, mining and military activities as well as consequences of technical production and traffic. Additionally, the soil development of young soils from technogenic substrates is highlighted. This process referring to anthropogenic soils shows exceptional rapid soil development. Therefore, some examples of anthropogenic soils with a large inner surface, with low bulk density, developed from pure matter, or with simple organic matter are given. A brief introduction to evaluation systems assessing the functionality anthropogenic soils is reflected in regard to the meaning of anthropogenic urban soils for urban planning.

S18.H.01
Deconstructing Technosols in World Reference Base (WRB)

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Recent publication of the World Reference Base for Soil Resources (2006) has set aside a new soil reference group (Technosols) for soils created predominantly by technical processes. Although this is limited to soils where such processes are easily recognizable, many soils which are the product of anthropogeomorphic processes are excluded and relegated to other reference soil groups. Critically the definition of Technosols in WRB depends on a highly idiosyncratic definition of artifact that includes not only artifacts in the strict sense but also geological substrate not influenced by surface processes. Problems in determining the pristine nature of geological substrates are bound to occur and make it difficult to adhere to the precise definitions offered for prefix qualifiers (urbic, spolic, garbic) in the system. Additionally, depth requirements do not allow sufficient "room" for intergrdes in the system and depend on subtle differences in artifact content (however defined) as criteria for recognizing intergrades. It would be more expedient to base these solely on depth, given workable definitions for diagnostic materials encountered in the field. Uses of Ekranic (pavements) and Linic (geomembranes) as prefix qualifiers could probably best be treated as phases of map units. In any case, the list for technogenic materials should clearly be expanded to include a wider range of soils produced by (direct) anthropogeomorphic processes. Recognition of a separate domain for these soils provides sufficient justification for expanding the basic concept of Technosols in the "artificial" realm.

S18.H.02
Soil Transformation Peculiarities in the City Forest Park (Case Study in Moscow).

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Forest parks, included in the territory of megapolis, represent significant and interesting subject of investigation. Forested territories are the main source of the biodiversity, place of recreation and the air pollution filter. Moscow is an ancient megapolis in the Northern Europe. Therefore, the history of the anthropogenic soil transformation of Moscow region is very diverse.
Due to the well-known historical land-use and high variety of the types of human activities, we have chosen forest park “Pokrovskoe-Streshnevo” as a very suitable subject of research. The land-use changes from the middle of XVII century until modern time have been analyzed. The soil mesouphona communities and the complex of physical, morphological and chemical analyses have been studied.
As the result of investigations, we discriminated the model series of city forest park soils transformation. The series depend on soil forming conditions especially of characteristics of land-use, ages and natural soils properties.
The natural soils of the forest park “Pokrovskoe-Streshnevo” are represented by rzhavozems (Haplic Cambisol Sceletic).
Three types of the soil model series of city forest park have been distinguished: (I) natural soil - the soil with light impact - strongly transformed urban soil, like urbanozems (Urbic Technosols) and agrozems (Anthrosols); (II) soil as the result of excavation, techno-soils (Technic Regosols); (III) surface transformed agro- and urbosoils. Different types of anthropogenic soils have different types of specific horizons (urbo-, agro- and techno-horizons). According to the stages of anthropogenic transformation, soil alters its chemical, morphological and physical properties. The soil properties transformation leads to the adequate alteration of the mesouphona communities.
The city forest-park soils form under the combined action of natural and anthropogenic agents of soil genesis. The anthropogenic transformation has several stages displayed by specific anthro-technogenic soils horizons and properties. Different stages of the anthropogenic soil transformation correlate with appropriate changes to land-use.

S18.I.01
Reflecting spatial heterogeneity in heavy metal distribution of Technosols performing soil column tests

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Agglomeration areas generally show an extensive distribution of urban soils consisting of technogenic substrates, e.g. construction rubble, ashes, mining waste or household waste. These substrates may represent sources of heavy metal contamination which tend to be leached into the groundwater. Therefore two aspects should be taken into account to derive a sophisticated risk assessment:
a) Considering the impact of the heterogeneity in heavy metal distribution on the mobile fraction and
b) testing the assumption that the (aqua regia extractable) total amount of heavy metals (HM_{ar}) influences the quantity of the H_2O_{dem} soluble, mobile fraction (HM_{mob}).
Randomized in situ undisturbed sampling was applied on diagnostic horizons from Technosols each consisting mainly of grate ashes. In additon bulk samples derived from garbage incinerator ash were investigated (reference substance supplied by Federal Institute for Materials Research and Testing - BAM, Berlin/D). Analyses on Cu and Zn were performed after aqua regia extraction (HM_{ar}) as well as mobilization by H_2O_{dem} percolation (HM_{mob}) through soil columns using the Dynamic Batchtest device. Each Technosol ash sample was measured for 24 replicates whereas the homogenized reference substance was restricted to four replicates.
In contrast to the reference substance the explorative data analysis depicts huge span width, extreme values and outliers for the Cu and Zn content in the undisturbed samples of ashes from Technosols. Obviously profound risk assessment based on threshold values need to take this heterogeneity into account. Moreover this result is essential when assessing the HM_{mob} share because both correlate on a positive, high significant level (Spearman-coefficient r_s = 0.732**; data sets not normal distributed). Thus it is recommended to calculate the HM_{mob}/HM_{ar}-ratio to prevent misleading interpretation of in situ hazard conditions of Technosols.

S18.I.02
Pollutant dispersion of alluvial soils in the industrialized region of Pernik, Bulgaria

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After the political changes in Bulgaria in 1990, a lot of industrial areas were shut down leading to extensive and contaminated brownfield areas. This tendency is also recognizable in the Pernik region southwest of Sofia, Bulgaria, which was dominated by heavy industry. The river Struma flows through this industrialized area. It was expected that pollutants have contaminated the river Struma for several decades due to discharge, erosion and deflation. Consequently, the pollutants were transported in the floodplain achieving ultimately the drinking-water reservoir Pchelina.
Our research includes analyses of organic pollutants and heavy metals of alluvial soils in lengthwise, vertical and horizontal direction as well as sediment analyses of the stream and the Pchelina reservoir. The research project is targeted at the determination of transport pathways from different industrial sources to the water reservoir sink. Relationships between the distinct industry complexes (e.g. steel works, iron industry, coking plants) and the type and quantity of pollution parameters are presented.
The results indicate higher concentrations in sapropel-like sediments than in the surrounding soils. In horizontal direction an influence of flood frequency is hardly visible. In some sectors the parameters show close relationships to the kind of industrial production. In the water basin profiles the depth of increased pollutant values and the period of sedimentation time could be distinguished. In general, the level of contamination is relatively high and comparable with other industrialized areas in Europe.
The research results demonstrate the typical pollution situation of heavily industrialized locations of former socialist countries without any effective environment protection measures.

S18.I.03
Historic waste disposal and present day contamination in Chat Moss, near Manchester, UK

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During the early 20th Century, Chat Moss near Manchester, U.K., was converted from a peat bog to arable farmland. The aims of the enterprise were twofold: to provide fresh produce for Manchester's growing population, and to create a waste disposal site for the increasing amounts of urban refuse being produced in the early 20th Century. Over the period of the project, from 1900 - 1964, over 737 tonnes of waste per hectare was incorporated into the soil, representing c. 30% of the current topsoil. The waste material included street sweepings, furnace slag, nightsoil and household refuse. Exploration by the British Geological Survey in the 1980's, as part of the national Geochemical Baseline Survey, showed elevated trace metal concentrations at Chat Moss, localised to the reclaimed land. It was hypothesised that the source of the apparent contamination was probably the result of historic waste disposal. The current project attempts to identify the source and extent of trace element amendment of the reclaimed Moss soils and assess the likely impact on future peri-urban horticulture for 'locally sourced' agricultural produce. Scanning electron microscopy has identified particles of combusted coal, pottery, furnace slag, which confirms urban waste as the source of contamination. Natural lead isotope abundance may suggest a combination of coal and petrogenic lead as the main contributors to the lead contamination load. Ongoing studies include investigation of metal fractionation by sequential extraction procedures and isotopic dilution. So far a surprisingly large proportion of the soil Pb (~55%) in Chat Moss appears to be chemically 'labile'. A risk assessment of the site will examine mobilization of trace elements under reducing conditions and soil-plant transfer factors for a range of horticultural plants.

S18.I.04
Accumulation and transport of lead in roadside soils

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The EU has 2.4 million km of paved roads. In the last 40 years, traffic on these roads has ensued in the continuous deposition of large amounts of lead (Pb) in adjacent soils. A resulting risk is the downwards migration of Pb and the contamination of groundwater. Factors that may enhance Pb mobility are low pH and iron (Fe) associated transport. A straightforward management strategy of roadside soils is therefore to use lime to increase soil pH. To optimise both application technique and immobilization efficiency, we need to know Pb concentrations in soil solution and to which extent particulate transport might be a limiting factor.
We mapped soil solution concentrations of Pb in a 25 m transect along a German motorway. Whereas Pb loads decreased with increasing distances from the road, concentrations in percolation water were smaller into the road bank due to high road runoff infiltration and dilution.
A complementary process-orientated experimental study was carried out in Switzerland to investigate particle-associated transport of Pb. Large size lysimeter were filled with the top 20 cm of the median strip of a Swiss motorway. They were exposed to natural rainfall, and the leachate was analysed for Pb and Fe concentrations. Results showed strong correlation between Pb and Fe leaching.
Based on our experimental results, we simulated the long-term Pb distribution in a roadside soil following scenarios with and without calcareous amendments and particulate transport. Profiles of Pb concentration calculated after 100 years showed accumulation of Pb in the first 10 cm of the soil profile and no downwards transport both with and without application of soil amendments. However, particle-associated leaching showed deeper penetration of Pb even when amendment was applied. This highlights the risk of only considering soil pH when assessing the efficiency of calcareous soil amendments in managing roadside soils.

S18.J.01
Using magnetic properties to compare impact of atmospheric dust influx to O-horizon soils and terrestrial moss along a transect through Oslo

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We report magnetic properties of 40 O-horizon, 40 C-horizon, and 39 terrestrial moss (*Hylocomium splendens)* samples from a 120 km long south - north transect through Oslo. In the mosses concentration dependent quantities, magnetic susceptibility κ, and induced remanent magnetization IRM(700 mT) have significantly higher values in urban regions. The soils do not show a similar pattern. Instead, weight normalized O-horizon induced remanent magnetization shows a broad variation across the transect probably related to the underlying lithology. Since *Hylocomium splendens* is not known to produce biogenic remanence carriers, the increase in IRM is attributed to mineralic dust adsorption.
Loss on ignition, a measure of the amount of organic material in a sample, shows a negative peak in Oslo, and at sites close to a known dust source. Here we also find that concentration independent quantities, like IRM_{30mT}/IRM_{60mT} (the ratio of alternating field demagnetized IRM at field amplitudes of 30 mT and 60 mT, respectively) are enhanced in urban parts of the transect. This indicates that adsorbed dust has different magnetic properties in urban and rural areas. Therefore, it is

likely that anthropogenic dust sources contribute considerably to the magnetic signal. Soil samples (O- and C-horizon) taken at the same sites show a completely different signal. Here the influence of the city of Oslo upon magnetic properties disappears completely in the higher background variation.
The anthropogenic dust input did thus not yet change the natural magnetic signal that we observe in these soils. The volume of anthropogenic magnetic minerals in these soils is insignificant in comparison to those comprising the natural background. The reason that moss shows such a clear anthropogenic signal is that it provides a natural almost "clean" receptor/collector of anthropogenic city dust. Pollution of plants (moss) and soil is visible at two different scales.

S18.J.02
Spatial Distribution and Leaching of Selected Heavy Metals in the Soils of Urban Areas

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Heavy metal distribution and mobility in soils of a highly populous district of Istanbul, Turkey were investigated. Samples from surface and 20 cm depth were collected from the area for laboratory analyses (Pb, Zn and Cu concentrations have been measured) and evaluation using geostatistical methods. Largest concentrations were found as 1572.5 mg/kg of dry soil for Pb, 522.1 for Zn and 136.0 for Cu. Initial statistical analyses showed that pollution characteristics in areas near major highways (receiving high traffic loads, higher concentrations of metals) and in urban land around secondary roads and streets (with less traffic activity and pollution) were significantly different, suggesting that the traffic is the main source of metal pollution. To accurately integrate the bimodal data obtained from these areas, an indicator kriging approach was used which treats two data subsets independently and combines them through an indicator function. Maps showing surface levels of heavy metals were generated for each of the selected heavy metals, showing the hot spots. Furthermore, leaching behavior of the pollutants was investigated by analyzing the samples taken from near major highways from 20 cm depth and evaluating their correlations with the surface concentrations. Pollution data from surface and deeper soils were significantly correlated to each other, albeit the deeper concentrations were much lower, showing limited mobility and downward migration of metals in the soil environment. The geostatistical methods used in this paper may be applied to other environmental studies in urban settings where the parameters are bimodally or multimodally distributed.

S18.J.03
PAHs in river floodplain soils: sequestration by carbonaceous geosorbents

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Coal and black carbon (BC) particles were identified as the two dominant geosorbents for PAHs in river floodplain soils. The coal particles are characterized by the dominance of 2-ring PAHs, while BC contains high concentration of heavy PAHs. Mild sequential supercritical fluid extraction (SFE) was performed in order to estimate desorption of PAHs from river floodplain soils. Desorption rate constants were one order of magnitude lower than those of “slow” and “very slow” desorption rates from other studies. This suggests very slow and extremely slow desorption. Futhermore, we demonstrate that, despite high soil PAH concentrations, which are due to coal and BC particles, the general environmental risk is reduced by the very slow and extremely slow desorption rates. In parallel, same soil samples were extracted with water using the accelerate solvent extraction (ASE) method. The absolute desorption enthalpy values for 2-ring PAHs were the greatest in the coal sample, followed by the soil samples with high coal content and then by the samples with low coal content. The values for the higher condensed PAHs showed the most negative desorption enthalpies for the samples with the most amount of black carbon. Elevated sorption enthalpies indicated a strong bonding between PAHs and geosorbents. Moreover, with the application of ASE this study was able to conclude that the extractable PAHs in the samples were predominately adsorbed to carbonaceous materials with high surface areas.

S18.J.04
Soil pollution with arsenic in the area of former gold and arsenic mining centre in Zloty Stok, SW Poland

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The problem of soil pollution with arsenic occurs in Poland locally, Zloty Stok being one of such sites with environmental problems caused by arsenic industry. This study presents the extent of soil contamination with arsenic in Zloty Stok, in three different regions: 1) a mountainous area above the town, along the valley with old mines, mine spoils and slag dumps spread in the forest, 2) in the valley of Trujaca river, below the town, with soils polluted by tailings occasionally drained out from the impoundments, 3) in allotment gardens in the town, used for recreational purposes and home production of vegetables. Soil samples of presumably natural origin, were collected in 72 sites, within the area of ca. 8 km^2. Additionally, mining and processing waste material was collected and examined. Mine wastes contained 54,700-102,000 mg/kg As, while As concentrations in slag dumps and tailings were: 4150-14300 mg/kg and 9,500-18,600 mg/kg, respectively. In some of the sites examined, natural soils were difficult to distinguish from those derived from mine waste material. The map of As distribution in the surface soil layer (0-20 cm) will be presented in the paper. As concentrations in soils were in the ranges: 1) 186-1,210; 2) 192-8,540; and 3) 72-520 mg/kg. Within the region 1, As concentrations in soils decreased downward profiles, which indicates air-borne pollution as the main factor of soil As enrichment. Such tendency did not occur in the areas 2 and 3. Environmental risk caused by soil pollution with As was discussed in the paper. For this reason, soluble forms of arsenic were determined using soil extraction with 0.05 M $(NH_4)_2SO_4$, and arsenic uptake by various plant species was examined. Arsenic solubility and phytoavailability proved to be generally low, and apparently depended on As origin and redox conditions.

S18.J.05
Bacterial and fungal abundances and diversities in a soil resulting from urban storm water infiltration

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In urban context, storm waters are often made to infiltrate towards groundwater through highly permeable subsoil. In Lyon (France), this has been practiced since two decades. The OTHU, a regional federation of urban hydrology researchers aims to study the impact of these practices on ground water quality. A central question concerns the retention and degradation of pollutants and the relationship with the biogeochemical properties of the soil. We have focused on the characterization of microbial diversity and its evolution in a soil from an infiltration facility.

The soil studied stems from the parallel evolution of parent rock, OM deposits and exogenous particles (deposited by storm water). It could have been called "sediments" but many of its characteristics lead us to consider it as a soil: it is subjected to dry and wet cycles, sustains plant growth, contains organic (10%DW) and mineral fractions, and aggregates (>160µm). It is quite contaminated by heavy metals: 1200 ppm Zn, 160 ppm Cu, 12 ppm Cd and by hydrocarbons.
This soil is colonized by a huge number of microorganisms (10^10 bacteria/g DW soil). The frequent disturbances may affect the microbial diversity. To assess this hypothesis, we have sampled during the different seasons and after these disturbances (rain, drought periods). A total of 25 samples (5 sampling times were observed) were obtained. The physico-chemical parameters (nutrient, TOC and heavy metal contents, aggregation state, pH) and biological parameters (biomasses: fumigation-extraction method and bacteria counts: fluorescence microscopy) of soil were measured.
Fungal and bacterial diversities are currently followed by PCR-CE-SSCP (Capillary Electrophoresis-Single Strand Conformation Polymorphism) over ITS1 region of ribosomal RNA genes for fungi and ADNr16S gene for bacteria. The available results show clear community shift according to moisture and season. Both biological and physicochemical parameters will be analyzed using to multivariate analysis (correspondence analysis and coinertia).

S18.J.06
Soil fauna influences the water and nutrient dynamics in urban soils

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In urban systems, detailed knowledge of the processes controlling the storage, mobilization and leaching behavior of water, nutrients and pollutants is of critical importance, since it characterizes the provision extent of ecosystem services crucial for the sites: the rate and quality of groundwater renewal, the buffering of urban climatic shifts and the transformation and detoxification of pollutants.
Soil fauna plays a major role in the processes of organic matter turnover, cycling of nutrients and the development of soil physical characteristics in terrestrial ecosystems. Although it is known that different soil organisms greatly affect organic matter and nutrient turnover rates, data on the impact of the soil fauna on processes at anthropogenic sites are limited.
Within the multidisciplinary research group INTERURBAN (DFG 409), the project FAUNA aimed at characterizing the functional impact of soil faunal activity on turnover processes in urban soils. We postulated that the dynamics of water and organic matter at urban locations is influenced by the specific composition of the involved faunal community.
In experiments with microcosms of different complexity, we described the specific impact of short food chains with varying combinations of soil faunal species on organic matter transformation, the release of nutrients and the mobilization of heavy metals.
As field studies of the INTERURBAN research group stressed the importance of heterogeneous soil areas for transport processes, we upgraded from a lab scale to field surveys through the set up of field mesocosms. Here we studied how the burrowing activity of earthworms modifies the structure of the soil horizons, the water retention capacity and the pattern of nutrient release. In particular, we employed successfully newly developed small-scale Electrical Resistivity Tomography (ERT) measuring tools, so to detect in situ and non-invasively the ongoing changes in the soil water distribution dynamics due to the activity of the soil fauna.

S18.K.01
A method for soil environmental quality evaluation for its management and planning in urban areas

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Soil represents a complex medium which quality is difficult to evaluate. In the past the soil quality evaluation was biased towards agricultural production rather than the broad range of functions and services it performs. Soil functions and soil quality in urban environment differ due to different needs and role of soil within diversity of urban land uses. The quality of urban soil should be interpreted in the way to support public services at environmental quality management and planners to adjust planning decisions towards more sustainable urban design. Simple and applicable soil quality evaluation methods accompanied by operative tools which can be used by soil inexpert are needed.
The presentation shortly discuses soil functions, soil quality indicators, pedotransfer functions and urban soil quality. It presents the method of urban soil quality evaluation for different land uses within one evaluation system. The calculation of three one-value measures of soil quality are introduced: the index of soil quality (expresses soil quality/suitability for a particular land use), the soil environmental quality index (environmental value of soil) in terms of performing the crucial ecological functions of soil, and the land use change index (land use planning impact assessment on the soil resource). The use of the method is described in two procedures: Urban soil quality control and Soil evaluation for urban planning. The method was partly developed within the TUSEC-IP project, financed by the European Commission.

S18.K.02
Tool of environmental risk assessment in urban areas

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Presentation is focused on research and assessment of environmental risk resulting from soil and substrate contamination of urbanized areas. Quality of urban soils is directly related with numerous and diverse soil functions, i.e. there are very various demands on soil quality by various groups of urban population. Some lacking knowlegde about urban soil characteristics and functions is recognized mainly at municipalities staff. Methodology of environmental risk assessment can be providing as a practical and helpful tool for city planers and managers dealing with urban land managing. The procedure consists of: (i) identification and delineation of so called pedo-urban complexes. The legend is specific, regarding different use of urban sites. Latest ortho-photo maps are inevitable to use for delineation and digitalization in the scale 1:5,000. (ii) assessment of soil quality can be carried out by respresentative soil profiles selection, by their soil survey and measurement of risk elements. Also surface soil contamination sampling is recommended to do. (iii) categorization of areas which are risk for city environment and areas which can be threatened (vulnerable) in urban ecosystem can be distiguished. Compiled map (using GIS tools) can show potential areas what have to be monitored regarding living quality in cities. This tool can be considered as a base for legislation principles proposal for urban soil protection what is lacking in Slovakia.

S18.K.03
Soil function living space for plants in urban land use planning

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Soil evaluation can be very useful in urban planning processes. It allows soil function prognoses such as suitability for storm water infiltration, as living space for plants or to transform organic pollutants to more harmless organic compounds. It is also possible to calculate the filter and buffer capacity for harmful substances and to calculate how much of the function is remaining for future prevention of groundwater pollution.
Urban soil mapping projects show that industrial soils with man made materials which are widespread on derelict land can fulfil some soil functions preferably needed in cities. Even for revitalisation of large brownfields the knowledge of benefits of the Anthrosols and Technosols are very useful for municipal and landscape planers and the owners. The reduction of such areas to the term 'contaminated land` reduce the potential of these sites noticeably.
Evaluation methods for industrial soils are new and still in the stage of development. They should be designed in close dialogue with landscape and municipal planners.. For brownfields, which are not or just badly marketable, innovative use options, e.g. renewable sources (biomass production as energy sources), forests, permanent or temporary nature conservation or recreation, will be considered.
Many young industrial soils have a high potential as habitat for specialised organisms. But some of these soils show a rapid development at the beginning of their pedogenesis. Extreme conditions for plants exist for a short term only. Therefore, a soil development prediction is useful for planning processes on young Technosoils.
The new developed evaluation key for the soil function "living space for plants" includes assessment criterions such as naturalness/hemeroby-ecogram, stability, minimum size of the area, nutrient/moisture ecogram and rarity.

S18.K.04
Ecoengineering soil by reinforcement with plant roots

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Years ago in Austria it was pronounced that 'the hills are alive' in the Sound of Music. From an environmental or geotechnical perspective, keeping the hills alive by maintaining or promoting vegetation might in fact be integral to their very survival, or at least the survival of someone living at their base. Plant roots are reinforcing rods and fibres in soil that can greatly improve mechanical stability. Logging has caused landslides, whilst the planting of vegetation is a green alternative to the use of soil nails and concrete facings.
Our research has started to unravel the mechanical interactions between roots and soil, from the mechanical behaviour of individual fibrous roots to processes occurring in a full slope. Controlled laboratory studies of soil reinforced with willow trees found a strong correlation between the cross-sectional area of soil covered by roots and shear reinforcement. We separated broken versus pulled-out roots and measured individual root diameters crossing the shear-plane. These data were used to evaluate several models of root-reinforcement. Models based on catastrophic failure of all roots at once over-predicted reinforcement by 34% on average. Better agreement between experimental and model results was found for a fibre-bundle-model, in which roots break progressively from weakest to strongest, with the load shared on the remaining roots at each step. However, the validity of this approach is questionable as it predicts that large roots break first, whereas smaller roots break first in testing.
Whole slope reinforcement by plant roots has been studied using a geotechnical centrifuge, which produces full-scale conditions in a controlled, small-scale model. Tests of model slopes planted with willow trees or controlled root analogues revealed a downward migration of the failure surface compared to fallow slopes and for the first time allowed direct measurement of the reinforcing effect of vegetation in a slope.

S19 Soil Forming Processes and Soil Morphology

S19.D.KL
Soil forming processes, soil functioning and soil classification - the example of allophanic and non-allophanic Andosols

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Soils conforming to Andosols in the World Reference Base (WRB) of Soil Resources have been reported from many places around the world developed from usually younger volcanic materials but also from nonvolcanic materials like granite or gneiss.
With this contribution we show that there are true Andosols of both the silandic (allophane containing) and the aluandic (Al-Humus dominated) type in Germany, and that their properties differ substantially from other soils which merely exhibit low bulk density. Our review includes soils that have developed from volcanic parent materials as well as such that have originated from non-volcanic materials. By (1) comparing soil carbon storage between some Andosols and non-andic Cambisols with particularly low bulk density and (2) elucidation of the differential pedogenetic pathways leading to Andosol formation we further demonstrate that Andosols are important objects of study in research issues of contemporary interest.
We further intend to point out significant similarities and differences in the properties and pedogenetic processes prevalent in Andosols. By doing so, we emphasize the necessity to separate true Andosols from other soils with low bulk density.

S19.D.01
Fractal structure in volcanic soils

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Abstract
Volcanic (allophanic) contain amorphous clays (allophanes), issued from the transformation of volcanic materials which present completely different structures and physical properties compared to usual clays. Allophanes have peculiar physical features very close to that of synthetic gels: a low bulk density, a high specific surface area and a very large large water content. The literature also show that allophanic soils exhibit higher carbon content than the one measured in other clay soils. They are thus interesting in terms of environmental properties

especially because of their potentialities as sinks for "greenhouse gases".
We propose that these properties (large porous features, large water and C content) can be due to the same factor: the peculiar structure of the allophane aggregates. We put in evidence and study the fractal structure of the allophane aggregates. The fractal dimension is in the range 2.5-2.7 and the fractal range covers more than one order of magnitude between 3-5 nm to more than 100 nm. The fractal range increases with the allophane content but the fractal dimension seems independent of the allophane content showing that the aggregation process of the allophane particles is independent on the concentration.
In these soils water content can be as high as 300% and during drying these soils present an irreversible shrinkage conversely to usual clays. We study the irreversible shrinkage of a set of allophanic soils and show that a large part of the water content is due to the fractal structure of the allophane aggregates. During a strong drying the fractal range shrinks and the fractal structure progressively disappears.
We measure the C content and show that C increases as the soil allophane content increases. We propose that this peculiar tortuous structure and the calculated low permeability and diffusivity could also explain the high carbon content.

S19.D.02
Formation and genesis of volcanic ash soils in the Matese Mountains of Southern Italy

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Over the past 40 ka, many volcanic eruptions in Southern Italy were explosive and related to the Campi Flegrei and Somma-Vesuvius volcanic activity. These eruptions produced a large amount of pyroclastitic material that was dispersed on the south Apennine Mountains surrounding the Matese Massif in southern Italy. A detailed mineralogical study was conducted on 5 pedons sampled on the Matese Massif to study volcanic ash soil genesis. Profiles MAT8, MAT10 and MAT13 occurred in a doline at an elevation of 1624 m and are characterized by moister and cooler climatic conditions. Profile MAT7 occurred in the same climate zone, but 50 m lower in elevation. Profile MAT9 occurred in an ancient paleobasin. We used x-ray diffraction (XRD) and differential x-ray diffraction (DXRD) techniques to analyze the samples. All profiles contained vermiculite, mica, kaolinite and some interstratified mica-kaolinite. The peaks of the diffraction patterns were weak, suggesting significant amounts of materials that did not diffract strongly, most likely allophane and unweathered volcanic glass. Sanidine was present in all of the samples. The mica is most likely primary mica that crystallized along with the sanadine, while the vermiculite is a weathering product of the mica. We assume that the finest ash cools faster, resulting in a glass, whereas the larger ash particles cool slower, resulting in the crystallization of sanadine and mica. Weathering of sanadine and mica released K and Na ions, that have been leached from the profile, while the remaining Al and Si crystallized as halloysite. We found partially dehydrated halloysite in the deepest horizons. We also found gibbsite in the deepest horizons of the MAT7 and MAT8 profiles. The sequence of pyroclastic deposits and the mineralogical evidence demonstrate the important contribution of the Campi Flegrei pyroclastic products to volcanic ash soils genesis.

S19.D.03
Mineralogical and geochemical changes associated with the loss of vertic properties in the upper horizons of a Vertisol

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Many Vertisols of the world tend to alter into Luvisols and various processes have been invoked to explain this transformation. We have studied a Luvisol (Hypereutric Chromic) / Vertisol (Humic) catena in the Indian Karnataka Plateau that has developed on complex metamorphic rock under semi-arid conditions. Although the catena differentiation is majorly driven by lithology, vertic properties of the Vertisol decrease towards the soil surface. To understand this, we investigated horizons chemistry (total elements, dithionite Fe and pH) and mineralogy with a closer insight into fine clay (< 0.1 µm) mineralogy using FTIR and XRD coupled with diagram decomposition with DECOMPXR to evidence interstratified clays. We were able to establish that the weathering process in the Vertisol can be divided in two steps. 1) In the saprolite fast weathering of chlorites and amphiboles produces ferriferous beidellite by dissolution and neoformation. This process continues in vertic horizons until primary minerals disappear. 2) Smectite transformation into kaolinite via an interstratified K/S also begins in the saprolite and takes over smectite formation in vertic horizons. In the upper part of vertic horizons, pH drops together with the total reserve in bases because basic primary minerals are exhausted and are no longer available to buffer the chemical environment through their hydrolysis. Therefore conditions become less prone to smectite stability and exalt its weathering which hinders the vertic typical shrink-swelling. Bases depletion implies their leaching away from the horizon, laterally or vertically. This leaching could account for a part of clay depletion along with the mass loss due to smectite transformation. Meanwhile weathering leads to relative accumulation of quartz sands. The resulting coarser texture is also unfavourable to vertic properties. As a conclusion, factors implied in Vertisol alteration here, are the combination of weathering processes with the drainage of elements and possibly of clay particles.

S19.D.04
Silicon isotopic fractionation by Si sorption onto iron oxides: evidence from synthesized oxides and basaltic ash soils

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The quantification of Si isotopic fractionation by biotic and abiotic processes contributes to understand the Si cycle at continental scale. Both plant uptake and clay formation leave a companion solution enriched in heavy Si. Iron oxides are ubiquitous in soils, where they can control the concentration of aqueous Si through specific adsorption of $H_4SiO_4^0$.
Here, we report on $\delta^{30}Si$ values of Si solutions after contact with (i) synthesized ferrihydrite (short-range ordered, sro) and goethite (crystalline), and (ii) soil horizons from weathering sequences of tropical volcanic ash soils characterized by contrasted Fe oxide content and various sro and crystalline oxides proportions. The time-dependent adsorption of $H_4SiO_4^0$ was measured in batch experiment at constant temperature (20°C), pH (5.5) and ionic force (1mM). Si isotopic compositions

were measured in solutions by MC-ICP-MS in dry plasma with Mg doping: $\delta^{30}Si$ vs NBS28 ± 0.15‰ (± $2\sigma_{SEM}$).
The adsorption was driven by specific interaction of monosilicic acid with oxide surface, and increased with time, first rapidly then more slowly. The solution was systematically enriched in ^{30}Si against its initial composition, inducing a larger fractionation for goethite (-1.60‰) vs. ferrihydrite (-1.08‰). A similar Si isotopic fractionation was induced by natural soils, and was related to high Fe oxide content and/or large proportion of sro oxide. The Si isotopic fractionation induced by Si sorption onto Fe oxide was likely due to the formation of oxide-monosilicate surface complexes. This process favoured light Si, just as biological uptake and clay neoformation do. The magnitude of fractionation was related to both the oxide content and type. As weathering leads to the accumulation of Fe oxide, soil evolution directly impacts Si sorption, thereby influencing the $\delta^{30}Si$ values of natural waters.

S19.E.01
Soil forming processes and related morphological changes during 11,000 years of soil development in marine sediments of S-Norway

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The coastal areas of the Oslofjord region have been subject to glacio-isostatic uplift during the whole Holocene and hence provide good conditions for studying soil chronosequences. Due to the steadiness of uplift, no marine terraces were formed, but soils continuously get older from the coast inland. We studied soil development in loamy marine sediments along both sides of the Oslofjord (Vestfold, Østfold). The climate in this area is mild with a mean temperature ranging from 5.4 to 6.0 °C, although it is located between 59° and 59° 40‘ latitude. Precipitation is 975 - 1094 mm year^{-1} in Vestfold and 751 - 829 mm year^{-1} in Østfold. Two soil chronosequences comprising six pedons each, one in Vestfold (1,500 - 10,000 years) and one in Østfold (2,300 - 11,050 years), were studied. The ages were estimated by use of existing sea level curves, based on calibrated radiocarbon datings. The geological basement below the loamy marine sediment consists of basic magmatite (monzonite, latite) in Vestfold and predominantly acid magmatite (granite) in Østfold. Due to the mild climate, Podzol development is limited to sandy parent materials (e.g. beach sand), while Albeluvisols develop in the loamy marine sediments. Higher precipitation in Vestfold leads to earlier beginning of clay illuviation than in Østfold. Clay coatings are perceptible in Vestfold already in the 1,500 years old soil. In Østfold they become visible for the first time in the 3,000 years old soil. The E horizons become lighter with age, but their thickness stays constantly around 40 cm in both areas. The development of the characteristic albeluvic tonguing starts after 4,000 to 5,000 years. The tongues initially develop mainly along intersections of cracks. Due to ongoing leaching they increase in length and width, progressively consuming the prisms between the cracks in the upper part of the Bt horizon.

S19.E.02
Role of Geological Factors on Soil Forming and Morphology in Western Latvia Coastal Plains

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The Coastal Lowland stretches along the Baltic Sea and Gulf of Riga, forming a low-lying region built of various sediments. The abrasion surface of Upper Pleistocene shallow basin sediments, till, glaciofluvial and glaciolacustrine deposits are marked by an occasional concentration of erratic boulders, and covered by a layer of nearshore and filling of lagoons sediments of various thickness, and in places by dune sand. Soil profile is poorly developed in places, where younger postglacial dunes occur. Here according to the international soil classification of *FAO WRB 2006 Haplic* or *Albic Arenosols* dominate.
Above the sandy deposits in the poorly drained lowland of the Baltic Ice Lake and in the lower parts of the Litorina lagoons peat was accumulated forming *Folic-Endogleyic-Ferralic Arenosols* and *Sapric-Ombric Histosols*. In the sense of soil forming and morphology, uncommon soils were formed in places, where sandy sediments of the Baltic Ice Lake is underlain by Devonian sandstone and clay, clayey till, clay or sandy silt material from ice-dammed lakes. The lithological discontinuity appears in alteration of the soil texture resulting in soil profiles where stagnic and gleyic colour pattern could be identified. Investigation of soils resting on Devonian sandstone, glacial till and sand of the Baltic Ice Lake carried out for the first time in Latvia.

S19.E.03
Geochemical soil zonality on loess in Danube Lowland (SW Slovakia)

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The existence of piedmont soil zonality on loess in Danube Lowland has been discussed long time with contradictory results. The soil toposequence was distinguishing starting with Calcaro- Haplic Chernozem to Haplic Chernozem and successively to Luvi-Haplic Chernozems and (Albi-) Haplic Luvisols. Some authors opposed and hypothesized that this zonality does not exist. Recently, samples from about 300 soil profiles has been collected (A horizons and loess) across loess uplands of Danube lowland (SW Slovakia) and analyzed for some major (Ca, Mg, K, Na) and trace elements (As, Ba, Be, Cd, Cr, Cu, Co, Hg, Mo, Ni, Pb, Sn, Sr, V, Zn). Based on analytical data and statistics, monoelemental geochemical maps were constructed that within individual loess uplands (Trnavská, Nitrianska, Žitavská and Hronská uplands) revealed a zonal distribution pattern of most mobile element (Ca, Mg, Na, K and Sr) in loessic soils, with depletion at higher- and enrichment at lower hypsometric levels. Chemical elements migrate within the gravity field and concentrate depending on bioclimatic, lithological-geomorphological and geochemical factors. This geochemical zonality is reflecting complicate flow of matter in which besides vertical leaching a lateral migration of substances on and through the soils play very important role.
Obtained results helped us to understand lateral geochemical migration of elements in soil cover on regional level, soil development in lowlands during the Holocene and get a better inside into environmental processes that have been or are active in the landscape. The existence of geochemical law of zonality does not repose on the fact that landscape units have zonal pattern but on fact that landscape depends on climate. A better understanding of soil-geochemical catenas on loess and redistribution of mobile chemical elements in a landscape is of great importance for the pedogenesis of Chernozemic soils in Danube lowland.

S19.F.01
The role of climate and vegetation in weathering and clay mineral formation in Alpine soils

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The interpretation of the effects that the factor climate has on the type and rate of soil processes, mineral formation and transformation, weathering rates and global biogeochemical cycles has produced unequivocal results and is consequently still a matter of intense debate. Recent studies suggest that climate feedbacks on weathering are much weaker than previously thought. Our work focuses on more than 20 sites with a siliceous parent material in the Swiss and Italian Alps. The sites are characterised by different altitudes and aspect. Element leaching was found to be greatest in subalpine forests near the timberline with decreasing weathering at higher and lower altitudes. The relationship between climate, element leaching (Fe, Al, Ca, Mg, K, Na) and smectite formation is strongly non-linear and driven by the pronounced podzolisation process which is more pronounced near the timberline due to the bio-climatic constellation. Vegetation, therefore, contributed significantly to the weathering processes. Furthermore, distinct differences between south- and north-facing sites exist. Higher temperatures and an increased number of freeze-thaw cycles on south-facing slopes should theoretically enhance rates of chemical weathering. Nonetheless, the degree of chemical weathering increases from the south- to the north-facing sites which are characterised by lower temperatures, lower evapotranspiration, a higher humidity and a higher production rate of organic ligands enhancing podzolisation processes. Although precipitation in Alpine regions is abundant, the availability and flux of water through the soil is a prime factor in weathering intensity. The observed higher accumulation of labile, weakly degraded organic matter at N-facing sites - and the subsequent higher quantity of ligands - was coupled to a more intense eluviation of Fe and Al with the consequence that more low-charged minerals (smectites) were formed.

S19.F.02
Geochemical distinction of subalpine soils based on Al, Fe, and REE

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To reconstruct soil genesis by using the geochemistry of lacustrine sediments, the geochemical signatures of modern soils must be first determined. Our study explores the geochemical variability between eight subalpine soil profiles from the inner Alps in order to find relevant tracers of modern soils. Based on the concentrations of secondary Al- and Fe-bearing phases, major elements and Rare Earth Elements (REE) analysis, these subalpine soils can be clearly distinguished. Although formed on similar geomorphic and lithologic conditions and at similar elevation, soil typologies display a large range of variations. Soils belonging to Podzol group (sensu WRB) are developed under old-growing coniferous forests, whereas Cambisols occur under present-day old-meadows. A PCA including pedological and geochemical parameters allows a good distinction between Podzol and Cambisol samples resulting from the intensity of chemical weathering whereas deep and surface samples are distinguished through physical weathering. The proportions of organic-bound Al and Fe are significantly higher in Podzols, thus providing a sediment tracer to reconstruct the intensity and degree of podzolisation. The increasing of Light REE fractionation from the C-horizons to the topsoil horizons is explained by soil processes. The high field strength element Nb is used to estimate enrichment or depletion relative to the unweathered parent material. The resulting normalized REE patterns indicate that Podzol profiles are more depleted than Cambisols. Moreover, normalized REE patterns of A- and Bw-horizons in the Cambisol profiles are similar whereas E- and Bs-horizons of Podzols express important variations. Normalized REE patterns may thus provide a precise tracer of the degree of weathering of materials. Hence, we suggest that REE behaviour and soil weathering are clearly related. This study also highlights the effects of millennial-scale agricultural practices on soils, e.g. the eventual depodzolization related to deforestation.

S19.F.03
Sediment redistribution as a key to understand soil formation in central Bhutan.

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Soil development and landscape evolution were studied in the basin-shaped Phobjikha Valley, West Central Bhutan. The local environmental setting with strong along-valley winds, frequent freeze-thaw cycles, extensive dry periods and sparse vegetation cover encourages the generation and transport of silt-sized particles. The effects of this process are evidenced in the smooth valley morphology and in the nature of the examined pedons.Their involvement in continuing redistribution of local sediments is reflected by a homogeneous silty-clayey and stone-free texture, varying profile depths, buried topsoils and weakly developed A horizons. In protected locations, in situ weathering of metamorphic parent materials results in alu-andic features with bulk densities < 0.9 g cm^{-3}, (Al_o + ½Fe_o) > 2%, and phosphate retention > 95%. Dominance by Al-hydroxy interlayered clay minerals and large amounts of well-crystallised iron oxides indicate an advanced stage of weathering. In areas of preferred aeolian deposition, argic and ferralic features emerge, with clay contents of up to 60% and surface areas of > 50 m^2 g^{-1}. Under forest, umbric horizons develop. CEC_{eff} is below 10 cmolc kg^{-1} at all sites. Cluster and factor analyses of soil chemical and physical parameters confirm the redistribution of local sediments as a dominant factor behind the measured variables. No clear indication of glacial activities was found, whereas the massive silty sediments in the lower parts of most profiles, the presence of debris slopes, and the asymmetric cross sections of the side valleys suggest periglacial conditions. Buried topsoils dated at about 2,000 conventional ^{14}C years BP indicate a weakening or absence of sediment influx under wetter conditions towards the end of the Holocene climate optimum. Charcoal on top of palaeosols suggests that human activities of deforestation, grazing and arable agriculture since then contributed to the reactivation of local sediment redistribution.

S19.F.04
Initial soil development in the foreland of a retreating Werenskjold Glacier, SW Spitsbergen

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Rapid retreating of Werenskjold Glacier (77°05'N, SW Spitsbergen, the Svalbard archipelago) leads to an extensive broadening of the foreland which is covered with recent glacial till and glacio-fluvial sediments over the older glacigenic deposits or immediately on bedrock schists. To study the kind and intensity of initial soil development under specific periglacial-marine climatic conditions, a chronosequence of six soils was established on 1- to about 70-year-old tills deposited between the glacier front and its terminal moraine. Although the surface layer of soil within the entire area of the study is frost-active, well developed patterned features are not present. Minimal vegetation cover, consisting of bryophytes/organic crusts and *Saxifraga* sp., appears initially 5-6 years after deglaciation. Present-day soil-forming processes occurring within a surface layer of recent moraine till comprise initial weathering of primary minerals, release of some elements (e.g. magnesium and iron), carbonates dissolution and base cations leaching associated with pH lowering, accumulation of organic matter, and weak migration or decomposition of clay fraction. First symptoms indicating chemical transformation of parent material within a near-surface soil layer develop not earlier than 5-6 years after deglaciation, however, significant changes of physico-chemical soil properties may be confirmed after minimum 10 years. Further processes of soil transformation, related to development of plant roots, and covering the entire volume of surface layer, to the depth 10-15 cm, may lead to formation of initial A horizon after a period of 50-70 years. A buried paleosol of Viking Age, discovered beneath the recent moraine till in the foreland of Werenskjold glacier, indicates that present WRB Cryosols may evolve into Cambisols under further climate warming, followed by decreasing frost action and succession of vegetation.

S19.F.05
The peculiarities of the automorphic loamy soils of the east european tundra

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The Russian European North-East has been studied throughly for the soil distribution and genesis. But most of the studies were done in its south-eastern part - Bolshezemelskaya tundra, other areas remaining poorly examined.
We investigate the Kara River basin, in the south and north (typical) tundra subzone transition. The greatest part of the investigated area is covered with loess-like silty loams. The tundra is in the zone of discontinuous permafrost. The active layer increases from north to south (from 0.3 to 0.6 cm in palsas, 0.6 to 3.0 cm on loamy substrates). Permafrost-affected relief forms are spread out here. In plains areas, palsas, hummocks, sorted and nonsorted circles, and other different kinds of patterned ground are widespread. The northern part of the Bolshezemelskaya and the Malozemelskaya tundra belong to the dwarf-shrub-mossy tundra subzone, were sedge-moss swamps are ubiquitous.
Owing to a variety of microrelief and cryoturbation processes, the investigated soils are inlaid and form complexes of soils. Complex of automorphic soils marks the presence of gley in all mineral horizons and surface gley profiles and reveals the soil profiles, the mineral horizons of which have no signs of morphologically pronounced gleyzation. In the northern part of the region on loamy materials, Tundra mucky gleyzems (Gleyi-Turbic Cryosols, Stagni-Turbic Cryosols) occur, while Tundra peaty gleyzems (Geli-Histic Gleysols) and Tundra peaty-mucky gleyzems (Turbi-Histic Cryosols [Stagnic] are common in the central part. Towards the south, Tundra surface gley soils and non-gleic soils prevail. The profile is characterized by a combination of peaty litter, presence or absence of surface gley and middle cryometamorphic horizons. Cryometamorphic horizon has specific angular-grumous or friable granular, curdled under moist conditions, cryogenic structure. The soil formation is the result of Gley-Al-Fe-Humus mobilization, migration, accumulation and cryogenic structural metamorphism.

S19.G.01
Long-term liming effects in Irish soils may have been underestimated

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Soil acidification is typical where precipitation exceeds potential evapotranspiration, making free-draining soils more acid than their parent materials. Liming offsets this tendency. Consequently, surface horizons of many free-drained mineral soils in agricultural lowland in Ireland have higher pH values than the immediate sub-surface, which has a lower pH value than the parent material. However, the degree of acidification, and the impact of liming, may both be underestimated. Frequently, morphological signs of pedogenic horizon development are inconsistent with the current surface or sub-surface pH or biological indicators. Furthermore, anomalous “podzolised limestone soils” show iron translocation, although conditions throughout are not reduced or acid enough to allow iron mobilization. These widespread phenomena are attributed here to a long history of using liming materials, applied to the soil surface as agricultural amendments to improve fertility for crop (including grass) production. Ireland’s regime of high and very frequent precipitation with a relatively high sodium content (from the adjacent windy North Atlantic ocean) allows leaching of calcium and magnesium derived from mineral weathering. This ultimately leads to higher rates of mineral weathering and translocation of the less soluble iron and aluminium, promoting podzolisation and persistently-lowered pH values in soils. This deposition environment has given ubiquitous Podzols on unmanaged free-draining parent materials. Previously-limed land begins a new generation of podzolisation within decades of abandonment. Several centuries of land liming are well documented for Ireland, while the practice of using sand (presumed to be calcareous shelly sea sand) to improve soil fertility was well established locally by the thirteenth century. It is important to recognise not just the long association between agriculture and the land, but that in terms of gross soil morphology, major soil types, and consequent long-term productive potential, agricultural amendment has been a dominating formative influence, and underpins the continued sustainability of agricultural ecosystems.

S19.G.02
Hydropedological Implications of Iron-Manganese Nodules in Rice-Growing Ultisols under Different Anthraquic Conditions

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The soil morphology is consequently characterized by seasonally high groundwater and irrigation water. In this study, Houko (Plinthic Paleaquult), Chuwei (Typic Plinthaquult) and Luchu (Typic Plinthaquult) soils were selected to determine the relationships between the characteristics of different sized Fe-Mn nodules and anthraquic conditions on the terrace. Groundwater table, water potential and redox potential of three soils at different depths were monitored during 2004 and 2005. Monitoring results indicated that the Chuwei soil was the moderate reduced (average 54% annual reduced duration during 50 cm and 200 cm from soil surface) which has the largest amount of Fe-Mn nodules (280 g/kg) in the three soils, particularly in the nodules ≥ 20 mm in diameter. Thin section microscopic observation of the Fe-Mn nodules further revealed that the co-presentation of secondary Fe and Mn oxides and oriented clay is higher in coarser nodules than in finer nodules. This indicated that the formation of nodules was accreted with clay and continued accumulation of pedogenic Fe and Mn in alteration of oxidation and reduction condition. Higher ratio of amorphous Fe and Free Fe suggested that nodules are currently formed by the accretion of Fe in situ. Significant positive correlation was found between the annual reduction duration and Fe activity index of nodules and it indicated that the formation of Fe nodules were affected by reduced duration in soils. In this study, the formation mechanism of Fe-Mn nodules in study site was deduced that reduced manganese firstly precipitated within micropores or coated on the coarse grain surface as a nucleus. The reduced iron, manganese and illuviated clay continue removing and precipitating on the initial manganese nodules and surrounding and embedding grains of matrix soil as they grow to be coarser one.

S19.G.03

Effect of wheat and ryegrass on recrystallisation rate of pedogenic carbonates

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Dissolution and recrystallisation of primary (geogenic) carbonates with CO_2 of soil air leads to the formation of secondary (pedogenic) carbonates. These are used as an important tool in geosciences as they offer the possibility of radiocarbon dating (^{14}C) of soils and paleosoils and the reconstruction of paleoclimatic conditions by $\delta^{13}C$ and $\delta^{18}O$. As the accuracy of these investigations depends on the formation rate of the pedogenic carbonates, it is the main intention of this study to determine the carbonate recrystallisation rate. Vegetation is the most important factor controlling CO_2 exchange between atmosphere and soil. Dependent on the plant's growth rate and the part of its assimilated carbon used for rhizosphere processes, differing intensities of $CaCO_3$ recrystallisation are assumed.
Spring wheat and ryegrass were grown on loess. Contrary to soil, this loess contains solely primary $CaCO_3$, has high $CaCO_3$ content (30%) and nearly no organic carbon. A ^{14}C pulse label was applied to the plant shoots one to five times in five days intervals. Prior to the next labeling, ^{14}C activity was measured by liquid scintillation counting in respired CO_2, loess carbonate, DOC and DIC, roots and shoots. The recrystallisation rate of $CaCO_3$ was calculated by the specific ^{14}C activity of respired CO_2. With ascending number of $^{14}CO_2$ pulses the amount of rhizosphere ^{14}C recovered in the $CaCO_3$ of loess linearly increased. Wheat led to a higher recrystallisation rate than ryegrass. The recrystallisation rate within the loess not adjacent to roots was very low, whereas much higher values were observed in loess close to roots (2 - 3 orders of magnitude). This clearly shows the significance of roots for $CaCO_3$ recrystallisation and formation of pedogenic carbonates.
Studies of various factors (e.g. length of growing season, temperature, humidity) are necessary to create a comprehensive model for the recrystallisation rate of pedogenic carbonates.

S19.G.04

Formation of cabonate precipitates in a marsh soil of northwest Germany

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Decalcification is a well-known process of marsh soils developed from marine-derived sediments. Major carbonate losses occur because of oxidation of reduced sulfur compounds and sulfuric acid production, followed by moderate decalcification by respiration processes and carbonic acid production.
It was only recently in 2007 that products of precipitation were observed in a marsh soil of Northwest Germany during archaeological excavations. These concretions showed the size and the form of hen eggs, incrusted by iron oxides, thus forming ooids. They were always found at a depth of 150 cm below the soil surface. A comprehensive study was performed to clarify their composition and formation.
The hitherto existing data showed that the ooids contain the following elements in decreasing amounts: Ca, Fe, O, Si, K,C, Mn, Al,P, S, Na, Mg. The external sectors showed distinctly lower Ca and higher Fe and Si contents than the centre.
As the precipitation of carbonates and formation of ooids is not common for marsh soils of the temperate zone, exceptional soil properties must be responsible for this process. The studied soil was built up by four geological layers. The first surface layer consisted of anthropogenically relocated marsh soil material. The second showed actual to postactual acid sulfate soil properties followed by a small oxidized layer. The fourth, beginning at depths of 150 cm, was a reduced impermeable layer showing potential acid soil characteristics. The following specific pedogenic conditions are considered having caused the ooid formation: I. Intense Ca leaching caused by quick pH decrease and jarosite formation. II. Prismatic to columnar structure allowing preferential flow. III. Impermeable layer in the subsoil preventing continuous loss of solution products. Hence, Ca-rich soil solution was transported via preferential flow to the impermeable subsoil, the Ca concentration increased as a consequence of transpiration, and precipitation took place.

S20 Soil Classification

S20.A.KL

The need for an overarching European soil classification

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The diversity of national soil classification systems in Europe, with their own terminology, classes and analytical procedures, hampers sustainable soil management at European level. The Soil Map of the European Communities at 1 : 1 000 000 of 1985 used a derivate of the FAO-UNESCO Legend of the Soil Map of the World to portray the distribution of soils in Europe in a unified manner. Since then, the FAO Revised Legend and its successor, the World Reference Base for Soil Resources (WRB), has been used to further build an information base on European soil resources.
WRB is a framework for soil classification and correlation world-wide, permitting precise recording of readily recognizable soil properties. However, is WRB a suitable system to delineate soil characteristics that are essential for managing and safeguarding European soil? Although the current stratification in WRB 2006, with its prefix and suffix system of qualifiers for the 32 Reference Soil Groups recognized, provides a lot of information at soil profile level, much of that information does not show when WRB is used for mapping, especially at small scales, because of the generalization needed to construct map and legend. Moreover, transferability of soil information contained in previously used systems is limited because of changing concepts and definitions. It is tempting to use readily available and internationally accepted soil classification systems as they are built on vast research and experience. However, the variety of national soil classification systems in Europe, some of which do not correlate easily with each other or with internationally accepted systems, calls for the construction of an overarching European soil classification system that recognizes national needs and respects generally accepted terminology.

S20.A.01

Using WRB 2006 in mapping and database design: practical issues at European scales

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The development of the Soil Framework Directive and other recent European and global initiatives has resulted in an increasing demand for harmonized soil information. The World Reference Base for Soil Resources (WRB) was endorsed by the European Commission as a common scheme for harmonized soil databases and maps for the European Union as the system

allows soil from different regions or countries to be identified and characterised with the same terminology. The diagnostic categories (horizons, properties, materials) and the qualifiers of the WRB carry important information on soil properties and the inherent vulnerability of individual soil types to various types of degradation.
The presentation will demonstrate how soil classification information of different origins can be harmonized using the WRB and how a database that stores the WRB categories can serve as a valuable information source for identifying and delineating soil units with certain properties that may result in degradation processes and threaten the normal functions of soil.
The presentation will also highlight some difficulties encountered during the development of the Atlas of Northern Circumpolar Soil during probably the first attempt to apply WRB 2006 in a major mapping programme and the construction of a map legend.

S20.B.01
New wine in old wineskins: Why soil maps cannot simply be "translated" from WRB 1998 into WRB 2006

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Let's start with an example looking at a landscape in southern Germany: Tertiary sediments with and without loess covers are found between the river Danube and the Alpine Pleistocene sediments. The Soil Atlas of Europe (2005) shows Cambisols and Luvisols, which is corrrect according to WRB 1998. The Luvisols developed on thick loess covers. According to WRB 2006 some of them are still Luvisols, some move to the Alisols (the Alisol definition has been widened) and some to the newly-introduced Stagnosols. Of the Cambisols, one part originated from Tertiary sediments without or with very thin loess covers and still belongs to the Cambisols according to the new WRB. But many of them formed on loess, experienced clay migration and lost their coarser-textured topsoil due to intensive agricultural use. They were Cambisols in WRB 1998 but now are Luvisols and Alisols, because WRB 2006 changed the definition of the argic horizon, now including horizons having clay skins and starting directly at the soil surface.

Many other changes affect maps: Podzols now include shallow and less pronounced varieties having been Cambisols in the old WRB. Cryosols may have a cryic horizon also at depths of 100-200 cm if cryoturbated above. The definitions of many other Reference Soil Groups have been widened (e.g. Histosols, Chernozems, Umbrisols) or restricted (e.g. Leptosols), and Technosols and Stagnosols have been newly introduced. Therefore, to achieve correct maps according to WRB 2006, it is essential to draw them newly, based on orignial soil profile data.

Contrary to the FAO legends, WRB always required to list all applying qualifiers for correct classification at the lower level. But WRB 2006 provides much more qualifiers, and soils with up to 10 qualifiers have been recorded. Therefore, the mapper has to select qualifiers according to the purpose of the map.

S20.B.02
Data harmonization and database development for a transnational area along the Hungarian-Slovakian border

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This paper summarizes the results of the work of a joint Hungarian-Slovakian team to harmonize the data of the two countries and create a WRB based database covering a transnational area. The project has collected recent and archived soil profile data, soil monitoring sites and large scale soil maps of different origin. These data sources were translated to a set of common variables using direct calculations/transformations or pedotransfer rules where direct tranlation were not possible. The harmonized soil profile dataset were than employed to extrapolate the soil variables using geostatistics and remote sensing/digital terrain modeling tools. The extrapolated soil properti layers were used as input factors into the pedotransfer rules to derive WRB reference groups and characteristic diagnostics.

S20.B.03
WRB and large scale soil inventory - possibilities and limitations

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Introduction. Internationalization of soil information seeks for standardization of methods for soil diagnosis and its classification. Research publications, realization of monitoring programs and environmental assessment are at least among spheres where national soil classifications alone are not able to provide adequate information flow. Despite of the wide-spread experience and common opinion that WRB is only applicable for small-scale soil inventory it is also almost non-alternative way how to provide information about soils in above mentioned situations. Therefore comparative study of use of Latvia national classification and WRB was performed to characterize number of pedons of agricultural and forest soils described according to the FAO (2006) guidelines.
The **aim of study** was to detect and characterize soil differences for profiles which were classified as similar units according to the WRB (2006) and evaluate importance of these differences for interpretation purposes. On the other hand similarity of soils which were keyed out in different WRB Reference groups was also under the study interest.
Results and discussion. As an example three different profiles of Arenosols (Dystric) (WRB 2006) located rather close (20 - 50 km) each from other (24°20' E and 57°00' N) is discussed. According to the Latvia Soil classification they were Typic Podzol, Typic Gleyic Podzol and Lamellar Alluvial Soil. The conclusion was that for better distinguishing differences within one WRB Reference Soil group number of qualifiers should be extended quoting soil properties inherited from parent material as well as pedogenetic features even in case if it's not sufficient for distinguishing as certain diagnostic horizons or properties. Extending the depth of diagnosis below wide-used 100 cm in some cases could be reasonable to assign additional qualifiers to Arenosol Reference Soil group.

S20.B.04
The conversion of a national soil classification to the World Reference Base. Problems met in Svete, Latvia

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In 2007, a UNCCD project started in Latvia for the conversion of the national soil classification to the World Reference Base for soil resources. This has several advantages. A WRB map enables communication with other countries and soil scientists about the Latvian soil classification, which is now only understood by Latvians. Also, a common classification system will be needed in the EU to equalize soil-based subsidies for farmers and to promote sustainable land, water and soil quality management. The WRB is suitable for that purpose. It is one of the basic principles of the WRB that it is "a comprehensive classification system that enables people to accommodate their national classification system".

Although the WRB and the Latvian classification which is derived from the Russian classification, follow similar principles, the conversion is not a simple matter of substituting names. Translating the legend of the existing soil maps of 1991 is not possible. These maps use taxonomic units as mapping units. This means that soils of different soil groups were by necessity included, especially in regions with complex Pleistocene parent materials, and that one Latvian name corresponds with several WRB names.

The conversion problem can only be solved in the field. The surveyor of the existing soil map used a landscape/soil genetic approach. The same insight in the landscape - soil relationships is needed to identify a location representative for the taxonomic unit which gave the mapping unit its name. Classifying that profile with the key of the WRB key produces an unambiguous 1:1 conversion of the national classification to the WRB.

S20.B.05
Applicability of WRB 2006 for classification of Slovenian soils

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Soil classification used in Slovenia has been a modified Yugoslavian soil classification (MYSC). For the purpose of soil evaluation, short guidelines based on Yugoslav soil classification (YSC) were prepared and published (Official Gazette, Ur.l. SRS. št. 36/84) and represent the only official document on Slovenian soil classification (SSC). During national soil mapping (1963 to 1990), internal classification guidelines based on YSC were prepared by pedologists from the Centre for Soil and Environmental Science at Biotechnical Faculty of University of Ljubljana. After Slovenia became an independent country in 1991, the need for an official soil classification appeared and became more pressing after Slovenia joined EU. At the same time a dilemma whether to continue developing SSC based on YSC or start using WRB exclusively appeared. One of the presumed advantages of MYSC may be a greater precision on national level.

In this study we compared the applicability of the two classification systems using selected Slovenian soils. The results of our study suggested that WRB system is more precise than MYSC with a higher number of diagnostic criteria which require additional measured parameters. As a consequence, the use of WRB requires highly skilled personnel. The main advantage of MYSC is its genetic approach and incorporation data of the parent material in the name of the soil. MYSC terminology has more meaning to non-experts; sometimes the use of a name of soil classified by MYSC (e.g. terra rossa) can be widespread and widely recognized. Certain soil types such as those formed in gravel and other sediments, which are relatively widespread in Slovenia, do not fulfill WRB criteria for continuous rock and cannot be characterized with leptic qualifier. As a consequence we loose the depth information for those soils. Therefore, national classification is important and we should continue to develop SSC.

S20.B.06
Classification Schemes of Soils: Principles, Issues and Purposes for Scientific and Technical Development

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Basic principle in any system of Soil Classification is to organize knowledge, so that these natural objects may be understood for some specific purposes. Any system of classification groups soil properties and relationships about statements for the objective purpose, scientific and technical development. Different systems have different objectives. Soil Taxonomy was designed to group soil series in the USA in increasingly-general interpretive groups. World Reference Base and its predecessor FAO Legend were designed to understand and organize world soil geography. Bulgarian Soil Classification (Extended Systematic List) was developed in 1976, as a result of large scale soil survey of the country territory.

The study focus on comparison of objectives and organization of the different world's soil systems and national one: scope of objects, assessment and ordinary evaluation approach for soil unit, the main issues and final selection. The purpose was to provide a framework for establishing relationships among soil units in Bulgaria and their environment, the correlation aspects of national classification with the Soil Taxonomy and World Reference Base. Many of the concepts from different systems are similar. However, direct correspondence between classes is rare.

The principle of Soil Taxonomy is a substantive diagnostic system based on the conception of diagnostic horizons of polypedons, which forms taxonomic unit. The principle of World Reference Base assumes that its units stimulate harmonization and correlation of existing national systems and also serves as a communication tool and for the inventory of the world's soil resources. Bulgarian Soil Classification system is based on the conception of soil genesis, which forms particular soil profile with the "factors-processes-properties" criteria, where the principles are: similar genesis, geographic dislocation, sequence of genetic horizons, similar relief occupation, similar air, and water and temperature regimes.

Key-words: 1st soil classification; 2nd Soil Taxonomy; 3rd World Reference Base.

S20.C.01
Soil Assessment in Austria

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The Soil Assessment in Austria is the only organisation that carries out analysis of physical (and partly also chemical) data in the fields in accordance to the lots of agricultural used land (Soil Evaluation in the fields). That's why this data offer a varied possibility of use and the have importance way over the use for fiscal purposes. Information on soil quality and distribution is crucial for soil protection. The Austrian Soil Assessment offers soil information for the whole agricultural used land of Austria.

The Austrian Soil Evaluation was started in 1947 and the first estimate was concluded in 1973.

Real estate valuation

The purpose of real estate valuation, within the meaning of the valuation law, is a standardised determination of the values of the economic units as the basis for a multitude of taxes, contributions and non-fiscal applications.

Results of Soil Evaluation

The results of the Soil Evaluation are characterised by the following:

high information content

immediacy

high geometric precision

detailed mapping

detailed description and avaluation of the agricultural used lands (available all Austria: 1.940.000 hectares of pasture land and 1.405.000 hectares of arable land) and

if available in digitalized form additional possibilities of analysis

Therefore the data of the Soil Evaluation are used also for non-fiscal purposes, especially for different applications in the fields of nature and soil conservancy.

S20.C.02
Classification of topsoils on national, European and international levels

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Soil taxonomies hardly consider the topsoil (litter, organic layers and A horizon) in spite of its importance for soil quality. Within the World Reference Base for Soil Resources (WRB) system topsoils cannot be described as detailed as needed in environmental monitoring to reflect their spatial and temporal variability. Since a few years a broad discussion on the classification of topsoils / humus forms is going on. There are suggestions for classifications from national and European research groups but there is still no international classification system for topsoils / humus forms in general existing. A topsoil classification system is needed corresponding to the terminology of the WRB.
Some years ago a study was carried out to improve and revise the FAO draft “Topsoil Characterization for Sustainable Land Management”, and some new qualifiers for the topsoil classification have been established. As a next step, a worldwide topsoil network has been established, consisting of about 80 scientists working on topsoils / humus forms and classification aspects. An ongoing Canadian-German project focusing on the characterization of topsoil quality in agricultural management systems will contribute to the classification of topsoils on arable land.
The objective of this presentation is to give an overview on national, European and international approaches for characterization and classification of topsoils / humus forms in order to encourage international cooperation. The aim of this cooperation could be the development of an international topsoil classification linked to WRB.

S20.C.03
Determination of soil condition using electromagnetic sensors array

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Soil has a complex structure and texture that are modified in depth. Ground penetrating radar (GPR), used currently in these condition, works at high frequency to have a good spatial resolution, having relative small depth penetration.
This paper propose the use of electromagnetic sensors array at low frequency (1-20kHz) that allows the obtaining of information from depth bigger that GPR, having in the same time, a good spatial resolution due to the algorithms of super-resolution used. The inversion technique allows the evaluation of the conductivity of the soil layers for the case of a multilayer soil. The theoretical results, numerical simulation and experimental results that correspond in good measure with the ones foreseen by inversion are presented.
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S20.C.04
The Khajeh Research Station Soils: Morphology, Mineralogy & Classification

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Abstract
This study aim was to evaluate soil formation and characteristics. Representative soil profiles morphological were described and Some physico-chemical and mineralogical properties determined and soil classification also carried out. The soils were found to be piedmonts with mainly calcareous, gypsiferous and shale parent materials , lying at low latitude .All studied soils were deep and well drained with overall slope of 1-5 % .The region was divided in three toposequences , that in two toposequences fron lower part to upper part morphological features are similar but in the other one , upper and middle parts have similar soil , which differ from the lower part soils .The calculated soil temperature and moisture regimes by using data from region climatological stations and Newhall method revealed mesic and weak aridic respectively. Mineralogical analysis showed chlorite, illite , kaolinite , vermiculite , palygorskite , quartz , and in a few portion smecttite . Illite and chlorite in all layers, kaolinite in the majority of horizons and palygorskite in some layer are inherited, but vermiculite in the majority of horizons seems to be formed in soil and is one of the main pedofeatures.
In general the soils with different topography showed same mineralogical properties, but kaolinite found mainly in the lower parts of soil profiles, which it shows similarity in parent rocks and also limited condition of minerals weathering. Calcium carbonate and gypsum are the dominant inorganic materials which have formed calcic and gypsic horizons by calcification and gypsification processes. The soils are neutral to slightly alkaline and texture is medium to relatively heavy before removing of salts
Subsequently soils were classified in Aridisols and suborders of calcids and gypsids , great groups of Haplocalcids ,Haplogypsids and Calcigysids based on Keys to Soil Taxonomy 2006 .
Keywords: Toposequence , calcification, gypsification,mineralogy, classification

S21A Society´s Demands for and Perceptions of Soil Conservation

S21A.D.KL
The role of policies in soil protection and conservation

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Agriculture, cultivating a substantial proportion of the European land, plays an important role in maintaining natural resources and cultural landscapes as a precondition for other human activities in rural areas. However, unsustainable agriculture practices pose a threat to natural resources (as soil), with serious impacts on farming, properties of local inhabitants and public infrastructure.
Land users, usually private individuals, are responsible for soil management. Although soil degradation has significant on site effects (as loss of fertility) the associated cost are insufficient to govern proper soil management. There are many factors affecting farmers' decisions on practices: market pressure, available technology, available information and farmers' knowledge, farming style, pressure of affected actors etc. On the other hand, there is societal interest to maintain soil fertility as a precondition of food supply (food security) and to regulate negative effects caused by soil management on properties of other individuals, public infrastructure and nature.
The need for policies results from the discrepancy between private supply and public demand for soil conservation. The

policies exist and have their history. However, it is difficult to make policies (measures) effective. The main objective of the paper is to show what policies are common in Europe and to present a conceptual framework for their assessment.
The paper refers to the Sustainable Agriculture and Soil Conservation project (SoCo) launched by JRC/IPTS on the request of the Commission and European Parliament and which objective is to assess how farmers can be encouraged by coordinated European policies to adopt farming practices enhancing soil conservation. The SoCo study provides an EU-wide survey of farming practices and systems related to soil conservation, a survey of current policies and their implementation and in-depth insight in 10 case studies in the process of farmers' response to private or public initiatives, regulations and incentives toward soil conservation.

S21A.D.01
Appreciation of soil by Dutch society

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Soils deliver many services to society. The importance of soil to society is acknowledged by scientists and in policy documents, such as the proposal for a EU Framework Directive for Soil Protection. However, citizens are not aware of the importance of soil. For example, a recent inquiry showed that only 8% of Dutch citizens consider the risk of soil contamination to be applicable to their own living situation. In reality, 45% of the respondents live within 100 meter of potentially seriously contaminated soils.
Why is soil underappreciated in the Netherlands? Most Dutch citizens are detached from nature and do not feel a sense-of-urgency of soil problems. Catastrophic events like severe soil erosion are virtually non-existing. Heavily contaminated soils that form a direct threat to human health are being remediated or contained. Diffuse pollution with phosphorous and heavy metals is widespread, but it takes hundreds of years before critical limits of hazardous substances are exceeded. And even if critical limits are exceeded, effects are difficult to proof. Moreover, many soil threats (e.g., compaction and organic carbon decline) are not easily observed and their effects are difficult to communicate.
In contrast, Dutch citizens do feel a sense-of-urgency for environmental problems like surface water contamination and climate change. The role of soils in these problems is often significant, but is completely overlooked by citizens and often also by policy makers. Surface water contamination may occur after long-term accumulation of phosphorous or metals in soils. Carbon is released to the atmosphere after drainage of peat soils. The task for soil specialists is to raise ‘soil awareness’ amongst farmers, water managers and policy makers. Policy makers don’t need to wait for the Soil Framework Directive. Many soil problems can be tackled by integration of soil into existing regulations like cross-compliance in the common agricultural policy.

S21A.D.02
Ecosystem services or soil functions? A closer look at the interface between natural and social sciences

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In environmental sciences as a whole, there has been significant progress on the development of integrated concepts for linking environmental and socio-economic knowledge. The most prominent effort has been the Millenium Ecosystem Assessment (MEA), which describes the relationships based on an ‘ecosystem services’ approach. Although soil - a central component of most terrestrial ecosystems - has been recognised by the MEA, the concept of ‘soil functions’ remains popular among soil scientists. Are ‘soil functions’ and ‘ecosystem services’ describing the same things? Conceptual clarity is necessary to identify knowledge gaps and research objectives between soil science and social sciences. We illustrate the communalities and the differences between two conceptual frameworks that are currently used by both researchers and policy makers. While the concept of soil functions can be a useful framework to identify research needs in soil science for improving the knowledge base on human-soil relationships, the ecosystem service model appears to be more appropriate to cater for the information needs of a much broader range of disciplines to describe, measure or evaluate the contribution of the natural environment, including soils, to human well-being. Many ecosystem services rely only in part on soil-related processes and the influence is often indirect. We therefore propose that soil function and the ecosystem service should not be used interchangeably. Ecosystem services carry a normative notion and should be demonstrably beneficial (or detrimental) to human well-being, whereas soil functions are limited to be descriptions of the subset of structures, processes and interactions that are potentially beneficial (or detrimental) to human well-being. Soil functions constitute the biological, chemical and physical basis for the development of biophysical models that - via multiple pathways - inform decisions on management and policies. In this regard, they should rather be conceived in analogy to ecosystem function within an ecosystem services framework.

S21A.D.03
Using the AMOEBA approach for effective soil conservation communication and information towards farmers in Belgium

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In developed countries, the main driver for soil conservation is the desire to inhibit the off-site effects of run-off and erosion. It is commonly understood that, since a great deal of run-off pollution is of agricultural source, the use of Best Management Practices by farmers would be an efficient way to contribute to this environmental goal. However, until now, adoption and diffusion of these BMP is low, despite many extension efforts and a subsidy policy for certain practices. Our past study on farmers’ beliefs and convictions influencing adoption of BMP reveal that farmers often have ideas about the impact of soil conservation practices that are not supported by science and extension. This study proposes a new way to communicate with and inform farmers on the consequences when implementing BMP. An AMOEBA approach is developed that contains information on most aspects that influence farmers soil conservation behavior. The AMOEBA is an easy-to-handle tool that visually informs farmers about the impact of soil conservation. It can also be used as a communication tool between farmers and science, and between farmers.

S21A.D.04
Heritage soils in Flanders: towards a conservation strategy

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Undisturbed soil profiles are important for soil and environmental science, nature conservation and natural and cultural heritage. Over the past 60 years the area of soil profiles that remain intact has been decreasing rapidly. In response of this urgent need for

the protection of valuable soil sites, the Flemish government issued an initiative in 2004 to set the scene for the identification, distribution, and protection of heritage soils in Flanders, as part of the general policy regarding the soil protection incentive of the European Union.
First an identification and classification key was developed to determine if a soil site was to be considered a heritage soil. It distinguishes soils that are characteristic (geo-genetically or culturally), are unique (geo-genetically or culturally), are of special age (buried soils and relict soils), are part of a unique sequence, are pristine, have a typical morphology or have unique properties for scientific research or educational purposes. Secondly, a database-GIS tool to collect and manage data was developed based on an inventory of known heritage soil sites. Third, possible treads to heritage soil sites were identified and potential conservation strategies were formulated. An emergency archiving procedure was developed for sites that could not be preserved. Several case studies were added to illustrate the conclusions of the study. Finally, recommendations for future policy were formulated, including opportunities to develop the educational and touristic potential of heritage soil sites.

S21A.E.01
Repeat photography to analyse the effects of 30 years of land rehabilitation in the Ethiopian highlands

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Studies on the impact of environmental rehabilitation in semi-arid areas are often limited in spatial and temporal scale, and do typically not include detailed bio-physical components. As a first in its kind, the present study makes a multi-scale assessment over a time span of 30 years of environmental rehabilitation in one of the worlds' most degraded areas: the Tigray highlands in Northern Ethiopia, where population has more than doubled over that period. Using methods from geomorphology, hydrology, soil science and multi-temporal photomonitoring, we show that in Tigray, soil erosion rates are estimated down by 68 %, infiltration and spring discharge are enhanced, vegetation cover has increased and crop production improved compared to the prevailing situation a few decades ago. These impacts are quantified and substantiated by a comparison of current landscapes to the past situation by means of a comprehensive database of 30-year old photographs of representative landscapes covering the major agro-ecological zones of the region. Observations on land rehabilitation despite a strongly increased population density become sound when considering the large-scale implementation of soil and water conservation (SWC) practices that has taken place over the last two decades. This study invalidates general perception on irreversibility of land degradation in Northern Ethiopia and *a fortiori* in less marginal semi-arid areas. The study furthermore demonstrates that it is possible to reverse environmental degradation and to provide ecosystem services to the society in semi-arid areas through active, farmer-centred SWC policies, whereby small-scale farmers are kept on their land by providing adequate levels of subsidies. In a highly degraded environment, with high pressure on the land, no alternatives are left open but to improve land husbandry.
Repeat photography was proven a powerful tool to demonstrate the benefits of land management to the broader public.

S21A.E.02
Landscape ecological factors influencing the spread of bubonic plague in Lushoto, Tanzania

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Plague is a zoonotic disease which traditionally circulates in wild rodents and their fleas. In humans, the plague bacillus Yersinia pestis causes a rapidly progressing, serious illness that is likely to be fatal. In most countries where the disease is endemic, it occurs seasonally and shows a well defined focal geographical distribution. In 1980 a persistent focus of human plague was discovered in Lushoto, Tanzania. By 2004 7603 cases had been reported from this region and a strong variation in plague frequency and incidence is seen among neighbouring villages in the endemic area. Earlier studies, which focused mainly on the host-vector-parasite system, demonstrated that this striking variation could not be explained by differences in fauna composition or human domestic behaviour. Abiotic, environmental and landscape factors are therefore suspected to play a role. In the present study, we would like to report on the link between plague incidence in Lushoto and data on soils and geology, climate, landforms and land cover. To this end, we performed a preliminary field survey in a number of plague-positive and -negative villages. Thirteen representative soil profiles were described, analyzed and classified. An exploratory soil map was created using geographic information systems and remote sensing data. We found a positive correlation between plague incidence and altitude. Moreover, the endemic plague area appeared to coincide with an area that had been totally deforested in the 1960s. Villages with a high plague incidence turned out to be connected through typical valley bottoms, i.e. Gleysols and Fluvisols. Today, additional field data on soil physical (texture) and chemical (concentrations of chemical elements) properties, climate (rainfall, minimum and maximum temperature) and landscape connectivities, are being collected aiming at establishing links between plague incidence and environmental variables in order to contribute to a better understanding of the plague's ecology in Lushoto.

S21A.E.03
A review of policies and the regulatory environment concerning soil conservation in the EU

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In the context of an EU study titled "Sustainable Agriculture and soil conservation", a concise EU-27-wide review on the policy and regulatory environment concerning conservation agriculture and soil conservation was performed. The EU member states have so far implemented a variety of measures on the national and regional level that regulate the use of soils or offer incentives for the adoption of soil conservation practices. These national efforts against soil degradation were reviewed in this survey on a comparable level.
Based on an online survey among implementation experts in the 27 EU member states and their regions, an inventory of soil conservation related policies was carried out. The study provides a classification of the policy measures and a gives an overview on the soil conservation efforts in each country. A server based database system allows the efficient management of the results and improves their presentation in standardised forms including country fiches and overview tables.
The presentation will draw conclusions on the different approaches to soil conservation policies that were found in different European countries. The main categories "incentive

based policies", "command-and-control measures" and "moral suasion activities" were found in differing extents. Furthermore, the level of incentives paid for similar conservation programmes vary throughout Europe.
The overview contributes to an efficient design of European agri-environmental policies concerning soil conservation.

S21A.E.04
Adapting policy measures to encourage the adoption of soil conservation practices

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Agriculture plays an important role in the maintenance of natural resources and cultural landscapes; a prerequisite for other human activities in rural landscapes across Europe. However, inappropriate agricultural practices and land use can have adverse impacts on natural resources.
This paper draws on findings from eight case studies conducted across Europe including Belgium, Bulgaria, the Czech Republic, Denmark, Germany, Greece, Spain, and the United Kingdom. Using a theoretical framework of policy and institutional analysis, the study was designed to improve knowledge on soil conservation practices in the agricultural sector and to analyse how farmers can be encouraged through policy measures such as the Rural Development Programme to adopt soil conservation practices. Data was gathered by means of qualitative interviews with farmers, administrative authorities implementing soil conservation policies, agricultural and environmental interest groups and other soil-related stakeholders. Quantitative data on soil conditions, degradation types, and related farming practices that cause or prevent soil degradation complemented the qualitative data.
The results provide insights into the perceptions and behaviour of farmers revealing their motivations to comply with a rule or to adopt voluntary measures. The findings also describe interests and attitudes prevailing in authorities responsible for implementing soil conservation policies, the resources available to them and their relationships with other organisations. Based on the analysis of a variety of physical, natural, institutional, socio-economic and historical factors, the study draws conclusions why some soil conservation measures are effective while others fail, and points to the current limitations of European soil conservation policy.

S21B Soils and Societies in History

S21B.F.KL
Soils and Societies in History: Bridging Approaches, Pooling Knowledge

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Soils are the most historical of all natural entities. Not only do they undergo a natural history, pedogenesis, but the history of their cultivation - their cultural history - is of utmist importance for their status. Soils - unless the problem is erosion - stay put and hence accumulate the history of human intervention. Soils are cultural archives, not just of artifacts, but also for the history of human interaction. Terra Preta soils are a case in point for Anthrosols, soils which would not exist without such human interaction.
This combined history meets the specialized training and expertise of historians and pedologists alike, and none of them alone can deal with it successfully.
The presentation by an environmental historian, who has learned a great deal about soils, but not enough, and a pedologist, who has learned a great deal about history, but not enough, will focus on the differences of approaches, of sources and data, but intends to show how a combined effort can lead to investigations which allow to deal with both the natural and cultural phenomena incurred in soil histories. We shall also address the question of narratives which allow to tell interactive stories adequate to the complexity of soil-society interactions.
We will use positive examples such as anthrosols or soil conserving cultivation techniques, but also negative ones such as human-induced erosion, salinisation and other forms of degradation. We will discuss the role of knowledge transfer in history as a prerequisite for sustainable soil use, and shed light on the role of soils in the cultural, even in transcendental spheres of human existence. We will use examples from our own research, showing pedological as well as historical approaches and conclude with a plea for pooling knowledge, albeit with respect for the difference the two approaches allow. We intend to give this joint presentation as a dialogue, with questions and answers by the two presenters. This experimental form allows us to draw attention to the experimental character of interdisciplinary approaches to soils and society in history on a more general level.

S21B.F.01
The sand land soil system and society

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World, arid soils from Latterites of African Savannas to the Xeralfs and Xererts of Mediterranian Basin, Ortents, Orthids of Asian Deserts are uniquely different in their strategic roles for utilizing the land where a delicate balance between annual climatic cycles and general trends toward desertification predominate.
Irreplaceable natural resources of arid lands that cover 1/3 of global land surface, contain potential productivity of meeting the demands of more than two billion people and potential sources / sinks of atmospheric CO2 . Soils of arid areas are being degraded due to adverse natural and anthropogenic activities and are underutilized , kept in a stage of obliviousness due to inadequate public literacy and in-sufficient scientific evaluations of the soil system.
Implementation of sustainable development programs, food security projects on randomly selected sites and assessment of land degradation by powerful computers, satellite imagery techniques without coupling with field work are data producing but, counter- productive because of non- recognition of representative soils based on internationally accepted soil taxonomy standards.
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We live in a world in which there is an order out there and things are precisely measured, categorized for efficient utilization. Why not the soils, mainly in arid areas ?.
Expansion of educational programs, quantification of multiple ecosystems within arid regions through detailed and correlated studies of soils on an applicable scale can provide opportunities for land users to diversify agro-eco systems and for food security and environmental programs to establish project sites on well defined Representative Soil Units in each region. This, would enable soil scientists to extrapolate the results of their studies and promote national productivity and enhance regional

economy. Otherwise, all nations would inevitably pursue a self-destructive cause of fueling their economies by consuming their capital, degrading natural ecosystems ,accelerating depletion of their most valuable natural resources.

S21B.F.02
Soil conservation in the Windward Islands, Eastern Caribbean, in the 1930s and 1940s

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In 1938, the Colonial Office in London directed British colonies throughout the Empire to implement programs to control soil erosion and report on progress made in ameliorating soil loss. This paper focuses on three of the Windward Islands in the Eastern Caribbean--St. Vincent and the Grenadines, Grenada, and St. Lucia--and compares their soil conservation efforts made in response to that Colonial Office directive.
Each of these British colonies shared certain characteristics. The three small volcanic islands had mountainous, rugged interiors with considerable rainfall, giving rise to a marked potential for soil erosion. In each island, peasants were the primary cultivators in the rugged interiors. Each was administered by the same governor. And officials on each colony had expressed only limited concern about erosion in the decades prior to 1938.
In spite of these similarities, the degree of concern by officials about soil loss and their initiatives in soil conservation after the 1938 directive varied considerably. The colony that exhibited the most concern and made the most progress in controlling erosion was St. Vincent and the Grenadines. The island making the least effort was Grenada.
This paper, based on archival research, explores the reasons for such variations in response to the Colonial Office directive. It first documents and explains the limited concerns about soil erosion in the decades prior to the 1938 directive. It then details differences in the initiatives and environmental discourses of officials in the three islands in response to the directive. Lastly, this paper explores the reasons for such differences in response. Key influences examined include the nature of land tenure, the degree of inequality in land holdings, the types of crops cultivated, cultivation techniques, the extent of previous government intervention in peasant agricultural practices, and the significance of government-sponsored land settlement schemes.

S21B.F.03
The "Great Leap Forward" - a soil erosion disaster in Chinese history? Results of a case study on the Chinese Loess Plateau

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The presentation is focussing on the interactions of land use and water erosion in the Yangjuangou catchment during the last 50 years. The study area (36° 42’ 6’’ N,
109° 31’ 17’’ E) is situated on the northern Chinese Loess Plateau about 25 km north of Yan’an City in Shaanxi Province. Geoarchives in the Yangjuangou catchment as colluvial layers, alluvial sediments and reservoir sediments of check-dams were investigated. By using different methods as field work (detailed soil and sediment profile analysis, DGPS measurements), absolute dating methods (^{14}C, ^{137}Cs and archaeological dating of pottery) and expert interviews, the historical water erosion in Yangjuangou was quantified on a catchment scale. Additionally changes of the geomorphology in the study area have been reconstructed on a long-term perspective. The investigations are documenting that, after a period of more than 4000 years of very low mean annual water erosion rates, soil erosion rates increased dramatically at the end of the 1950s due to agrarian and political reforms.

S21B.F.04
Reclamation history as explaining factor for soil organic matter content in agricultural landscapes

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The way a soilscape is managed can have long term effects on size and characteristics of the soil organic carbon (SOC) pool. Because of the often slow response of the SOC pool to changes in input, we hypothesize that land use history, even up to centuries ago, is still reflected in present-day SOC pool variability at landscape level. We tested this hypothesis for a case study in the Dutch cover sand region and evaluated the implications for refining spatial information on SOC pools.
The study area was reclaimed from heathlands in several stages between the 17th century and 1950. Land use history was reconstructed from topographic maps from 1850 to 2000 and from land use databases. Soil data was derived from a soil mapping exercise where numerous samples were analysed for organic matter (OM) contents. We used GIS and statistical methods to describe and quantify the effects of land use history, soil classification, groundwater level, elevation and hydrology on OM content.
A trend of increasing OM content with increasing reclamation age was found. Especially the oldest reclamations within each soil-groundwater class combination had high OM contents. This relationship is interpreted as the result of the development of so-called plaggen soils in the oldest reclamations, containing high amounts of resistant OM and therefore having large resistant OM pools. Apart from reclamation age, OM content variability can be explained by soil type, groundwater level, distance to the main drainage system and loam content of the soil.
We conclude that reclamation age explains part of the variation in OM contents at landscape level. This information about land use history can be useful to refine SOC pool (quantity and quality) mapping efforts at landscape level. Such improved estimates of the SOC pool help to improve estimates of current and future soil carbon balances.

S21B.G.01
European soils: natural vs. anthropogenic entities? - examples from Central Europe

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The history of soil science brings about that recent soil classification systems are oriented on a climatic soil zonation paradigm. Several years ago serious efforts were made to create new viewpoints from a rather geological perspective (Paton et al. 1995). These ideas correspond to regions where they were developed for (especially Australia) and where only a few anthropogenic influences on soil formation have occurred or where these influences just started several decades ago. Since agricultural land use and therewith associated energy and matter fluxes have a long history in Europe, this creates a demand for future prospects, too.
Soil Scientists, Geographers, Geologists, Biologists, Archaeologists and Historians accumulate, analyse and evaluate information about settlement and land use systems and therefore environmental conditions that provided the basis for the formation of our present soils. The integration of all available information (like in a recent attempt by McNeill and Weingarten 2006) would enable a detailed reconstruction of the conditions that influenced the formation of soils in Europe.
As a dense record of information exists in the mentioned disciplines, an enormous potential for interconnecting studies of the Holocene soil formation and its environmental background is given in Central Europe.
An overview about the evidence of human impact is given from pollen data across Central Europe and the archaeological as well as historical record in the presented review. But it focuses on the investigation results on soils, colluvial layers, buried soils,

settlement structures, land use systems, alluvial and lake sediments.
Based on our experience on Central European soils we recommend: 1) to attract the interest of the soil scientific community 2) to include all evidence of former land use in soil survey instructions 3) to intensify the activities of interdisciplinary research on the development of soils (including historians, archaeologists, as well as natural scientists).

S21B.G.02
Ecosystem Challenge and Creative Human Response to Soil Salinity: Role in the Rise and Possible Decline of Ancient Mesopotamian Civilization

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Integration of new thinking surrounding disturbance-recovery dynamics of ecosystems and theories of historian Arnold Toynbee related to natural resource challenges and creative human response provides a framework for understanding the rise of ancient Mesopotamian civilizations. Disturbances of climax ecological communities (e.g., return to a pioneer stage) and human-induced changes in soil conditions (e.g., increasing soil salinity) have been traditionally viewed as undesirable for soil quality, ecosystem health, and the sustainability of human societies. Such changes have also been viewed as contributing to the fall of ancient cultures dependent on long-term use of irrigated soils. New observations in ecosystem ecology now show that stable ecosystems actually are continually and beneficially recovering from regular disturbances of intermediate severity. A striking parallel exists between such ecological disturbance-recovery processes and Toynbee's ideas that human civilizations arise in response to environmental challenges that are not too severe and when human cultures are ready to respond creatively. A brief case study will be presented to illustrate how increasing soil salinity initially led to creative responses by monarchs at a societal level and by farmers at the field level in ancient Mesopotamia. These responses contributed to rising social complexity and stability of the early urban cultures in Southwest Asia. A gradually-rising water table due to continued irrigation without subsurface drainage may have been an ecological disturbance and an environmental challenge for which creative responses were insufficient to sustain agricultural production and the urban centers based on it. According to Toynbee, the loss of creative power of a minority then led to the breakdown of society as a whole.

S21B.G.03
Ontological and epistemological considerations on soil - a soil scientist perspective

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Ontologicaly, the soil is a concrete thing or entity of nature that possess the crucial features of an "entityhood" e.g. determinate identity conditions, expressed by its spatiality and temporality, its own organization and laws of development. Although apparently static the soil presents a continuous change in time (becoming). Accordingly, we may think to an ontological definition of soil that might be:
"A natural auto-organized spatio-temporal and pluricausal, independent entity component of physical world, with determinate identity conditions, historically developed and that continues to develop at the Earth's surface as a results of complex interactions between geologico-geomorphic, biotic and climatic (cosmic) factors, to which past and present human actions have to be added".
Because the terms "auto-organized" and "determinate identity" excludes the so called "man made soils" (Anthrosols), it appears necessary to split out the soil world in two broad categories:
a) - very soils - are the soils naturally developed and with organizational identity.
b) - metasoils - non-naturally developed, bodies with no organizational identity but that may behave like the natural soils as concern their use and some function in the environment.
The term "pluricausal entity" refers to the pedogenetic factors paradigm of which
climate and biota are "efficient causes" while parent material and relief are "passive" ones. The space and time are prerequisite condition of soil existence. In this sense the time is "neutral" and has to be understood as "duration" or "endurance" of soil.
Ontologically, the soil in sense of soil cover is one. Its partition in discrete units (soil bodies, soil scape, pedon a.o.) is a reductionist approach justified only by epistemological needs (mainly classification and study) and practical reasons.

S21B.G.04
Inner and Outer Soil… Depth Psychology of Human Soil Relation

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Humans working with the soil encounter more than the outer soil and the graspable life it brings forth. As farmer, gardener or scientist facing the soil, one may also encounter emotions, feelings, intuitions and thoughts, linked with fascinating ideas and meaningful inner images.
These mental phenomena, which appear when working with the outer soil, link humans with their inner soil. By the term 'inner soil', the unconscious psyche is addressed and the contents appearing out of it to human ego-consciousness. As a result, agriculture and soil science are always double grounded in their material and mental environment, both shaping human soil relation and understanding.
In this contribution, typical connections of motivating archetypal images and ideas (including religious motives) with different kinds of soil relation and understanding will be shown and interpreted psychologically. The base material of this presentation consists of images and quotations from scientific primary literature and from (mostly European) cultural history.

S22 Education in Soil Science and Raising Public Awareness

S22.L.KL
To raise soil awareness - a hard job, but worth to go for it

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There is no doubt that soils are an essential resource, e.g. for producing food, as a habitat for organisms or as a factor regulating the climate; reasons enough to treat soils carefully. At the same time it's obvious that awareness of the significance of soils is only rudimentarily developed on all levels from public to politicians.
The implementation of soil awareness has to overcome a lot of special obstacles: normally, soils are invisible and they have no

concrete shape and pictures of soil profiles are only a surrogate. People, particularly children, have no contact to soil (how long ago did you walk on a soil?). We lost the knowledge that our food is generated on soils. Soils do not move and lack the charm of a panda bear - essential for television. In contrast to water or air, soils are often in possession of individual persons who have no awareness of the need for soil protection.
From communication studies we know that there are two components which generate soil awareness: (a) enough knowledge to “understand” soils, their significance and the necessity to protect them, (b) the conviction that the sustainable management of soils is essential for our survival. Both arguments should evoke actions of soil protection, not only by direct actors like farmers, but of the public as well, because everybody is an indirect actor on soils.
What can we scientists do to raise soil awareness? First, on a professional level we should prepare well-adapted information materials for all soil actors: for children in the kindergarten as well as for students and their teachers, the general public, land owners, farmers, foresters, (landscape) gardeners, planers, architects, building contractors, administrators and politicians. Second, we should make soils visible by establishing open pits in soil trails or in nature reserves. Third, we should engage in transmitting our enthusiasm for the object of our profession.

S22.L.01
Experience of making soil ecology excursions: what is in the future?

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Scientists and students from different countries are interested in the landscapes of the West Siberian south, and it may be understood. West Siberian plain is a nearly ideal area for studying spatial zone distribution of vegetation and soil cover as well as processes of their long-term evolution. The degree of transformation of natural ecosystems under the human influence is not as great as in Europe, and on its territory still exist standard ecosystems which serve as an example of correlation between basic components of ecosystems including soils.
Annual international soil ecology excursions organized for students, studying fundamental sciences, are provided to meet these requirements to some extent. These excursions have become very popular due to the well developed program and the system approach to understanding natural phenomena and objects. The excursion route includes basic climate zones of West Siberia; it has been changing for a number of years; the excursion managers have been trying to make it better, but in the whole the scheme of vertical zone studying landscapes from southern taiga and peat bogs of West Siberian plain to high mountain steppe and tundra of the Altai has preserved.
How can excursion routes be developed further? We can disseminate the experience of making such excursion by: dissemination of experience of making excursions in other regions and countries with diversity of landscapes and local scientists interested in such a form of teaching; publishing a textbook containing a description of the route and methods of studying vegetation, fauna and soils.

S22.L.02
(Forest) Soil Education Trail “Taferlklause”

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The soil education trail “Taferlklause”, opened in May 2008, responds to the increasing importance which soils and soil conservation is given in public. The trail should attract school-classes with their teachers as well as tourists and hikers. It can be used in courses of the nearby forest education centre (BFW Gmunden) and for scientific soil excursions.
It consists of two major parts: The “Real” Education Trail and the “Virtual” Education Trail.
The “Real” Education Trail is located in the beautiful landscape of the Salzkammergut at the boundary between the geological units “Northern Limestone Alps” and “Flysch-Zone”. The ice ages have added their marks to the given geological diversity. As a consequence, a wide range of soil types has developed. The soils are covered with different forest types, ranging from mixed broadleaf to pure conifer stands. Seven soil profiles can be visited along a path of five kilometers length. Next to the soil pit, each profile is presented on a poster, where the visitor can learn about the specific site conditions, the soil horizons, and the chemical soil properties. Additional soil related issues of general relevance are displayed on numerous posters along the path.
The “Virtual” Education Trail consists of an interactive DVD and a website. In the DVD, the soil profiles and other points of interest are presented. Like in nature, there is no predetermined direction to move through the path. At each crossway, the user may choose the direction using the mouse or the remote control of the DVD player.
On the website, general information about the trail and the profiles as well as data of chemical soil analysis are available. Moreover, all posters presented along the “Real” trail can be downloaded.

S22.L.03
SoilWeb: An Interactive, On-Line Teaching Tool

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Introductory soil science courses are challenging because students are required to make connections among a large number of concepts, while relying on the fundamental principles of physics, chemistry, and biology. At the University of British Columbia (UBC) the SOIL 200 - Introduction to Soil Science course is no exception. The material of SOIL 200 is extremely diverse, incorporating the aforementioned science disciplines and applying them to management applications in agriculture, forestry, and environmental protection. The SoilWeb teaching tool (http://www.landfood.ubc.ca/soil200/) was developed in 2003/04 to (1) enhance connectivity of material covered, (2) allow for inclusion of a greater variability of learning styles, (3) increase student’s motivation for learning about soil science, and (4) link the material presented in this undergraduate course to research carried out by various faculty members at UBC and scientist from various research institutions throughout Canada and North America. SoilWeb is used to support the lecture based and WebCT teaching methods, providing students with a graphical, interactive, and text web-based information online. It was developed using Macromedia Flash animation, slide shows, online quizzes and glossary, photos, and graphs combined with text and weblinks to present course material. To date, this tool has been used during four academic years and the student response has been excellent. In addition to SOIL 200, SoilWeb is also used as a review tool in several upper level courses (e.g., AGRO 401, 402, 403) offered at UBC. This tool is also used by soil science instructors at several other universities in Canada, North America, and Europe. An interactive overview of the SoilWeb will be given during the presentation.

S22.L.04
E-learning tools in soil physics

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The aim of this project was to develop an online learning platform, where the students can do virtual soil physical experiments and watch movies of experiments actually carried out in the classroom of the introduction soil physics course at ETH Zürich. Demonstration experiments played a didactically important role in its teaching concept. In order to enable the students t to repeat the experiments and to let them explore how the individual soil physical parameters affect the transport processes, we offer virtual experiments and movies of the real experiments in the internet. The web pages generally contain a video sequence of the classroom experiment, an animation or a virtual experiment, as well as short explanations of the phenomena. In addition to the class room experiments, we created virtual experiments of soil physical processes, which cannot easily be demonstrated in the classroom. Some of these case studies are based on extended simulations of water movement and solute transport.
The objective of the learning material is to give the students an additional access to soil physics. They can play with the experiments, change the system parameters, and question the behaviour of the system in order to deepen the intuitive and individual understanding of the physical processes in the soil. The online learning material also allows the students to prepare and practice the learning matter independently from time and place of the instruction event. It is an addition to the lecture and is not meant to replace the classroom activities. The feedback of the students about the learning material has, so far, been positive and it stimulated an increased involvement in the ongoing teaching program.

S22.M.01
How much land do we possess - how much land do we consume

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The exponential growth of the world population, while arable land is increasingly being sealed in the industrialised countries, caused a 24% reduction in arable land per capita between 1980 and 2000 and has now fallen to a value of 2.2 hectares per capita.
As we need food as well as energy, water, fibres, infrastructure etc., the term Ecological Footprint has been coined to demonstrate how much land per capita is needed to provide a certain resource.
Comparison between our consumption levels and availability yield a severely negative balance: In many countries of our earth, we consume at present more land than is available to us. This is why a testing method for each and a list of conservation or saving potentials should encourage us to change our way of thinking and point out possibilities of reaching an even land balance.

S22.M.02
Standards for soil topics in education in Europe

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Soil scientists talking about their subject are used to find lack of understanding and even lack of interest on soils in the public. One reason might be that the topics soil scientists consider to be important in education, for example knowledge of soil horizons, are not the topics which are really necessary in education, such as knowledge of soil threats like contamination for example. Usually, soil scientists are only trained to teach students in soil science, agronomy, forestry or ecology. In most cases, they are not experienced in teaching children or non scientists. Many soil scientists think that the same soil topics which are important for scientists like soil genesis are of the same importance for children at school or for the public in general. During the last decade many efforts have been made to bring soil to public attention and to the school curriculum - sometimes not very successful. Obviously, the first step is to revise the canon of soil topics which are really relevant in education and thus for the society. Soil topic standards are needed for presentation in school and in the public. Therefore, a canon of basic knowledge on soil is set to discussion. This canon includes knowledge of soil functions, for example, that would enable children to understand soil as basis for food production or groundwater protection. Also, a didactical concept for teaching soil will be presented including the competencies children should develop. The concept also comprises training, public relation and evaluation of innovative didactical instruments. Some examples of soil topics in primary school may prove the need for educational standards. Moreover, out-of-school-learning opens enormous possibilities to teach soil topics in the context of environmental protection and social awareness.

S22.N.01
Soils and Soil related Subjects on Stamps

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Soil profiles, soil-related and soil science-related subjects have been reproduced on stamps, postcards, letter covers, letter grams and postmarks.
Soil profiles on stamps are rare, but for some years *The Soil of the Year* has been shown in Central Europe. Some national societies of soil science have presented soil profiles on postcards. Realistic paintings of landscapes are reproduced on stamps and postcards, which show soil profiles in form of road cuts, stone pits, and land slides. Pictures of parent materials, minerals, animals and microbes of soils are printed on stamps and other philatelic products as well.
Authorities of soil science have been printed on stamps, as well as famous scientists who stimulated soil research. Buildings, test fields and farms for soil research and teaching are available, too. Many stamps and other philatelic products show equipment for digging, plowing, raking, rolling, hoeing, fertilizing, sowing, draining and irrigating soils. Pictures of soil erosion, compaction, salinization and poisoning are available besides techniques of soil protection.
Stamps and other philatelic products are prepared in relation to congresses of soil science societies and neighbouring societies. Many departments and research institutions of soil science or producers of agricultural machines or fertilizers, as well as editors of books and journals about soils use postmarks or letter covers related to soils. Stamps and other philatelic products are printed by national and international authorities like the UNO to seek publicity for soil protection.
In the paper some examples of soil profiles are presented on stamps, postcards and envelops. Pioneers and authorities of soil science from the beginning in the ancient age until the 20^{th} century are presented on stamps. Furthermore, it is shown how different countries try to gain public interest for soil protection. At last philatelic attention is drawn to conferences of soil science societies.

S22.N.02
Ecological aesthetics as catalyst for the discovery of soil as living space

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Present-day experience suggests that science expertise on soil issues alone might not reach far enough to cope with the progressive world wide problem of inappropriate land use and

soil degradation. Soil protection as a basic social concern is requiring extended concepts for raising affective and effective public attention. Interdisciplinary dialogue, open discourse of science and art can be considered as decisive step in a promising direction.
Creating sensitive awareness and deep understanding of soil as a precious living space is an urgent issue for education in soil science as well as in the area of general environmental education. Knowledge of the complex functions of soils as fundamental life base for thousands of millions of microorganisms, for plants, animals and, last but not least, for mankind, is a precondition for careful treatment and sustainable use of soils. Soils are rarely known as a limited resource that can be spoiled in just one second but take thousands of years to grow!
By creating scenarios free of utilitarian considerations art is the medium to heighten awareness for the applicability and scope of new integrative approaches in science. Art in the sense of "ecological aesthetics" is focussing on vital processes in nature, on interactions of organisms in soil i.e. symbiosis of rhizomes and mycorrhiza, thus enabling the perception of principles of nature's functioning. By bridging art and science, ecological aesthetics is a new path towards experiencing, understanding and practising a deep and comprehensive understanding of soils. Art of that kind acts as a catalyst by perceiving and appreciating soils - the earth we walk upon - as a fascinating living space of unique beauty and magnificent wealth.

S22.N.03
Soil and Art- on the aesthetics of dirt

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We introduce *soil art* as a subgenre of ecological art and address the possible implications of *soil art* for the field of soil science. We take a look at some existing cross-disciplinary opportunities in environmental education and research programs, which may hopefully inspire new impetus for collaborations within and beyond the soil science community. What aesthetic features or experiences do soils have to offer, and how do these correlate with or differ from other aesthetic experiences in nature? In our contribution we turn our attention towards in the establishment of aesthetic criteria for soil. In light of a recent survey on the aesthetic and artistic prospects of soil science, carried out on the occasion of the German Soil Science conference in 2007 and SUITMA 2007, we examine what aesthetics may contribute to pedology. While the proposed aesthetic framework does not necessarily reflect traditional land evaluation methods, it may offer new modes of appraisal for conservation strategies as well as new educational parameters. Soil art communicates environmental concepts differently than soil science. The creation, presentation and promotion of soil art may serve "to offer soil a new, more up-to-date image in addition to its undisputed ecological significance, but should not exclude the aesthetic appreciation of soils in the absence of artistic intention. Although we have shown that art may be used as an instrument to facilitate a deeper understanding of soils, it is important to extend the argument further, to recognize that a discussion about the aesthetics of soil is an entirely different undertaking as the making and exhibition of art with, in or about soil.

S22.N.04
Connecting soil to society - experiences of different approaches from Scotland

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Soil has been the under recognised environmental medium until recently but there is an increasing recognition that soil is a key component of ecosystems, of the services that they provide to society and in the sustainable development debate. The Soil Science community therefore has a duty to communicate the value of soil and the results of research across a wide range of different interests.
The Macaulay Institute has been engaged and communicated with a wide range of different interest groups using a range of mechanisms with which to do so. The audiences include politicians, policy makers, environmental regulators, conservationists, industry, land owners and managers, educationalists and the general public. We have worked directly with government policy units supporting the development of a Scottish Soils Strategy, spoken directly with politicians on the value of our work and prepared briefing notes for the Scottish Parliament. Regular meetings are held with key government agencies responsible for environmental regulation and nature conservation to exchange information and research results. We also work closely with the Soils Consultative Group, set up to provide advice on and to provide practical support, where appropriate, on our research activities.
Contact is maintained with land managers through direct dialogue on specific topics, for example on LFA designation and also through the specialist farming press. Direct contact with the farming community during field work provides a less formal but nonetheless very useful method of awareness raising. Targeted popular articles to trade or industry journals, for example to the building industry and planners, have proved useful outlets for very specific soil issues. We have also provided teaching material for the school sector in the form of CDs, posters and powerpoint presentations and a number of more novel exhibits and leaflet material for public exhibitions.

S22.N.05
Action Soil of the Year in Germany

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The German Soil Society and the Federal Association of Soil nominated a "Soil of Year". The curatorship chose a Chernozem (WRB) for the Soil of the Year 2005, a Haplic Albeluvisols (WRB) for 2006, a Podzol for the year 2007 and an Arenosol/ Cambisol is the Soil of the Year 2008. Beside the bird, the tree, the insect and other interesting subjects there should been nominated an important soil of the year on the World soil day every year.. With such an action it would be possible to start a fight for soils awareness in all population groups. We hope to realise an increased attention for soil problems and to influence the policy and decision makers positively. In this year we had a cooperation with the Austrian Soil Society to propose the elected soil and to prepare the material. We hope, that this campaign will get many friends all over the word in future. "Recognizing the importance of soil as a non - renewable resource which provides many functions crucial to human activities as well as ecological functions (hosting soil biodiversity, the filtering and buffering capacity, the role as an archive of cultural heritage, etc.) will support the development of protective measures that will incorporate local knowledge about each specific soil type and function as well as safeguarding soils for future generations" (European Communities, 2005).
Open questions are:
- a continuous financial support will be ensured;
- the action is not accepted by all mass media until now;
- teachers and educators were right from the beginning quite hesitant to the action; - an European action alliance "soil of the year" would be a
favourable solution

S23 Rhizosphere Processes

S23.A.KL

Rhizosphere processes from the microsite to the global scale: Raising the (soil) profile

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The rhizosphere is recognized as a hot spot of soil microbial activity and biogeochemistry. Because of rapid methodological progress, considerable advances have been made over the last decades in elucidating many processes that make the rhizosphere so special. Much of the accumulated knowledge though has been gained from microcosm studies, with rather simplified, model rhizospheres. This reductionist approach questions the ecological relevance of many of those processes. Moving towards a more holistic approach of rhizosphere functioning, and upscaling to a broader, ecosystem or global scale is a huge challenge for soil scientists.
The aim of our talk is to provide some examples of rhizosphere processes that make a major contribution to supporting ecosystem services such as nutrient cycling, soil formation and the provision of habitats, primary production of the land and thereby to sustaining life on Earth and biodiversity. We will attempt to provide also a broader, temporal perspective and answer the question : what would a soil be like without such processes, would there be any soil ?
Most of our examples will focus on the obvious contribution of rhizosphere processes to major nutrient cycling, with an emphasis on carbon and nitrogen and their relationships with climate regulation at the global scale : the inclusion of a multitrophic perspective of these cycles and their interplay will be a major focus. The cycles of cations such as calcium and potassium will provide opportunities to link rhizosphere processes with rock weathering and soil formation, thereby challenging geochemical models of Earth history. Based on case studies on the fate of iron and phosphorus, we will address some prospects for better using our knowledge of rhizosphere processes for a sustainable increase in primary productivity of exploited ecosystems in order to meet an increasing food demand of human populations.

S23.A.01

Common mycelial networks and interactions in mycorrhizosphere determine carbon dynamics in the forest ecosystem

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Forest soils are the major stocks of carbon in terrestrial ecosystems. Among different components of highly heterogeneous forest soils mycorrhizal fungi represent the main element, linking different sinks and sources of carbon, influencing transfer of carbon belowground, soil respiration, and translocation to or out of the above ground biomass. We have focused on dynamics of fine roots and rhizosphere organisms influencing carbon dynamics in forest ecosystems in Slovenia. The presented studies were obtained either from beech (*Fagus sylvatica* L.) or from spruce (*Picea abies* (L.) Karst dominated sites where we studied the influence of clear-cutting to sporocarp and ectomycorrhiza abundance and possible effects of the management practice to ectomycorrhizal species diversity and preferences, the effect of management and stand age to changes in the organic matter decomposition rates, and contribution of ectomycorrhizae and fine roots to soil carbon pools. The management practices indicated a clear influence to all measured ectomycorrhizal parameters and subsequently to the carbon retention in soil ecosystems. The decomposition rates were significantly changed as well. The distribution of fine roots at different soil depths was not uniform with depth but showed the importance of the upper soil layers. The current available data indicate an important contribution of soil, fine roots and rhizosphere organisms to the overall carbon dynamics in forest ecosystems, their influence on other processes in soil and the importance of soil (micro)organisms biodiversity.
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S23.B.01

Changes in mycorrhizosphere functions of ozone stressed forest trees

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Elevated tropospheric ozone can damage crop and forest plants due to reduced photosynthesis and changed physiology. Subsequent quantitative and qualitative changes in below-ground carbon allocation may change nutrient turnover processes in soil. Forest tree species allocate 10-30% of their assimilates to their mycorrhizal symbionts which in turn supply their plant hosts with nutrients, water or protect them from soil born pathogens. Thus altered carbon allocation due to elevated ozone is likely to influence the structure and function of mycorrhizal symbionts and soil biological processes.
We studied reactions in the mycorrhizosphere of *Fagus sylvatica* L. and *Picea abies* (L.) Karst. under double ambient ozone exposure at different experimental scales on different aged plants. Simultaneous ozone fumigation and ^{13}C depleted CO_2-labelling was applied to follow carbon allocation to the mycorrhizosphere-soil-system. The diversity of ectomycorrhizae was determined and the allocation of carbon to different morphotypes was studied. As important functional parameters, enzyme activities involved in carbon, nitrogen and phosphorus cycling were measured of the dominant mycorrhizal morphotypes and in mycorrhizosphere soil. Differences between the two tree species were found with respect to their carbon allocation to the mycorrhizal roots, enzymatic activities in the mycorrhizosphere soil and enzymatic activities of mycorrhizal roots. Elevated ozone also changed diversity of mycorrhizal types although there were also strong differences in reactions due to plant species and the different mycorrhizal symbionts.Examples will be given from experiments with young (2-3 year old plants, 6 year old plants and adult trees from a free-air ozone fumigation experiment in a forest stand).

S23.B.02

Mobilization and complexation of Zn and Cd in the rhizosphere of Thlaspi caerulescens

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By using a rhizobox micro-suction cup technique that allows to study in-situ metal concentrations and speciation in the vicinity of roots, we investigated mobilisation and complexation of Zn and Cd in the rhizosphere of non-hyperaccumulating Thlaspi perfoliatum and two different Thlaspi caerulescens ecotypes, one of them hyperaccumulating Zn, the other Zn and Cd. At the end of the experiment, the total Zn and Cd concentrations in soil solution did not differ between the three rhizospheres and the plant free soil. By contrast, the dynamic fraction (free metal ions and small labile complexes) of Zn and Cd decreased with time in the rhizosphere solution of the respective hyperaccumulating Thlaspi caerulescens ecotypes, and at the end of the experiment, it was significantly smaller than in the rhizosphere of the non-hyperaccumulating Thlaspi plants and in the plant-free soil. Furthermore, the rhizosphere solutions of the Thlaspi caerulescens ecotypes were characterized by higher UV absorptivity compared to the Thlaspi perfoliatum rhizosphere and the plant-free soil. Based on our findings we suggest that the rapid replenishment of labile metal pools in the rhizosphere of hyperaccumulating Thlaspi caerulescens ecotypes, which has been postulated in earlier studies, is accomplished by a rapid "turnover" of labile metal complexes with dissolved organic matter derived from soil organic matter degradation. This would include facilitated transport of small complexes, that are both mobile and labile, into the rhizosphere, their dissociation in the rhizosphere and the microbial assimilation of the freed ligands. As a consequence, large inert complexes with highly-aromatic ligands become enriched in the rhizosphere.

S23.B.03
A Rhizotest to account for the impact of root-induced changes in the rhizosphere on metal bioavailability to plants: a case study with durum wheat cultivated on Cu-contaminated, former vineyard soils

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The conceptual framework of metal bioavailability recently put forward by ISO points the importance of a bio-influenced zone, the rhizosphere for soil-plant systems.
This study aimed at comparing the ability of ion selective electrode (ISE), diffusive gradient in thin film (DGT) and a recently developed biotest which provides easy access to the rhizosphere (Rhizotest) for assessing Cu bioavailability for field-grown durum wheat (*Triticum turgidum durum*).
Roots of wheat and rhizosphere soil were sampled at 40 locations in former vineyard soils, showing a range of contamination (32-184 mg kg^{-1}) and pH (4.2-7.8). ISE, DGT and Rhizotest were carried out on the 40 soil samples, plus 4 additional strongly acidic, contaminated soils. Rhizotest consisted in 8 days of contact between soil and the planar mat of wheat roots. Root Cu content measured in field-grown plants, Cu-ISE and Cu fluxes in DGT and Rhizotest as well as rhizosphere pH were measured.
Root Cu content measured *in situ* was mainly determined by total soil Cu and only slightly correlated to pH. This may be due to the strong alkalisation measured in the rhizosphere of plants cropped in the most acidic soils (pH < 5). Root Cu content was significantly but loosely correlated with Rhizotest-Cu (R^2 = 0.22, p<0.01) and DGT-Cu (R^2 = 0.46, p<0.001). ISE measurements were mainly driven by pH and therefore poorly correlated with *in situ* measurements. DGT-Cu was also sensitive to soil pH with DGT flux being higher in the most acidic soils. In the opposite, Rhizotest-Cu was insensitive to bulk soil pH, due to the strong alkalisation of the rhizosphere (up to +1.8 pH unit) in the most acidic soils, as observed *in situ*.
Rhizotest therefore appeared as a promising tool to estimate metal bioavailability to plant as it could account for root-induced changes in rhizosphere chemistry.

S23.B.04
Effect of rhizosphere pH on PAH availability

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Soils contaminated by PAHs (Polycyclic Aromatic Hydrocarbons) are of environmental concern because of their ubiquity, persistence and toxicity. Their persistence in soils is related to their low availability due to adsorption processes and sequestration in aggregates. This pollutant state prevents soil microorganisms from PAHs absorption and degradation. Some soil physico-chemical properties modified by plant roots (*e.g.* organic matter quantity and quality and rhizosphere pH) are known to control PAHs availability. In this work, we studied the influence of the rhizosphere pH on PAHs availability in industrial wastelands soils. This is the first step of the calibrating of our model for PAHs evolution in a rhizosphere soil. We made the hypothesis that PAHs availability may decrease during acidification and increase for a soil alkalinization. Batch experiments (s/l = 1/10) using three contaminated soils sampled on former industrial site were conducted under anaerobic conditions. The pH was modified by mineral acid or base additions. The available fraction of PAH was determined with butanol extraction of the soil. Results showed that a pH decrease had no significant influence on PAHs available fraction. This is in contradiction with results obtained in the literature. The soil suspension alkalinization had different effects in three soils. In two of them, a pH elevation increased the PAHs availability like it was found by many authors. In the third soil, a moderate alkalinization had no effect but a strong one reduced the PAHs availability. It seems that soil cation content may explain these different effects of the pH. The second step of our work will be to elucidate the role of root exudates on PAHs availability. The applied objective of the work is to evaluate if rhizotechnologies may be sustainable solutions for contaminated wastes land management.

S23.B.05
Uptake of intact amino acids from soil by plants - a matter of above- and below ground biodiversity?

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Studies have shown the potential of plants to take up intact amino acids not only when grown in sterile hydro solutions but also in soil. This was described the first time for a field study in subarctic soils, revealing low mineralization rates. Further studies suggested that low mineral N concentrations in soil generally alter the significance of amino acid uptake for the N supply of plants. N limitation, however, may not only be caused by low mineral N concentrations, but also by plant - plant and plant - micro organism competition. Though it is still not fully understood if and/or where biotic factors like biodiversity and plant - microbe competition, or abiotic soil variables are the main regulating forces for intact amino acid uptake.
To answer this question we investigated intact amino acid uptake in a plant diversity experiment in Jena, Germany. The experimental design included plots with varying numbers of grassland species and/or varying numbers of functional plant groups, enabling us to differentiate between complementarity and the influence of functional groups. Double labelled (^{15}N, ^{13}C) amino acids were applied to determine uptake by plants via measurement of heavy isotope enrichment in the plants. Any overestimation of intact amino acid uptake caused by uptake of tracer fragments was precluded by substance specific GC-C-IRMS measurements.
Preliminary experiments showed that amino acid uptake can be measured in monocultures of *Festuca pratensis*, *Plantago lanceolata* and *Geranium pratensis* on the field site with this method. We thereafter investigated amino acid uptake in a biodiversity gradient reaching from 1 - 16 species. In detail not only results on the amino acid uptake by the plants for root and shoot, but also the incorporation of ^{15}N and ^{13}C into the microbial soil biomass, which is described in its community structure via PLFA analysis, will be discussed.

S23.B.06

Response of old, new and organically bred winter wheat cultivars in different farming systems related to arbuscular mycorrhizal fungi

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Organic farmers often use winter wheat (Triticum aestivum L.) cultivars that have been bred under conventional high-input conditions. In organic farming systems these cultivars cannot perform to the full extent of their high genetic potential because organic soils frequently do not deliver enough nutrients and fertilizers are limited. Nitrogen (N) and phosphorus (P) are usually the most limiting macro-elements in organic farming. P in soils is largely secluded in minerals and organic compounds, or heavily absorbed. The supply of soil-N by mineralization is limited. The symbiosis with arbuscular mycorrhizal fungi (AMF) can positively influence plant growth, nutrient uptake and plant health. AMF are known to be strongly affected by concentrations of soluble nutrients, specifically P, and plant genotype. This suggests a suppression of the AMF symbiosis with wheat cultivars selected under high-input conditions. We test the hypothesis, whether old and organically bred cultivars are better adapted to low-input conditions through a better functioning of the AMF-symbiosis. Our aim is to assess the nutrient acquisition potential of old, new and organically bred cultivars and to identify the role of AMF for nutrient uptake and growth. In October 2006, an experiment with 10 cultivars was superimposed to all four field replicates of the DOK long-term experiment, comprising four different treatments with increasing nutrient input: unfertilized, biodynamic low and moderate intensity and conventional mineral system. Analysis of harvest parameters showed the same ranking of yields for all varieties and treatments, whereby conventionally bred varieties had the highest yields. No statistical interaction between varieties x treatments was found (2-way ANOVA). Beside growth and harvest parameters we will present relocation of nutrients at different growth stages and the results of AMF root-colonization at tillering and flowering of wheat.

S23.C.01

Modelling the Rhizosphere: Challenges and Future Perspectives

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Mathematical models of the rhizosphere provide powerful tools to gain a better understanding of the relevant processes in plant and soil interactions. The understanding of underlying mechanisms like root system development or plant solute uptake is an essential prerequisite, *e.g.*, for modern agriculture. Thus, with respect to all fields of applications, predictive mathematical models can contribute to the solution of optimal control problems in plant recourse efficiency. This may result in enormous gains in productivity, efficiency and environmental sustainability in various land use activities. Only recently, with the general advance of mathematical biology, more applied mathematicians have been attracted into the plant and soil sciences. This has the effect that mathematical methods used in other fields of applied mathematics, such as in fluid mechanics, are now introduced into the area of rhizosphere modelling. These are for example the methods of nondimensionalisation, matched asymptotic expansions and upscaling techniques.
Major challenges include the coupling of model parameters of the relevant process with the surrounding environment such as temperature, nutrient concentration or soil water content. A further challenge is the mathematical description of the geometric structures involved. This includes in particular the fibrous networks formed by root systems or the external mycelium of mycorrhizal fungi. Here, reducing complexity, *e.g.* by local averaging, as well as bridging between spatial scales is required. Possibly methods such as stochastic geometry, *e.g.* known in angiogenesis, may be of use for the representation of these fibrous structures.
Furthermore, the combination of experimental and mathematical techniques may advance the field enormously. In this presentation, the use of rhizosphere models in agriculture, forestry and phytoremediation is presented through a number of modelling case studies.

S23.C.02

Soil properties and the rhizosphere: Theoretical considerations

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The rhizosphere is increasingly recognized as a fundamental volume of the soil. The aim of this work is to explore the role of soil, plant and solute properties on the development of the rhizosphere. To this end, we have generated a numerical model of solute movement around the roots, and analyzed its sensitivity to several parameters including soil water content, lifetime of exudates, root exudation rates, among others. In the analysis, the thickness of the simulated rhizosphere is ca. 10mm, which is of the same order of magnitude as published values. However, simulations suggest that soil water content is the major determinant of the extent of the rhizosphere after solute's lifetime and therefore should have a fundamental role in determining the degree of interactions between neighbouring roots. For most types of solutes, the existence of bulk soil is therefore difficult to justify in ecosystems with moderate to high root densities as rhizosphere have a high probability to overlap.

S23.C.03

Non-invasive imaging of root structure and root water uptake

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Water flow in soils with plants depends on the complex interactions between roots and soils acting at the rhizosphere. Thus, water uptake by roots is a function of both, the root and the soil properties. We have applied non-invasive and non-destructive imaging techniques yielding two-dimensional transmission images and three-dimensional tomograms of soil-root-water systems. The objective was to identify structural properties as the root system and soil heterogeneities, and to localize changes in soil water distribution driven by root water uptake and soil water flow. We summarize the results of several series of experiments with different plants, soil types and water flow boundaries.
The main imaging technique we used is neutron radiography, which has high spatial and temporal resolution and high contrast to water. The main experiments were performed using eight rectangular containers of 15 x 15 x 1.5 cm, having a porous plate at the bottom for controlling the water potential, which were filled with two types of sandy soil. Lupin and maize plants were grown in these containers at controlled conditions and the root water uptake was monitored every three hours for 10 days. At the end of the experiment, we made a tomography of each sample to obtain the 3-D root structures. Another imaging

method applied to soil-plant systems was X-ray tomography. Though it cannot distinguish water and air filled pore space as well as neutron radiography, it can distinguish large pores, cracks and roots from the finer grained soil material. Results showed that there are fissures along the tap root of lupin plants, which may influence water flow and uptake. Due to the quantitative and spatially resolved character of the imaging methods applied the results provide a basis for mathematically based interpretations of structures and processes in soil-root-water systems.

S23.C.04
Contribution of root respiration to CO_2 emission from soil in mediterranean grassland: comparison of partitioning methods

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Carbon dioxide efflux from soil surface (soil respiration) is an important source of atmospheric CO_2. Partitioning of soil respiration into autotrophic (root) and heterotrophic (microbial) components is urgent for long-scale modeling of changes in global C cycling and thus forecasting global climatic changes. However, the widely used partitioning methods (root exclusion, trenching, girdling etc.) do not enable us to separate root respiration and rhizomicrobial respiration of rhizodeposits, resulting in overestimation of the autotrophic component of CO_2 emission. Our research was aimed to compare estimates of root/microbial contribution to soil respiration obtained by three partitioning methods *in situ*, and to evaluate possible methodological shortcomings associated with an accuracy of estimation of single components of soil respiration.
The comparison of the partitioning methods was carried out in parallel on the field experimental plots located in central Italy (mediterranean grassland, May - October 2007) The methods tested were: 1) the modified root exclusion technique: nylon meshes (1 µm openings) were used for isolating root-free soil from surrounding rooted soil, 2) the soil induced respiration (SIR) based on the respiration response of microbial community to the glucose addition, with no stimulation effect on root respiration, and 3) the regression technique, which hypothesizes a linear relationship between root biomass and the amounts of CO_2 respired by roots and rhizosphere microorganisms. The amount of CO_2 derived from SOM decomposition corresponds to the intercept of the regression line between root biomass and total CO_2 evolved from the soil. The basic assumption was that SIR method allows estimation of rhizomicrobial respiration as a fraction of microbial respiration, unlike the other two methods tested. The reasons of discrepancies between the estimates of root/microbial contribution obtained by different methods as well as shortcomings and advantages of each of the approaches tested will be discussed.

S24 Soils and GMOs

S24.H.KL
Impact of transgenic potato lines on microbial functions in the rhizosphere

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Different transgenic potato lines have been constructed in the last two decades. Their properties range from increased resistance against plant pathogens, to modified product quality mainly interesting for food industry. Furthermore selected transgenic potato lines have become increasingly important as renewable resources throughout the world for production of textiles, paper and other synthetic materials. However the ecological consequences of an increased cultivation of these crops are still under discussion. Without doubt most transgenic lines will cause shifts in microbial community structure and function in the rhizosphere. But how can these differences be assessed in the frame of cultivar specific effects of nontransgenic plants, shifts in microbial community structure and function during the vegetation period and finally site specific effects including soil type, weather conditions, pesticide and fertilizer application?
The presentation will try to give answers to these questions. As an example results will be presented from field studies using transgenic potato lines with modified biosynthetic properties. Over a three-years investigation period, field experiments were conducted on two different sites comparing not only the transgenic clones with the corresponding parental variety, but also with five additional commercial potato varieties to assess the range of variability within different cultivars. We targeted selected functional groups of microbes in the rhizosphere as well as during litter degradation, involved in nutrient cycling and biocontrol. Results were related to the plant-nutritional status and possible physiological alterations resulting in changed pattern of exsudation in the rhizosphere, as well as the production of secondary metabolites in the plant.

S24.H.01
Molecular diversity of potato associated bacterial isolates with in vitro antagonistic activity influenced by site, cultivar and genetic modification

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In the vicinity of plant roots the abundance and activity of soil bacteria is influenced by root exudates and deposits. It is assumed that genetic modifications of plants might cause changes in the root exudation patterns which can influence the structural and functional diversity of bacteria in the rhizosphere. In this study, potential effects of transgenic potatoes, modified in their carotenoid-production on bacterial communities in the rhizosphere and geocaulosphere were assessed for potato plants grown at two different sites. In order to relate potential effects to natural variability between cultivars, two transgenic potato clones were planted together with five commercially available cultivars in a randomized field trial with six replicated plots per treatment at two sites in Germany. A cultivation approach coupled to a screening of bacterial isolates for *in vitro* antagonistic activity towards the major potato pathogens was performed in order to obtain information on the diversity of antagonistic bacteria. A total of 1946 bacterial isolates originating from the potato rhizosphere in Roggenstein as well as 2039 isolates from the rhizosphere and geocaulosphere in Oberviehhausen were tested in a dual-culture assay towards *Rhizoctonia solani*, *Verticillium dahliae*. Genotypic analysis of the *in vitro* antagonists was performed by ARDRA and BOX-PCR and 229 and 319 *in vitro* antagonists obtained from Roggenstein and Oberviehhausen, respectively were identified by 16S rRNA gene sequencing. The molecular characterization revealed strong site- and microenvironment-dependent differences. At the site in Roggenstein the majority of antagonists was assigned to *Pseudomonas*, whereas most of the antagonists from Oberviehhausen were assigned to *Streptomyces* and *Bacillus*. While the *Pseudomonas* isolates were characterized by their strong siderophore production, the *Streptomyces* and *Bacillus* isolates displayed strong glucanase activity. Strong site-dependent differences could also be observed using the cultivation-independent DGGE analysis. The analysis of bacterial DGGE patterns revealed that differences between the cultivars and clones were always minor compared to the site-specific differences.

S24.H.02

Impact of transgenic potato producing antibacterial substances on plant-associated microbial communities in comparison to effects caused by other parameters

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A greenhouse experiment was performed to analyze a potential effect of genetically modified potatoes expressing antibacterial compounds (attacin/cecropin, T4 lysozyme) and their nearly isogenic, non-transformed parental wildtypes on rhizosphere and endophytic bacterial communities. In order to compare plant transformation related variations with commonly accepted impacts caused by altered environmental conditions, potatoes were cultivated under different environmental conditions such as in two contrasting soil types. Further, plants were challenged with the blackleg pathogen *Erwinia carotovora* ssp. *atroseptica* (Eca). Rhizosphere soil and endophyte samples were obtained at stem elongation and early flowering stage. Activities of various extracellular rhizosphere enzymes involved in the C-, P- and N-nutrient cycles were determined as rates of fluorescence of enzymatic hydrolyzed substrates containing the highly fluorescent compounds 4-methylumbelliferone (4-MUF) or 7-amino-4-methyl coumarin (7-AMC). Structural diversity of the bacterial communities was assessed by 16S rRNA-based T-RFLP analysis, and 16S rRNA gene clone libraries were established for the flowering conventional and T4 lysozyme expressing Desirée lines grown on the chernozem soil, each line treated with and without Eca. Both genetic transformation events studied induced a differentiation in the activity rates and community structures of associated bacterial populations. In general, a stronger effect of T4 lysozyme as compared to attacin/cecropin was determined. In comparison to the other factors analyzed, the impact of the genetic modification was only transient and minor or comparable to the dominant variations caused by soil type, plant genotype, vegetation stage, and pathogen exposure.

S24.H.03

Detection of impacts by genetically modified plants to the rhizosphere by molecular-chemical screening and comparison to conventional techniques

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The detection of impacts by transgenic plants on the rhizosphere is an enduring challenge in environmental sciences. Conventional methods were combined with the novel and rapid molecular characterisation of rhizodeposits by Field Ionisation Mass Spectrometry (Py-FIMS) to detect even minor effects of transgenic roots of *Vicia hirsuta*. Composite plantlets were used with transgenic roots on wild-type shoots. Three treatments with composite plants (ARqua1, nptII, and PsbYcyel), one wild-type and one unplanted treatment were investigated in a pot experiment. Analyses of arbuscular mycorrhizal root colonisation and soil spore density of arbuscular mycorrhizal fungi and gas-chromatographic (GC) analysis of phospholipid fatty acid (PLFA) extracts were done after leaching of the rhizodeposits for Py-FIMS analysis. Mean spore density of arbuscular mycorrhizal fungi ranged from 7 to 12 (g soil)$^{-1}$; while differences were significant between ARqua1 and PsbYcyel only. ARqua1 had the significantly lowest spore density in soil and the highest root colonisation. Arbuscular mycorrhizal root colonisation of all plant types ranged from 22 to 56 %. Total fatty acid concentration ranged from 349 to 969 nmol (g soil)$^{-1}$ with significant differences between ARqua1 / wild-type and wild-type / unplanted soil. Py-FIMS of the rhizodeposits revealed no significant differences in total fatty acid amount, whereas Py-FIMS of the soils and GC analysis of PLFA pattern showed significant differences between ARqua1 and nptII and the wild-type. The indicator signals for free fatty acids were relevant for discrimination of soils from the different treatments, whereas indicator signals of carbohydrates, sterols and N-containing compounds hat the highest discriminating power for rhizodeposits. This finally led to an absolute discrimination of all treatments. We conclude that Py-FIMS is a fast, sensitive and comprehensive technique with less efforts than necessary for PLFA analysis to detect changes in rhizodeposits caused by transgenic plants.

S24.H.04

Transport und deposition of a genetically modified *Pseudomonas fluorescens* in saturated porous media

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The transport and deposition of bacteria through porous media is a complex phenomenon and of significant interest for the protection of drinking water supplies and for bioremediation. This study was conducted to understand the transport and deposition behaviour of the genetically modified *Pseudomonas fluorescens Pf0-2x*.. *Pf0-2x* is a non motile microorganism without flagella.
A series of column experiments with *Pf0-2x* at cell concentrations from 10^7 to 10^9 cells /mL was performed in quartz sand packing under saturated conditions at flow velocities 0.07 and 0.14 cm/min, respectively. For comparison experiments with *Pseudomonas fluorescens* were also conducted. The effluent concentrations and the retained particle concentrations were determined by fluorescent microscopy.
Transport experiments with *Pf0-2x* led to an early breakthrough at various input concentrations and both flow velocities. Both in the effluent and in the sand packing we detected rod shaped as well as coccoid shaped cells. Generally, the spatial distribution

of retained microorganisms in the column revealed a non exponential retention profile. Accordingly *Pf02x* may be considered as inert particles which can be transported by diffusion and emerge with the media front. For the transport of *Pseudomonas fluorescens* two consecutive breakthrough curves were detected at various input concentrations and both flow velocities which was attributed to the different breakthrough behaviour of rod and coccoid shaped cells of *Pseudomonas fluorescens*. Furthermore, a lower input concentration of *Pseudomonas fluorescens* tended to a lower relative effluent concentration. Generally, there were differences in their breakthrough behaviour between *Pseudomonas fluorescens* and the genetically modified *Pf0-2x*. In this context the role of flagella in the bacteria transport will be also discussed.

S24.I.01
Glyphosate modified rhizobacterial activities of transgenic soybean

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The rhizosphere is a crucial soil environment where plant-microbe interaction occurs. The increasing use of glyphosate-resistant (GR) soybean may change microbial populations and activities in response to variations in quantities and composition of organic compounds released in root exudates and to the buildup of metabolites by microbial activity that detrimentally affect growth of certain microorganisms in the rhizosphere community. Relationships of glyphosate with microbial activity in the rhizosphere of GR soybean were evaluated. Measurement of rhizosphere microbial activity was based on the urease assay, and C and N mineralization determinations. The results showed that glyphosate application decreased urease activity and total organic C (TOC) and increased total bacteria population significantly. Principle component analysis (PCA) indicated that glyphosate application affected overall total bacterial population, urease activity, TOC, and total organic N (TON) to a limited extent. Glyphosate application on GR soybean may increase phytotoxicity of the herbicide via foliar absorption, thereby decreasing the release of TOC and TON into the rhizosphere.

S24.I.02
Adsorption and desorption of monomeric Bt (*Bacillus thuringiensis*) Cry1Aa toxin on two reference minerals : montmorillonite and kaolinite

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Genetically modified crops, which produce insecticidal proteins from *Bacillus thuringiensis*, release the toxins into soils through root exudates and upon decomposition of residues. The fate of these toxins in soil is not completely understood. Adsorption on soil, and the reversibility of this adsorption is an important aspect of the environmental behaviour of these toxins. The aim of this study was to investigate the adsorption and the desorbability of the Cry1Aa Bt insecticidal protein on two different homoionic clays: montmorillonite and kaolinite. The originality of our work was to focus on the monomeric form of the protein. We demonstrated that specific sample conditions were required to avoid polymerisation. Indeed, we showed that a pH above 6.5 and a high ionic strength of 150 mM were necessary to keep the protein soluble and in a monomeric state. Adsorption isotherms obtained followed a low affinity interaction for both clays and could be fitted using the Langmuir equation. Binding of the toxin decreased as the pH increased from 6.5 (close to the isoelectric point) to 9. Maximum adsorption was about 40 times greater on montmorillonite (1.71 g g^{-1}) than on kaolinite (0.04 g g^{-1}) in line with the contrasting respective specific surface areas of the minerals. Finally, the desorbability analysis showed that up to 14% of the adsorbed toxin was desorbed by water and about 36 % by high pH buffers, indicating that it was not extremely tightly bound. Moreover, the test of a large panel of desorption buffers indicated that the toxin was easily and quasi-completely desorbed when using zwiterrionic and non-ionic detergents like CHAPS, TritonX100 and Tween20, from both clays, which was promising for further detection experiments of Bt toxins in soil.

S24.I.03
Evaluation of some soil-dependent direct and indirect, inner and outer mycorrhizosphere parameters at field-grown GMO corn

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Rhizosphere of the higher plants is a unique environment, where the microbiological status is mainly dependent on the hosts. Rhizobiological characteristics, however might be depending on their proximity from the plant-roots.
Microbiological parameters were tested in the rhizosphere of genetically modified model corn expresses the cry1ab gene from Bacillus thuringiensis ssp. kurstaki. During three consecutive years, soil- and root samples of transgenic Bt (DK-440-BTY) and isogenic non-Bt (DK-440) control corn were collected seasonally. Besides the endorhiza colonization by the arbuscular mycorrhizal fungi the countable microbial components (r, k, l strategist heterotrophs, oligotrophs and spore-forming bacteria respectively) were assessed and the catabolic enzymatic activity of the total microbial biomass was measured by fluorescent diacetate hydrolysis. Abundance and species composition of the Trichoderma fungi were assessed from the outer rhizosphere soil.
The exudates of transgenic Bt corn had no apparent detrimental effect on the rhizosphere microbiota, as reported by the countable microbiological parameters. There was a strong seasonal variability recorded, however, as a function of the studied microbial groups, independently from the gene-modification. Total microbial activity measured by the FDA hydrolysis at the Bt corn, was significantly higher ($P<0,05$) in comparison with the non-Bt corn all along the three consecutive years. Rates of the mycorrhizal colonization were significantly lower ($P<0,05$) at the early stages of the vegetation, while the reduction was diminished at the later sampling periods. Differences between the total annual AMF activities of the Bt or non Bt corn became non-significant at the third vegetation periods. No differences were found in the abundance and diversity of Trichoderma fungi in the soils with the least influence of plant-rhizosphere. The abundance and activity among the various microbial groups can be further discussed, more particularly when considering the direct and indirect effects of the GMO corn.

S25 Memory Function of Recent and Paleosoils

S25.A.KL
Facing constraints in environmental reconstruction from soils data

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Many soil scientists are aware that as well surface as buried soils can have a potential memory function. Yet numerous constraints exist when performing research in this domain of soil science.
There are few special education and training programmes in this orientation and most scientists rely on the "standard" field recording guidelines and laboratory analysis. Unfortunately these documents do pay little or even no attention to a set of essential questions. Information about activity status of the processes, spatial and temporal variability of processes and characteristics, related distributions of characteristics and even origin of the features recorded, are mostly missing. Very rarely attention is paid to the recording of soil profiles in 3D by the addition of horizontal sections to the standard vertical profile face. The final result is that the field data base often provides information that can be needed for the location of the soil within a particular soil classification system, or to evaluate the soil fertility status. However, these are no the topics of primary importance when it comes to unravel the memory function of a soil or a soilscape.
The previous comments are illustrated and discussed on the basis of some soil characteristics such as stoniness, pedality, redoximorphic mottling and processes such as groundwater table dynamics and bioturbation. The study sites are mainly from West and Central Europe. An open checklist is proposed in order to provide more comprehensive and adequate data bases.
The presentation will end with a discussion on the urgent need to come to the characterisation and conservation of those soil sites and soilscapes that have still today a unique heritage value. Many of these sites are under threat and risk to disappear under the overall expanding human impact.

S25.A.01
Soil organic matter as a proxy for climate and environment in last-interglacial palaeosols

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Loess-palaeosol characteristics are important records of past environmental conditions. Methods for interpreting this 'soil memory' however are limited. A promising environmental proxy is the detailed analysis of fossil soil organic matter (SOM). Yet it remains underexploited as its assessment is complicated. Two approaches were evaluated: SOM fingerprinting by Pyrolysis-GC/MS and combined Mid Infra Red Spectroscopy - thermostability analysis. Results were related to total organic carbon content, δ13C and grain-size variation. The Early Weichselian Warneton Complex of humiferous layers in the Veldwezelt-Hezerwater archaeological site (Belgian Loess belt) was investigated as a model case study. Both methods confirm each other and indicate that the lower unit of the humiferous complex reflects a stable soil surface, allowing SOM build-up and high decomposition. Higher in the profile, decomposition decreases and evidence of wildfires was encountered, indicating a colder and drier climate. These results were consistent with and complementary to the information based on the total carbon content, isotopic signal and grain-size variation. Pyrolysis-GC/MS yielded very detailed results and allowed evaluating the microbial contribution to SOM, yet it is a complicated analysis requiring high levels of expertise. MIRS-thermostability provided less information but general conclusions regarding SOM stability were in line with the ones based on pyrolysis, suggesting MIRS as a possible alternative analysis technique.

S25.B.01
The mycological memory in natural and anthropogenically transformed paleosoils

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The fungal communities in paleosoils can be the carriers of soil biological memory of ecological situations in the past. This preposition has been confirmed in our study of the buried paleosoils of Pleistocene (30000 years) and Holocene (250-10000 years), and cultural layers of the medieval settlements (VIII-XIV century A.D.) in the European part of Russia. Since the formation of fungal communities is closely connected with vegetative cover and soil, simultaneously the fungal spores can survive in a viable state for the long time. As biological indexes the fungal biomass, species diversity and composition of fungal assemblages, soil respiration were determined. The fungal biomass and biomass structure were evaluated using luminescent microscopy. The isolation and enumeration of microfungi were done on the solid media and by bite technique. The identification of unsporulated strains was performed using molecular genetic analysis of ITS regions of rDNA. The investigated fragments of buried paleohumus horizons of late Pleistocene and early Holocene contain the viable microfungal spores. The highest microfungal diversity was determined in the central part of paleosoil fragments. The species composition of microfungi in that paleosoils was consistent with paleobotanical data. In "younger" (1000 years) buried humus horizons, the fungal assemblages include some stenotopic species, which are not typical for the recent soils, but character for a coniferous ecosystems developed at the examined area in the past. The study found that investigated medieval cultural layers and the recent urban soils have rather similar mycological properties, comparing with undisturbed zonal soils. The similarities were expressed in: a biggest ratio of fungal spores in fungal biomass, mosaic distribution of fungal populations in urban horizons, biggest share of everytophic species, increased occurrence of some trophic fungal groups (for example, potentially pathogenic for human).

S25.B.02
Near infrared spectroscopy as a tool to identify soil organic matter origin

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The aim of the present work is to develop a new method based on the capacity of near infrared spectrometry (NIRS) to identify the vegetal origin of soil organic matter (SOM). This method is easy to carry out and could be very helpful not only for reconstitution of paleo vegetation in the Holocene, but could also help to understand the SOM dynamics.
NIRS has been commonly used for 40 years in pharmacy, chemistry and other industrial sectors working with organic products either to quantify elements or to check quality of products. More recently, NIRS was used in soil science as a fast and inexpensive tool to predict the contents of major organic elements in soils. On the other hand, the NIR spectra can be considered as a fingerprint of SOM. Our recent work shows that it is possible to discriminate recent SOM accumulated in the first centimetres of A horizons and, thus, to identify its vegetal origin (a forest or a grassland ecosystem). The prediction of the forest/grassland origin remains accurate when exploring various ecosystems and soils' types.
After being enlarged, the data constitutes a library which is representative of nearly all major ecosystems that can be found in the Vosges Mountains (France). This larger set allows especially to compare various types of forests soils. This enables to determine a specific fingerprint for a precise ecosystem. The typical vegetation associations of the area like

beech-fir or oak forests are examined on several sites where they have been present for over 150 years. NIR spectra of surface soil coupled with a precise description of the vegetation show how accurate this new method can be. Further applications in paleosoils are expected.

S25.B.03

Links between composition of heavy organo-mineral fractions and forest expansion on grassland with long-term fire history

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Does Araucaria forest (C3) expansion on frequently burned grassland (C4) on the nonallophanic Andosols of the southern Brazilian highlands affect the chemical composition of soil organic matter (SOM)? Studying eight topsoils, we used the 13C/12C isotopic signature to group SOM according to the source vegetation and 13C NMR spectroscopy, lignin analyses (CuO oxidation), and soil lightness detection to characterise the chemical structure of plants, organic surface layers, light organic fractions, and heavy organo-mineral fractions.
Large proportions of aromatic C combined with low contents of lignin-derived phenols in the heavy fractions with C4 signature and grass-derived deeper horizons of Araucaria forest (C3) soils indicate the presence of charred grass residues in SOM. The increasing contributions of this material with depth may have led to the uncommon increase of C/N ratios with soil depth as well as to soil colour changes, because C4-derived heavy fractions are darker and show higher C/N ratios than those with C3 signature. Plants have characteristic distributions of vanillyl, syringyl and cinnamyl units of lignin-derived phenols which are not found in the heavy organo-mineral fractions. Shrubs or trees (C3) are composed of larger alkyl-C and smaller O/N-alkyl C proportions compared to grasses (C4). This plant-specific difference is still found in heavy fractions. Forest soils show with increasing soil depths consistent changes of (alkyl C)/(O/N-alkyl C) ratios and 13C/12C isotopic signatures towards the values which are typical for grassland-derived SOM. This demonstrates the memory function of SOM composition for source vegetation. The chemical composition of SOM combined with the grouping according to 13C/12C isotopic signatures leads to differentiation of soils. Our results show that soils may preserve humus components from earlier vegetation and land use indicating that the knowledge of past vegetation covers is necessary to interpret SOM composition.

S25.B.04

Rare earth elements as tracers of pedogenic processes in old soils

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To quantify the impact of the different pedogenetic processes on pedogenesis, we propose to use rare earth elements (REE, atomic numbers 57 to 71) as tracers of these processes. This approach was applied onto old soils that developed into a calcitic limestone and that underwent successively decarbonatation, oxidative and reductive conditions, and eluviation/illuviation.
In order to consider the impact of a single pedological process onto the soil evolution, an original REE normalizing approach is proposed. This approach is based on the classical pedological theory, which considers that a pedological feature results from the impact of a pedological process acting on the underlying or surrounding pedological material.
Three pits were opened along an erosional toposequence of more or less truncated soils. All the horizons of the three soils and their underlying limestones were sampled. Limestones were experimentally decarbonated and initial and final REE-bearing minerals were identified by microsonde and X-ray diffraction analyses. Particle-size and mineralogical fractionations of the different pedological features were chemically extracted to determine, together with X-ray diffraction analyses, the speciation of REE. Mass balance calculations were achieved to quantify fluxes due to each process in the three solums.
Our results illustrate the potential of REE as tracers, since each pedogenetic process acts differently on REE mobilization. Decarbonatation shows that a large amount of REE is released into soil solution. All REE are exported down slope into the seasonal water table, except Ce. This last element is enriched in the Fe-Mn concretions that are formed thanks to redox changes during water table fluctuations. When degradation, i.e. unfavorable redox conditions, begins, MREE are impoverished due to the dissolution of the Fe/Mn-(hydr)oxides cementing the finest soil fractions. Then preferential eluviation of some phyllosilicates induces a subsequent MREE impoverishment, while Ce is not affected.

S25.B.05

Nitrogen isotopic studies (∂15N) reveal past agricultural activities in soils from a 14th century archaeological site

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The history of Europe may well be recorded in the landscape. Can traces of past land use be found in present-day soils? The archaeological site of St Martin du Mont, northwest of Dijon (Côte d'Or, France), is the remains of a hamlet from the Middle Ages, probably from the 14^{th} to the beginning of the 15^{th} century. Currently forested, the site was composed of two farms, with separate enclosures interpreted as vegetable gardens. Soils studied are calcisols exposed on a calcareous plateau. From archives and a concentric ring model of soil occupation, different types of land use have been identified and investigated: garden enclosures, long-term forest and long-term pastures.
Chemical and isotopic investigations were performed on five soil profiles sampled through soil horizons. Pedological observations (colour, structure, texture) and chemical analyses (pH, organic carbon and nitrogen contents) do not establish differences between profiles, with the exception of the lack of calcareous gravels and stones in the two enclosures. Nitrogen isotopic analyses (∂15N), however, coupled with the carbon and nitrogen ratio (C/N) of total organic matter, show differences related to land use. Soils from long-term forest and long-term pasture show two parallel trends with increasing ∂15N values and decreasing C/N ratios related to depth profile. The two enclosures exhibit trends that are completely different, with higher ∂15N values and lower C/N ratios. A significant ∂15N shift is also observed in the subsoil of these enclosures. These trends are discussed in terms of the dynamics of organic matter, particularly its isotopic signature related to microbial degradation. These results are interpreted as a geochemical long-term impact of past agricultural activities, especially organic fertilization. The efficiency of isotopic studies of soil organic matter is confirmed as revealing former land use, even after seven centuries of disuse.

S25.B.06

Specialities of structure of compound paleosoil later and middle pleistocene on morphological and micromorphological data

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The profiles Michnevo, Ozherelje were studied in loess sediments of central regions in between rivers Oka - Moskva. In these sections the complete specter of interglacial soils of Later Pleistocene (Mikulinskoe interglacial -125000) and Middle Pleistocene (Kamenskoe - 250000 and Inzhvinskoe interglacials - 350000 year ago) is represented. Obtained data suggest, that pedogenesis in interglacial epochs Later and Middle Pleistocene took place in subboreal belt under forest vegetation. The most important indicator of genesis of forest soils is presence of illuviation in E-Bt horizons, which structure and complex shows the conditions of pedogenesis. In Mikulinskoe interglacial texture-differentiated soils were formed under processes of lessivage, great amount of clay illuviation coating in Bt horizon was characteristic. In profile of paleosoils coatings are homogeneous by structure, brown and dark-brown. The layered structure is found only in complex iron-clay and iron-humus coatings. In Mikulinskoe interglacial soils iron neoformation are found. In Kamenskoe interglacial along with clay coatings great amount of humus-clay and iron-clay coatings are presented. In a number of profiles they are situated in break system, they have layered structure, thickness is less then 0.4 mm. Quantity of iron neoformation is great. In Inzhvinskoe interglacial soils iron-clay coatings occupies the most part of profile and accumulates in its lower part. In comparison with Kamenskoe paleosoils, coatings here are situated not in break system, but in pores 0.3-0.5 mm in diameter. The most part of clay coatings are firm, brown coloured, layered structure is weekly presented. Iron neoformations are spreaded homogeneous by profile, their diameter is less than 0.3 mm, dark-grey coloured with glasses point of inclusions. All of these things may show that in pedogenesis took part lessivage, surface gley. The results of these researches can be used in reconstruction of environment conditions of previous epochs of pedogenesis.

S25.C.01

Multiultivariate numerical methods for paleoenvironment reconstruction by the example of monocultural kurgan cemetery within steppe Pre-Ural, Russia

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Filippovka I is the monocultural kurgan cemetery dated to the Vth-IVth centuries BC and located within steppe area of the Southern Pre-Ural, Russia. It consists of about 30 burial mounds scattered on 25 km2 area. 9 paleosols and 9 modern soils were described morphologically and sampled with 20 cm interval through 200 cm soil profiles. Soil samples were analyzed on pH, content of organic carbon, carbonate, gypsum and exchangeable bases.
Differences in morphology of buried soils allowed us to suggest that the paleoclimate changes were reflected on soil properties. However, the high variability in parent material of this territory made some difficulties to determine whether the differences in properties caused by lithological heterogeneity or paleoclimate changing.
To establish which of the measured soil properties make the greatest contribution in common variability of studied soils, they were analyzed (only in the modern soils) with the principal components method. As a result the most contribution in common variability was mainly related to the particle size distribution. At that the size of particles is one of the least changeable properties in the soil and must be connected with lithological heterogeneity only. Therefore, selection of modern analogues to the buried soils was based on the content of particles <0.01mm.
Selection of modern analogues to the paleosols was realized by cluster analysis, using different distance measures and allowable linkage rules to increase accuracy and examine stability of obtained groups. Properties of paleosols in obtained groups were attributed to the properties of their modern analogues, and then the signed numbers for chemical properties were compared in the chronosequence. This way lets us to reveal the directional changeability in the paleosols properties and reconstruct the paleoenvironmental conditions with decreased influence of soil spatial variability.
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S25.C.02

Investigations of buried soil profiles beneath kurgans: Case study of the Lyukas-mound kurgan

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Kurgans are significant cultural and ecological values of the Carpathian Basin and Hungary, too. These formation were primarirly built in order to serve sacral-burial purposes. By the erection of these mounds, the ancient soil surface has been covered and isolated.
Due to the protection of law, kurgans in Hungary can only be examined by drillings. Due to a special and unconventional occasion the Lyukas-halom kurgan could have been excavated.
The mound is situated on the Great Hungarian Plain in the Carpatian Basin. The surrounding landscape dominated by agricultural production.
Together with an archaeological experts transverse section of the kurgan has been prepared as a result of the excavation. It reveals the kurgan in 40 meters length and 8 meters height.
Not only the stages of the erection of the mound was easily detectable, but the buried soil profile could be easily identified. According to the morphology (crumby structure, dun colour, typical lime and humus dynamics) and to the results of the laboratory analyses (TOC. loamy texture, balanced water regime) the 5500 B.P. aged soil (C^{14} calibration) can be classified as a Chernozem, which is an interesting data in the light of former theories. Formerly, researches on the vegetation development of the inner basin territories underlined the existance and dominance of forest cover on the Great Hungarian Plain.
Additional soil analyses, such as micromorphological investigations and geochemical examinations support the same as no signs of Luvisol evolution processes, such as lessivage, clay migration nor forms of clay coatings were found. In addition, paleobotanical results (phytolith analysis) of the palaeo [A]-horizon refer to steppe-dominated vegetation mosaics.

S25.C.03

Eurasian mountain soils as a paleoarchives of Holocene

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The soil cover of the extensive territories of Eurasian mountains is represented by polygenetic Holocene soils along with soils buried by late Pleistocene and Holocene loess. Specific features of these soils are due to the action of elementary modern and relic soil processes, whose age and intensity varied under influence of glacier movements and climatic fluctuations. These properties could help to elucidate conditions of soil formation during the Holocene and, as well as, can be used as indicators of paleoclimatic changes.

A soil chrono-climosequence was studied in the mountains of Eurasia, focusing in Tian-Shan, Pamir, Alay, Caucasus, Hibiny.
Diagnosis of ancient pedogenesis was based on criteria with the longest response time, namely soil morphology, humus characteristics (lignin proportions, optical properties of humic acids, NMR-spectroscopy characteristics of organic matter), isotope composition of humus and carbonates, soil mineralogy, grain-size distribution and soil age.
The profiles of the mountain Holocene polygenetic soils, which were formed on the glacier moraines during the last 13000 years are clearly differentiated in the late Holocene upper part (about 1000-3000 years), buried middle Holocene (5500 years) and early Holocene (7000-10000 years) lower parts. Since soil evolution is determined by a trend in the landscape development, paleosoils studied indicate a glacial conditions during the late Pleistocene, a dry and cold climate during the early Holocene, warm and dry conditions of soil formation in the middle Holocene, and a moderate humid climate of the late Holocene. Holocene climatic changes in the central Asia seem to coincide with those of Eastern Europe, northwestern Caucasus, and correspond to global climate changes.

S25.C.04
Modelling the genesis of Luvisols from calcareous loess

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Many soils in the western European loess belt have in common (i) a parent material deposited in the late Weichsel period, (ii) a mineralogical composition with some 10-15% calcium carbonate, some 12-18% clay and mostly quartz minerals with some feldspar. Soil genesis in leaching climates is often decarbonisation followed by clay migration. Clay migration may no longer be an active process when pH drops to levels at which Aluminium enters the soil solution and keeps the clays flocculated, while in agricultural environments liming may have favoured a re-start of clay migration, often in combination with organic materials. Most of the underlying processes are now understood quite well and can be modelled. The formulation of a model incorporating unsaturated flow, soil and colloid chemistry and transport should therefore theoretically allow for the reconstruction of the formation of Luvisols.
This paper reports on the modelling of the formation of Luvisols starting with a virgin loess parent material using 15000 years of reconstructed climate and vegetation data to construct boundary conditions. Soil formation processes included are weathering of primary minerals, decarbonization, bioturbation, clay migration, accumulation of organic carbon and exchange processes.The SoilGen model combines an existing soil chemistry model (LEACHC) for unsaturated water flow (Richards' equation) and solute transport (Convection Dispersion Equation). The model also includes carbonate and aluminium chemistry and sorption of cations to the exchange complex. Detachment, release and mobilisation of colloids, bioturbation and subsequent effects on porosity and flow-related soil physical properties were added to the model, as well as a description of the C-cycle and associated nutrients according to the concepts of the Roth-C model. Some climate-dependent scenario's as well as calibration and sensitivity issues will be demonstrated.

S26 Pedometrics and Digital Soil Mapping

S26.D.KL
Pedometrics, some applications and preoccupations

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Pedometrics is mathematics and statistics in service of the study of how soils vary in space and time. All statistical methodology entails assumptions, and it is of the essence of a science such as pedometrics that these assumptions are subject to scrutiny which is informed by our empirical and theoretical understanding of the processes of interest. It is also the case that a statistical method does not entirely stand or fall by the plausibility of its assumptions. Most working methods have some degree of robustness, a property that can be defined quantitatively in some circumstances. Pedometrics therefore combines strands of speculative science, and practical art. The success of pedometrics requires that we balance appropriately the requirement for theoretical rigour and a prudential assessment of what is required to fulfil our requirements: soil inventory, monitoring, inference about management options and greater insight into the formation and function of the soil.
In this talk I shall focus on quantitative description of the spatial variation of soil. This can be done by simple statistics and descriptors, by enhancements of well-tried design-based methods (e.g. nested sampling), by models based on stationary random functions (variograms), by more complex non-stationary variance models, and by methods such as the wavelet packet transform. The more complex methods have, in general, emerged as Pedometrics has matured, but it is a mistake to think that the simpler approaches are therefore superseded. Using examples from precision agriculture, national-scale inventory and monitoring design and fundamental studies on soil processes, I shall try to illustrate how an informed understanding of statistical method, and the nature of the problems that soil scientists have to solve, is essential if Pedometrics is to deliver on its promises to the wider disciplines of soils science.

S26.D.01
Integrating auxiliary data and expert knowledge: an object-based approach for fuzzy soil class prediction

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In Germany, the state-wide soil mapping is controlled by expert perceptions, the quality of input data and landscape heterogeneity which all influence the prediction uncertainty: Expert perception depends on soil landscape concepts that vary from state to state. Data quality refers to scales and semantics, landscape heterogeneity affects the soil class variability.
The presented fuzzy expert system for digital soil mapping aims at the reproducible and scale-specific integration of existing soil and auxiliary data as well as expert knowledge. Reproducibility means that all steps of data integration are stored and can be changed if necessary. Reproducibility refers also to the

delineation of soil units. And finally, reproducibility has to include prediction quality assessment.
The expert system consists of four key modules: (1) The segmentation module using a region-growing algorithm leads to scale-specific soil-terrain units based on terrain attributes. (2) Within the transformation module, all soil and auxiliary data are expert-based or geo-statistically transformed into so called 'soil target features' (STF). STF represent soil-forming processes and properties like 'clay illuviation' or 'clay content' and characterize the target soil classes (TSC) - the aim of the prediction. (3) The fuzzy classification module enables the definition of TSC by using logical combinations of two-dimensional membership functions. The membership functions refer to STF-mean values of the segmented soil-terrain units. The classified segments are characterized by class memberships which express core and transition soil zones as well as the prediction quality. (4) The prediction quality can only be assessed by classification validation. Within the validation module accuracy measures can be calculated that are derived from a confusion matrix. The measures show how strong classification results match with random samples of reference information.

S26.D.02

Multiple Additive Regression Trees as a tool for estimating soil properties. Principles and applications

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Pedotransfer functions (PTFs) are used to estimate soil properties that are difficult and costly to measure, from others properties that are available. MART, namely Multiple Additive Regression Trees belongs to the boosted regression trees (BRT) family. It has been applied in various scientific fields such as remote sensing, ecology and prediction of species distribution, medicine and chemometrics and only very recently to soil science. The MART method, which includes the use of stochastic gradient boosting, is known for having a set of interesting properties, although as for other techniques such as neural networks, attention must be paid to overfitting behavior. It can work with either qualitative or quantitative predictive variables, can handle missing data, correlated predictive variables and is robust to the presence of outliers within the dataset and to the use of irrelevant predictor variables. It comes with different output for interpreting the results and assessing the validity of the fit.
Here, we present development of PTFs using MART for diverse soil science application as estimation of missing values of bulk density of French metropolitan soils, prediction of soil carbon stocks in Guadeloupe (French Caribbean Island) and development of correspondence function between different methods of heavy metals analysis (aqua regia and total analysis, i.e. inductively coupled plasma mass spectroscopy after dissolution with hydrofluoric and perchloric acids). MART proved to be a versatile and convenient tool for building such functions without much a priori knowledge about the relationships between response variable and predictors. MART was able to grasp the full dataset diversity when fitting PTFs as challenging as PTF for bulk density.

S26.D.03

Topsoil organic carbon content in relation to edaphic and anthropogenic site variables in Rwanda

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In view of ongoing expansion and intensification of agricultural land in Rwanda, protection of soil resources, and especially of organic matter content, is of utmost importance for the majority of its population depending on agriculture. Rwanda has a considerable diversity of soils, ranging from Andosols in the volcanic highlands, over Cambisols, Luvisols, Alisols and Acrisols in the sub-humid, hilly western highlands, to strongly weathered Ferralsols in the semi-arid eastern lowlands. We analysed the nation-wide soil profile database, containing 1463 described and analysed soil profiles distributed across the country and determined to what extent independent site variables such as altitude, soil moisture regime, slope gradient, soil reference group, parent material, internal drainage, granulometry, pH, land use, and population density explain the recorded variation in topsoil (0-30 cm, mineral layer) organic carbon content (O.C). Statistical tools used include regression tree analysis and stepwise general linear modelling. Two linear regressions based on altitude, clay + fine silt or sand content, and population density both explain 48% of the variation in O.C at national level. In the regression tree analysis, including also categorical site variables, the impact of parent material and land use on O.C is highlighted as well. The regression tree - comprising in order of decreasing importance, altitude, parent material, land use, sand content, clay + fine silt content, and population density - explains 53% of the variation in O.C. By adopting a multi-level approach differences in relative importance of the site variables within specific agro-ecological zones can be identified. The analysis provides insight in the O.C pool present in the Rwandan topsoils and highlights challenges faced when characterising the spatial distribution of O.C in environmentally very diverse tropical regions with high population densities.

S26.D.04

Enhanced soil phosphorus mapping with common secondary information

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A good spatial estimate of soil phosphorus is a key element in a site specific management strategy which helps to reduce economic expenses and its environmental impacts. But a high spatial variation of soil properties in fields, due to numerous influences, makes mapping of soil phosphorus rather problematic. To overcome this problem, an intensive grid soil sampling approach can be applied. However, the increased sample size means high costs and, from the farmer's point of view, is often considered as uneconomical. An alternative is, to assume a relationship of soil phosphorus to secondary spatial data that are more economically sampled.
The purpose of this study was to evaluate the performance of spatial estimates of phosphorus for different prediction methods, with and without incorporating secondary information on multiple scales. As covariates we chose soil conductivity, crop yield data and soil pH. Soil samples were taken on a 36 ha field along a 100 m grid and a 50 m grid with a regular grid design. We combined both grids so that three grids could be yielded. Correlation and cluster analysis were performed to reveal relationships between nutrients and covariates. Soil phosphorus estimation maps were created from each grid using inverse

distance weighting (IDW), ordinary kriging (OK), kriging with external drift (KED) and multivariate regression. Theoretical variograms for kriging prediction were calculated using maximum likelihood estimation. All prediction maps were evaluated by cross validation.
Correlation between soil phosphorus and covariates was low. Prediction quality was best with KED, OK performed well, whereas IDW and multivariate regression were the poorest predictors of soil phosphorus. The highest improvement of KED over OK was seen using the 100 m scale. Results indicate that as long as spatial autocorrelation is present geostatistical modelling with covariates is favoured when data are sparse.

S26.E.01
DEM quality indicators for the derivation of geomorphological parameters

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Digital Elevation Models (DEMs) provide a model of the continuous representation of the earth's elevation surface. This form of spatial data contains errors from the true elevation values. The nature and extent of these errors are often unknown and not readily available to users of spatial data. Topographic attributes are frequently derived directly from DEMs and DEM errors propagate to derived parameters. Normally, DEM accuracy is quantified using the Root Mean Square Error (RMSE) that assumes DEM errors are random. However assessment of DEM uncertainty requires more information on the spatial structure of the errors.
The aim of this study was to provide an example of simple indicators of the performance of a given dataset for hydrological networks derivation and to model the errors propagation in such process. Three DEMs of different origin and cell resolution were compared in an area of about 120 km2 in the Rhein basin. SRTM dataset with resolution of 100m, DEM dataset mosaic from various sources with a resolution of 60m and ASTER derived dataset with a resolution of 30 m were used. All datasets were resampled to a common cell-size of 30m. The sinks were removed prior to the derivation of hydrological parameters. The river network was then extracted for different flow accumulation thresholds. The Strahler order and the contributing area network were calculated. Significant differences were found among the considered DEMs, showing the impact of the original resolution. The DEM with lower original resolution extracted river network with lower Strahler order. The DEM with the highest original resolution showed a higher contributing area for lower Strahler order. The propagation of errors was estimated using a Monte Carlo simulation including the spatial variability of DEM errors.

S26.E.02
Digital terrain analysis in an approach to stratify geological mapping units and soil data as a basis for a medium-scale soil map of Germany

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The ongoing German soil mapping campaign for the scale of 1 : 200,000 combines seamlessly soil data from the different federal states in order to come to a nation-wide, consistent soil geometric and semantic database. During this process, problems arise originating from differing high-resolution basic datasets, soil descriptions, mapping strategies and data gaps. These problems have to be solved by applying and developing extensive coordination and quality control procedures. For the design of the European Soil map 1: 250,000 similar problems are to be expected.
Digital soil mapping techniques are considered to be a powerful tool to harmonise data from different data sources, filling gaps in the existing soil maps and cross-validation. The German Federal Institute for Geosciences and Natural Resources therefore initiated a project to integrate existing soil data, auxiliary data (digital elevation models, land-use information, climatic data, etc.) and knowledge about regional soil forming processes by developing a scale-dependend soil inference model to derive the location and the properties of soil mapping units and parent materials for medium-scale soil maps.
As a first step, we focused on identifying areas with similar soil forming conditions. Different approaches based on digital terrain analysis and geological mapping units were tested. A reproducible method for the identification and delineation of such areas is necessary (i) to fit a soil inference model to different landscapes and (ii) to define the limitations to which the model can be used in different settings without further modifications. The results were compared with soil scapes and soil regions as delineated by local experts based on field work. Furthermore, a soil map 1 : 50,000 was used to calculate indices to characterize the diversity and heterogeneity of soil and parent material units within these areas. The assets and drawbacks of various approaches will be presented.

S26.E.03
Soil-hydrological runoff processes - a medium scale digital mapping approach

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Due worldwide lack of high resolution soil and hydrological maps fast and accurate predictions of soil-hydrological properties and processes are needed to face the changes of the hydrological regime resulting from global change.
Based on a hydrological process mapping scheme developed by Scherrer et al. in Switzerland, a hierarchical decision system was developed to derive the relevant runoff processes at a scale of 1:25.000. The approach consists of two major parts: first an artificial neural network prediction based on digital terrain analysis, and second a rule based system to classify soil maps in terms of hydrological processes. The final inference can be applied including land use/cover to calculate scenarios of runoff changes.
The study area which is frequently affected by flood events, is located in Rhineland Palatinate, Germany, and comprises over 500 km2. Five sub-catchments had been mapped by Scherrer et al. at a scale of 1:10.000. Three were used for learning and two for validation.
The prediction is based on resilient backpropagation neural networks and 25 terrain attributes derived from a 20 m DEM. The hydrological interpretation of the existing soil map (1:50.000) was conducted by a soil surveyor with local experience.
The results, with high accuracies of about 60 to 85 %, are very promising and provide the basis for high resolution soil-hydrological process maps for large areas. A hydrological model based on these datasets is under development.

S26.E.04
Prediction of groundwater levels and amplitudes in typical soil landscapes (low lands) of the Soil Map of Germany at scale 1:200,000 with Digital Soil Mapping

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Groundwater levels in soil mapping are determined in the field mostly by looking at the hydromorphic properties of soil profiles,

combined with indications from the vegetation pattern and relief position. During aggregation procedures in small scale soil mapping such as 1:200,000, the area estimate of hydromorphic soils and the groundwater levels become less and less accurate, despite the need for such data e.g. for modelling. Ground water levels from gauges were used in a project in the northern German lowlands with the objective to predict the groundwater surfaces in areas dominated by unconsolidated rocks (high and low water levels and the derived amplitude). The target scales were 1:50,000 and 1:200,000.
An official network of actual water courses was used instead of a theoretical channel network to create complex terrain parameters called “baselevel of vertical distance to channel network” and “vertical distance to channel network”. In the terrain analysis procedure a theoretical surface was stretched between the water courses. The difference between the surface of the DTM and the theoretical water surface (baselevel) was calculated. This data set is called “vertical distance to channel network” and has been developed for the German soil geomorphographic map (GMK 1000; Köthe et al. 2008). For the assessment of groundwater levels, both parameters appeared as main predictors in a multiple regression model. High, low and medium water levels were produced in this way and the associated amplitude was derived. The approach is currently being validated with profile data from soil mapping activities.
This method provides a quantitative spatial assessment of current ground water levels. The data can be used for cross-validation with existing soil maps, to facilitate and improve current soil mapping, and, in particular, to update the area extend of hydromorphic mineral and organic soils in existing aggregated soil maps.

S26.F.01
Digital mapping of soil layers and substrates - a machine learning approach based on GPR data

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The focus of this presentation is on the combination of ground penetrating radar (GPR) surveys and data mining based digital mapping of soils and substrates formed through periglacial processes. As periglacial slope deposits cover nearly all European mid latitude landscapes they strongly influence the distribution and the properties of soils as well as hydrological processes in this region, and thus, are of great importance.
The study area - the Nidda catchment - comprises about 1.600 km2 and is located in the German mid-latitude landscapes in Hesse, north of Frankfurt/Main. Based on a stacked sampling scheme to obtain a valid basis for subsequent extrapolations, comprising landscape segmentation, the detection of representative spatial subsets, and two different representative transect sampling schemes the distributions of periglacial slope deposits were surveyed using GPR measurements. The GPR measurements were carried out using an optimized signal processing approach and were accompanied by detailed analysis of pedons along the transects to gain physical and chemical soil characteristics.
The main focus is on the application and evaluation of different (spatial) machine learning techniques to analyse and predict the GPR data. Cross-validation is based on the two different line transect sampling approaches.

S26.F.02
Single line Ground Penetrating Radar soil survey along a representative transect in the soilscape of Buedingen (Hesse/Germany)

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The combination of ground penetrating radar (GPR) sensing and soil survey offers a time and cost efficient methodology to obtain high resolution spatial information of soil properties.
Based on a stacked sampling scheme (landscape segmentation, representative patch and transect sampling) of the Nidda catchment (1.600 km², Hesse, Germany) one of the six resulting soilscapes and the corresponding representative transect will be investigated to present how consistent soil information and substrate distribution can be gained by GPR sensing.
For the representative transect of the soilscape Forest of Buedingen, which comprises 4.3 km, the GPR survey delineates the substrate distribution and its depth by using 400 and 200 MHz antennas. To receive true depth of changes in substrate composition the velocity of the wave propagation was determined by hyperbola adaptation of artificial reflectors in known depth. The soil water content was measured for each layer with Time Domain Reflectometry (TDR) probes to verify our propagated velocities and layer boundary depths. Finally soil physical and chemical parameters were acquired in 11 pedons and by 55 augers. The soil properties were linked to our GPR substrate layer model to obtain a consistent interpolation of soil property distribution along the transect.

S26.F.03
Gamma-ray spectrometry; local or global calibration?

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Gamma-ray spectrometry is one of the current (commercially available) options for soil sensing. As a passive on-the-go system with a soil-depth coverage of approximately 40 cm it is a promising high resolution tool for low-cost soil survey. Being a proximal sensor, it needs some calibration soil samples to translate the measured gamma emission data to soil properties. This raises the question whether global or local calibration of the gamma data is possible or desirable. To test this, samples are taken in the Netherlands (n=70) and Germany (n=28) to represent two different geological regions. At the sample locations gamma emission is measured using the Mole, a gamma-ray spectrometer containing a CsI scintillation crystal. The obtained spectrum is analyzed using FSA, a full spectrum analysis to calculate Th^{232}, K^{40}, U^{238} and Cs^{137} concentrations. Soil samples are analyzed on clay percentage. Without stratification according to geology the R^2 of clay versus Th^{232} is 0,34. After stratification the R^2 of the separate strata increase drastically to 0,74 and 0,83. This indicates that local calibration of gamma emission data is desirable to obtain optimal results.

S26.F.04
Use of electrical resistivity prospecting to characterize soil spatial variability links to actual and past hedgerows networks landscape

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Hedgerow network landscapes, located in contexts of agricultural landscapes in temperate climates, are characterized by a complex soil organisation. The most systematic effect of hedges on soils, is a thickness increase of the A horizon uphill from hedges due to colluvial deposition, attributed to an anti-erosive effect of hedges. This modification of soil at slope scale is tied to modifications of soil properties in the vicinity of hedges. But the present soil organisation at the landscape scale cannot be explained by considering only the existing soil surface topography and actual hedgerow network pattern: actual soil organisation is controlled by past and recent evolution processes, modulated by past and actual landscape structures. It appears clearly that classical approaches undertaken in 2D and under favorable conditions for soil accumulation, perpendicular to the hedges are not relevant to understand and estimate processes responsible of soil redistributions at the landscape scale. New 3D approaches require to be developed. This is possible by the contribution of subsurface geophysical methods, in particular the electric and electromagnetic methods, which can help us to finely characterize the space variability of soil physical properties, but also to locate disappeared landscape structures. The aim of this communication is to test the relevance of using subsurface geophysical methods to improve the space prediction of intrinsec soil properties in a complex agricultural landscape. A field experiment was carried out within an old agricultural area with a high density of hedges. We establish a 3D map of the pedological cover by means of auger boring to quantify spatial variations of soil horizon geometry and properties (soil horizon thicknesses, soil organic carbon) within the landscape in relation to anthropogenic landscape structures. Then, the results were combined to a high resolution electrical resistivity map to improve estimation of soil properties at the landscape scale.

S26.F.05
Is systematic EMI two dimensional soil survey suitable for vineyard production management? A test on two pedologically-contrasted Mediterranean vineyards

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Thanks to recent technological developments, apparent soil electrical conductivity (EC_a) can now be mapped over large areas which provides new data for precision agriculture. However, in Mediterranean vineyards rooting depth can be greater than usual crop and the volume of the soil cover that needs to be explored is more important. This study examined the ability of an EC_a map from mobile EM38 to predict water related vineyard variability on two fields. To depict EC_a -vineyard relations, Electrical Resistivity Tomography (ERT) profiles and soil observations, (42 boreholes 4 meters deep) were made over 7 representative transects of both fields. In one of the fields, EC_a map and NDVI map were found correlated whereas only weak correlations were found for the other one. The examination of ERT measures and soil observations in the former field showed a clear relation between soil electrical properties and soil properties known as influencing vine water supply (e.g. bedrock depth) and a good discrimination of ERT measures at the measurement depth explored by EM38. Conversely the later field showed that the ERT measurements are lower and not directly in relation with any of the soil differentiations that may causes variations in plant water. The contrasted performances between the two fields demonstrates the importance of a prior knowledge of soil patterns as a prerequisite to EC_a survey.

S26.F.06
Regionalisation of soil data as basis for the evaluation of natural soil functions

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While soil was of little relevance in spatial planning in the past, current legislation - e.g. the so-called “Strategic Environmental Assessment Directive” (2001/42/EC) or the Protocol of Soil Conservation of the Alpine Convention - demands planners and decision-makers to take environmental issues into consideration when preparing certain plans and programmes. In terms of soils, their potentials to fulfil specific (natural) functions need to be evaluated before the likely significant effects of the implementation of plans and programmes on these potentials can be assessed.
The most essential prerequisite for the evaluation of soil potentials and all subsequent work steps is the availability of area-wide soil data. However, in Austria as well as in many other countries such data usually is limited to agricultural areas and to some extent to forests, but is almost completely missing in high-mountain regions and densely populated areas. This article shows examples how area-wide soil data can be derived by combining data from existing soil maps, additional surveys at selected locations and secondary sources about soil forming factors (most notably geology, relief and land use). In the ongoing national research project “SEPP” (Soil Evaluation for Planning Procedures) geostatistical regionalisation algorithms as well as a method utilising classification and regression trees (CART) are tested in two study areas in the district of Kufstein.
The calculated data provide a basis for soil evaluation in these areas. Results shall be incorporated in the assessment of current infrastructural projects. The long-term objective is to provide area-wide soil information for this alpine region as input for an evaluation system, thus facilitating a more sensible handling of soil resources in planning practice.

S26.G.01
A multi-scale study on organic carbon stock variability in forest soils

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Estimates of regional and global carbon stocks in forest soils are often based on mean soil organic carbon (SOC) stocks for broad categories such as soil types. To improve carbon stock estimates for temperate forest soils data on the SOC stock variability at different spatial scales are required. Here we studied the plot scale (3 ha) and regional scale (30 000 ha) variation of OC stocks in forest soils of the Hainich-Dün region in Thuringia, Germany. The objective of this study were (i) to determine the accuracy with which SOC stocks can be estimated at the plot and regional scale (ii) to indentify the most convenient categories that can be used to regionalize SOC stocks (iii) to assess the number of samples needed to detect carbon stock changes at the plot and regional scale. Litter, topsoil and subsoil samples were collected at more than 600 sampling points in the Hainich-Dün region and analyzed for SOC concentrations and stocks. The standard error of organic carbon stocks increased in the order forest floor, topsoil and subsoil at the plot and regional scale. The regional scale variation of total carbon stocks (coefficient of variation: 22%) was not much higher than at the plot scale (coefficient of variation: 16%). Our results showed that the thickness of the loess layer covaried significantly with SOC stocks, whereas tree biomass was a poor predictor for carbon stocks. A stratified sampling design under consideration of loess depositions would decrease the number of samples needed to detect carbon stock changes.

S26.G.02
Exploring spatial variation of soil organic matter fractions to optimize a subsequent sampling

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Cereal crop yields are very dependent on nitrogen supply (N). Soil organic matter provides a large proportion of N through mineralisation, but this varies across the field. The source and pattern of this variation has not been extensively studied, but the spatial structure of the variation for any soil property can be determined by applying nested sampling and a hierarchical analysis of the variation.
The purpose of this research is to determine the spatial variability of the input variables to a soil organic matter model (*SOMA*), with the overall objective to improve - through subsequent study - the prediction and management of soil N supply. The input variables to SOMA are measurable rather than rational fractions of the soil carbon.
Soils were sampled in an unbalanced nested design over a 4-ha arable field to examine the distribution of the variation over 30m, 10m, 1m, and 0.12m. Organic matter in free and intra-aggregate light fractions (FLF and IALF) - input variables to *SOMA* - was obtained by physical fractionation using NaI (1.80 g cm^{-3}) and C and N quantified by mass spectrometry.
The mean carbon content of FLF was 0.66 mg C g $soil^{-1}$ and of IALF was 0.79 mg C g $soil^{-1}$. Components of variance were estimated using the residual maximun likelihood (REML) procedure and a first approximation to the variogram was displayed for both variables. The variation occurred entirely within 0.12 m for FLF, and there were no contribution to the variance from the larger distances. In comparison, the 0.12m and 1m stages accounted 58% of the spatial variation in IALF.
Using this approach we are able to inform the sampling strategy for the next study, which will tie the status of these model input variables to those relating to key model outputs, such as potentially available nitrogen.

S26.G.03
Mapping phreatic groundwater dynamics in the Dijle Valley

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Phreatic groundwater dynamics (GD) are one of the most important land characteristics for agriculture, ecology and other land uses, especially in riparian wetlands like the Dijle valley in central Belgium. Usually, these dynamics are estimated from the drainage classes that are indicated on the soil map. This information is however partly outdated, due to human intervention (artificial drainage, levelling, groundwater extraction).
Moreover, the traditional estimation of drainage classes is associated with uncertainty due to the subjective approach based on soil morphology that was used for the creation of the original map. It only allows an estimation of the mean highest and the mean lowest groundwater level, and gives no other information on the groundwater level.
Two new methodologies to map the GD have been applied in the Dijle Valley. The first method maps the output of time series models. It consists of four steps: (1) analysis of long time-series of piezometric data using a time-series model, (2) correlation to a large number of shorter time-series to expand the data set, (3) derivation of high-resolution, area-covering digital auxiliary information and (4) mapping the GD by interpolation of the point data using the high resolution auxiliary information to increase precision.
The second method is similar, but instead of using the results of the time-series model, the parameters of the model are mapped, and the model outputs (mean highest groundwater level, regime curve, ...) are derived from the mapped model parameters. This allows a more direct evaluation of the effect of changing precipitation regimes on GD.
Both approaches were compared in a number of validation piezometers for several model outputs describing the GD.

S26.G.04
Short-range soil spatial variability structures and soil sampling for change detection

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Soil spatial variability represents a challenge for the design of sampling schemes to provide medium to long-term ecosystem monitoring data, at affordable cost.
Both pedology and geostatistics have produced convincing evidence of the intrinsic difficulties created by the interaction of highly destructive sampling and nested spatial variability.
However, this problem exists at different scales, each of which requires a specific approach. For such existing monitoring schemes as BioSoil - ICP, where the fixed-plot-oriented approach has long since been chosen, the problem takes two quite different aspects, each requiring an independent approach. The first is the very high frequency component of soil spatial variability, the one that interacts physically with the sampling procedures. The second is a landscape component, actually variable in scale according to plot density that must be tackled for upscaling.
The first problem has been experimentally addressed. Spatial variability at decameter scale has been deconvolved into two components: range-independent variability linked to self-organizing, non-linear processes ("chaos"), and short range, spatially dependent variability. In geostatistical terms, this corresponds to separating the nugget and the (first) regionalized component.
High-density sampling and low-cost data production has been employed to provide the necessary density of spatial coverage.
The imperfectly chaotic nature of "nugget" is analyzed in view of a possible sampling strategy, while short range linear variation appeared rather deterministic, and likely to be manageable with support of adequate numerical landscape knowledge.

S27 The Influence of Soil Quality on Human Health and Food Security

S27.A.KL
Soils and Geomedicine

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Geomedicine is the science dealing with the influence of natural factors on the geographical distribution of problems in human and veterinary medicine. Discussions on potential harmful impacts on human and animal health related to soil chemistry are frequently focused on soil pollution. However, problems

related to natural excess or deficiency of chemical substances may be even more important in a global perspective. Particularly problems related to trace element deficiencies in soils have been frequently reported in agricultural crops as well as in livestock. Deficiencies in plants are often observed for boron, manganese, copper, zinc, and molybdenum. In animals deficiency problems related to cobalt, copper, iodine, manganese, and selenium are well known. Toxicity problems in animals exposed to excess intake have also been reported e.g. for copper, fluorine, and selenium.
Humans are similar to mammals in their relations to trace elements and thus likely to develop corresponding problems as observed in domestic animals if their supply of food is local and dependent on soils providing trace element imbalances in food crops. In large parts of Africa, Asia, and Latin America people depend on locally grown food, and geomedical problems in man are therefore common in these parts of the world. Well-known examples are the Keshan disease in China associated with selenium deficiency, large-scale arsenic poisoning in Bangladesh and adjacent parts of India, and iodine deficiency disorders in many countries.
Not all essential elements are derived only from the soil minerals. Some trace elements such as boron, iodine, and selenium are supplied in significant amounts to soils by atmospheric transport from the marine environment, and disorders associated with these elements are therefore generally less common in coastal areas than farther inland. Iodine deficiency disorders in humans e.g. are most common in areas situated far from the ocean.

S27.A.01
Changes of trace element concentrations in wheat - data from Swedish long-term field experiments

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Archived wheat grain samples from 10 Swedish long-term field sites run for 30 to 50 years were analyzed with the aim to find out which changes in trace metal contents have taken place.
Some distinct trends were found: Non-wanted elements such as Cd and Pb decreased significantly over time in all treatments due to a reduction of atmospheric deposition. On the other hand, molybdenum concentrations increased in grains probably due to a lower sulfur supply also related to deposition.
No differences in metal contents between fertilizer treatments (NPK, manure, NPK+ manure, unfertilized) were found for elements mainly taken up through mass flow such as Se, Cr, Ni, Co and Mo. Only elements in crops supplied by diffusion (Cu, Fe, Zn and Mn) differed between fertilizer treatments. Lower yields in unfertilized plots did not result in higher contents as compared to manure-treated or NPK + manure treated plots.
The most distinct changes occurred in the NPK treatment without manure addition. Levels of Fe in crops declined significantly from 32 to 24 mg Fe kg^{-1} as well as those of Cu, from 3.6 to 3.2 mg Cu kg^{-1}. The decline in Cu in crops is underpinned by a soil survey showing that copper contents are very low (< 7.6 mg total Cu kg^{-1} soil) in roughly 25% of Swedish arable soils. High Mo and low Cu levels in wheat grains indicate an imbalance. The ratio of Cu/Mo ratio is falling below 1, which is critical for ruminants causing molybdenum poisoning.
It may be useful to widen the perspective on micronutrients from crops to the demand of consuming organism in order to define desired concentrations for crops.

S27.B.KL
Soil Factors Associated with Zinc Deficiency in Crops and Humans

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Zinc (Zn) deficiency in crops is the most ubiquitous micronutrient problem in the world and areas with Zn-deficient soils often have widespread Zn-deficiency in humans. One third of the world's population is at risk of Zn deficiency, which is considered to be the fifth most important risk factor in human disease in the developing world. Many of the largest areas affected by Zn-deficiency in crops are in developing countries. Fifty one percent of soils in China, 48.5% in India and 50% in Turkey are Zn-deficient and require regular zinc fertilisation. Intensification of crop production often exacerbates Zn deficiency and has important economic consequences.
A wide range of soils are associated with Zn-deficiency in crops. These often differ in their background total Zn contents, but all have low concentrations of plant-available Zn. Soil groups such as the Arenosols and Ferralsols have low total Zn contents, but in Calcisols Zn is rendered unavailable by the high pH and calcium carbonate contents. Zinc also has a low availability in salt-affected soils (Solonetz and Solonchaks). Rice grown in flooded soils is highly prone to Zn deficiency. A range of soil groups are used for growing rice, but the effect of them being submerged for most of the growing season leads to Zn being rendered unavailable by high pH, high concentrations of phosphate and bicarbonate ions and precipitation of insoluble Zn sulphide. A significant proportion of the 70 Mha of flooded rice-growing soils in the world could be affected by Zn-deficiency. Other rice-growing systems are also affected by Zn-deficiency.
The factors affecting the soil-plant-human pathway of Zn will be considered together with the biofortification of staples to increase human intake of this important micronutrient.

S27.B.01
May nutritionally relevant elements in grains be influenced by the choice of site and/or variety?

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An adequate supply with nutritionally essential elements (e.g. K, P, Mg, Ca, Zn, Fe, Cu) and a minimum uptake of harmful elements (e.g. Cd, Pb, V) is of great importance for human health. In this study the influence of different factors (e.g. pH, organic C, soil texture) on the total element content in arable crops due to varying mobility in and uptake from the soil has been investigated. On the other hand it is well known that within the varieties of a species high variability in the element contents in the edible parts of staple food crops may occur. The objective of this work was to evaluate

- the variation of the contents of nutritionally essential as well as harmful elements in different grains on well described, representative sites in Austria
- the possibility to improve the nutritional value of food grains with the choice of the varieties
- the influence of site characteristics on the element contents

For this purpose we investigated 4-12 varieties of winter wheat (n=136), 6 varieties of spring durum (n=30), 5 varieties of winter durum (n=15), 7 varieties of rye (n=49) and 5 varieties of spring barley (n=30) at representative sites in Austria.
Between the investigated species high variability in the element contents could be detected.
Element accumulations in grains varied distinctly with site conditions, except for Pb and V. Further, the content of Ca, Na, Zn and Cd in the grain revealed significant differences between varieties. On the other hand the macroelements K, P and Mg, as well as the micronutrients B, Co, Mo, Cu, and Fe, were influenced by variety choices in only a few cases. As a result, element concentration changes may influence dietary intake considerably. Therefore, varieties should be carefully selected due to appropriate analysis, to meet nutritional requirements.

S27.B.02
Tsunami affected agricultural soils of paddy fields in Sri Lanka - improvement of rice yield parameters by soil amendments

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The Tsunami disaster in December 2004 caused devastation of agricultural soils by salt water in wide areas of the south- and eastcoast of Sri Lanka. Many paddy fields located close to the coast were affected by the flood of seawater. Salt concentrations in tsunami-affected paddy fields were found to be higher compared to unaffected fields.
Four soil amendments were tested in small field plots (4 x 4 m) for their influence on improving the yield parameters of rice. The four soil amendments were gypsum, dolomite, cinnamon ash and rice-husk-charcoal. Yield parameters from rice cultivated on the plots with soil amendments were compared with an untreated control and with a salt resistant rice variety (AT 354). Soil parameters and CEC (= cation exchange capacity) were determined before application of soil amendments and after harvest.
The salt resistant variety brought the highest grain yield. The four soil amendments led to an increase in grain yield compared to the untreated control in the order gypsum > rice husk charcoal > dolomite > cinnamon ash.
The effects of the soil amendments on various yield parameters will be discussed with the possible modes of action of the investigated soil amendments.

S27.B.03
Arable soils in Austria contaminated with Cd, Pb, and Zn: How to treat them? Results of four years experiments in the field

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Arable sites with metal contamination are mostly due to anthropogenic activities such as mining and smelting or farming practice and entail risks for environment and human health. A few square kilometres of arable and forest soils are contaminated in the surroundings of a former Pb/Zn-smelter in Austria. As one of the negative side-effect of the industrial activity was the intoxication of animals, especially horses, but this is not very well documented. Nonetheless, the investigations of horse deaths reveals that at least a few died due to heavy metal intoxication in the time of full operation of the smelter.
In principle it is aimed at finding practical and cost-effective measures to reduce metal uptake into crops grown on metal contaminated soils. Previous promising results from batch, hydroponic and pot experiments showed a high potential for the reduction of metals entering the food chain via crops grown on contaminated soils by the use of amendments and metal inefficient cultivars. Several soil amendments (e.g. gravel sludge, red mud) and barley varieties (e.g. *Hordeum distichon* cv. HELLANA, BODEGA) were tested in field experiments. The aim of this study was to optimize a field experiment for overcoming the gap between pot and field experiments. Field experiment results in the first year did not reflect consistently previous pot experiment results. Adaptation measures before the second year planting barley reduced the uptake of metals by deeper placement and more homogeneity of added amendments, especially gravel sludge and red mud. Results indicate that adaptation measures improved the efficiency of the used soil amendments and managing extensively contaminated land seems to be a realistic and practical measure.

S27.B.04
Sustainable mitigation and land use options for human health and environmental quality in respect to the nutrition system and the nutrients C, N, P, S

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Resulting from Life Cycle Analysis (LCA´s) about 50 (20-80) % of these anthropogenic C-, N-, P-, S-fluxes, -emissions and corresponding environmental damages as well as 9 of the 10 main threats on soils are caused by the system nutrition of agriculture with plant and animal nutrition (production), human nutrition (consump-tion) and waste as well as waste water management (disposal), the resting similar shares by the use of (fossil) energy and industrial / trade activities mainly in the so called developed countries. Therefore there is a need to op-timise sustainable use and management of the nutrients C, N, P and S in respect to environment and (natural) re-sources (Consistency), corresponding consumption (Sufficiency and Human Health) and production (Efficiency), especially within the above mentioned nutrition system. These aims are also consistent with the demands discussed here in EUROSOILS 2008 in the symposia S1-S9, S21A, especially S17, S27 and S28 and its workshops W1-W11.
Here the way is shown away from national strategies of mitigation and adaptation only on single environ-mental pressures like climate change, acidification, eutrophication and decline of biosphere to corresponding needed integrated strategies and legislations on human health, environment and (natural) resources in re-spect to the above mentioned nutrition system and the nutrients C, N, P, S.
With a holistic approach integrated protection aims / nutrient standards are set here as critical C-, N-, P-, S- levels and loads for both all environmental spheres and anthroposphere (healthy human nutrition). These aims are neces-sary prerequisites for cause oriented and sufficient mitigation and adaptation options and measures done simultane-ously within the nutrition system and in land use.
In this way BSNLC integrates e.g the following two EU-ACTIONS (2006-2011):
COST 869: Eutrophication and land use and COST 639: “Greenhouse-gas budget and land use (Burn-Out)”

S27.C.01
A GIS-based probabilistic health risk assessment methodology for screening soil pollution

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Levels of soil contamination by different substances as well as land uses (agriculture, housing, etc.) differ over space and even time. Hence, GIS-based methods are needed to assess human health risks due to the exposure to contaminated soil in a spatially explicit way. A methodology has been developed which identifies different receptors based on spatial data of land-use types. Scenarios defining the relevant exposure parameters for different receptors and their behaviour (e.g. playing children) are linked to these land-use types. Exposure is calculated for different pathways and receptors, i.e. subpopulations. Risk evaluation is carried out by comparison of total exposure with toxicological reference values deriving a risk index. To account for parameter uncertainties, the exposure calculations make use of probabilistic Monte-Carlo methods. Due to the considerable contribution of homegrown plants to total exposure an additional focus is set on soil-to-plant transfer. Substances under consideration are metals as well as neutral organic substances. Plant concentrations are estimated by the use of empirical transfer models coupled to soil maps taking relevant soil properties such as pH, organic matter, and clay content into account. The results are displayed as risk maps, showing the spatial distribution of substance and receptor-specific risks based on different substance concentrations, soil properties, and the occurence of potential receptors. These maps can then be used for risk manangement and land-use planning purposes.

S27.C.02
Modeling soil degradation effect on long-term food security in China

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China is the most populous country on earth. The enthusiasm to monitor its food security has never faded. This paper presents a modeling approach to assess the overall effect of soil degradation on long-term food security in China, based on the quantification of the ASSOD impact class of soil degradation on crop productivity. Food production in 2030 and 2050 under the most-likely production scenarios were simulated using a Web-based land evaluation system. The model predicted that food crops may experience a 9.7% productivity loss by 2030 if the soil is degraded at the current rate (business-as-usual scenario, BAU); productivity loss will increase to an unbearable level of 36.7% by 2050, should the soil be twice more degraded than it is now (double-degradation scenario, 2D). China will be able to achieve a production of 429 and 409 million tons from food crops under BAU - while this production will be 391 and 326 million tons under 2D - in 2030 and 2050, respectively, compared to 484 million tons in 2005. In per capita terms, the proposed food security index (FSI) - or relative food surplus in percentages - has been estimated to drop from 12.7 in 2005 to -17.3 ~ -22.6 and -24.5 ~ -38.3 under BAU and 2D, respectively, during the 2030-2050 period. Our modeling results show that the present-day producing capacity will not be able to sustain the long-term needs of a growing population, which demands a richer diet, under the current management level. This study reveals the very fact that China is facing great challenges in realizing food security by 2030/2050. The detrimental effect of soil degradation on long-term food security is so evident that technical measures and policy levers must be activated today in order to avoid, or at least mitigate, the risks of food insecurity tomorrow.

S27.C.03
Spatial analysis and modeling for mapping environmental and social land vulnerability in México

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In Mexico, like other countries of region, there is considerable pressure on land, water and biological resources. Soil erosion is one of Mexico's most serious ecological problems with agriculture identified as the major cause of soil degradation. Pressure on the environment from agriculture has increased considerably over the 1990s. This trend is expected to continue over the next decade as projections indicate further expansion of the agricultural sector. Because of this limiting the adverse impacts of agriculture on the environment poses a formidable challenge

In this study spatial analysis and modeling is used for mapping environmental and social land vulnerability in Mexico. First, information of soil, climate and slope were modeled to produce a vulnerability land class map. On the other hand, base on a marginalization index map and a population density map, a social stress index was constructed by a decision model. Finally the vulnerability land classes and the social stress index were combined in a decision model in order to know where is the most vulnerable land in relation to medium to high social stress index.

The analysis of constraints in the use of land resources clearly indicates that sustainable agriculture is a major challenge that Mexican decision-makers and land users face. It is only through an understanding of the location of such constraints that land degradation program can be effectively implemented, reducing in this way the land degradation process. This analysis provides new information for reevaluation of the country's land use policy and can be used for targeting areas for new initiatives

S27.C.04
Human health risk assessment in an urban park - Planning issues

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A greater attention to soil has been given by EU member states and European Commission, recognising its role and functions. Urban soils are often source of pollution which can induce health problems of citizens. The interaction of humans with soils strongly depends on the land use considered.

The study presents a method for evaluation of human health risk due to heavy metal contamination in urban soils as a part of planning process and environmental management. The method addressed the soil pollution - human health risk interaction within diverse urban land uses. The method is used to i) analyse the level of current soil contamination risk in the area under current land use, and ii) to estimate the potential risk in case of land use change. For areas where risk is identified as unacceptable the management options have to reduce health risk in a cost effective way. A step-by-step procedure and desktop computer evaluation calculation tool were developed and implemented in a GIS system.

The method was tested for human health risk monitoring and as support for a green area planning case in the territory of Grugliasco (Torino) municipality. The estimation of the risk for the current land uses indicated that more than 30% of the area under different land uses presents a high risk for health of citizens. The scenario analysis of the planned situation indicated a decrease of the risk due to the land use change of agricultural areas to urban parks. Land use change is shown to be a good option to reduce risk, breaking the significant source-pathway-receptor relationship.

The method enables the possibility to easily identify the risks within different land uses, easily identifying areas of concern for human health. The method was partly developed within the Interreg-IIIB TUSEC-IP project.

S28 Soil Fertility and Environment

S28.A.KL
Sustainability investigations at farm level on Nitrate Vulnerable Zones

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According to the Nitrates Directive, in Hungary, law regulates the rules of Good Agricultural Practice that serves protection of groundwater against nitrate pollution.

The subject of our investigation was to prove that knowing the environmental conditions of the farming area and using an

appropriate fertilization advisory system, farming on nitrate vulnerable zones could be economic without environmental hazard.
An investigation was carried out to estimate the risk of nitrate infiltration based on farm and field level data collection. Test farms were involved representing arable, animal breeding and mixed farm types.
The subject of optimisation the nitrate-use was approached by different point of view based on the investigation of the collected farms' data.
Field level N-supply and N-balance calculation for the test farms' area
Based on the field level data of the test farms, by RISSAC's environmentally friendly fertiliser recommendation system, the N-supply categories and their spatial distribution were determined. Furthermore, the N-balances at field level were calculated and their summary at farm level was made.
Farm level calculation of N-balance for the test farms' area
N-balance calculation at farm level based on the comparison of input and output items. Three years data of farm production were collected for the test farms. The applied nutrient balance calculation method was jointly developed by RISSAC and Ghent University.
Nitrate profile survey of selected fields
3-6 meters deep drillings was applied to determine the nitrate profile. Nitrogen content and other soil analyses were made from samples taken every 20 centimetres.
Nutrient supply category and recommended N-fertilizer dose must be compared to the N-utilization, N-surplus/deficit data of farm balance. The applicability of the recommended N-dose depends on the risk of infiltration determined by the nitrate profile.
Consequently, scientific based farm management could run profitable farming and no environmental risk on nitrate vulnerable zones.

S28.A.01
Nitrogen budget and nitrogen stock in soils under organic and conventional farming

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Maintenance of soil N stock in cropping systems requires balanced nitrogen (N) budgets. To assess the impact of cropping system management on soil N stock, soil-surface N budgets were calculated and changes in soil N content of an organic (BIOORG) and a conventional (CONMIN) arable cropping system were measured in the DOC long-term field experiment (Switzerland). The soil is a loamy silt Typic Hapludalf developed on loess. N budgets were calculated as difference between total N inputs (manure or mineral fertilizer N, atmospheric N deposition, symbiotic N_2-fixation, seed N) and total N outputs (N export by harvested products, N losses from manure or mineral fertilizer) over a 26-years period (1978-2003). Changes in soil N stock of both cropping systems were assessed by the difference in N content of the topsoil (0-20 cm) in 2003 and at establishment of the field experiment in 1977. Additionally soil N content of the topsoil was monitored based on total N measured in samples taken between 1977 and 2003. N budgets are negative for both BIOORG and CONMIN suggesting a yearly N deficit of -77 ±17 kg N ha^{-1} and -89 ±10 kg N ha^{-1}, respectively. Simple linear regression analyses showed a decrease in soil N content of the topsoil of both cropping systems between 1977 and 2003. Measured yearly decrease in topsoil N stock was -29 kg N ha^{-1} for BIOORG and -39 kg N ha^{-1} for CONMIN. Despite inclusion of grass-clover mixtures and green manure crops in BIOORG and CONMIN and application of animal manure in BIOORG, maintenance of soil N stocks may be difficult due to the high N mineralization potential of the soil at this experimental site. Ongoing decrease of soil N stock may only be countered by reducing soil tillage activities to minimize release of N protected in soil aggregates.

S28.B.01
Nitrogen mineralization of winter wheat residues in a temperate climate as affected by tillage intensity

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Conservation tillage is any tillage and planting system in which 30 % or more of the crop residues remains on the soil after planting. Surface managed crop residues generally decompose more slowly and have a greater N immobilization potential or lower rate of mineralization than incorporated residues. However, much of our knowledge comes from litterbag studies or studies where disturbed (most often dried and sieved) soil samples are used in combination with dried and ground plant residues.
To evaluate the effect of tillage and the resulting location of crop residues on the N mineralization pattern of winter wheat residues undisturbed soil samples were taken on six sites in Belgium with a different tillage management. Site NT_K had been managed for 10 years under reduced till (RT), whereby the last 4 years the crops were sown using direct seeding (NT). Site RT_{CSE} had been managed for 20 years under RT and site RT_H for 3 years. For each site under RT a nearby site under conventional till (CT) was selected.
After 98 days of incubation more N was immobilized under NT than under CT. This higher immobilization potential can be related with a higher microbial biomass and activity and a change to a more fungi dominant microbial population. In RT soils a similar pattern (net immobilization) was found but less pronounced. The higher net immobilization of RT compared to CT can be explained by the higher amount of crop residues in the upper soil layer and the difference in tillage (superficial and not inverting). When expressing net N mineralization as percentage of total N added, N immobilization of straw residues was higher under CT than under RT. This indicated that high C:N residues decompose slower under RT compared to CT.

S28.B.02
Nitrogen management and nitrate leaching on some Dutch dairy farms

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Previous high N surplus levels on Dutch dairy farms have stimulated investigations into more efficient ways of farming. Increases in N efficiencies are especially relevant for the Pleistocene sandy soils where nitrate concentrations in the upper groundwater have exceeded the EU 50 mg/l threshold in the past. On the northern fringe of the Dutch coversand area, several farmers have reduced N surpluses from over 300 kg per ha per year to about 120 kg per ha per year over a period of 10 years. Reduced surplus levels were especially reached through reduced use of fertilizer N. A field survey into soil nitrate levels was performed in spring 2007 on 29 dairy farms on sandy soil. This followed a previous survey in 2006 focusing on soil mineral N levels in autumn. On the farms, land use was dominantly grassland with a small percentage of silage maize.
During the survey of 2007 measurements were done on 300 locations selected by stratified random sampling with combinations of soil type, groundwater level and land use as strata. During the 20 days sampling period, continuous monitoring was performed on two locations.
It was found that almost 70% of the observations were below the detection threshold of 1.5 mg/l Nitrate-N although locally much

higher concentrations were observed. For further analysis we preferred to use 90th percentile points and areal proportion where a specified threshold is exceeded. When distinguishing between two contrasting types of N-management among the farms we found that the relative area where the NO_3-standard is exceeded was 6.3% for high N-input farms and 8.7% for low N-input farms. Our results confirm some national forecasts where regional average nitrate concentrations in the upper groundwater in the northern sandy regions are expected to stay below the established EU threshold.

S28.B.03
Nutrients soil and gate balances in beef cattle production systems of southern Chile and their implications for the environment

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The Lake Region of southern Chile has suitable conditions for cattle production, so that most of the dairy and beef production of the country is generated in this region. Even though animal production has been widely studied, there is little information on the environmental issues associated to this activity. The main inputs and outputs of nitrogen (N) and phosphorus (P) in an andisoil of this area were determined between 2004 and 2007 to establish soil and field gate N and P balances under different stocking rates (63 and 191 anim ha^{-1} d^{-1}) and field slope treatments (4 and 12%). Treatments received 67.5 and 40 kg N and P ha^{-1} yr^{-1} as inorganic fertilizer and were managed under rotational grazing in closed paddocks. The main N and P input to the soil balances was N mineralization (304 kg ha^{-1} yr^{-1}) and inorganic fertilizer (62 and 69% for N and P, respectively). The main output for all treatments was plant uptake (95% and 100% for N and P, respectively). The N and P apparent use efficiency was high (>95%). The main N and P input to field gate balances was inorganic fertiliser (>95%). Animals had a minor effect on N and P export. The soil balances ranged from -303 up to +58 and from -3 up to +20 kg of N and P ha^{-1} yr^{-1}. Field N and P gate budgets ranged between -309 up to +58 and from -8 up to +20 kg of N and P ha^{-1} yr^{-1}, respectively, indicating a potential soil degradation in areas with low nutrient inputs as inorganic fertiliser and an overaccumulation in areas with low grassland dry matter production, which in turn can lead to environmental contrains. This should be especially considered for dairy production systems in this area, which are more intensively managed.

S28.B.04
Soil N dynamic as affected by tillage and N fertilisation in a mediterranean semiarid agroecosystem

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In the Ebro valley (NE Spain) almost half of the soil surface is cropped with winter cereals under rainfed conditions. Yields are mainly restricted by low annual precipitation that ranges between 250 and 500 mm. Conservation tillage, minimum tillage (MT) or no-tillage (NT), and rational use of N fertiliser can enhance soil water conservation and soil fertility. Soil N dynamic is affected as a consequence, leading to a deficiency or excess of N which can promote productive or environmental negative consequences. Long-term field experiments of crop response to N fertilizer depending on soil management together with soil N analysis supply a basic tool for crop fertilisation planning.
A long-term field experiment was established in 1996 in Agramunt, 350 m AMLS in the Ebro valley, mean annual precipitation 430 mm. The soil was described as a Xerofluvent typic, with loamy texture and 130 cm depth. The experiment compares 3 N fertiliser levels (zero, medium -60 kg N ha^{-1}- and high -120 kg N ha^{-1}-) in three tillage systems (NT, MT and CT) in a factorial experiment in a randomized complete block design with three replications. Plot size is 300 m^2 (6 x 50 m). The field has been annually cropped with winter barley.
During present cropping season (2007-2008) every plot has been divided in two parts. One 24 m^2 part of the plot (6 x 4 m) has been left aside with no-crop, while the remaining 276 m^2 (6 x 44 m) of the plot is being cropped to barley as usual. Soil water content and soil mineral N (ammonia and nitrate) will be sampled 5 times during cropping season in pre-tillage, emergence, flowering, maturity and harvest. Plant N will be sampled at flowering, maturity and harvest. We are here presenting new data regarding N mineralization dynamic in a Mediterranean agroecosystem.

S28.B.05
Retention and leaching of nitrate after nitrification of pig manure on variable charge soil (Nitisol)

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On the island of Réunion (Indian Ocean), livestock manure is commonly recycled by spreading it on crop fields. However, the area is limited and problems of nitrate pollution of groundwater may arise. This study aimed at assessing the risks related with nitrate leaching and retention in a variable charge soil (Nitisol) after pig manure amendment, by quantifying (i) the nitrification of pig manure and the acidification of the soil solution, (ii) the lag times in nitrate and chloride breakthrough curves, and (iii) the amount of nitrate retained in the soil.
We constructed 3 large columns filled with a packed Nitisol. The soil moisture, the water potential, and the drainage flow were continuously monitored and stored in a datalogger respectively with TDR probes and micro-tensiometers (17, 30, 55 and 85 cm depth) and limnigraphs at the outlet of the columns. After pig manure amendment on 2 columns, the columns were irrigated with amounts of water corresponding to three years of typical annual rainfall level (3600 mm).
Manure nitrification was rapid and not limited since ammonium concentrations in the soil solution were always very low. Nitrification led to acidification of the soil solution down to 55 cm depth. The chloride and nitrate breakthrough curves differed at all depths. At 17 cm depth, the very clearcut leaching peaks were reached earlier for chloride (0.27 pore volume of water application) than for nitrate (0.43 pore volume) mainly because of nitrification kinetic. On a soil column scale (0-85 cm), lag time differences between these anions were less significant and driven principally by the high competition for anion adsorption in this soil. Nitrate retention can be seen as an advantage since nitrate remains longer available for crop roots; however, it also represents a leaching risk in the long run, since adsorption is a reversible process.

S28.B.06
Tillage intensity: Influence on soil C and soil N - modelling approach based on CANDY

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Tillage intensity influences the quality and quantity of soil organic matter and has thereby a key role for soil fertility. Yet, little is known, concerning the long term effects of tillage intensity on SOM concentration and mineralization. The effects of different tillage intensity on soil organic C, microbial biomass and mineral N were determined in a field experiment. There, conventional tillage (CT), reduced tillage (RT) and no-tillage (NT) have been applied for 15 yr on a loamy soil in temperate climate in Central Germany, with a crop rotation including field bean, spring barley, winter wheat, mustard and sugar beet. Soil organic C and microbial biomass were determined at 0-10, 10-20 and 20-30 cm depth for all tillage systems in spring and autumn 2007. After 15 years, soil organic C and microbial biomass concentrations were 18 % and 95 % higher (NT), and 20 % and 108 % higher (RT), respectively, as compared to CT up to a depth of 10 cm. Below 10 cm the soil organic C under NT and RT was lower than under CT. For microbial biomass at 10-20 cm higher concentrations for NT (19 %) und RT (12 %) could be found whereas at 20-30 cm the concentration under CT was 50 % higher than under NT and RT. Including the data of a former sampling period (2000-2004), in the top 10 cm layer for microbial biomass steady state condition were observed in all tillage systems whereas for soil organic C an accumulation is still observable with respect to NT and RT. According to this data the performance of the Carbon and Nitrogen Dynamics model CANDY was evaluated to simulate soil C and N fluxes under field conditions. Problems of model application will be discussed.

S28.C.01

'Nitrogenome' - Studying nitrogen pathways and soil-plant-microbe relationships in agricultural soils within a standardized microcosm system

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Within the present project we developed a new, easily available and cheap laboratory format microcosm system for high throughput analysis of soil N pools, N transformation rates, N losses, as well as microbial populations and their activities in soil-plant systems. The system consists of polypropylene centrifuge tubes complemented with two sieves for soil and plant containment, aerated cones for soil water sampling, a retrofit kit for elongation and butyl rubber seals for gas sampling.
Two agricultural soils from the vicinity of Vienna were used for growing barley plants in the microcosms. Within three experimental setups the ratio of nitrate to ammonium fertilizer was varied to study the impact of different N forms on the N uptake by plants, fungi and microorganisms. By using 15N tracers, given either as 15NH4 15NO3, 15NH4Cl or K15NO3, it was possible to follow the exact fate of applied fertilizer N within the test system. The amount of N taken up by the plants was set in relation to N taken up by microorganisms and fungi, losses to the environment, and to N transformation rates. Investigating and quantifying the fluxes of the trace gases N2O, CO2 and CH4 from the soils provided additional information on the release of climate relevant gases.
Overall, investigation, understanding and future modelling of N cycling dynamics within the presented laboratory format microcosm system will provide novel insights into the mechanisms regulating the distribution and compartmentalization of fertilizer-N to plant, soil, fungal, bacterial and environmental pools. The gained knowledge will help to set up further extensive studies in the field and to provide concepts for targeted strategies to improve N fertilizer use efficiency, by specific agricultural management practices, fungal 'nitrate-traps' and growth promoting bacterial strain additions to the soils.

S28.C.02

Current limitations of the Barometric Process Separation method for quantifying gross nitrification rates in calcareous soils

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In a growing number of studies the Barometric Process Separation (BaPS) method has been applied for measuring gross nitrification rates in soil. Advantages of the BaPS method, compared to the standard method for measuring gross nitrification rates in soil, the ^{15}N pool dilution technique, include the fact that no labeled material must be added to the soil. In addition the equipment is relatively inexpensive, widely available, easy to operate, and the measurement is quick. In an ongoing project we have used the BaPS method to measure gross nitrification rates in two alkaline agricultural soils. Soil samples were incubated for 20 h at 17 °C. The volumetric water content was adjusted to 25%. Soil pH, which is needed to compute the carbonate equilibrium, was measured either in water or in 0.01 M $CaCl_2$. Results of the BaPS method were compared with those of the ^{15}N pool dilution technique. Using the pH(H_2O) in the calculation of the carbonate equilibrium, the gross nitrification rates measured with the BaPS method were very close to the rate determined with the ^{15}N pool dilution technique. Using the pH($CaCl_2$), the BaPS method overestimated the ^{15}N gross nitrification rate by a factor of up to 2.4. The significant difference between the rates obtained with pH($CaCl_2$) or pH(H_2O) underlines the high sensitivity of the BaPS method with regard to soil pH in neutral to alkaline soils. Our study shows that future research is needed to adapt the BaPS method to neutral and alkaline soils and to reliably quantify the transfer of gaseous CO_2 from the incubation chamber's atmosphere to soil solution during incubation.

S28.C.03

Recovery and retranslocation of ^{15}N-urea in a drained minerotrophic peatland 13 years after application

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The long-term recovery of ^{15}N-labelled urea was studied in a tamarack (*Larix laricina*)-black spruce (*Picea mariana*) mixedwood stand on a drained minerotrophic peatland in Alberta 1, 2, and 13 growing seasons after fertilization. The %N recovery in the aboveground vegetation and soil was 59.7% after 13 growing seasons, which was lower than after 1 (76.83%) and 2 (68.9%) growing seasons; %N recovery in aboveground tree (combining both species) increased from 5.70%, after 1 growing season, to 9.15 and 14.82%, after 2 and 13 growing seasons, respectively. Black spruce had a greater capacity to take up and retain the applied fertilizer. The %N recovery in the understory vegetation decreased with time and was 8.06, 3.88, and 1.71% in the 1st, 2nd, and 13th growing season, respectively. Percent N recovery in moss changed little with time and was 34.28, 35.10, and 35.22% in the 1st, 2nd, and 13th growing season, respectively; however, total N recovered in moss as a percentage of total ecosystem recovery increased with time and was 44.62, 50.94, and 58.99% in the 1st, 2nd, and 13th growing season, respectively. The %N recovery in soil decreased from 20.12%, after 1 growing season, to 12.1 and 7.95% after 2 and 13 growing seasons, respectively. Fertilizer N showed little mobility in soil during the 1st and 2nd growing seasons, but was found to have moved to deeper soil layers in the 13th growing season. Fertilizer N was found to retranslocate from the tree rings formed in the year of fertilization to the new growth rings and the old tree rings formed before fertilization. This study indicates that the studied peatland system had a tight N cycle and retranslocation of N within the trees was an important mechanism for meeting part of the growth requirement of the two studied tree species.

S28.C.04
Conventional versus sustainable fertilization: adaptation for climate change

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Forecast of the global climate change emphasises that air temperature and precipitation will change. Consequently, soil and fertiliser nutrient assimilation level, tillage and sowing time and intensity may vary. Due to this a new approach and propagation of sustainable soil management technologies implementation in practical farming is vital and requires careful revision of traditional soil and plant management technologies.
Main goal of this study was to evaluate soil properties changes and crop yield under different tillage (conventional - CT, reduced - RT, and direct drilling - NT) in combination with 3 rates (none, moderate and enlarged) of mineral NPK fertiliser application.
Implementation of NT with moderate rate of fertilisation could be more suitable under climate change. NT increased soil moisture content after crop sowing in the upper 0-5 and 5-10 cm layer and resulted in a better distribution of nutrients and humus within the plant roots zone.
The yield of metabolizable energy (ME) of a crop rotation in the soil of high fertility was on average by 27 % higher than in the soil of moderate fertility. Application of NT caused higher effectiveness of fertilisers. Moderate rates of fertilisers increased yield of ME in the soil of high fertility and in the soil of moderate fertility by 31 and 29 %, respectively under CT, by 27 and 40 % under RT, and by 28 and 60 % under NT compared to unfertilised plots. Enlarged rates of fertilisers increased yield of ME in the soil of high fertility and in the soil of moderate fertility by 37 and 37 %, respectively under CT, by 29 and 49 % under RT, and by 39 and 77 % under NT compared to unfertilised plots.
The study has been supported by the Lithuanian State Science and Studies Foundation and the Lithuanian Ministry of Agriculture.

S28.D.01
Impact of climate uncertainties and soil characteristics on rainfed maize productivity in South Bulgaria

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The study is based upon model simulation relative to rainfed maize and grain dry matter at four experimental sites in Sofia field and Stara Zagora (Thracian plain). The simulations are performed by validated CERES-maize (Jones&Kinary 1986) and ISAREG (Pereira et al, 2003) models for maize hybrids of different resistance to water stress in Chromic Luvisol, Chromic Cambic and Vertisols for present and scenario built weather conditions.
Frequency analyses of the results indicate that:
1) Relative to **Sofia** field, **chromic luvisol** is associated with a coefficient of variation of yields $\boldsymbol{C_v}$**=43 %** and drought frequency (22 of 30 studied years). Average yield losses of rainfed maize, compared to those under full irrigation, are 60 % in dry vegetation seasons.
Soils of high water holding capacity (**vertisols**) store 50-150 mm more precipitation for crop evapotranspiration, mitigate drought consequences and reduce their frequency to 6-7 cases in 30 years. Rainfed agriculture is much more sustainable since $\boldsymbol{C_v}$ of maize yield drops to **21 %** and yield decrease is 22 % during dry vegetation seasons.
2) Relative to **Stara Zagora**, yields in **vertisol** vary substantially for the water stress sensitive hybrid ***H708*** ($\boldsymbol{C_v}$**=34%)** versus $\boldsymbol{C_v}$**=18%** for the hybrid *Kn-2L-611*. Considering critical yield threshold of 3200 kg DM ha^{-1} at a grain price 95 EUR t^{-1} (Varlev, 2002), economical risk is available in **16%** of the studied years (4 of 23). There is no risk when the drought resistant hybrid *Kn-2L-611* is cultivated without irrigation.
Crop without irrigation in **chromic cambisol** produce the highest variation of yields in the study ($\boldsymbol{C_v}$**=51%**). Rainfed maize is unprofitable in **43%** of the years (10 of 23). Compared with the chromic luvisol in Sofia field, where 6 of 30 years are susceptible to economical losses, the risk relative to chromic cambisol, Stara Zagora is twice more often.

S28.D.02
Temperature and moisture effects on N-N_2O losses from soils by different land use

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The N_2O emissions from soils are caused principally by processes of microbial nitrification and denitrification. The key factors affecting soil N_2O flux are moisture, temperature, and land use governing the main soil properties (concentration of organic and mineral nitrogen, C content, pH etc). This study was aimed to (1) quantify the N-losses as N_2O from soils depending on moisture level, temperature and land use, (2) estimate Q_{10} values of N_2O emission under various environments.
A laboratory study was conducted with forest, pasture, and arable soils (Central Valley, California, USA) fertilized with NH_4NO_3 (80 mg N per 1 kg of soil). The soils were incubated during two weeks at 5, 10, 15, 20, and 25^{o}C and under varying moisture levels (60, 75, and 90% of water holding capacity, WHC). The rate of N_2O emission was measured 6 times at each temperature and moisture with a gas chromatographic system.
It was found that the environmental factors brought the integrated effect on N_2O emission from soils. The temperature increase induced the significant amplification of N_2O emission from soils at high level of moisture alone. Land use effect on N_2O emission rate was also observed at high water content and temperature. The N-losses as N_2O comprised 0.01 and 3.20% depending on environmental factors. The highest Q_{10} values of N_2O emission amounted to 20-114 and were observed for 10-20^{o}C intervals at 90% WHC.
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S28.D.03
Irrigation - a prerequisite for sustainable agriculture in Bulgaria

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The study is based upon statistical data relative to maize yields averaged over the country and additional yield dataset from 30 experimental fields.
Experimental field data analyses indicate that yields of late hybrids cultivated **without irrigation** are quite unstable over the years. They are characterized with coefficient of variation C_v ranging from 30 to 60%. Lower values are relative to North Bulgaria or to the soils of high water holding capacity. Maize yields **under irrigation** are much more stable. Coefficients C_v are within the limits 12-18%.
When averaging yields over the whole country territory, coefficients of variation are lower. They are from 21 to 24% over the periods 1968-1966 and 1990-2006, when the area of irrigated maize was insignificant. The coefficient of variation of yields is much lower (12%) in the period 1967-1989. The irrigated area was 25-30% then. It is obvious that on the average

for the country, irrigation used to contribute to stabilize and raise maize productivity.
If maize irrigation fields revives upon 100 000ha in near future, the total production from irrigated and rainfed maize fields will be within the limits 1.6-3.1 mil. t. In this way an important step towards sustainable agriculture will be maid, while the domestic need and export will be fully satisfied.

S28.D.04
Cover crops as a nitrogen contamination control system in olive groves

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Directive 91/676 related to human nitrate contamination, was put in force by the European Commission, as the nitrogen contamination associated to the fertilization is one of the biggest problems in conventional agriculture.
This situation is especially important in olive grove. Although in Spain in the last years the new olive crops are sown in more productive and flat regions, the majority of the olive groves are situated in high slopes lands. Around the 36% of these trees are grown on hillsides with over 15% slope. This fact added to the low soil protection that olive provides itself, produce a very important run-off generation that drags high amounts of nitrogen. The elements contained in the run-off water, contaminate rivers and reservoir situated under the basin. Another issue is the nitrate lixiviating through deeps layers of the soil, which result the aquifers contamination due to the high amounts of nitrogen applied for the crop.
The study has carried out a comparison of the evolution of the nitrogen concentration in run-off and in soil under two different soil managements, cover crops and conventional tillage. The results show that the conservation agriculture provides important decreases of the run-off, which reduce the nitrate contamination at water run-off. On the other hand, the increases of infiltration due to cover crops could cause a lixiviation increase. Nevertheless, this situation does not happen, as the plant´s roots absorb the nitrogen from the deeper layers of the soil to their leaves, avoiding the potential contamination. The cycle ends when the plant dies and the N is left over the soil.

S28.D.05
The fate of N, P and ethoprophos in sandy loam soil under red pepper cultivation as affected by different surface management practices

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A field study was conducted to determine the fate of N, P, and ethoprophos in small scale of red pepper field plots with sandy loam soil and 10% slope, consisting of three different plots with black polyethylene vinyl mulching (mulching), ridge without mulching (ridge), and flat without ridge and mulching (flat). Composted manure at 2 MT ha^{-1}, urea at 93 kg N ha^{-1} and ethoprophos at 4.5 kg a.i. ha^{-1} were treated with basal application. Urea at 189 kg N ha^{-1} and inorganic-P at 67 kg P ha^{-1} were top-dressed at June 25 using a compound fertilizer (N-P_2O_5-K_2O=21-17-17). The ethoprophos concentration (>1 mg kg^{-1}) in surface soil of mulching plot remained high until August 31, which indicated a prolonged degradation due probably to low soil water content in rainy season, compared to ridge and flat plots. On August 31, the inorganic-N concentration highest in the soil depth deeper than 30cm of flat plot, and decreased in the order of ridge plot and mulching plot. In contrast to inorganic-N, ethoprophos was transported deeper in mulching plot on August 31 than in flat and ridge plots. Nitrate loss by runoff was proportional to the volume of runoff water, but phosphate and ethoprophos loss were not proportional. Phosphate loss in this soil associated with high-energy rainfall for detaching from soil matrix, significantly in the ridge plot. The highest loss of ethoprophos also occurred in the ridge plot and initial runoff was almost equal to the total runoff mass. Meanwhile, mulching plot had significant increase of ethoprophos runoff loss after July 22. This field study suggested that flat plot had high potential of vertical loss, but ridge plot had high runoff potential due to high exposure of ridge surface with high solute concentration in the soil.

S28.D.06
Relative efficiency of nitrate-N and ammonium-N in the nutrition of young corn plants

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There is much confusion in the literature concerning the relative effectiveness of nitrate and ammonium as sources of nitrogen for plants. Only after the introduction of specific nitrification inhibitors, it was possible to investigate - not only in nutrient solutions or controlled soil media- but also under field conditions - the effects of the predominance of either NO_3^- or NH_4^+ ions on the growth and yields of various crops.
In a pot experiment, corn seeds were germinated and grown on a clay loam soil packed in 5 kg capacity plastic pots. After germination, plants were thinned to 5 per pot. Each pot received a nitrogen dose of 0.75 g as a mixture of potassium nitrate and ammonium sulphate giving different NO_3^-: NH_4^+ ratios. A nitrification inhibitor was added to sustain the ratios along the experimental time. Sufficient replications were made to allow for periodical analysis of the plants of each treatment. After 3, 5, and 7 weeks from germination, plant samples were collected for analysis.
NH_4^+ treated plants gave up to 100% more fresh and dry matter compared to those received sole NO_3^-. Intermediate ratios of NO_3^- NH_4^+gave different fresh and dry weights which increased as the proportion of NH_4^+ increased. Nitrogen content of the ammonium fertilized plants was in average 1.5 fold that of the nitrate fertilized ones. The effect of increasing the proportion of NH_4^+ on the nitrogen uptake was inconsistent and varied with plant age. Data showed that at any given plant age, phosphorus concentration was not significantly affected by the different NO_3^-: NH_4^+ ratio. However, increased dry matter due to increased proportion of NH_4^+ reflected an increase in phosphorus uptake.

S28.E.01
Effects of bulking agent on nitrogen availability of sewage sludge composts: influence of measurement scale for N availability

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To ensure aerobic conditions during sewage sludge composting, carbonaceous bulking agents (CBA) are mixed to sludge. We investigated the influence of CBA on N availability of sludge composts based on laboratory, greenhouse and field experiments.
Eleven mixtures were composted using the same sludge and mixtures of different CBA: screening refuses, yard trimmings, pallets, barks and corn stalks. Four mixtures were composted at industrial-scale with screening before maturation and 7 at pilot-scale without screening. N availability of composts was estimated at 3 scales: laboratory incubation without plant, greenhouse experiment with ryegrass and field experiment with maize (only for industrial composts).

N availability measured with plant was higher than in "compost-soil" incubation. For "industrial" composts, it varied between 18 and 22 % of applied N in field, between 10 and 14 % in greenhouse and between 7 and 11 % in laboratory. The N availability of "vessel" composts was lower than for "industrial" ones. In greenhouse, the N use by ray grass varied between 2 and 4 % of N applied that could be explained by N immobilisation observed during the first days of laboratory incubations. However, some "vessel" composts induced an N immobilization during all the incubation period that was not observed with plant indicating that the presence of plant modified N availability in soil.
The larger N availability of industrial composts could be explained by their larger N mineral content and their larger C and N contents in soluble fraction. The higher maturity of industrial composts, revealed by lower C degradation during incubation in soil, seemed to be another indicator of their larger N availability. Finally, the influence of CBA on N availability remains low for composts but was detected in laboratory incubations. However it did not appear or in a different way when N availability was estimated with plants.

S28.E.02
Evaluation of crop responses to organomineral fertilisers in the UK and measurement of nitrogen availability in controlled laboratory conditions

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A novel method for blending biosolids with mineral fertilisers (urea) to produce organomineral fertilisers (OMFs) has recently been developed by a major UK water company. This method allows the concentration of nutrients in the OMFs to be adjusted to satisfy specific needs. Two OMF with the following N:P:K ratios, 15:4:4 (OMF_{15}) and 10:4:4 (OMF_{10}) were formulated and they are being produced experimentally in granules of 2-4 mm in diameter.
The aim of this work was to identify the effects of the use of OMFs in agricultural crops and grassland and to measure N-availability under controlled laboratory conditions. Two soil types were used, sandy-loam and clay-loam. The formulated OMFs were compared against urea (46% N) which was used as a standard fertiliser. To achieve the aim, a field trial using small plots with winter wheat (*Triticum aestivum L.*) and a pot experiment with rye-grass (*Lolium perenne L.*) in the glasshouse were set-up. Application rates of N varied between 0 (control) and 350 kg [N] ha^{-1} (plots) and between 0 and 300 kg [N] ha^{-1} (pots).
In addition, an incubation experiment was conducted to measure the N release from the fertilisers over a period of 6 months. The soil was maintained at 25ºC and at around field capacity throughout the experiment.
In the plot experiment, OMF-N produced similar ($p=0.690$) crop yields to urea-N (10.3 and 10.5 t ha^{-1} respectively). The most economic rate of N was 220 kg [N] ha^{-1}.
In the pot trial, significant differences ($p<0.01$) were found for the two soils types with the clay-loam producing consistently higher dry-matter than the sandy-loam (3229 and 2790 kg [DM] ha^{-1} respectively).
The incubation experiment showed that N-release increases progressively during the first three months and slowed down thereafter. Overall, larger amounts of N-availability were found for the clay-loam compared with the sandy-loam.

S28.E.03
Estimation of nitrogen mineralization of forest soil by temperature, nitrogen content, and soil type, and its application in Japan

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To determine the rate of nitrogen mineralization in topsoil, soil samples were incubated in the field using the resin core method under the forest across the climatic zones of Japan. The annual rates of nitrogen mineralization were high in the soils of warm and cool temperate zones, and were low in those of subarctic and subtropical zones. The nitrogen mineralization rates by laboratory incubation were high in the subarctic soils and decreased in the warmer zones. There was a significant correlation coefficient between the nitrogen mineralization rate and the organic nitrogen contents in the soil. The field rates of nitrogen mineralization were estimated by a multiple regression model using three factors: the ratio of cumulative temperature in the field, organic nitrogen contents in the soil, and soil type. To discuss the application of this simple model, the annual rate in surface soil in the field was estimated using this model in a small forested catchment at north Kanto, Japan, and estimated values were compared with measured values. The estimated values correlated well with measured values in the field. These results suggest the effectiveness of estimating the rate of nitrogen mineralization in the field from these factors, data on which were easy to get from AMeDAS (Automated Meteorological Data Acquisition System, Meteorological Agency, Japan), as well as from published data and soil maps.

S28.E.04
Long-term projections of chemical soil fertility of grassland soils in Switzerland

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Projections of chemical soil fertility provide essential information to maintain soil fertility in the long term. Such projections can be achieved in measuring the chemical status of the soil and modelling the relevant inputs and outputs of the soil system. However, to provide meaningful projections, validated element balance models are needed. For this purpose we modelled nutrient and trace metal balances of eleven grassland sites of the Swiss Soil Monitoring Network for two decades (1986 - 2006). For each monitoring site data for fertilization, crop production, pest and soil management were gathered annually. The altitude of the monitoring sites varied between 431 and 1100 m.a.s.l., the livestock density of the agricultural farms between 0.8 and 2.8 livestock units per hectare. We used a stochastic balance approach that takes into account inputs by animal manure, mineral fertilizer, sewage sludge, compost, pesticides and atmospheric deposition as well as outputs by crops and leaching. For the validation of these element balances we adjusted the balance model to the measured temporal changes in soil by repeated soil sampling. Based on the adjusted balance model we performed long-term projections of trace metal concentrations in soil assuming (i) the same land use as recorded over the last 20 years, (ii) land use scenarios and (iii) temporal changes of soil properties.

S28.F.01
Soil quality in a pasture after application of organic fertilizers or mineral for 7 years

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Organic fertilizers can complement or replace mineral fertilization of a pasture with a sustained production; in this paper an evaluation is made of the changes occurring in the fertility of a soil (short term variable) and in its quality (long term variable) after 7 years of applying two types of organic fertilizer on it: poultry manure (PM) and sewage sludge pellets (SP), in comparison to those produced by mineral fertilization with respect to a control soil. The study has considered easily assessable physical, chemical and biological parameters as being possible “key factors” in the change. In addition, a study was made of the influence of the treatments on the stability of the soil (dispersion analyses), its moisture retention capacity (CAP) and the density of worms in the soil. The organic fertilizers were effective for improving the soil’s surface horizon, so that its bulk density diminished and its structural stability increased; its biological activity, evaluated by means of its β - glucosidase activity and worm density, improved, especially with bird manure, which favoured the soil’s stability for plant maintenance, microbial development and C and N storage in the form of organic matter. The soil’s water storage capacity and conservation also benefitted from the application of organic fertilizers. The parameters selected which were seen to be sensitive to the different treatments and which, moreover, had important correlations with physical, chemical or biological properties, were designated as the “key factors” of the study.

S28.F.02

Changes in Chemical Soil Properties after 11 Years of Different N and Regular P and K Fertilization

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Fertilization with different amounts of mineral nitrogen (0 to 300 kg N ha^{-1}) have been applied continuously, in eleven years investigation period, from 1996 till 2006, in stationary field experiment established on drained Stagnosol. Trial treatments included annual fertilization with different mineral nitrogen rates, respectively with 0, 100, 150, 200, 250 and 300 kg N ha^{-1} what imply total nitrogen input in eleven years investigation period of 0, 1100, 1650, 2200, 2750 and 3300 kg N ha^{-1}. Fertilization with phosphorus and potassium has been equal for all trial treatments in the same year of investigation, excluding check treatment.
This paper presents results of changes of pH value, humus content and plant available phosphorus and potassium content in soil at three investigation depths (0-30 cm, 30-55 cm and 55-80 cm) for soil samples taken before establishment of field trial in May 1996 and 11 years later, after the harvest of winter wheat in July 2006. Chemical soil properties in 2006 have been measured in frame of EU LIFE Project, Development of the Croatian soil monitoring programme with a pilot project.
During the investigation period, mean pH value in soil at selected treatments decreased in average. At the depth 0-30 cm average soil pH decreased from 4.25 to 4.18, at depth 30-55 cm from 4.84 to 4.59 and at depth 55-80 cm from 5.04 to 4.70. At the same time, average humus content in soil increased, at the depth 0-30 cm from 2.06 to 2.29, at the depth 30-55 cm from 1.57 to 2.14, and at the depth of 55-80 cm from 0.61 to 1.20 %. In studied period plant available phosphorus and potassium content in soil generally increased, because of consistent fertilization with single P and K and complex NPK fertilizers.

S28.F.03

In-situ measurement of plant available nutrients in tropical savanna and forest soils - correlations with plant functional traits

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The mobility and bioavailability of nutrients in soils depends largely on their chemical forms and geochemical interactions as well as microsite conditions like temperature and humidity. Conventional soil analysis often fails to take these factors into account and ignores the buffer capacity of soil to replenish nutrients after uptake by plants.
Diffusive Equilibrium in Thin Films (DET) and Diffusive Gradients in Thin Films (DGT) are novel gel techniques that allow for high-resolution in-situ measurement of fluxes and concentrations of phytoavailable nutrients and might provide a means for a more reliable measurement of the phytoavailable part of nutrients in natural soils.
DET and DGT were applied in undisturbed forest and savanna soils along precipitation transects and within ecotones in Africa and South-America. Cl and the labile pool of N, S, P, metals and organic acids, as well as re-supply kinetics of P were quantified. Functional traits of trees larger than 10cm diameter and environmental factors were assessed.
Preliminary results suggest a significant species specific difference between forest and savanna soil nutrient availability, with marked Nitrate peaks in forests and generally less variation in savanna soils. Plant functional traits support the DET/DGT results, showing distinct species specific patterns.
DET and DGT may help to elucidate perceived patterns in tropical vegetation and in combination with plant functional trait analysis contribute to the evidence for a functional distinction between forest and savanna trees.

S28.F.04

Effect of Continuous Fertilization on Soil Health in Rice Paddy

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Quantitative and qualitative changes in the population of soil microorganisms were thought to reflect changes in soil quality. These changes are potentially useful as responsive indicators of the effects of crop and soil management. We examined the impact of long-term fertilization in rice paddy soil that is being practiced for more than 40 years (2005) on microbial activity and microbial community structure in the surface soil at the harvesting stage. To evaluate soil health statues, four treatments (Control, NPK, Compost and NPK+Compost) of eight fertilization treatments were selected to determine the structure of the microbial community by Fatty acid methyl ester (FAME) analysis. The FAME analysis demonstrated that there were large differences in the composition of the soil communities between treatments. Different amendments have caused shifts in microbial community composition. The amount of total phospholipid fatty acid (TPLFA) was significantly increased by fertilization, and compost was more effective than chemical fertilization on increasing microbial biomass. The amounts of bacteria and fungi were markedly increased by fertilization, and more effective in compost application than in chemical fertilization only. The proportion of bacteria to fungi was not changed by fertilization methodology, but gram (+)/gram (-) ratio was significantly increased by compost application. This means the different fertilization by chemical or organic fertilizer did not affect the ratio of bacteria to fungi, but changed bacteria community structure in this paddy soil. In particular, compost application increased gram (+) to gram (-) bacteria proportion. Microbial community structure analysed by principle component analysis (PCA) was significantly differentiated by fertilization, specially by Chemical fertilizer and Compost application. However, there was no significant difference of microbial community structure between Compost and NPK+Compost treatments. Considering soil productivity and quality, the combination of chemical fertilizer and organic sources could be a best nutrient management strategy in paddy soils.

S28.F.05
Soil sulfur - transformations and plant uptake

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In recent years sulfur (S) deficiency has occurred with increasing frequency around the world. This has increased the demand for a better knowledge of soil organic S transformation processes and availability to plants. In this project we aim to investigate the relationships between S availability to plants and different properties of soils collected at Swedish long-term fertility experiments.
On each of five sites, topsoil was collected from two treatments (+/- farmyard manure). The soils were characterized for e.g. pH, texture, total C, N and S, sulfate and physically protected S. The net S mineralization potential of the soils was determined in an open incubation experiment and correlations with different soil properties were tested by single- and multivariate analyses. Some evidence of negative correlations between the net S mineralization and the C/N-ratio as well as the initial sulfate content were found, although they were not significant for all soils.
Four of the five soils (with both field treatments) were chosen for a pot experiment, where plant uptake of S and N, as well as plant biomass development were studied in relation to different soil properties, including the net S mineralization potential. In this second experiment the inorganic soil sulfur pool was labeled with the radioactive isotope ^{35}S, in order to achieve a better understanding of S transformation processes. Half of the pots received a full S fertilization, while no S was applied to the remaining pots. Results will be presented at the congress.
The chemical speciation of soil organic S in the five soils was examined by X-ray Absorption Near Edge Structure (XANES) spectroscopy. The results from this study will be used to explore chemical features that could help to further explain the pattern of S mineralization and plant uptake of S.

S28.G.01
Agronomic potential of P-fertilisers made from sewage sludge ashes - The EU-Project SUSAN

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In terms of secondary raw material recycling, sewage sludge holds the largest potential to recover P in Germany. Thus, a re-use of P provided by sewage sludge in agriculture must be encouraged. However, due to the high content of organic and inorganic pollutants in untreated sewage sludge, its use in agriculture is a matter of considerable debate. The content of undesired substances, the low bioavailability of P in untreated sewage sludge is of concern, as well.
The EU-Project SUSAN (Sustainable and Safe Re-use of Municipal Sewage Sludge for Nutrient Recovery) aims to process sewage sludge by means of mono-incineration and an ensuing thermochemical treatment of the ashes with different chlorine-donors ($MgCl_2$ or $CaCl_2$) which leads to the destruction of organic pollutants and the removal of heavy metals as volatile chlorides. Ideally, the heavy metal content in the treated ashes is below the threshold values of the German Fertiliser Ordinance. In addition, the solubility of P in the sewage sludge ashes is increased by the treatment. Consequently, the thermochemical treatment of sewage sludge results in a raw product that can be used to produce P-containing mineral fertilisers.
Pot experiments with maize were conducted in two consecutive years to assess the fertilising potential of ash-based mineral fertilisers made of thermochemically treated sewage sludge ashes. For control, conventional PK- and P-fertilisers were applied. The results revealed that it is possible to obtain yields which are on the same level as the yield obtained by fertilisation with conventional fertilisers. The level of P-uptake among the ash-based fertilisers appeared to depend on the type of chlorine-donator applied in the thermochemical treatment. For a better understanding of the P-uptake from ash-based fertilisers further investigations on the elemental composition of test plants and test soil are underway.

S28.G.02
Land-use evoked changes in soil phosphorus fractions

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The objective of this study was to investigate the effect of different land-use practices on the different pools of soil phosphorus (P). The P in a soil continuum from a set-aside soil and an organically farmed to a conventionally farmed one was characterized using a slightly modified Hedley's fractionation procedure based on biological availability of P. One gram of soil was sequentially extracted with H2O, NaHCO3, NaOH and HCl. The suspensions were analysed for molybdate reactive P (RP) and total P (TP). Organic P concentrations in samples, referred as unreactive phosphorus (UP), were calculated as a difference between TP and RP.
The largest P concentrations were found in the NaOH-extractable fraction that constituted 57 - 60% of the total fractionated P. The second largest fraction was HCl-extractable P being 24-29% of the TP. The corresponding portion of water-extractable was 5 - 6% and that of NaHCO3-extractable 10 - 11%. The TP in each fraction was not affected by change in land-use. However the intensified land use (set-aside<organic<conventional farming) increased the concentration of RP and decreased the concentration of UP in NaHCO3 and NaOH fractions. The proportion of RP in total labile P (TPH2O +TPNaHCO3) increased and UP decreased whit increasing land-use intensity. Similar trend can be seen in total fractionable P where the total of RP in all fractions increased. Compared to the set-aside soil, the proportion of RP seems to increase at the expense of UP in more intensively managed soils.

S28.G.03
Fertilization effect on phosphorus fractionation accumulation and release in Greek Alfisols

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The impact of inorganic P fertilization was examined in three cultivated Alfisols, in South Greece. For all soils samples amorphous oxides (Fe, Al), oxalate extractable P (Pox), P sorption capacity (PSC) and the degree of P saturation (DPS) were measured with the acid ammonium oxalate method. Potential change of P retention due to following P fertilization was also estimated with phosphorus sorption index (PSI). Hedley P fractionation (resin, $NaHCO_3$, NaOH, dilute HCl, concentrated HCl, H_2SO_4/H_2O_2) was used to determine soil P fractions of varying bioavailability, while P release was estimated with distilled water (Pw). The total phosphorus (sum of the fractions-Pt) and labile P (resin-P + $NaHCO_3$-P) accumulated strong in the surface horizon due to the heavy P fertilization. The unexpected high value of Ca-bound P (d.HCl-Pi) in the surface horizon of the weathered studied soils and its reversely depth distribution with soil pH indicates that inorganic P fertilization was in the form of Ca-P (single superposphate).The concentrations of all P fractions except of H_2SO_4/H_2O_2-P were strong significantly correlated with Pw denoting that most of P fractions can contribute to the P release and thus to the potential pollution of waters with P. The DPS values from 42% to100% for surfaces horizons is above the critical limit (DPS: 25%) for the potential movement of P in water, showing that the studied Alfisols may contribute to the pollution of surface waters with P. DPS and labile-P were weakly but significantly correlated with PSI ($r=-0.61$, $p<0.05$ and $r=-0.57$, $p<0.05$ respectively) denoting that an increase of labile-P, reduces the soil capacity to sorbs P and enhances the risk of P transfer to waters resources.

S28.G.04
Soil phosphorus status and turnover in a central-European beech forest ecosystem

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Problems in the phosphorus nutrition of forest trees raise questions concerning the soil phosphorus forms, concentrations, pools and turnover in forests. The aim of this study was to investigate the phosphorus status and turnover of a deciduous beech forest ecosystem and to elucidate which role heterogeneities in soil conditions and tree species diversity play. A large proportion of soil phosphorus is organically bound and this pool is strongly influenced by the trees. The soils of the mixed-species stands contain more organically bound phosphorus than pure beech stands, however, the phosphorus input through the leaf litter does not differ significantly between the stand types. Instead, the litter turnover rates differ, with higher rates for the mixed-species stands than for the pure beech stands. Possible explanations for the different turnover rates are differences in the litter quality, interactions in mixed-species litter and soil characteristics. In addition, the higher soil phosphorus content in the mixed-species stands is dependent on the higher clay content of these sites, which leads to an increased adsorption of the organically bound phosphorus to the clay minerals. Furthermore, the differences in the tree species composition between the stands are strongly influenced by the pH of the soils. Hence, important factors determining the soil phosphorus status and turnover and even the tree species distribution pattern are the soil properties of a forest ecosystem.

S28.H.01
Potassium dynamics and contribution from soil resources in a 30 year grass rotation experiment

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Ensuring there is an adequate and balanced supply of all nutrients remains a central requirement of soil fertility management. It is likely that where we have a combination of increased off-take, insufficient fertiliser use and soils naturally deficient in potassium (K), a long-term depletion of K reserves may have consequences for crop yields leading to an inefficient utilisation of nitrogen and phosphorus. The general importance of weathering rates and soil mineralogy becomes of increasing significance, especially for reduced input systems associated with organic farming and extensification.
Potassium dynamics of a 30-year field experiment including two ten years perennial ryegrass (*Lolium Perenne* L.) periods and two K-fertilisation regimes, nil (K0) and 65 kg K ha^{-1} yr^{-1} (K65), were studied. Herbage K concentrations for K0 ranged from 1.2 to 0.5% compared to 1.7 to 1.1% in K65. The biomass harvest was significantly lower in K0 when the K% was approaching 0.6%. The average net K off-take (Input-Output) for the two grass periods was 50-65 kg $ha^{-1}yr^{-1}$ (independent of K fertiliser regime) suggesting a similar rate of release from soil resources. The accumulated (30 year) off-take was ~1,100 kg K. The exchangeable K pool in the rooting zone (0-40 cm) was ~100 kg ha^{-1}, indicating that a substantial release of non-exchangeable K had occurred. Total soil K was 71,000 kg ha^{-1} and the K bearing soil minerals were K-feldspar (10%) and phyllosilicates (21-25%), of which 2/3 was di- and the remainder more easily weathered trioctahedral mica/clay. Combining quantitative geochemical and mineralogical data will be the next step forward to elucidate possible sources responsible for supplying the grass with K and hence explaining the large net K off-take.

S28.H.02
Mineralogical speciation of soil potassium - a basis for sustainable management options for grassland soils

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Grassland and grassland soils provide important environmental and economic functions such as forage for livestock, habitats for flora and fauna and being a net sink for carbon. Increasing demand for locally produced farm products, with a lower input of mineral fertilisers, leads to a greater reliance on the inherent capacity of soils to supply plant nutrients. Typically 98% of all soil potassium (K) is found in K-feldspars and phyllosilicates, however the bioavailability of K from different mineral forms varies significantly. As a basis for further discussion on sustainable nutrient management options for grassland systems it is therefore of interest to know 1) how soil parent material influences the amount of K in soils, 2) how the K is distributed between mineral groups, and 3) if aqua regia extractable K (a frequently used measure of K content) reflects any of the soil K mineralogical properties. Soils representing eight of the most extensive soil associations (defined by different parent materials) under improved grassland in Scotland were analysed for total K (X-ray fluorescence), aqua regia extractable K and quantitative mineralogical composition (X-Ray powder diffraction). The last named was combined with normative calculations to obtain the mineralogical speciation of K. The soils covered a wide range of total K concentrations, from 1.3 to 39 g kg-1 and the distribution of K between different K-bearing minerals varied significantly between the soils, from those with almost all K in the form of different phyllosilicates to others with most of the K in K-feldspars. This suggests that the soils' inherent potential to deliver K to plants vary significantly between the soil parent material groupings. Aqua regia extractable K seemed to be most related to K in phyllosilicates; however, further investigation is needed for a more precise understanding of what the extraction represents in terms of soil K.

S28.H.03

Comparison of kinetics of non-exchangeable potassium release from profile samples of mineralogically varying benchmark soil series

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We investigated kinetics of non-exchangeable K release from soil samples and their different size fractions belonging to five major benchmark soils series in relation to mineralogy and soil depth. These soil series are representative of major agricultural production areas of the country. Cumulative K release was relatively higher in smectitic vertisol soils (52 to118 mg K kg^{-1}) as compared to illitic alluvial (44 to78 mg K kg^{-1}) and kaolinitic alfisol soils (30 to 36 mg K kg^{-1}). Surface soils, invariably exhibited larger cumulative K release in smectitic and illitic soils whereas sub-surface soils had larger cumulative K release in kaolinitic soils. Though kaolintic soils released lowest cumulative K but relatively rapid initial release during the first hour of equilibration in these soils is evident from higher proportion of total K released as compared to smectitic and illitic soils during similar initial equilibration times. Among the different soil separates, clay fractions contributed the highest to the total K release. Three mathematical models (first-order, parabolic diffusion and power function) were tried to describe the non-exchangeable K release from these soils. On the basis of consistently lower values of standard error of estimate and highest values of coefficient of determination for parabolic diffusion equation suggested that diffusion of K out of mineral matrix or weathered periphery of these soils is the rate controlling process. This holds true for all the experimental soil samples and their different size fractions. Release rate constant further confirmed that smectitic vertisols maintained higher release rate as compared to kaolinitic alfisols and illitic alluvial soils. Release rate constant for different size fractions were in the similar order as observed for cumulative amount of K released for these soils. In general surface soils showed higher release rate constant than sub-surface ones.

S28.H.04

Lime use, requirement and pH values on grassland soils in Ireland based on statistics and soil database results

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Liming to maintain soil pH is necessary for good nutrient availability and to avoid aluminium and manganese toxicity. The Shoemaker SMP buffer method to estimate lime requirement (LR) was introduced in Ireland in 1964. New buffer methods (without toxic *p*-nitrophenol) are being adopted in USA to replace SMP (e.g. Sikora buffer).
This study compared lime use, lime requirement (LR) and pH values with current advice and is based on lime use statistics and soil results from the National Soil Database (NSD; 1310 samples, i.e. 2 grid samples per km^2). A total of 641 NSD mineral grassland soils (where pH and LR results were available) were used for this study.
Mean annual agricultural lime use was $1.7x10^6$ t between 1975 and 1984 but was only half of this between 1995 and 2004. A small increase in recent years (1995 to 1996) was partly related to the requirement to lime soils in agri-environmental scheme.
The mean pH of the 641 soils from the NSD was 5.4 (standard deviation 0.7) and mean LR was 9.3 (5.6) t ha^{-1}, this compares with pH 6.3 advised for grassland. To meet current advice would require 32.6 m t lime (3.5 ha x 9.3 t) at a total cost of €749m (€23 t^{-1}). In addition to the financial cost benefit of lime it is estimated that 1 t limestone applied releases about 2 t of carbon dioxide. If the 32.6 m t lime was applied to meet advice, the release of carbon dioxide would be equivalent to about half the total current annual national emission.
Lime use is declining and less is being applied than advised, in contrast to N and P fertiliser use. Based on economic and environmental needs it is necessary to review and revise as necessary the LR method and advice.

S28.H.05

A case study of olive oil mill waste water application in corn fields: Soil and groundwater quality assessment

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Greece is the third oil production country in Europe, after Italy and Spain, with annual production of 500 kilotonnes per annum. Due to the intensive oil production a large amount of Olive Oil Mill Waste Water (OOMWW) is generated, which needs to be treated. For the case of Greece, vast proportion of oil production depends on family enterprises, which seek for low cost and low environmental disturbance solutions. The application of OOMWW in soils has been already applied in pilot level in some areas (mainly Spain). The target of our study is to evaluate soil and groundwater effects from the application of OOMWW in a corn field. The oil mill is located in Lakonia Prefecture and uses a three phases centrifugation oil production process, which produces about 1 kg of OOMWW per 1 L of oil. The family enterprise has been operated this cost effective treatment solution for the last 3 years. The OOMWW is pretreated with calcium oxide and stored for 3 months in waste ponds before the application. The corn production has been increased since the OOMWW application and profits arises also from the extra reserve of water supply during dry period (May-August). Several chemical and physical parameters have been measured such as pH, conductivity, chemical oxygen demand, total phenols, etc. for both soil and groundwater. Total phenols level in groundwater appeared relatively low (1.9 to 2 mg/L) while conductivity is relatively stable (1105 μS/cm) which shows no further salt burden. Soil pH is 7.73 and conductivity 320 μS/cm, whereas organic matter (OM) ranges from 1 to 2.5 %. Up to now no adverse effects have been noticed. However future aspects of maintaining soil fertility and eliminating the possibility of soil degradation should be taken under consideration.

S28.H.06

Response of pasture and vetch-cereal crops to sugar foam waste applications in a mediterranean Palexerult "raña" soil

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A long-term field experiment was conducted on a deteriorated and highly acid soil of "raña" (plinthic Palexerult). The natural pasture produced by these degraded soils was of a very bad quality and with a scant volume.
The response of fertilized natural pasture (NP), improved pasture (IP) and vetch-cereal crop (VC) to the application of sugar foam waste (F) and sugar foam waste +phosphogypsum (FPG) was measured.
The mean yields from the limed plots increased compared to those of the control plots during the three years they were studied. The maximum production of dry biomass observed was 7225 kg/ha. This was obtained in 2006 in the plots with VC treated with FG. That year the plots amended with foams yielded a mean of 472 kg/ha of raw protein (CP) v. 235 kg/ha in the fertilized control plots.
With the amendments, the forage quality also significantly improved as the concentrations of Ca, P and N increased. However, F did not succeed in increasing Mg levels, and the incorporation of phosphogypsum even reduced them. Neither was the extremely low level of Cu modified.

The concentrations of Zn, Mn and Fe in the forage proceeding from the limed plots dropped abruptly: by between 20-35% in the case of Zn and Fe, and 60-64% in the case of Mn. The Zn in the limed plots was very much below the mineral requirements for beef cattle, and even reached marginal levels for the plants.
This indicated that F or FPG should not be applied on these Mediterranean acid soils without any supplementary Mg, Zn and Cu.

S28.I.01

Fate of fluorescent dissolved organic matter (FDOM) released from organic manures applied in cultivated soils: A biodegradation study

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Farm waste amendments in agricultural watersheds may be susceptible of dissolved organic matter (DOM) pollution in aquatic resources. Our objective was to i) test the potential of fluorescence spectroscopy to discriminate soil DOM from farm waste, ii) quantify the persistence of fluorescent DOM originating from farm waste amendment. DOM fluorescence properties were studied in an incubation experiment. Cultivated soil was incubated at 25°C with organic manures (T_{om}) along with control ($T_{0)}$ and hydroextracts at 3 hours, 15 days and 29 days were analysed. Measurements of fulvic and humic like (F-L and H-L), Tryptophan (Tryp), Tyrosine (Tyr) relative fluorescence intensities, peak position shifts in excitation emission matrix (EEM) and humification index (HIX) were carried out.
At 3 hours, DOC in T_{om} was 5 fold higher compared to T_0 but H-L and Tryp fluorescence intensities were same in both treatments although F-L intensity was higher. F-L and H-L fluorescence intensities increased up to 15 days in T_{om} compared to T_0 where it declined. They were stable between 15 and 29 days but DOC was still 2 fold higher in T_{om}. Rapid declined in Tryptophan and Tyrosine up to 15 days in T_{om} suggested more rapidly biodegradation than H-L and F-L. DOM in T_{om} showed lower HIX values at 3 hours than soil DOM suggested that it might be easily biodegradable and less humified. But higher HIX and red shifted peak positions for the H-L and F-L fluorophores at the end of experiment in T_{om} suggests that this FDOM released from organic manure was more humified and recalcitrant than soil DOM. The above fluorescence indices demonstrated that FDOM released during biodegradation of manure can be discriminated from soil DOM even after one month of incubation. Fluorescence spectroscopy is a good tool to track farming waste DOM pollution sources in the natural waters.

S28.I.02

Bioavailability of Si in long-term cultivated soils

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While silicon is the second most abundant element in the Earth crust, it is not considered essential to the plants realm. However, Si is taken up by many plants and has proved to be beneficial to them. Although Si can be found under numerous forms in soils, not all of them are taken up by plants. The most available source of Si for plants should be the most soluble silicates. Phytoliths (amorphous silica particles formed in plants) are one of the most soluble forms of Si in soils and therefore one of the best sources of Si for plants. In cultivated areas, part of the Si taken up by plants is exported at harvest, unlike in natural conditions. We speculate that a decrease of the phytolith stock should lead to a decrease in bioavailable Si and a possible impact on crop yields unless amendments are provided. Here we present the results on three experimental plots located at Boigneville (France). Our goal was to assess the possible effect of straw incorporation and direct seeding on Si stocks. Using chemical extractants, we determined the amount of amorphous silica of the three plots. Preliminary results show that the soil where straw was exported seems poorer in amorphous silica than the others. Another field of study was the Broadbalk experiment at Rothamsted Experimental Station (Harpenden, UK). Wheat has been grown there continuously since 1843 and straw removed. Soil samples from 1881, 1893, 1944 and 2000 were analysed and showed that the amorphous silica content remained quite constant at a very low level (0,35%). Profiles showed that, contrary to natural soils, amorphous silica was depleted at the surface but enriched at depth. This study is partly supported by the French program ECCO. Soil samples courtesy of ARVALIS and Rothamsted Experimental Station.

S28.I.03

Distribution and transformation of different forms of zinc in acid soils of Iran

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The knowledge of the distribution of zinc between its different chemical forms is useful in understanding the chemistry of this element in soil and its behavior in the soil-plant system. The present work studied the distribution of native zinc in main fractions of acid soils of Iran and redistribution of these forms after corn crop.
Twenty surface (0-30 cm) soil samples were extracted in a sequential extraction procedure, according to the method of Singh *et al*. (1988), to determine the zinc in fractions of soil, as follows: Exchangeable, carbonate, organically bound, Mn oxide, amorphous and crystalline Fe oxide and residual. A pot culture experiment with corn plant was carried out to understand the effect of crop on transformation of zinc in these soils.
Native Zn in acid soils of Iran was mainly distributed over the residual fraction, followed by crystalline Fe oxide fraction. After the crop of corn, Zn in soils has been shown to occur mainly in the residual fraction too. Also all of the forms except amorphous Fe oxide fraction changed. The amount of organically bound, Mn oxide, crystalline Fe oxide and residual fractions decreased, indicated that these forms transformed to the more available form as exchangeable fraction increased. Changes in organically bound and Mn oxides bound forms of Zn showed a significant correlation with the plant responses, so these forms might be considered the available forms for plants.

S28.I.04

Sedimentation in paddy fields: A neglected issue associated with land use intensification

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Considerable research regarding impact of land use intensification on erosion and runoff has been carried out worldwide. However, little is known about the impact of associated sediment transfer from eroded upland fields, to lower paddy fields. The aim of this study was to identify the resulting spatial variability in soil characteristics along a toposequence and to link this variability with the variability of rice performance for two cropping seasons. Two toposequences of paddy fields were selected and divided in a fertilized and unfertilized part. Soil samples were taken on detailed grid basis and 30% analyzed for plant available nitrogen and phosphor, total nitrogen, organic carbon and particle size. Further, mid infrared spectroscopy was conducted on all samples. Spatial variability of soil parameters and rice performance among paddy fields in a toposequence was assessed in function of position to irrigation channel and sequence slope gradient and linked through correlation and multiple regression analysis. Finally, two crop seasons were compared by simple ANOVA tests to analyse sediment impact. Results indicated that there is a strong correlation between organic carbon, clay content, yield and position of a field. Initially, as deposition of organic material and finer particles increased with distance from the irrigation channel, rice performance increased accordingly. However, towards the end of the toposequence sediment inputs decreased resulting in lower performance. Comparing two cropping seasons, results suggest that changes in soil characteristics during main rainy season have a comparatively larger impact on rice performance than at the beginning of the cropping season. In conclusion, runoff from upland fields delivers sufficient nutrients and organic matter input to maintain a high productivity of two rice crops a year. However, delivery of variable sediment quality and quantity has, depending on the paddy field position within a toposequence, strong implications for crop development and its management.

S28.J.01

Effect of soil tillage and fertilization on micronutrients and heavy metals concentrations in a soil cultivated with corn and winter cereal

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The aim of this study was to evaluate the effect of livestock slurry on nutrient accumulation at the surface layer of an acid, rich-in-organic matter soil with loamy texture. A field trial was conducted, near Pastoriza, Lugo province, Galicia, north-western of Spain from 2004 to 2006. Two reduced tillage systems, no-tillage (NT) and minimum tillage (MT) and four different fertilizer treatments, i. e. mineral fertilizer as a control and livestock manure applied at rates of 30, 60 and 90 Mg ha^{-1} were factorially combined. The crop rotation was maize and winter cereal. Mineral fertilizer and livestock manure were applied two times per year. Soil samples were collected after the first and the second year since experimental set-up at the 0-5 cm depth. Micronutrients (Zn and Cu) and heavy metals (Pb, Cr, Ni and Cd) concentrations were analyzed using Mehlich-3 as extractant. There was no significant influence of the tillage systems on micronutrients and heavy metals levels in the topsoil. After one year experiment, mean Zn concentration on the plots with mineral fertilizer was 7.8 mg dm^{-3} and those of the plots amended at the highest rate of slurry was 9.7 mg dm^{-3}. After two years, the control treatment with mineral fertilizer presented 9.7 mg dm^{-3} of Zn and plots with the highest rate of slurry, 17.4 mg dm^{-3}. The treatment with mineral fertilizer showed a tendency to present higher levels of Cu than treatments with livestock manure. Cd, Cr and Ni were not significantly affected by fertilizer treatment. Pb even showed a tendency to decrease from the first to the second sampling date. It was concluded that tillage systems did not influence micronutrients and heavy metals levels in the soils and that both, mineral fertilizer and slurry application contributed to significantly increase Zn levels in the topsoil.

S28.J.02

Input of organic micropollutants in soil through compost and sludge application: possible transfer to plants

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Three long-term field experiments located at Feucherolles (Ile de France, 35 km west of Paris), Colmar (Alsace) and Ensisheim (Alsace) have been initiated in 1998, 2000 and 1995, respectively to study the effects of different urban composts or sewage sludges application on soil and plant qualities. Organic pollutants (PAHs, polycyclic aromatic hydrocarbons; PCBs, polychlorobiphenyls, PCDD/F, polychloro-dioxins and furans; DEHP, Di(2-ethylhexyl)phthalate and other phtalates; NP, nonylphenol; LAS, Linear Alkyl Sulfonates) have been analyzed in the applied organic products, the soils and the harvested grains (wheat and maize). The PAH and PCB concentrations varied a lot among the different organic amendments but were always lower than requested by the French legislation. The fluxes generated by the organic product application varied between 1.1 and 1.5 kg/ha for PAHs (total of 16 PAHs) and 15g/ha for PCB (total of the 7 reglemented PCBs). In none of the field experiments, an increase of PAH and PCB concentrations was observed in the soils. In Colmar and Feucherolles, naphtalen was the only PAH detected in the harvested grains (4µg/kg DM) but the concentrations did not differ between the treatments, including the control treatments.
Among the other organic pollutants, PCDD/F were not detected. Some LAS and phtalates were detected in the applied organic products (up to 1g/kg DM for phtalates and 0.1g/kg DM for LAS). However, no differences were observed in soil concentration among the different treatments (DEHP: 64µg/kg, LAS: 85 µg/kg). In the grains, DIBP was the phthalate presenting the largest concentration (80 to 1800 µg/kg DM) and LAS concentrations varied from below detection limit up to 2300 µg/kg DM without any relationship with the treatments.
In none of the field experiment, any impact of the organic application was observed.

S28.J.03

Factors controlling the biodegradation of 17b-estradiol, estrone and 17a-ethinylestradiol in different natural soils

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Estrogens like 17b-estradiol (E2), estrone (E1) and 17a-ethinylestradiol (EE2) reach agricultural soils through the application of animal manure, sewage sludge and wastewater. These hormones can effect fish at extremely low aquatic concentrations which has resulted in an increased interest regarding the persistence and mobility of these compounds in the environment. We conducted a series of laboratory microcosm incubations with [14C]-labeled E2, E1 and EE2 in 17 different natural soils to characterize hormone mineralization. A significantly higher E2 (4.2 - 50.2 %) degradation compared to EE2 (0.5 - 2.6 %) was observed in all testsoils after 21 days. Soil parameters as well as sorption parameters of E2 (Kd = 21.9 - 317.5 ml g-1), E1 (Kd = 46.0 - 517.5 ml g-1) and EE2 (Kd = 29.9 - 326.1 ml g-1) seem to have minor effects on estrogen degradation. Also our results indicate that E2 must be readily transformed to E1 via biological processes.
Factors controlling estrogen degradation (N-limitation, co-metabolism) as well as the degrading microbial community are currently not well characterized. Therefore, soil incubations with combined additions of radiolabeled estrogens and different substrates were conducted. Combined additions of estrogens and ammoniumnitrate or alanine to soil samples indicates that

EE2 degradation is N-limited. Combined additions of estrogens and glucose induced higher E2 and EE2 degradation in comparison to control samples which is attributed to co-metabolism. The microbial community structure of the soils seems to be affected through combined additions of estrogens and ground wood, catechol or streptomycin. Thus, we can clearly demonstrate that there are different microbial communities responsible for E2 and EE2 degradation in soils. We suggest that white-rot fungi could be EE2 degraders whereas E2 is mineralized by bacteria in general.

S28.J.04
Principal component analysis of the heavy metals distribution in soils

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The high variability of the heavy metals soil concentrations obtained at various sampling sites requires a careful evaluation and interpretation. Principal component analysis (PCA) seem to deliver more information on links among sampling sites, pollutant concentrations, correlation patterns and latent factors responsible for the data set structure. In this work PCA was performed on data matrices consisted of information on heavy metals presence in soils and soil characteristics gathered from the relevant published data in order to clarify the soil distribution patterns of these compounds, and also to evaluate their spatial distribution. Data concerning the heavy metal presence in Serbian soils from urban and arable zones have been also included.
Two groups of data were analyzed by PCA in order: a) to investigate correlation between the heavy metal loads of soil and soil characteristics, and b) to reveal distribution of heavy metal in soils worldwide. Thus, previously assayed results on content of heavy metals (such as Zn, Cu, Fe, Pb, Mn, etc.) in soil samples are taken as variables (column of the input matrix) and various sites throughout the world occurring both in areas without direct pollution sources and the ones affected by industrial activities as mathematical - statistical cases (rows of the matrix). Soil characteristics such as percentage of clay, organic matter content, the acidity (pH), etc. were also included in the input matrix as variables, for these parameters are known to affect both the current concentrations in the soil system and possible adsorption. The Statistica for Windows program package (version 5.0, Tulsa, Oklahoma, USA) was used for PCA.
PCA classified the soil samples worldwide according to their element contents finding out their regional variability. Loading values suggested the correlation between the levels of certain elements and soil characteristics, revealing the underlying structure of analyzed data.

S28.J.05
Arsenic, cadmium and uranium in soil solution extracts of forest and agricultural soils contaminated by uranium mining activities

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Arsenic, cadmium, phosphorus and uranium were examined in 6 Saxony soils and one soil from Braunschweig (Lower Saxony) under forest, cropping and grassland landuses. Two of the Saxony soils were highly contaminated by previous uranium mining activities and the other Saxony soils less so. The Braunschweig forest soil was unaffected by mining activities and had received no known phosphate fertiliser. None of the soils tested had alkaline pHs.
Strong acid extractions indicated at least two sources of contamination. One highly contaminated soil, with the largest inputs of contaminated sediment of mining origin and no known phosphate fertiliser additions, had different cadmium, phosphate and uranium ratios compared with the other sites. The other highly contaminated site also showed the impact of phosphate fertiliser additions as well as the contaminated mining sediment. All the farmed soils had higher phosphorus, cadmium and uranium contents than forest soils due to P fertiliser additions. Soil solution showed the impact of addition of contaminants and soil pH. Increasing the total amount of arsenic, cadmium and uranium in soil also increased their amounts in soil solution, showing the increased risk of leaching or plant uptake. The soil solution: soil partitioning coefficients also tended to increase with additions of contaminants, indicating the contaminants are more mobile and likely to be bioavailable than their native counterparts. However, the amount of U in soil solution and the soil solution: soil partitioning coefficients decreased with increasing pH indicating this is a potential mechanism for reducing uranium mobility and plant uptake in these acid soils.

S28.J.06
Zinc speciation and exchangeability in six polluted soils

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A correct characterization of heavy metal availability is necessary for an adequate management of polluted soils. Our objective was to describe zinc (Zn) availability in polluted soils by measuring the isotopic exchangeability of Zn in soil/solution (E value) and in soil/plant systems (L value), by assessing the transfer of Zn and 65Zn in the fractions of a six-step selective sequential extraction (SSE) in incubated soils and by identifying Zn forms in soils using extended X-ray absorption fine structure (EXAFS) spectroscopy. We distinguished 3 pools of exchangeable Zn: the pool of Zn exchangeable within 1 minute which was observed in all soils, the Zn exchangeable on the medium term, and the slowly and not exchangeable Zn. The amount of Zn present in the 2 first pools was similar to the L value measured with T. caerulescens. The 3 first steps of the SSE solubilized the 1st pool and a fraction of the 2nd pool. Most of the 2nd pool and a fraction of the 3rd pool were extracted in the 4th step of the SSE, while the rest of the 3rd pool was extracted in the final steps of the SSE. The EXAFS study conducted on two soils showed that more than half of the Zn was present in species weakly bound to organic compounds and/or outer sphere inorganic and organic complexes. Other species included strongly sorbed Zn species and Zn species in crystalline minerals. The EXAFS study of selected SSE residues showed that the specificity of the extractions depended on soil pH and soil organic matter content. Altogether these results suggest that rapidly exchangeable Zn is present as weakly bound octahedral Zn species but that the proportion of weakly bound octahedral Zn that can rapidly exchange with Zn2+ in the solution decreases when soil pH and organic matter content increase.

S28.K.01
Alleviation of salt stress in carrots with salt tolerant rhizosphere bacteria in arid soils of Uzbekistan

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Accelerated secondary salinization of irrigated soil is recognized as the major agricultural problem in Uzbekistan High salinity may inhibit root and shoot elongation due to slowing down the water uptake by the plant may be another reason for this decrease. Removing the salt from this soil is practically impossible. One possibility to circumvent this problem is to use salt tolerant bacterial inoculants that may prove useful in developing strategies to facilitate plant growth in saline soils and improve soil productivity. In the present work a salt tolerant rhizosphere bacteria were screened for their effect on growth of carrot in salinated arid soils. Bacterial strains *Pseudomonas putida* TSAU22 and *Pseudomonas putida* TSAU1 alleviated salt stress in carrot and appeared to stimulate its root as well as shoot growth significantly from 10 to 37% as compared to the control. They were able to produce auxin (IAA), and ACC deaminase. These results are promising for the application of selected microbes for agriculture in salinated soils, it will reduce using agrochemicals, improve plant growth in stressed environment and also soil productivity will be improved.

S28.K.02
Growth and mineral status of barley plants as affected by drought and foliar fertilization

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Two field experiments were conducted in the Experimental Farm of the National Research Centre to evaluate the influence of foliar (commercial multinutrients foliar fertilizer) in the rates 1 and 2 g/L compared with control and water deficit at two growth stages (Elongation and dough stages) and those irrigate regularly on growth and yield of barley c.v. Giza125.
Plant height, number of tiller and spikes / plant and spike length, in the 1^{st} as well as 2^{nd} seasons, did not show any significant effect by water deficit at heading or late at dough stage. Dry weight of shoots, spikes and whole plant values, in the 1^{st} season, were lower when plants subjected to omitting of irrigation at heading than that at dough stage or control plants. However, the differences in whole plant was the only significant. The differences in these parameters in plants exposed to water deficit at dough stage and that irrigated regularly were approximately equal. The highest negative effect by omitting of irrigation at heading was in the dry weight of the whole plant followed by that on shoots in the 2^{nd} season while in the 1^{st} season the degree of depression was similar.
Phosphorus concentration in straw drastically decreased by subjection barley plants to drought at heading and at dough stages and at latter stage the effect was more pronounced. However, the differences in N and K concentrations seemed to be equal with both drought treatments and the control treatment. Marketable decreases in Fe, Mn and Zn concentrations in straw of barley plants were detected by missing of irrigation at heading and dough stages.This led to conclude that the foliar fertilization ameliorate the adverse effect of drought on growth, mineral status and grains yield of barley.

S28.K.03
Soils of Georgia in living space: problems and perspectives

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Georgia is characterized by very interesting soil cover. The founder of genetical soil science prof. V. Dokuchaev called Georgia “Natural Soils Museum in the Open Air”. Some soils (cinnamonic, meadow-cinnamonic, yellow-brown) were first described and established in Georgia as independent genetic types of soils and as result received “World Citizenship”. Georgia is an ancient agricultural country. Consequently the anthropogenic influence on soils is an intensive press counting several millenniums. Nowadays, the state of soils is described as extremely alarming due to strong erosion and contamination with heavy metals, radionuclides and toxic substances. The soils of main agricultural zones at 1000 m above sea level are in hardest conditions.
According to approximate data 30 % of arable lands are strongly eroded. In some districts more than 80% of arable lands are eroded. In West Georgia we observe “soil migration” when the population leaves their places of residence because of highly eroded lands.
Industrial districts which are characterized by contamination with heavy metals are connected with main agricultural zone. Progressive soil contamination of agricultural lands is connected with the influence of transport.
The Soils of Georgia are more or less contaminated with radionuclides (^{90}Sr, ^{137}Cs). The most damaged was West Georgia which is washed by the Black Sea.
Soils erodibility considerably decreases productivity of the agricultural crops, growing on it. Contamination with heavy metals and radionuclides puts under the question ecological purity of final products: wine, citrus, tea and others. All this is the serious “risk factor” to obtain the deserved share on the world market. Technical and methodological difficulties of organizing soil monitoring in many countries, including Georgia, require creating a unit interstate service of soil protection with the network of monitoring centres in different countries and regions. The live of soils in healthy environment can be achieved by joint efforts.

S28.K.04
A novel microwave-assisted technique for measuring soluble organic N in soil extracts

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Many efforts have been spent on rapid determination of soil biochemical and biological properties. Soluble organic N (SON) is thought to be a labile soil N pool. Furthermore, total soluble N is widely measured following soil fumigation to determine soil microbial biomass N. Microwave irradiation has been used as an alternate energy source for many experimental procedures. The objective of this study was to identify whether the microwave irradiation can be used as an alternative to the autoclave-assisted digestion of soluble N to nitrate. For this purpose, 29 soil samples were collected from different climatic regions of Iran. Soluble N in the soil samples were extracted by 0.5M K_2SO_4. The alkaline persulfate reagent was added to the soil extracts and the digestion procedure was performed either by 30 minutes autoclaving (standard technique) or by microwave irradiation. In order to calculate SON, the soluble inorganic N was subtracted from total soluble N. For optimizing the microwave irradiation technique, various levels of microwave energy and different ratios of reagent: sample (R/S) were used. Results indicated that when the R/S ratio approached 2:1, the microwave energy 800 j g^{-1} was adequate to obtain a very highly significant correlation (r = 0.9, P<0.001) between the standard and the microwave-assisted technique. The regression equation obtained between the standard (Y) and the microwave-assisted (X) technique was as Y= 1.06 X, while the coefficient (1.06) was not significantly different from 1. A *t*-test revealed that the difference between SON values obtained by the standard and the microwave-assisted technique was not significant. Overall, our findings clearly demonstrate that microwave irradiation can provide a simple and rapid alternative for autoclaving in the procedure of alkaline persulfate oxidation of N and hence, can be satisfactorily used routinely for rapid and precise determination of soluble organic N in soil extracts.

S29 Time scales of pedogenic processes for predicting soil changes in time

S29.J.KL
Pedogenetic gold nuggets

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Predictive pedogenesis, prognostic premonitions, crystal-balling the future, call it what you will. We have been doing this for more than a century. Now it is pay-back time!
Thinking about monogenetic natural soils is an escape from reality, a generalization that pleases our sensibility of a universe of organized systematic interactions and fluxes of energy. Stop dreaming! How can our knowledge of pedogenesis become a meaningful, powerful force to help civilization continue to grow and develop? Can we effectively collect our scattered “nuggets of gold” to help create a treasure worthy of the legacy of our predecessors?
The fundamentals of pedogenesis are well known. Recognize accumulations of parent materials, estimate their original state, observe features that seem to be alterations of the parent materials into pedological features, develop explanations (multiple working hypotheses) and carefully evaluate them for probability and relevance of cause-and-effect relationships. Discard, modify, and synthesize results into better working models, continue testing to increase knowledge and understanding.
Survival of civilization depends on clean environments - air, water, food, and shelter; growth and development depend on social environments that permit us to strive to reach our human potential in a global community that values the harmony of man and nature. A modest approach begins with an “ideal soil” for a given purpose. Proper functioning of any soil relies on conditions that approach an ideal - that is when our knowledge is useful. Some soil properties change so slowly they appear to be static, others change rapidly and that is where human interventions can be extremely important.
Who will bring our collective knowledge together - who will package it to assist individual land users achieve success in managing soil resources for tomorrow’s civilization? We can begin to do it now - if not us, who?

S29.J.01
Rare - Earth Elemental Analysis as a Tool for Assessment of Chemical Weathering Rates of Eocene Flysch Deposits in Two Catchments in Istria, Croatia

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Geochemical research determined relative intensities of chemical weathering in neighbouring catchments of rivers Argilla, a tributary of the river Dragonja, and river Bazuja, river with a floodplain in the swallow hole (ponor) zone. Catchments differ by intensity of agricultural activity - Argilla catchment with high activity, while Bazuja catchment is mostly abandoned. Catchments are characterized with rapid denudation processes of flysch bedrock composed of turbidite deposits.
Recent weathering was evaluated using bulk chemistry analysis focused on rare earth elements (REE), major elements and zirconium at 32 sites. Land-use in Argilla catchment significantly contributes to amount of fine carbonate rich rock debris within the soil profiles. Result is a mass transfer 0 or slight accumulation of all major elements and REE in the surface horizons and the deeper 5-20 cm horizons. In the same horizons of the forest soils of Bazuja catchment mass loss of REE was 17.5% in the topsoil horizons, and 14% in the deeper horizons. During the weathering both in soil horizons and weathering rinds in corresponding calcarenite rocks the fractionation of REE occurs indicating a higher mobility of light REE than of heavy REE.
Changes in long-term weathering were evaluated through comparison of REE geochemistry and molar ratios of major elements in recent stream sediments, overbank sediment profiles in ponor zone and soil profiles. The REE geochemistry and molar ratios in the overbank profile of the ponor zone showed that the oldest sediments deposited are similar to present day Argilla catchment. The younger overbank sediments geochemically correspond to the eastern part of the Bazuja catchment.
The mass balance calculations show that flysch rocks and overlying soils are more intensively chemically weathered with significant base cation loses and enrichment of conservative elements (REE, Zr, Ti) in the soil profiles in areas covered by forest (the r. Bazuja catchment).

S29.J.02
Rates and characteristic periods of soil-forming processes activated due to windthrows in spruce forests at the Central region of Russia

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Periodically repeating in mature boreal forests windthrow is accompanied by deep disturbances of soils, background combinations of their local conditions and regimes, formation of windthrow soil patterns (WSP) in soil cover and sharp activization of different landscape and soil-forming processes.
Specific objectives of this paper consist in quantitative analysis of rates and characteristic periods of typomorphic soil-forming processes (SFPs) in chronosequences of WSP within mature spruce forests at the Central region of Russia. The basic researches were carried out in three types of forest ecosystems, distinguished by soil parent materials (silt loam: homogeneous, with moraine or fluvioglacial), soil profile and hydrology (from pale-podzolic to peaty gleyed textural-podzolic ones).
Morphogenetic analysis of microrelief, soil profile and cover were accompanied by researches of soil regimes (temperature, moisture, pH, oxidation-reduction potential, microbiological activity) and transformations of representative topsoil materials at the different stages of windthrow soil successions.
The carried out researches have shown sharp increase of rates of typomorphic SFPs within windthrow hole and mound soil successions: (a) lateral input of organic matter, clay and silt in soils of fresh holes - up to 2-3 kg $m^{-2}y^{-1}$; (b) fulvic acid formation - 100-200 g $m^{-2}y^{-1}$ in soils of young holes and mounds; (c) formation-accumulation of R_2O_3 and SiO_2 mobile forms, clay and thin silt at the open surface of windthrow «earthen wall» - correspondingly, up to 2 and 3, 40-50 and 26-30 g $kg^{-1}y^{-1}$; (d) lessivage and partluvation - 4 and 2 kg cm $m^{-2}y^{-1}$; (e) Al-Fe-humus migration - 0.7-1.2 kg cm $m^{-2}y^{-1}$; (f) clay transformation «montmorillonite → illite → montmorillonite» - 200-450 and 100-150 g $m^{-2}y^{-1}$; (g) eluvial horizon development - up to 1-2 mm y^{-1}.
The characteristic periods of investigated SFPs development within WSP varies from 3-5 years for gleyzation to 30-50 years for lessivage and 30-150 years for clay transformation.

S29.J.03
Weathering and soil formation along a volcanic climosequence in Northern Taiwan

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In mountain regions, soil formation is often affected by pronounced variations of climatic parameters within short distances; however, the pathways and rates of pedogenic development depend on the specific environmental conditions at a given location. In this study, we analyze mineral weathering and soil formation along a soil climosequence formed on volcanic deposits of approximately 300,000 yrs of age in the subtropical climate of Northern Taiwan. We sampled 6 pedons at elevations between 140 and 1090 m above sea level (asl), representing a climatic gradient from about 22°C mean annual temperature (MAT) and 2000 mm mean annual precipitation (MAP) to about 16.5°C MAT and 5000 mm MAP.
Soil mineralogy and the expression of andic properties show clear altitudinal trends. The high-elevation (>900 m asl) soils have high topsoil organic C contents (mean, 133 g kg^{-1}), low bulk densities (mean, 0.52 Mg m^{-3}), high P retention (mean, 90%), and classify as Andisols. They have considerable amounts of active amorphous constituents (allophane and ferrihydrite) and only traces of kaolinite and crystalline Fe oxides. By contrast, the low-elevation (<300 m asl) soils show lower topsoil organic C contents (mean, 52 g kg^{-1}), higher bulk densities (mean, 0.87 Mg m^{-3}), lower P retention (mean, 55%), and classify as Typic Inceptisols. Their colloidal fraction is dominated by kaolinite with significant amounts of hematite but only traces of allophane and ferrihydrite. The soils at intermediate elevation (440 m asl) take a middle position in pedogenic development and mineralogical composition and classify as Andic Inceptisols.
Our study shows that the different weathering regimes along the volcanic slopes have led to different pedogenic pathways favouring the formation of active amorphous constituents under cooler and moister conditions and crystalline weathering products under warmer and less moist climate.

S29.J.04
Soil history reconstructed by sediment analyses in the French Alps

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Only few paleoecological studies have attempted to reconstruct the history of soil genesis using geochemical analyses of lacustrine sediments. In a previous study, the geochemical investigation of eight subalpine soil profiles from the inner Alps allowed to define relevant proxies of podzolization and chemical weathering. Based on these proxies, secondary Al- and Fe-bearing phases, major elements as well as Rare Earth Elements (REE) analysis were performed on lacustrine and peat sediments samples in order to reconstruct aspects of pedogenesis during c.a. 5000 years. Evidence of changes in the proportions of secondary Al- and Fe-bearing phases as well as enrichment of different REE's fractions are preserved in the sediment record. This makes thus possible the reconstruction of soil genesis with a better temporal resolution than chronosequences approaches. The present results show that rapid or progressive processes have affected the elementary geochemical cycle within the catchment area of the Thyl lake during a period of 5000 years. Processes are obviously related to progressive pedogenesis expected after the deglaciation in such stable subalpine ecosystem. Consequently, the progressive setting of the mixed cembra pine ecosystem is associated to the progressive podzolisation process (proportions of Al- and Fe-bearing phase are maximal) and the increase of chemical weathering (enrichments of different REE's fractions compared to the unweathered parent material) that lasted totally ca. 1500 to 2000 years. These progressive pathways are followed by abrupt and rapid secondary processes that could result from drastic transformation of the plant cover with changes in fire regimes. The flat normalized REE patterns associated with low secondary Al and Fe values suggest a decrease of chemical weathering and podzolization. Moreover, the higher variability in cembra pine and the enrichment in sedge and other herbs remains in the lake suggest the setting of semi-open vegetation associated to the evidence of depodzolisation.

S29.K.KL
Soil and Soil-Like Systems and Bodies: Soil-Functioning and Soil-Forming Processes

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The essence and distinction of these notions and concepts are discussed as a contribution to the theoretical basis of pedology. ***Soil systems*** are perceived as any open four component bio-litho-atmo-hydro-systems functioning in any solid-phase substratum regardless of its pedogenic horizonation. When being close to 0-time, the soil systems have main attributes of bio-abiotic multiphase functioning although their solid phases have not yet acquired distinct pedogenetic horizons. A long-term *in situ* functioning of the soil system produces a solid phase ***soil body*** composed of the vertical sequences of (sub)horizontal genetic horizons generated by specific pedogenic processes. Soil bodies are obligatory ingredients of their particular soil systems, but they can also exist outside them: in experimental lyzimeters, soil monoliths, be fossilized, i.e. soil bodies can be either "living" or "dead".
The terms ***soil-like systems*** and ***soil-like bodies*** should denote formations having many soil features, but they are somewhat unusual or strange: aquatic soils, "ocean as soil", bottom sediments as "underwater soils", planetary regoliths as "lunar and martian soils", "soils" of greenhouses and hydroponics, young fertile fresh sediments both natural or technogenic. The notion of soil-likeness has a dual sense: ***functional*** - when soil-like systems have bio-productive functioning but have no pedogenic horizonated soil body ("aquic soils", 'soils' of hydroponics and fresh depositions) and ***structural***: - when exogenic solid-phase body develops in abiotic environment but have horizonated in situ genetic profile (abiotic horizons of weathering mantles, "lunar and martian soil" profiles). The processes of soil functioning and specific soil-forming processes are inseparably linked with each other, but drastically differ in terms of their substantial essence and rates. The former are diverse multiphase interactions among all four soil system components, the latter are processes transforming the parent material of soil systems into solid-phase soil body.

S29.K.01
Pedogenesis on two sequences of marine terraces in Southern Italy

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Two soil sequences on marine terraces - one near Metaponto, S-Basilicata, and one near Menfi, SW-Sicily - were investigated with regard to pedogenetic properties. The terraces near

Metaponto had previously been mapped and morphologically and sedimentologically investigated by Brückner, who distinguished one Holocene and eleven Pleistocene terraces, and assumed subsequent terrace formation. However, the sequence was later interpreted by Bentivenga and colleagues as single terrace body of Mid-Pleistocene age which had later been tectonically displaced so that the terrace fragments are nowadays located at different altitudes. The soils have developed in fine-grained terrace top sediments, overlying the main gravel body. The terraces near Menfi also developed during the Pleistocene; their ages were correlated with marine terrace ages in an adjacent area. Their soils developed on marine calcareous material and overlying fluvial sediments. In both areas, the soils can have surface additions of aeolian and/or colluvial deposits.
The soils of the Metaponto sequence show increasing decalcification, clay illuviation, rubefication, iron oxide formation and chemical weathering, while their silt/clay-ratios decrease from lower to higher terraces. In the soils of the Menfi sequence, these processes are already advanced on lower terraces, whereas only decalcification and iron oxide formation increase towards the highest terrace. Soil development is most advanced in the subsoils. Differences between soil and parent material are more pronounced in the Menfi sequence. Soil properties were converted into soil development indices (SDI). Soil horizons in both sequences were grouped into the following pedostratigraphic levels (PLs): [Ap-], [Bw- and Bt-], [Bk- and Ck-] horizons and [main gravel body/parent material]. The average SDI in the PL was related to the presumed terrace age. The results will contribute to the knowledge whether the marine terraces represent different time intervals of pedogenesis, or if some of them are of the same age and were later displaced.

S29.K.02
Pedogenic properties of surface deposit as evidences on landscape formation of the Tadu tableland in central Taiwan

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Tadu tableland is located at the deformation front of the western Foothills in central Taiwan. The surface of the tableland is covered by the reddish soils and/or gravels, and is folded with gently dipping toward both wings. Previous geomorphology studies suggested levels of fluvial terraces were developed on the surfaces of the tableland. However, different opinions and interpretations were proposed by geologists in recent years. This study attempts to solve the argument by examining the pedogenesis of the surface deposits.
Five soil pedons were sampled to the depth of C horizons from the surface deposits of the tableland, and three of them were further examined under microscopic scale. Strong weathering condition is indicated by the field and micro morphology. Their degrees in pedogenesis are equivalent based on the soil development indices determined by morphological properties. According to *soil taxonomy*, these lateritic soils are characterized and classified as Ultisols. The morphological quantification in terms of soil development indices (WPDI and HI) indicates all the soils of the Tadu tablelad are equivalent in degrees of pedogenesis. It suggests all the geomorphic surfaces on the tableland were probably developed at the same time or age, which rules out the previous interpretation of fluvial terraces developed on the tableland..

S29.K.03
Physical and chemical properties of soils on farmer's fields fertilized by solid urban wastes in the peri-urban area of Ouagadougou, Burkina Faso

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To improve crop yields in peri-urban areas of Burkina Faso, farmers use solid urban wastes (SUW) without any treatment. The effects of SUW on Physical and chemical properties of soil were investigated in farmer's fields fertilized with SUW for more than 10 years in the peri-urban area of Ouagadougou.
Soils were sampled on 8 adjacent plots, 4 plots fertilized with SUW and 4 without fertilization (control). Soil properties were analyzed such as soil morphological characteristics, bulk density, total C and N, organic and mineral C content, structural stability and texture. Weed diversity was measured. Crop biomass, grain, straw and roots were measured in glasshouses.
The results show that the plinthic or petroplinthic leptosols in control fields tend to have an anthropedogenic horizon in the plots fertilized with SUW. The difference is visible in the 0-5 cm depth layer. The soil bulk density (1,56±0,03 mg.cm^{-3} vs 1,30±0,07 mg cm^{-3}), the structural stability, the total carbon (1,65±0,08% vs. 0,56±0,07%) and the mineral carbon were significantly higher in the SUW plots compared to the control. A great amount of charcoal in SUW soils was noticed. Significant differences were also observed in Ca, CEC and total nitrogen contents in the subsurface horizon of the SUW plots. As a consequence there was more weeds and crop yields were higher in the fertilized plots. The importance of the C of 0-50 µm fraction and soluble C is shown in the particle-size fractionation. On the other hand, the fine fractions are relatively stable whereas important variations are reported for the coarse fractions. Overall, this study showed that the soils in the plots fertilized with SUW were markedly modified.

S30 Micromorphological and mineralogical features (evidence) of soil environmental change

S30.A.KL
How to read the book of soils?

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A specific constitution of soil forming factors, consequently promotes several soil forming processes. The ongoing of soil forming processes will change morphological features and therefore are detectable in soils. This hierarchical dependence is well known since long. Iron oxides are formed in soils, clay minerals are crystalised and aggregates are formed by biological and physical action. Under a certain influence of soil forming factors the soil tends to reach an equilibrium. However on its way it has to carry on the heritage of its primary conditions.

Therefore, from this heritage we can reconstruct the original condition of the rock.
In nature it seems to be impossible to reach ever an equilibrium, because conditions will change before. New materials, erosion events or transported soil material may change the conditions. After such a change the system will define a new equilibrium which it tends to approach. However from the time of the first change on, the soil carries a new heritage, mainly the morphological features, which document the first soil forming period. Now change could also occur when climate, relieve or man change there influence on the solum. However, each influence leaves its contributions to the memory. We rarely find a complete extinction of the historic paleofeatures.
Therefore soil mineralogists and micromorphologists have to act as detectives in order to read these message from the book of soils. In order to be successful one has to know the environmental conditions, which lead to certain features or minerals. One has to identify the sequence of processes and one has to separate single events from long lasting conditions. A good, often existing, example is the relation of clay skins and iron oxide coatings. Pore walls covered with iron oxide coatings and later with clay skins will have upwards water movement with gleysation and later downwards with clay illuviation. Iron oxide coatings above ar ready existing well developed clay skins, do show a sequence of downwards movement with clay illuviation and later occurring reductomorphic features with stagnant and/or ground water influence. Silt layers within thick clay skins show the occurrence of catastrophic events, which could mobilise even silt particles.
The lecture will give some examples of documentation of environmental change from paleo and recent soils of Southwest Germany from cretaceous period till holocene in a carstic environment, an example of development of intramountainous basins in Southern Portugal from miocene till holocene, the development of soils on volcanic ash at Lanzarote, Canary Island, from pliocene until recent and finally the documentation how a former Plinthosol through aridisation is turned into a proper Calcisol in a semi-desert of Central Australia. Furthermore it is emphasized to specify some general rules, how environmental change is implemented in our soils.

S30.A.01

Short time clay minerals evolution in a chronosequence of micropodzols in oleron island (France)

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Major weathering sequences in soils are well established; however the kinetics of these transformations remains unclear because it is often difficult to date precisely soil processes. This work was carried out on soils developed on recent and dated (< 188 years) sand dunes on the west coast of Oleron Island (France). The coast has been protected against marine and wind erosions by the settling of 5 consecutive barriers close to the coastline since 1820 (1820-1864-1876-1889-1945) that made possible to know the maximum age of the soils as before it was the ocean. The observed soils range from Arenosol on recent dunes (60-120 years), to well developed micropodzols (E and Bs horizons) on older dunes (188 years).
The soil samples had about 5% of clays, and 95% of sand; pH_{water} varied between 8.5 (C horizon) to 4.5 (E horizon). The mineralogy of C horizons was homogenous and constituted of chlorite, mica-illite and kaolinite with quartz, calcite (~10 %, shellfish fragments) and feldspars. The mineralogy of the E horizons is dominated by interstratified illite-smectite and smectite along with chlorite, mica-illite, kaolinite and quartz, smectite being more abundant in the older soils. In addition, the illite-smectite present in the E horizons correspond to regular interstratified, what is not common in soils, and that can correspond to earlier stage of weathering of muscovite into smectite. In the Bs horizons randomly interstratified illite-smectite are present with traces of smectite, and with Al and Fe oxi-hydroxydes as revealed by chemical extractions.
This chronosequence illustrates that over short distances and short time (< 190 years) intense minerals weathering and soil developments occurred. These features are suitable to study the earlier stage of soil development and mineral weathering in a natural system.

S30.B.01

Biotransformation of Fe oxides by Shewanella oneidensis

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Dissimilatory Fe reduction strongly influences the cycling of Fe and the degradation of organic matter under anaerobic conditions. At later stages of microbial reduction ceasing reduction rates are often observed, even when Fe(III) sources are not depleted and reducing conditions prevail. This study investigates, whether surface passivation, i.e. the formation of Fe(II)-rich coatings on the original Fe(III) particles might be a limiting factor in dissimilatory Fe reduction.
We performed incubation experiments with Shewanella oneidensis using acetate as the carbon source and goethite, poorly crystalline goethite, or ferrihydrite as electron acceptors. Solids were than examined by Fe-XANES to determine extent, arrangement, and mineralogy of newly formed Fe(II) minerals. Whereas literature suggests the formation of magnetite for the chosen experimental conditions, we found a couple of other Fe(II) phases in each sample. However, we could not identify these phases by comparison to our set of standards or to published spectra. The formation of new Fe(II) phases must therefore be explained by other minerals than magnet-ite, siderite, vivianite, pyrite, FeS, marcasite, or green rust. To investigate the spatial Fe(II) distri-bution we collected maps at different energies (pre-edge: 7110eV; high energy: 7200 eV; white-line Fe(II): 7127.5 eV, whiteline Fe(III): 7131.5eV) and maps of XANES spectra across individual particles. While very fine Fe(III) particles were not converted to Fe(II) phases, we observed that most of the larger particles (5-100µm) have been completely transformed or newly formed. Within the spatial resolution of the instrument (~1µm) XANES spectra and major element distri-bution of all investigated bioreduced Fe(II) particles did not differ between core and rim.
From these preliminary results we conclude that the mineralogy of the microbially produced phases is more complex than usually acknowledged and that Shewanella oneidensis does not produce Fe(II) crusts on Fe(III) oxides under the given experimental conditions.

S30.B.02

Mineral transformations in soils on mine spoils (*Technosols*) of abandoned pyrite mine in Wiesciszowice (Lower Silesia, SW Poland)

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Soils developed on spoils (*Technosols*) of abandoned pyrite mine in Wiesciszowice represent an initial stage of weathering (soil-forming) processes. That soils are strongly acidulated by sulfuric acid - the product of pyrite weathering.
In studied soils intensive mineral transformations involving weathering of primary minerals and formation of new secondary minerals are observed. X-ray diffraction (XRD) method was used to determine mineral composition of investigated rock and soil samples. Studies in scanning electron microscope (SEM) equipped in EDS system were also performed to observe a morphology of minerals and determine their chemical composition.
Primary rock from which pyrite was exploited, were deposited on spoils. That rocks mainly consist of quartz, trioctahedral chlorites, dioctahedral micas (muscovite and paragonite), albite and pyrite. In bulk soil material (<2 mm) both primary minerals (instead of pyrite, which underwent a decay) and a number of secondary minerals are present. Secondary minerals are represented by sulfate minerals (gypsum $CaSO_4 \cdot 2H_2O$, jarosite $KFe^{3+}_3(SO_4)_2(OH)_6$ and fibroferrite $Fe^{3+}(SO_4)(OH) \cdot 5H_2O$) and iron oxides (mainly goethite). In clay fraction (<2 μm) of investigated soils phyllosilicates inherited from primary rocks (chlorites, micas) are present as well as secondary clay minerals - illite ("illitic material"), kaolinite and smectite group minerals. Mixed-layered illite/smectite minerals are also present in clay fraction of soils.

S30.B.03
Direct X-Ray diffraction pattern fitting: an advance in the characterisation of soil clay minerals

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Clay minerals play a key part in major soil properties such as soil structure, organic matter stabilisation, CEC. X-Ray diffraction (XRD) is routinely used to characterize soil clay minerals; however, due to different pathways of their formation (weathering of primary silicates, nucleation-growth), soil mineralogy is often complex. The main difficulties are due to the presence of several clay mineral species which are often poorly ordered and interstratified implying wide and overlapped diffraction bands being hardly interpreted.
In this work, we applied, for the first time to soil samples, direct X-Ray diffraction pattern fitting that was developed for diagenetic clays and afforded great improvements in the identification of the mixed layer minerals. The fitting software directly compute a theoretical *(00l)* reflection set which is adjusted to the experimental XRD patterns obtained from oriented preparations in the air-dried and ethylene glycol solvated states. The crystallographic characteristics of the different clay minerals are adjusted to fit the experimental pattern. When achieved, the fit provides a semi-quantification of the different clay minerals involved in the calculation.
The studied soil is a tilled Luvisol overlying loess deposits (INRA Versailles, France). The clay fraction extracted from the five horizons (L_1, L_2, E, BT, BT/M) is composed of illite, smectite, randomly interstratified illite/smectite (60/40), chlorite/smectite (50/50) and two kaolinites of different crystallinity. The semi-quantification highlights that only smectite amount varies along the soil profile. In addition, the carbon content of the < 2 μm fraction is closely related to the variation of the smectite amount suggesting a strong link between carbon storage dynamics and smectites content in the deep horizons.
The direct fitting is a promising method to refine the interpretation of XRD patterns, identification and quantification of clays minerals, and especially poorly crystallized ones which constitute the most reactive part of minerals in soils.

S30.B.04
Assessment concerning the parent material influence on the clay quality from Romanian chernozems

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The paper is a comparative mineralogical study of clay fraction below 2μ separated from surface (A horizon) and parent material (C horizon) of a number of 61 soil profiles belonging to the chernozem type, located in different regions of Romania.
The clay quality (mineralogical composition) from the invesigated soils is quite similar, the principal identified clay minerals beeing illite, smectite (montmorillonite) and kaolinite. From the quantitative point of view, between the studied profiles, some mineralogical differences at the level of clay fraction can be observed. Sometimes these differences appear just within the same soil profile.
Assessment concerning the parent material influence on the mineralogical composition of soil clay fraction were accomplished by corelation attempts of certain parameters which express the clay quantity and quality at the level of both investigated horizons of the studied soils.
The results of these correlations show that parent material can influence the mineralogical composition of the soil clay fraction by means its texture (clay quantity) and mineralogy (clay quality). Thus for the both horizons, a linear relationship between the clay content and the dominant clay minerals was established. This relation was direct for the smectite and inverse for the illite. An increase of the clay content determines an increase of smectite/illite ratio, in spite of the trend of this ratio to indicate the lower values in the surface horizons, on account of natural (bioacumulation) and artificial causes (potassium fertilization).
The established direct relationships between illite, smectite and kaolinite contents from the parent material with those from surface horizons pointed out the influence of parent material on the mineralogical composition of the clay fraction from these soils and the role of mineralogical inheritance in the formation of clay fraction of chernozems.

S30.B.05
Micromorphological identification of various silica polymorphs in geochemically different environments and changing (paleo-)climate in southern Portugal

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In two adjacent areas, the Oriola Basin and the Sado Basin, situated in the Alentejo in southern Portugal, strongly cemented soils with duripans of up to several meters thickness are a common phenomenon. Previous studies described several forms of cementing agents, including carbonate, palygorskite, opal-A, opal-CT, chalcedony and secondary quartz.
The aim of the study presented in this paper is to investigate the factors which are responsible for the formation of different types of silica accumulations. The main focus is on the micromorphological description of silica accumulations in pedons along a transect from the western Serra de Portel to the west, through the Oriola basin into the Sado basin. A combination of chemical extractions for amorphous/poorly crystalline and adsorbed silica, SEM and EDX analysis and additional mineralogical and chemical methods is applied to complement the micromorphological results.
The data obtained so far imply primarily an influence of parent material and topographic position of the pedon on the type of precipitation. The age of the precipitates is estimated to late Tertiary, since they cannot be older, because they occur in late Tertiary sediments, and on the other hand, the main phase of duripan formation cannot have taken place later, because it

required warmer and drier conditions than the present. Although probably most of the observed accumulations are relicts of former environmental conditions, there is clear evidence of recent or subrecent formation of silica polymorphs as well. The latter is observed for example in a pedon including a palycrete more than 2 m thick. Palygorskite develops under semiarid conditions combined with high abundance of Si and Mg. Under the recent Mediterranean conditions, it is not stable anymore. Thus, palygorskite is transformed to smectite in the upper horizons of the profile, but, simultaneously, amorphous/poorly-crystalline silica is formed in pores of underlying horizons.

S30.B.06

Determination of multifractal spectra in three dimensional soil aggregate images

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Multifractal methods have a potential to be useful tools for characterizing spatial distributions of soil pores from microtomographic images of undisturbed soil cores and soil aggregates. However, most of the studies that apply multifractal analyses to soil images work with 2D image cross-sections. This raises a question of how informative a cross-section's data are for characterizing the entire 3D medium of soil aggregate or soil core. The first objective of this study is to apply multifractal analyses to the 3D images of soil aggregates and to assess usefulness of data from individual 2D cross-sections. The second objective is to examine the multifractal characteristics of the pore space in interiors and exteriors of soil aggregates. We will test the hypothesis that in well-formed stable aggregates the pore distribution in internal aggregate layers differ from that in external layers contributing to stronger inner core of such aggregates. Twelve aggregates ranging in size from 6 to 9 mm from Typic Fragiudalf soil under long-term row-crop agriculture were used in the study. The aggregate image data were collected on the bending magnet beam line, station 13-BM-D of the GeoSoilEnvironCARS (GSECARS) at the Advanced Photon Source (APS), Argonne National Laboratory (ANL), IL. Multifractal spectra for 2D and 3D images of the internal and external portions of the aggregates will be reported and discussed.

S30.C.01

Phytolith transport in sandy soil: experiments and modeling

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Soil phytoliths have been widely used in paleoenvironmental reconstructions. However, the mechanisms controlling phytolith distribution in soil are not well understood, which causes uncertainties in the interpretation of phytolith data. The objectives of the present study were (1) to determine vertical displacement of phytoliths by moving water in a sandy soil, and (2) to model phytolith transport for assessing the long-term phytolith distribution in sandy soil.
Six intact cores of Haplic Cambisol (27 cm length and 10.3 cm i.d.) were excavated in Schurwald, South Germany. Silica phytoliths were extracted from Phragmites australis and labelled by fluorescent dye fluorescein isothiocyanate. The labelled phytoliths were applied on the surface of each column. Three cores were periodically irrigated resulting in a cumulative water flux of 3600 mm, while three other cores were left without irrigation as a control treatment. The duration of experiment was 6 months. After the experiment was finished the cores were sliced into layers of 0.5 cm to 2 cm thickness. One sample from each layer was analysed for phytolith concentration in five replicates. A confocal LSM microscope was used for detecting the fluorescent labelled phytoliths and 3D image acquisition. The image processing was done using the ImageJ freeware code to obtain absolute number, size and shape characteristics of phytoliths in each layer. Finally the weighted mean travel distance of phytoliths was calculated. The effect of size and shape on phytolith transport is discussed. Phytolith transport was modelled using a convection-dispersion model with attachment, detachment and straining terms. The resulting set of differential equations was solved numerically using the package Berkeley Madonna 8.1. Our preliminary experimental results indicate significant translocation of phytoliths in sandy soil by percolating water. Hence, we expect the transport of phytoliths with the percolating water to be an important process of phytolith displacement in sandy soil.

S30.C.02

Semi quantitative analysis of clay illuviation in Alfisols of subhumid regions of northern Iran, Golestan

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Formation of argillic horizons in loess derived soils of Golestan Province was investigated. To evaluate clay orientation, four pedons from two different soil moisture regimes were studied using micromorphological techniques. Studied pedons were classified as *Hapludalfs* and *Haploxeralfs*. The precipitation evapotranspiration (P/ET^O) ratio ranges from 0.62 to 0.84 in the study area. The main objectives were to semi-quantitatively analyze the clay orientation and to study the micromorphological factors affecting the development of argillic horizons. The most developed clay coatings observed in the xeric moisture regime were thin and discontinuous, and generally associated with channels and chambers. Thick and continuous illuvial coatings with strong orientation pattern were observed in the udic regions where P/ET^O ratio exceeded 0.8. Occurrence of illuvial clay features associated with pedogenic carbonates in the same depth was found as one of the significant features of loess derived soils in the study area. The dominant microstructures were moderately developed subangular blocky indicating stress of micromass caused by high shrink/swell activity. The coefficient of linear extensibility ranges from 0.04 to 0.07 that demonstrate high shrink/swell potential. Clay coatings were observed mainly in soils with smectite and vermiculite as the dominant clay minerals. In the well-developed horizons, the occurrence of vermiculite clay mineral reduced the shrink/swell potential and increased quantity and orientation of clay coatings. In all pedons the clay increase and degree of orientation had a good correlation with the P/ET^O ratio but could be attributed to a particular genetic process. Both illuviation processes and shrink/swell activity have affected the orientation of clay coatings. Thickness and the area of the thin sections covered with clay coatings ranged from 20 to 300 (μm) and 2 to 10 % respectively. Clay orientation observed from weakly oriented, to strongly oriented associated with pedogenic carbonates in xeric and udic soil moisture regimes, respectively.

S30.C.03

Using ΔpH as a geochemical index of illite neoformation in saprolite

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Soil pH is routinely measured for agronomic purposes. When the difference between KCl pH and H_2O pH, or ΔpH, yields positive values, it is used by soil scientists as a classification criterion for identifying anionic subgroups according to the Soil Taxonomy or geric properties according to the WRB. Negative values have not been granted much attention. Here we focus on the occurrence of highly negative ΔpH values in the weathering zone of profiles developed on gneiss in semiarid Northeast Brazil and semiarid South India and interpret them as proxies of a geochemical weathering process involving the neoformation of illite.
Detailed optical, chemical and mineralogical characterizations involving scanning electron microscopy coupled with X-ray element mapping demonstrate the neoformation of illite inside plagioclase feldspar crystals after their partial dissolution. This study thus reveals that meteoric weathering is capable of producing illite not only from mica, *i.e.*, by a transformation process, but also within non-alkali feldspar by a neoformation process. The ΔpH is shown to be a good proxy for detecting such weathering signatures because the recently neoformed illite flakes, which present a significant compositional deficit in K, reveal their presence by a detectable uptake of K from the KCl solution. This finding changes the perspective over the origin of illite in continental environments, which has most commonly been attributed to hydrothermal processes.

Posters

(Please note that the posters are ordered by presentation number according to the postersessions during which they were presented)

S20 Soil Classification

P001
Genesis and classification of some soils derived from gypsiferous and calcareous material in Wadi el-Sheikh, Beni Suef, Egypt

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This study examined pedogenesis, of soils derived from calcareous and gypsiferous parent materials in Wadi el-Sheikh, opposite Al Fashn, Beni Suef, Egypt. The main objectives of this research were to study the relationship between clay minerals and physiographic units as well as the relative importance of key pedogenic processes in controlling clay mineralogy. Palygorskite, chlorite, illite, smectite, quartz and interstratified minerals were observed in soil samples, using XRD analyses. Gypsiferous soils showed more pedogenic palygorskite as compared to calcareous soils. Lithic Gypsicalcids and Calcigypsids, Typic Calcigypsids, Lithic Haplocalcids, Haplocalcids Calcic Haplosalids are the classification of the studied samples. Dissolution and transport of anhydrite from outcrops, is considered the main source of pedogenic gypsum in these soils. Micromorphological studies, of thin section observations indicated variable habits of gypsum crystals suggested a dynamic soil environment.

P002
Spectrophotometric method of Soil Classification

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For various types of soil by means of special spectrophotometer the packages of curves of reflection of electromagnetic waves in the field of a visible and near infra-red spectrum are received. On the basis of the complex analysis of the received curves factors of chromaticity, integrated factor of reflection are received. All factors compared to various characteristics of soil. Correlation dependences between reflective property of soil and various parameters of soil are established. For example, it is shown that between the contents of organic substance in soil and reflective ability of soil exists a feedback. The same connection exists and between reflective ability and humidity of soil.
Between the contents of carbonic calcium and factor of reflection of ground there is a direct dependence. Similar dependence exists between the contents of salts and factor of reflection of soil etc.
To differentiate a share of influence of each factor values of factor of reflection were used at various lengths of waves.
On the basis of the combined analysis the model for definition of color parameters of soils in three-dimensional measurement is offered, i.e. each soil type is characterized by three numerical values. Advantage of an offered way of soil classification that all types of soil are investigated in identical conditions.

P003

Using a geopedologic approach to increase soil- map unit purity: a case study of Aqqaleh area, Iran

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This research was conducted to investigate the capability of a geopedologic approach in increasing the purity of soil map in Aqqaleh area in north of Iran. The geomorphic units were delineated based on aerial photo interpretation, using topographic and geologic maps as auxiliary materials. Soil survey investigations were performed in sample areas and the results obtained were extrapolated to similar areas outside sample areas. Data were manipulated and analyses using ILWIS software package. A geopedologic map was produced, base of landforms in the study area and soils were mapped within each landform. The geopedologic approach used substantially enhanced the composition of soil map units and hence their use potentiality.

P004

An optimal approach for quantitative land suitability evalution using geostatistics, remote sensing (RS) and geographic information system (GIS)

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Land suitability evalution for sustainable crop production involves an effort to match the land characteristics with crop requirements. The objective of this study was to incorporate geostatistics, RS and GIS methods for improving the quantitative land suitability evalution in Arsanjan plain, southern Iran. The primary data was collected from 85 soil samples from tree depths (0-30, 30-60 and 60-90 cm) and the secondary information from remotely sensed data "LISS-III receiver from IRS-P6 satellite". In order to identify the spatial dependence of soil important properties for land suitability, we are used ordinary kriging and simple kriging with varying local means (SKVLM) methods. The SKVLM method is an interpolation that incorporates secondary information into the kriging systems for enhancing the spatial prediction in surface soil properties. The results indicated that best method with lowest mean square error for mapping pH and electrical conductivity (0-30 cm) obtained from SKVLM method in which spectral values of band 1 of LISS-III receiver used as secondary variable. Other soil properties indicated moderate to strong spatial dependence in tree depths and estimated in unsampled point by ordinary kriging method with reliable accuracy. The new proposed method used in this study, has applied the parametric methods on the density points (150×150m) that was obtained by kriging or SKVLM method instead of applying on the limited representative profiles conventionally. From GIS was used for overlying the data layer and producing the final suitability maps. The results indicated that accuracy of maps obtained from this approach in better than maps produced by conventional data. It could be attributed to this fact that changes in land characteristics even in the same soil units using this method could be as locally identified. In addition, this method can easily present squares and limitation factors of different land suitability classes with considerable accuracy.

P005

Proposed Canadian approach for enhanced A horizon designations for characterizing topsoil quality

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Land use and management practices impact on the physical, chemical and biological processes of the surface soil layer, the A horizon which is the soil layer essential for crop production and forest sustainability. Currently the Canadian System of Soil Classification (1998) includes designations (lower case suffixes) for the upper A horizon that describe the overall general feature related to soil formation such as the Ah (accumulated organic matter), the Ae (eluviation of materials) or in agricultural situations, the Ap (indicating disturbance by cultivation). Specific impacts on topsoil quality either from intensive and extensive long term management practices that are related to structural and chemical changes or the influences from climate change impacts on extent of biological activity or chemical processes cannot be fully captured with the currently available lower case suffixes for the upper Ah and Ap mineral horizon designations. The proposal presented will recommend two additional levels of description be added to the current Canadian system to enable specific field characterization of the extent of topsoil quality with respect to soil structure and reaction class attributes. This proposal is related directly to Canada-Germany projects on characterizing topsoil quality and humusforms on agricultural lands.

P006

The system of the land-capability classification in Poland

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The land-capability classification was being prepared in Poland in the period between 1956 and 1980. The legal act, which regulates the land-capability classification and sets forth the basis of the system of this classification in Poland is the Council of Ministers' Decree dated 4 June 1956 on land-capability classification, which amends in next years.
The database about soils, which comprises the land-capability documents and the land-capability maps at a scale of 1:5,000, constitutes a wealthy and very valuable source of data for land and buildings registration, soil protection and sustainable rural area development purposes.
These data may also constitute the basis for elaboration of database of risk areas, referred to in Thematic Strategy on Soil Protection. Within the time period, which have passed from the preparation of the land-capability classification, the use of land has changed significantly, which has often resulted in change of this classification. The introductory results of investigations indicate that, unfortunately, updated data concerning the land-capability classification and land use are not reflected on maps.

P007

Burnt soils and proposal of their position in National classification

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In a wide mine coal area we have estimated correlation relationships between natural and burnt soils. In that frame we compared physical, chemical and mineralogical characteristics in soil profiles on a sandy and clayish geological substratum. There are dominantly present Miocene lignite coal layers on deferent

deeps. All analysed soils are from Automorphic Division. As metamorphosed units we had in focus the soils which have been and which are recently under the high undergrounds temperature influents. Simultaneous description between natural and burnt soil characteristics are analysed by intervals from maximum to the minimum and for mean value. For mean value are given confidence interval P≥95%, standard deviation and standard error. We have established more unified of variable in a pyrogenic soil series on clay. Using ANOVA analyse we have established significant differences between natural and burned soils in a clay and skeleton content. Similarity or differences and their significance we have established using correlation analyses. According to finding results, we concluded that these soils could be separate as a new and independent component in National Classification System. Following this direction we have proposed the next:
- Investigated burnt soils belong to Automorphic Division,
- We suggest a new Class as a lover level from Division, that could be a Class of Pirosols,
- This Class could be divided on two sub classes (i) Metamorphosed soils dominantly influenced by up ground fire; (ii) Metamorphosed soils dominantly influenced by under ground fire,
- We suggest two type of soils as essential level; (i) relict Pirosols; (ii) recent Pirosols.

Lover classification levels from type of soils could be formed on the base of chemical and physical characteristics and content of skeleton.

P008
Correlation problems with WRB of some soils of the Sopron- Neusiedler See region

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The **"**Sopron-Neusiedler See" region is situated in North-western Hungary, with very diverse soil types developed on different geomorphological and climatical conditions. The cooler and more humid sub-alpine climate, and the metamorphic parent materials of the Sopron Hill area is characterized by different Luvisols, while the neighbourhood, the UNESCO World Heritage Neusiedler See region with warmer and more arid continental climate in the depressional landscape of old lake beds is typical of Solonchaks, Fluvisols and different Histosols.

The Hungarian soil classification system (HSCS) classifies soils based on the genetic principles of Dokuchaev. Categories of the system are based on the recognition of sets of soil forming processes, morphology, soil geographic approach and some laboratory data.

This system has served the nation well for several decades, but the present needs of the digital information based world require more definitions and quantitative limits, which make the classifier's decision objective and the correlation with diagnostic classification systems like World Reference Base (WRB) possible.

Based on the example of some soils of the Sopron- Neusiedler See region, the poster will present the classification problems of the HSCS, and it's correlation with WRB.

S30 Micromorphological and mineralogical features (evidence) of soil environmental change

P009
Major problems in quantifying amorphous silica in soils

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Si is the second most abundant element in the earth's crust and is released during mineral weathering and soil formation. Released Si may form silicic acid that can be dissolved or adsorbed to soil particles; some Si is consumed in clay mineral formation and some in formation of amorphous silica. Some Si is taken up by plants and returned to the soil through plant litter. To understand Si cycling in soils, methods for quantification of the different Si pools in soils, especially of amorphous silica, are required. Several extraction methods for the determination of amorphous silica in soils and sediments exist, using mainly NaOH, Tiron or Na_2CO_3. However, it is not clear yet, how the different extractants attack the sample components.

The experiments reported in this paper aimed on quantifying the effect of the most common extractants on various soil components. For this purpose, kaolinite, Ca- and Na-montmorillonite, allophane, microcline, phytoliths (obtained from horsetail) and silicagel were extracted at 85° with 0.1 M Tiron, 0.1M NaOH and 1% Na_2CO_3. Kinetic Si-release from these substances was observed in several extraction time steps (5 min., 10 min., 20 min., 30 min., 1 h, 3 h and 5 h). The time series showed that Tiron and Na_2CO_3 did not completely dissolve amorphous silica, but all three extractants attacked minerals, too. Hence, the contribution of mineral-Si in amorphous silica extraction needs to be considered and extraction results need to be corrected for this portion of Si. Such correction is common in marine sedimentology but not in soil science. However, the Si-release curves of minerals are not linear as presumed in the DeMaster extrapolation method used in marine sedimentology. The method is thus a better approach than the simple extraction used in soil science, but still does not yield exact amorphous silica contents.

P010
Impact of pollution on the clay mineralogical composition of some soils from Zlatna zone (Romania)

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Zlatna area is a high polluted zone with heavy metals due to industrial activity (extraction and processing of non-ferrous area). In spite of the fact that industrial activity was stoped for 2-3 years, the effect of pollution are still obvious.

The aim of this paper is to make evident some aspects concerning the impact of pollution on the mineralogical composition of the clay fraction (below 2µ) from some soils belonging to dystric cambisol and luvisol type.

From the chemical point of view, the effect of pollution is the acidifiation and depletion of bases, reflected by the decrease of values of indices which express soil reaction (pH) and soil exchange properties, especially in the surface horizon.

From mineralogical point of view, the acidifiation determines a strong alteration of primary minerals (micas and feldspars) and just of secondary minerals (illite), evolution beeing towards hydroxy interlayered minerals (intergrade) and kaolinite. As result of this alteration the content of kaolinite increases, achiving a double content in the surface horizon of some polluted soils. Sometimes kaolinite becomes the dominant mineral in the clay fraction of some strong polluted soil.

P011
Clay mineralogy influence on the physical and chemical properties of vertisols from Romania

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The mineralogical investigation of the 33 profiles of vertisol from Romania indicated that there are two principal geographical zones with vertisols (West and South) which present some quantitative mineralogical differences at the colloidal level. In spite of the fact that in all investigated profiles, the quantitative mineralogical composition of the clay fraction (below 2μ) was the same, (smectite, illite and kaolinite) the vertisols from the western zone show a higher content of smectite (montmorillonite) and a lower content of illite in comparison with vertisols from southern zone.
The correlations between some physical indices of soil and smectite quantity indicated that an increase of soil smectite content determines an increase of bulk density and compaction degree, concomitantly with a decrease of total porosity and air porosity.
The established relationships between some chemical indices and mineralogical parameters indicated that cation exchange properties and reaction of these soils appear more closely related to the quality (mineralogical composition) than to the quantity of clay fraction.
The empirical relationships established between physical and chemical indices of vertisols and mineralogical parameters suggest that in some cases, considered favorable, the clay mineral information could allow some predictions on the physical and chemical properties, in spite of the fact that such of predictions have a limited value from quantitative point of view.

P012
Black carbon fall out impact on soil life in Copsa Mica-Romania

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In the Eastern Europe countries, many factories were closed, leaving a polluted landscape. This is the case of black carbon factory in Copsa Mica, Romania.
The black carbon fall out was less studied, comparing with the others pollutants. At present, black carbon persistence in the landscape could have an important impact on soil life.
The objective of the paper was to analyze how harmful black carbon falls out is for the soil life and how long could endure its effects in Copsa Mica landscape.
Two soil profiles were made in the neighborhood of the factory, on Târnava Mare flood plain: one in the arable land, in the lower part of the relief; and the second in the forest, in a higher location, on the terrace slope.
The morphological observations in the field were corroborated with the micromorphological, physical and chemical data.
The micromorphological study on soil thin sections, pointed out that in arable land, the black carbon fall out is uniformly distributed in the soil matrix of the first 30 cm, giving to it a mollic like appearance. In the lower horizons it also appears in the randomly distributed rare lumbric coprolites as fine black mass and covering undecomposed vegetal remains.
In the forest, the black carbon fall covers all vegetal debris of the litter, as thin black films. In the lower soil horizon, the distribution is similar to the arable land, but fewer. It also appears as fine layers parallel to the soil surface, as a result of leaching.
This pointed out that under the "protection" of black carbon, the vegetal remains are less or no decomposed and the biological activity is very low. As a result, the endurance of black carbon effects in Copsa Mica soil and landscape will be very long.

S06 Soil and Water - Theory

P013
Derivation of Pedo-transfer functions for predicting soil retention curve in some saline and saline-sodic soils of Iran

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In many Studies, retention curve is used as basic dataset. But its direct measurement is cost and time consuming and needs special laboratory equipment. So in recent years many efforts have been done to predict it by using soil availability properties without direct measurement. Although the retention curve exhibit the relationship between metric potential and the amounts of water contents, it seems that *EC* and *SAR* affect pore size distribution and consequently the water content. In order to study the effects of *EC* and *SAR* on water contents 64 disturbed and undisturbed samples were selected from 0 -10 cm depth of saline and saline-solic soils. The retention curve was measured by using of hanging water column in 15, 25 and 55 *cm* H_2O also by pressure plate apparatus at 0, 10, 20, 30, 50, 100, 200, 300, 500 and 1000 *KPa* pressure heads. Regression analysis was made by stepwise method using *SPSS13* software. The water contents were used as dependant variables and soil available properties such as particle size distribution, organic matter, bulk density, Electrical Conductivity (*EC*), *SAR* and Calcium Carbonate were considered as independent variables. The results showed in these soils, *EC* and *SAR* affected the water contents in different pressure heads. Also there was a significant correlation (p=0.01) between the measured and predicted water contents in all pressure heads. In addition to clay percentage in all pressure heads was considered as independent variable for predicting water content.

P014
Prediction of soil retention curve in some saline-sodic soils of Iran by using of Rosetta software

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Indirect methods for prediction of soil hydraulic properties play an important role in understanding site-specific unsaturated water flow and transport processes, usually via numerical simulation models. In order to study the capability of Rosetta software to predict water retention curve in saline-sodic soils 30 disturbed and undisturbed samples were selected from 0 - 10 *cm* depth. The retention curve was measured by using hanging water column in 15, 25 and 55 *cm* H_2O also by pressure plate apparatus at 0, 10, 20, 30, 50, 100, 200, 300, 500 and 1000 *Kpa* pressure heads. The parameters of Van Genuchten equation (1980) were estimated by using bulk density and particle size distribution (sand, silt and clay) and by Rosetta software. Then according to these parameters water contents were predicted in different pressure heads and compared with measured contents. The obtained results in this study showed that Rosetta software could not predict the saturated water content (θ_s) well and the predicted values were less than the measured values in all cases. So when all four Vav Genuchten equation parameters (θ_s, θ_r, α, and n) were predicted by Rosetta software, the correlation between measured and predicted values of retention curve were not significant. It seems that swelling of studied soils leads to increasing of θ_s. But when θ_s was known (measured) and other three parameters (θ_s, α, and n) were predicted by Rosetta software, there was a positive and significant correlation between measured and predicted water contents in all pressure heads (p=0.01).

P015
Modeling soil permeability based on fuzzy system for calcareous soils in Marbore watershed, Iran

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Abstract
Measurement of soil permeability is a cumbersome and expensive in field. Therefore, there is a need to develop simple method for predicting soil permeability using easily measurable factors. The present paper has attempted to estimate soil permeability by sand, silt, lime and organic matter parameters using the soil permeability fuzzy model (SPFM). Singleton Fuzzyfier, minimum Mamdani inference engine and centriod Defuzzyfier were selected to determine soil permeability based on fuzzy system. The modeling was conducted using observed erodibility data of calcareous soils of Marbore Watershed . The soil permeability values of this model were also compared with direct measurement of soil permeability in the field with the analysis of residual errors. The results verified close agreement between estimated SPFM and observed data. Salient features of the approach and the results of the study are also presented in this paper.
Keywords: Calcareous soil, Fuzzy system, Modeling, Soil permeability, Iran.

P016
Response of soil dehydrogenase activity to varied conditions of water potential and oxygen availability

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The purpose of the study was to provide information about soil dehydrogenase activity at varied water potential and soil oxygen availability. *Eutric Fluvisol*, *Orthic Rendzina* and *Eutric Histosol* samples from two depths (0-20 and 50-60 cm) were tested. The relationship between volumetric water content and water potential (pF) were determined by use of laboratory set for: 0, 1.5; 2.2, 2.7 and 3.2 pF values. At mentioned pF values oxygen diffusion rate (ODR) was measured as well as dehydrogenase activity.
In the pF range from 0 to 3.2, the greatest changes in water content *(V/V)* were stated in *Eutric Histosol* from 40% - pF 0 to 9% - pF 3.2, then in *Orthic Rendzina* from 41% to 13% and the smallest in *Eutric Fluvisol* from 32% to 14% in surface layers, meanwhile, in deeper layers, values ranged from 27% to 13% , over 24% to 9%, till to 23% - 3% in *Eutric Fluvisol*, *Orthic Rendzina* and *Eutric Histosol*, at pF 0 and pF 3.2 respectively. At tested ranges of water content, ODR reached values from 32,5 to 98,2 $\mu g m^{-2} s^{-1}$ *in surface layer of* *Eutric Histosol*, in contrast to *Eutric Fluvisol* and *Orthic Rendzina*, where in the deeper layer, higher values of ODR from 24 to 103 $\mu g m^{-2} s^{-1}$ and from 13,6 to 113,8 $\mu g m^{-2} s^{-1}$ respectively, were registered. As a result of varied soil conditions the dehydrogenase activity response showed a tendency for higher activity at surface layers at the same pF=0 (from 150, through 36.3 till to 23.3 ($\mu g TPF g^{-1} min^{-1}) 10^{-6}$ for *Orthic Rendzina*, *Eutric Histosol* and *Eutric Fluvisol* respectively and, for lower one in the deeper layers in *Eutric Fluvisol*, *Eutric Histosol* and *Orthic Rendzina* (79%, 55% and 37%) respectively. Drop of enzymatic activity with decrease of water content were stated for all the soils.

P017
Evaluating local soil-root interactions with 3D plant scale models

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Three dimensional plant scale models based on water potential differences in soil and root allow us to assess the distribution of local soil-root water fluxes. We developed several models which explicitly consider the local conductivity drop below the voxel scale, occurring around extracting roots. Then, we compared how these local scales models, implemented in the plant scale model, will affect the plant scale behavior. Several criteria were used to compare the local scale models: sink term profile, time at which plant stress occurs and probability density function of water fluxes. Results show that after a certain moment differences in local uptake mechanisms will affect the water potential distribution in soil and root, and the root extraction pattern.

P018
Soil micromorphological features in soil hydraulic properties obtained using three various techniques

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The goal of this study is comparison of three methods for determination of soil hydraulic properties and utilization of soil micromorphology for explanation of preferential flow occurrence. The humic horizons of two types of soils (Haplic Luvisol and Haplic Cambisol) were investigated. Soil pore structure and porosity of all diagnostic horizons was studied in thin soil sections of size 7x4 cm. Soil hydraulic properties (soil water retention curve and soil hydraulic conductivities) were determined using the multi-step outflow method, the evaporation method and the ponding infiltration method. The multi-step outflow test was performed on the 100-cm3 undisturbed soil samples placed in the Tempe cells. Soil samples were initially saturated. Then several pressure heads were applied and outflow was measured in time using burettes. The evaporation test was performed on 525-cm3 undisturbed soil samples. Soil samples were initially saturated on the saturation pan. Then the soil sample bottom was sealed and water was evaporated from the soil sample top. Soil water content and consequently evaporation in time was determined gravimetrically. Micro-tensiometers were used for pressure head measurements at two positions in time. The ponding infiltration test was performed on 1125-cm3 unsaturated undisturbed soil samples. Ponding infiltration was applied on the top of the soil samples. Cumulative water infiltration and outflow at the bottom were monitored. Pressure heads were measured at two positions using the micro-tensiometers. In all cases the single-porosity, dual-porosity and dual-permeability flow models in HYDRUS-1D were used to estimate the soil hydraulic parameters from the laboratory transient flow data via numerical inversion. Depending on maximum soil sample saturations reached during the different experiments, various fractions of macropores (large capillary and gravitational) were involved in flow processes (reflecting preferential flow) and incorporated in the numerical inversions. However results strongly depended also on sample sizes, flow regime and assumed simplified conditions.

P019
Verification of capillary crumbling model for estimation of optimum soil water content for tillage in western Iran

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Optimum water content for tillage (θ_{opt}) is defined as the water content at which tillage produces greatest proportion of small aggregates. A physically-based approach was introduced by Koolen and Aluko (2000) [*Aluko, O.B., and Koolen, A.J., 2000. The essential mechanics of capillary crumbling of structured agricultural soils. Soil Till. Res. 55, 117-126*] and tested on a silty clay loam soil in the Netherlands. This approach is named in this study as "capillary crumbling model (CCM)". Briefly, a water content (i.e. θ_{opt}) might be defined, according to this approach, at which capillary bonding strength between aggregates is minimum. There is no quantitative information about the θ_{opt} in western Iran. The objective of this study was to investigate the suitability of CCM to determine the workability limit (i.e. θ_{opt}) of ten selected soils ranging from sandy loam to clay in Hamadan Province, western Iran. Intact soil aggregates (0.5-4.75 mm) were compressed by confined compression, at a constant initial soil matric suction of 50 kPa, to a defined bulk density (90% of critical bulk density for root growth). The compressed soil cores were allowed to dry uniformly in free air, and tensile strength of the cores was determined by the indirect Brazilian test upon drying. The matric suction was determined immediately in the fractured samples using a minitensiometer. The θ_{opt} was considered the matric suction or water content, at which, a fall in the tensile strength was recorded. The θ_{opt} values were found at matric suction in the range of 55-61 kPa corresponding to 0.91-0.79PL (where PL is the soil plastic limit) which were in agreement with the published values on soil workability limit. The results showed that the CCM might be recommended as a physically-based method for determination of θ_{opt} in the region, and the correlation between θ_{opt} and PL was satisfactory.

P020
Physical-statistical model of dielectric permittivity in soil

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The dielectric permittivity is an important physical quantity which describes the ability of a material to polarize in response to the electric field and is used to determine water content of porous media. The measurements of this quantity in terrestrial and extraterrestrial conditions require different probes and the results are presented as mean values. Because wide use of the measurement methods is limited with respect to space bodies, the use of the model approach can be useful alternative. Moreover, the model approach enables to obtain expected value of the permittivity and evaluate the content of particular components of the given porous medium. The aim of this work is to determine the dielectric permittivity of various porous media using time domain reflectometry (TDR) and comparison of the observed and predicted data using the physical-statistical model. The model is built as a mesh of elementary electric capacitors in a way enabling expressing porosity and other physical conditions. The assessed permittivity is dependent on the water contents, the bulk density, the specific surface area of grains and the temperature. For the fine grained media, as characterized by a greater specific surface area, this increase was lesser at lower than higher water contents. This lesser increase resulted from decrease of the dielectric permittivity of water bounded on the grain surfaces. In the case of media consisted of coarse grains increase of temperature caused drop of the permittivity to a higher degree at high than low water contents. However, in the fine grained media, increase of the temperature resulted in a greater and somewhat lower permittivity at low and high water contents, respectively. The physical-statistical model predicts the dielectric permittivity well for the porous media and can be useful for validating the electro-magnetic surveying by the remote sensing means.

P021
Model analysis of water balance sensitivity to uncertainty in plant root distribution under different climate, moisture and soil conditions

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Water uptake by plant roots is a major component of the water balance in the Soil - Plant - Atmosphere - Continuum. Optimizing the allocation of soil water resources to plant uptake and minimizing evaporation losses is of great importance in crop production. Generally, in modeling studies root water extraction is integrated as a volumetric sink term in the Richard's equation and related to measured root density distributions in the soil profile. Substantial uncertainty in this extraction term arises from hesitance about the most appropriate root morphological parameter to be used, high spatiotemporal variability of rooting patterns as well as shortcomings in the methods of root observation.
The main objective of this work is the quantification of the effect of different root distributions on water balance estimates. Based on simulations using the software package COMSOL Multiphysics, we will analyze the sensitivity of the water balance components to changes in root distribution under different boundary conditions and soil properties, *i.e.* varying soil texture, moisture and climatic regimes. Particular attention will be given to root distribution effects on the relationship of productive water uptake by crops to evaporation losses from the soil surface. Plant rooting patterns will be described using mathematical functions for increasingly complex distributions. Thus, their parameterization would require higher depth resolution of root sampling in water balance field studies.
The results will allow deriving recommendations on sampling resolution requirements for the plant root system based on previous knowledge of site specific soil and environmental characteristics. These conclusions from the simulation study will be tested for available data sets of field experiments.

P022
Monitoring soil solution electrical conductivity in agricultural field

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One-time electromagnetic induction surveys of soil apparent electrical conductivity (σ_a) have been applied to assess soil salinity and for fertilization control in precision agriculture. As far, no reports are available on automatic monitoring of soil solution electrical conductivity (σ_w). We applied conductivity forks (by the Geological Survey of Finland) with a half-space Wenner set-up to monitor 3-hour-changes in the soil σ_a of agricultural field in mid-boreal (61°53'N, 27°53'E) Finland. The site had been three years on grass, tilled in fall 2006 and cultivated with wheat in spring 2007. No fertilization was applied. Test pit was excavated on the down slope (5%) position and the conductivity forks were installed horizontally into soil sequences (30-, 60- and 90-cm-depths). The fine fraction contents were 14%, 22%, and 20%, respectively. Each fork composes of four 15-cm-long steel rods with 16-cm-spacing. In order to obtain soil solution electrical conductivity (σ_w) our experimental set-up also provided simultaneous data on soil water content (CS616 reflectometers), and stored with CR10X-loggers (Campbell Scientific Inc). The σ_w-data from October 2006 until October 2007 and with 3-hour daily intervals indicated that snowmelt brings a substantial dose of electrolytes into all soil layers of the barley field. This eventually is due to low pH of snowmelt water (pH≈4.5). Tillage changed the soil structure and lead to another anomalous rise in the soil σ_w at 30-cm-depth occurred in June-July. We argue that till-treatment had altered surface runoff conditions hence posing a risk to the depletion of nutrients.

P023
A 3D structural model of a lignitic mine soil based on classification and interpolation of profile images

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A 3D structural model describes the spatial arrangement of solid phase components, geometries of layers and system boundaries and is a prerequisite for any flow and transport model. Observations on soil profiles (e.g., vertical cross-sections of soil trenches) provide information on the relevant structural features, but are mostly qualitative and inherently 2-dimensional. The objective was to develop an image analysis approach for identification and segmentation of 2D structural units and subsequent identification of 3-D regions of relatively 'uniform' soil hydraulic properties. Here, five vertical soil profiles from a soil monolith (3 m3) sampling were used. The pictures were from a lignitic mine soil near the city of Cottbus, that features complex, yet regular structures as a result of the mechanical deposition of overburden as well as smaller-scale heterogeneities by embedded lignitic fragments within a sandy soil matrix. Six-seven structural units were identified as areas of similar gray scale properties and segmented by a supervised classification based on spectral properties of individual sediments from the digital profile images using ERDAS Imagine. The 3D interpolation between the identified 2D structural units was carried out using 3D-GIS software GoCAD assuming different spatial relations for each class. The resulting 3-D model reveals the spatial arrangement of hydraulically relevant structural units such as inclined layers, root channels, or lignitic fragments. In a second step, the gradients along inclined sediment boundaries (here possibly representing a preferential flow domain) were segmented and 3D interpolated as well. Both distributions provide the hydraulic structure for 2D dual-permeability modeling. The structural model can improve identifying 3-D preferential flow paths in heterogeneous soil by utilizing additional information from images of soil profiles.

P024
Rainfall electrical conductivity evaluation in two different locations in South Brazil

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Electrical conductivity (Ec) is used to measure the amount of salt in a solution. When the amount of salt is high, highest would be the Ec. The excess of salt in the roots zone, damages the germination and the plants development, because a high salt concentration requires more energy to water absorption (osmotic effect) damaging is essential metabolic processes. The study was conducted from September, 2006 to August, 2007 in two different areas: a) open field area near a Seasonal Deciduous Forest in Itaara, RS and b) open area close to an eucalyptus plantation area in Candiota, RS. The average values for E.C. in site A was 29,28μS/cm (highest value in September, 2006 (102,41 μS/cm) lowest value in December, 2006 and March, (4,60 μS/cm). In location B, the average was 51,94 μS/cm (highest in September, 2006 (123,14 μS/cm) and lowest in April, 2007 (28,34 μS/cm). It is possible to assert that the differences in EC values between the locations is due to the fact that the rainfall volume is considerable higher in location A when compared to location B, because as high as the rainfall is, the lowest would be the electrical conductivity.

P025
The effect of debris layers on the water balance of an urban soil profile

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Urban soils in cities that have suffered from damages during the Second World War often
contain strong layers of debris of very heterogeneous materials. These are generally coarser
than the surrounding soil matrix but may also contain porous debris such as clay bricks which
under certain conditions can take part in water flow processes in a soil.
A soil profile in Berlin containing a debris layer of about 20 centimetres at a depth between
30 and 50 centimetres below the ground has been instrumented with 54 TDR-probes. 42 field probes were
located above and below the debris layer across a profile of 80 cm depth and 90 cm width. In
addition, 12 laboratory probes were built in the upper three centimetres of the vegetated soil
profile. During various storm events and some irrigation experiments, changes in water
content have been detected at high temporal resolutions across the whole profile. The focus
analyzing this data has been put on the effect such a debris layer has on the water balance of
the soil profile. Based on the measuring results, we try to reproduce the processes within the
numerical model Hydrus 2D.

P026
Laboratory-scale modelling and observation of LNAPL - APL transport in porous media

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Crude oil (petroleum) derivatives are widely used liquids in our modern lives. The chemical structure of petroleum is composed of hydrocarbon chains of different lengths. The distillation process in refineries is the tool to get different liquid derivatives

(fuels, olefins, lubricants and others). These liquids are known as Non-Aqueous Phase Liquids (NAPLs). Current consumption of these NAPLs has brought great convenience to our lives, but on the other side, their use may result in contamination of the environment (soil and groundwater). According to US EPA, recovery of a product above the earth surface, surface water bodies, and/or sewers are relatively routine operations, and effective methods for cleaning up are well established. Recovery of NAPLs from the locations below the earth surface, like soil or rock profiles is usually much more difficult, more costly, and less effective. Therefore, the observation and sampling (extraction) of the mixture of liquids from porous media is an important tool for the NAPL - water (or Aqueous Phase Liquids - APLs) joint transport observations.
This study is focused on water and light NAPL (LNAPL) movement through the porous system. To observe the movement, laboratory experiments on a simplified model of soil profile using sand with known properties and oil as a LNAPL were carried out. The main aim of the experimental work is to identify a simple suitable method to extract a two-phase solution (LNAPL + APL) from the soil porous system under laboratory conditions at the certain time intervals. Activated carbon was employed as an adsorption medium. An amount of adsorbed LNAPL - water solution was determined and analysed with respect to the proportional representation of both liquids. A new sampling method has been developed. It was proven that with this method using activated carbon as an adsorption medium is possible to sample LNAPL - water solution at the regular time-intervals.

P027
Design and analysis of structures in and on expansive soils

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Many engineered structures in arid and semiarid regions suffer sever distress and damage due to expansive soils. The change in moisture content produce deformation in the soil during the swelling and shrinkage processes. Major damages can be avoided if the moisture content is kept stable. Damage from shrinking and swelling soils can also be reduced or prevented with proper foundation design. The initial additional cost of a properly designed foundation offsets the potential for extensive damage to the structure without reinforced foundations. Several design alternatives are discussed in this paper. The application of the empirical methods, closed form solutions and numerical procedures for analysis of structures in and on expansive soils is described and followed by the a discussion of the design of those structures sustained on such soils.

P028
The occurrence of soil water repellency under different vegetation and land uses in central Iran

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Soil water repellency is a phenomenon which affects many soil water processes including infiltration and solute transport. This conracteristic is often recognized at surface layers of soils which dry out frequently. The degree of water repellency of a soil can be measured by using the water drop penetration time (WDPT) test. Soil water repellency has not been reported in Iran. The purpose of present study was to test water repellency in some arid Iranian soils, and to investigate the effect of change in land-use, on water repellent soils. The persistence of soil water repellency was measured on field-moist and dried soil samples from forest, unaltered pastures and cultivated lands in semi-arid regions. Water repellency is observed in forest, but has not been observed in pasture and cultivated lands. Water repellency was not found in soil samples containing less than 4.1% organic matter. By increasing soil organic matter, soil water repellency intensity increased, too. Water drop penetration time in samples under the trees was higher than far from trees. Samples with more than 4.3% organic matter were slightly water repellent and samples with more than 4.6% organic matter were strongly water repellent. Overall in the region a severely water repellent soil was not found.

S19 Soil Forming Processes and Soil Morphology

P029
Surface water chemistry: the key to partitioning matter sources and assessing carbon cycle parameters

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Chemical composition of surface water (SW) is the result of soil solution interaction with soil matter. In unpolluted areas, the most important solution reactant is carbon in the form of carbonic and carboxylic acids. Weathering results in cation release due to hydrogen interactions with minerals and formation of secondary minerals, if reaction products such as aluminum and iron are not sequestered into soluble organo-mineral complexes. Base cations (BC) and hydrocarbon ion are leached out from profile and complexes are adsorbed by soil. Some organic carbon is washed out from soil (DOC). This study was aimed at partitioning sources of dissolved matter flux such as weathering, atmosphere and subsoil water (SBSW) and roughly estimating the value of carbon fixation in soil. Estimates were based on quantifying the amounts of 1) total carbon reacted with minerals and 2) organic carbon leached out from watershed. The first was characterized by the value of riverine Acid Neutralizing Capacity runoff (ANC_{runoff}, eq = ([BC] - [strong mineral acid anions]) x runoff volume) expressed also as carbon of acid functional groups - 6ANC. For soils containing strong mineral acid anions, rainwater concentrations of these anions were used for ANC calculations instead of riverine ones. The second was evaluated using DOC concentrations. Weathering (including SBSW cations) is characterized by ANC, atmospheric deposition calculated as the difference between total BC runoff and ANC. Since the only water supply under the ice is SBSW and its only DOC source is soil percolate, the contribution of SBSW in the studied period is calculated as the ratio between winter average DOC runoff normalized to 6ANC (DOC/6ANC) and DOC/6ANC value in the studied period being the mixture of SBSW and "SW" DOCs. The carbon fixation is preliminary estimated using organic acids contribution to weathering, ANC and DOC acidity.

P030
Soil evolution in a dune coastal ecosystem of north-eastern Sardinia

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In Mediterranean climates soil evolution of coastal dunes remain only at low grades of development, but environmental gradients in these ecosystem are usually pronounced: this characteristic can leads to the existence of several kind of soils and plants

associations in short time and very reduced space. For these reasons soils of dune coastal system are ideal to study characteristics like: soil-plant relationships, the influence of micro-topography in soil evolution, the rule of the soil in influencing the characteristics of the ecosystem. In addition, dune coastal ecosystem are considered very important habitats for biodiversity conservation and human recreational use: from this point of view these environments are under a very high pressure in the Mediterranean coastal areas, like Sardinia, due to intensive urban development for tourism purposes.
The aims of this research were to evaluated the soil evolution in a coastal dune system, located in north-eastern Sardinia, in relation to the micro-topography, vegetation type and level of human pressure. Several profile were described, analysed and classified according to Soil Taxonomy and WRB. The soils generally showed scarce development, with an O-OA/A-C type profile. In some soils a buried horizon, with a higher organic matter content than the actual epipedon, was identified: these horizons can be considered as an evidence of a dense ancient vegetation cover, which was probably destroyed to facilitate the reforestation with Pine trees.
The effect of recreational impact on soil is clearly evidence in the upper part of profile: in these horizons (O/OA), organic matter content were lower on areas subjected to high visitor pressure than that on low use. This fact in vary important in the stabilised sand dunes because after the organic horizon destruction is possible to observe a more rapid transition on unstable sand dune.

P031
Chronosequential alterations of properties of post-agrogenic sandy southern taiga soils of Russia under self-restoration

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Until recently a lot of arable lands were abandoned due to different reasons (wars, economical and ecological crises, intensification of agriculture) in many countries of the world. Consequently, the soils of these abandoned sites went into the process of natural restoration (self-restoration).
We studied succession of vegetation, profile morphology, soil carbon (SOC) store, contents of nutrients, pH, CEC and exchangeable cations of post-agrogenic sandy soils under self-restoration of the southern taiga in the European part of Russia. The ages of abundance of the post-agrogenic soils were 4, 20, 55, 100 and 170 years. One actual arable soil and one natural soil, never been cultivated, were included in the study as a control.
The laboratory investigations are still on going and will be presented in Wien. Alterations in soil morphology and vegetations are the following. After 4 years under self-restoration the soil showed no alteration in soil morphology, whereas the vegetation changed from crop to a rural appearance. After 10-20 years a meadow vegetation with single small pines came up and the top soil showed changes in respect of a more intense rooting and decreased bulk density. After 50 years the vegetation showed a young pine forest with dwarf-shrubs and moss and the soil - a slight bleached horizon, while the clear ploughing boundary was still pronounced. After 100 years a mixed pine and spruce forest was developed and a small Podzol-like profile was formed in the top of the still well visible relic ploughing horizon. After 130-170 years spruce forest came up and the ploughing horizon was still well visible, indicating a low rate of self-restoration for Podzols.

P032
Genesis and characteristics of clay rich subsoil horizons in two soils on limestone at the Teutoburg Forest/Germany

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In the Mesozoic and hilly region of North Germany limestone soils covered by an upper layer of loess are frequently found. Soils forming from these parent materials often show a clay poor topsoil horizon over a well developed clay rich subsoil horizon intruding into the limestone. The development of these clay rich horizons is still not clarified and especially in North Germany these soils are not well investigated and described. Two genetic processes are possible: clay illuviation from the loess layer or residual clay accumulation from limestone weathering. A lithological stratification is also to consider. The aim of this contribution is to describe the development and characteristics of these clay rich subsoil horizons. For this reason several soil profiles distributed over the hilly region of Northern Germany where analysed. This paper presents the results of two representative soil profiles 160 m and 198 m above sea level on an southwest slope of the Teutoburg Forest near Bad Iburg. Chemical, physical and mineralogical examinations where conducted on every soil horizon and the limestone residues (after dissolving the carbonate): pH-value, organic content, carbonate content, dithionite and oxalate extractable iron, cation exchange capacity, soil texture, bulk density, water tension curves, total element content measured by X-ray fluorescence, quartz and clay mineral content by x-ray powder diffraction and analysis of soil thin sections. The results show that the soil was formed by several different influencing variables: Clay illuviation and clay accumulation are both important factors, but also bioturbation, tree uprooting, illuviation of silt and solifluction. The data also give indications about the age of the soil.

P033
Unmixing parent materials of soils using linear combination of sand fractions on a catena in western France

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The study took place in France, in a sedimentary area, thin layers with different facies, in the Paris Basin. The data were obtained from field study, along a lithotoposequence, i.e. a serial arrangement in which geologic layers and soils are ordered logically along the main slope. Nine pits were dug enough to reach the bedrock. Each horizon and bedrock, which is a potentially parent material, was described and sampled. We used eight fractions of particle-size distribution measurements to characterize these samples along this lithotoposequence. Two quantitative indicators, based on the skeleton fractions (2 silts and 5 sand fractions) are used to compare (1) each horizon to the different parent materials and (2) each horizon to the neighboring bellowed horizon in all soil profiles.
The results determine, for each profile, the range of (1) allochthony or autochthony, and (2) soil heterogeneity or homogeneity. In some cases, horizons were not in correlation with the bedrocks characterized but were a mix of those materials. To quantify this mix, we solved mixing equations.
In conclusion, thanks to particle-size distribution measurements, we were able to characterize and quantify the origin of soil parent materials and to understand pedogenesis. In our case, the deposits create mixing rather than superposition. From these results, we propose a soil spatial organization model which summarizes 1) the regional soils distribution, and 2) the possible pedogenic scenario through time.

P034
Phosphorus compaunds in soils with bog iron ore horizons or iron precipitations

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Searching was conducted on soils located in Warsaw and Brwinow in central Poland. Mineral phosphorus compounds (according to Chang and Jackson procedure) were studied in soils with clear bog iron ore horizons (containing >20% Fe_2O_3) and in soils with only iron precipitation (containing <20% Fe_2O_3). Differences in amount and rate of phosphorus forms to total quantity of this element in these two groups of soils were recognized.
Poor alluvial or glacial sands were parent materials, but specific hydrographic condition led to form horizons of higher than usual iron and phosphorus concentration. Total P in soils with bog iron ore (bio) ranged from 12.49 up to 24.33 g P kg^{-1} in Box or Aox horizons whilst only 0.11 - 0.53 g P kg^{-1} in silica horizons. Soils with lower iron accumulation contained less total P: 0.44 - 6.42 g P kg^{-1} in 'ox' horizons and 0.08 - 0.66 g P kg^{-1} in silica horizons. Fe-Po (occluded) was main P form in bio horizons. Share of other forms was balanced.

P035
The impact of carbon management on the soil's macropore structure in an orchard

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Sustainable fruit production depends, inter alia, on the integrity of various soil functions. These soil functions in turn directly depend on the soil's structure. A necessary step to create eco-efficient techno-gardens for the future is to identify how we can preserve and manipulate soil structure by management practices.
We investigated the impact of soil carbon management on soil structure by comparing the soil structure in the top 100 mm of the soil in the tree row of two adjacent apple orchards in Hawke's Bay, New Zealand. One is an organic apple orchard that conserves carbon by regular compost applications and growing pasture in the tree row. The other is an integrated apple orchard without any external input of organic matter, with regular herbicide applications in the tree row, and drip-irrigation. Both orchards have operated in these ways for at least 10 years, and both have the same soil type (Fluvisol) and texture (silt loam), and they were both previously used for market gardening. The soil organic carbon contents, microbial activities and density of anecic earthworms in the topsoil were significantly higher in the organic, rather than in the integrated apple orchard.
We used the geometry of the macropores (>0.3 mm) as an indicator for the soil's structure. The 3D macropore networks of nine undisturbed soil cores were derived with X-ray computed tomography for each orchard system. We found that both the macro-porosity and the connectivity of macropores was higher in the organic orchard. However, the macro-pore size distribution was similar in both systems.
We will discuss the consequences of the morphological information for soil functions, for example the soil's gas exchange with the atmosphere. From this information we will try to identify which macropore structure, and, thus, which soil carbon management is superior.

P036
Soils of temporary ponds in the Doñana National Park (SW Spain) - Morphological traits and water persistence

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Within the National Park of Doñana (SW Spain) there exists an important system of temporary ponds with more than 4000 water bodies (in wet years). Most of the ponds are filled with autumnal or winter rains, and depending on their location and depth present a different hydro-period, some of them lasting up to early summer. The temporary ponds system favours the presence of a very high diversity of amphibians and macroinvertebrate species (some of them protected or rare), and its study is considered as an important goal in the wildlife diversity protection.
Soil processes occurring at the ponds are being studied to elucidate which are the main facts that favour the water maintenance or desiccation of a pond, as this information is basic to explain the actual hydrodynamics of the area.
The ponds are formed on aeolian sands, where water persistence is related to different factors, among them proximity of the water table, presence of an argilic horizon, and / or presence of a granulometrical discontinuity (a relict horizon).
The soils of 20 ponds have been studied doing a preliminary field work of more than 60 boreholes in the deepest part of the ponds during the dry period. Each horizon has been described, sampled, and analysed.
The morphology of the soil profile, based on the similarities and/or differences among the different geomorphological units, allows the following typification:
1.
Ponds placed at the border mobile dune system - eroded sand sheet
2.
Ponds placed on the eroded sand sheet
3.
Ponds placed in the contact area stabilized sand dunes - marsh
The origin of the granulometrical discontinuities in the horizon and their significance in soil processes and characterization is discussed, as well as the relationship between soil properties, geomorphological position in the landscape and water persistence.

P037
Soil development on spongilitic marlstones in natural and human impacted systems at selected localities of Prague (Czech Republic)

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Parent material is a starting point for the process of soil formation. The ways in which bedrock is converted to soil vary considerably. The type of soil genesis is determined by the stability of soil-forming factors. A change in this stability can provoke different types of pedogenesis on the same type of parent material. This contribution showed differences in the set of specific pedogenic processes on spongilitic marlstones in natural and human impacted systems. The most characteristic soil sequences are situated in the protected and agricultural areas in the NW part of Prague. Leptosols and Cambisols were identified in the protected areas. Human impacted systems were covered by Cambisols. Soil development was evaluated on the basis of particle-size distribution, chemical properties (pH, $CaCO_3$, Fet, Feo, Fed, CEC, exchangeable cations), soil organic matter (Cox, hot-water extractable carbon, Nt), mineralogy of clay fraction, macromorphological and micromorphological analyses. The difference in soil development in the protected areas was controlled by relief. Human activity has an emphatic significance on the values of pH and the uniformity of the set of specific pedogenic processes in the case of Cambisols. The results revealed differences in the qualitative and quantitative parameters of soil organic matter in agricultural landscape and in protected areas. Specific pedogenic processes of the litter formation and humification in natural conditions were replaced by ploughing disturbance in agricultural areas.

P038
Meliorative memory of gypsic pedofeatures

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At present, a bulk of materials has been accumulated to judge about gypsic soils as a very complicated object of amelioration, requiring specific measures to be improved. This is conditioned by ameliorative peculiarities of soils, which are determined not only by quantity and depth of gypsic horizons. The form of gypsic pedofeatures confined to definite fabric elements - voids or intrapedal mass is also of great importance. Our studies were aimed at typifying the microforms of gypsic pedofeatures in different virgin soils within the sierozem zone of Central Asia to be compared to those occurred in soils under irrigation.
The objects of research were virgin gypsic soils in catena represented by automorphic, semihydromorphic and hydromorphic soils and by soils used under irrigation from 5 to 3 thousand years.
In virgin automorphic and hydromorphic soils the microforms of gypsic pedofeatures identified in horizons of their maximum accumulation proved to be most informative with respect to better understanding of the soil genesis. 5 diagnostically valuable typomorphic forms of gypsic pedofeatures have been distinguished depending on the peculiar water regime of soils.
When comparing the fabric in every horizon of virgin and irrigated soils, it seemed reasonable to conclude that the typomorphic gypsic pedofeatures are rather stable and can be preserved in irrigated soils for a long period of time. Even the irrigated soil revealed single intergrowths in voids so typical for virgin soils in the given area before irrigation. Thus, irrigation can lead to increasing the diversity of gypsic pedofeatures forms in the soil profile due to partial destroying of initial typomorphic gypsic pedofeatures and their secondary recrystallisation. Typomorphic gypsic pedofeatures containing hard-soluble gypsum minerals are rather stable and can serve as a marker of initial soil type.

P039
Formation of Cambic B horizons in Western Carpathians, their characterization and classification

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The aim of this study was to investigate the weathering and alteration processes resulting in formation of Cambic B horizons. The selected soil profiles representing major parent materials of Western Carpathians were investigated using the field survey, conventional analytical characteristics, clay mineralogy and soil micromorphology. In order to achieve better understanding of the Cambic horizon formation the weathering and alteration features found in Cambisols were compared to similar features found in other soils (Fluvisols, Chernozems, Luvisols, Anthrosols and Technosols).
The results showed that the recent concept of Cambisols makes this taxonomical unit a “waste box” involving soils resulting from variable pedogenesis and having variable morphological and phytoecological properties. The studied soils were divided to two groups.
The first group involves older Cambisols affected by weathering processes which are manifested by brown or rusty color of B horizons caused by formation of iron oxides and hydroxides. The color of such B horizon is characterized by chroma stronger than the chroma of underlying C horizons. The formation of such B horizons needs relatively long time (several centuries or more probably few millennia). These soils correspond to earlier concept of soils with weathering B horizons traditionally called *brown earths* or *brown forest soils*.
The second group involves young Cambisols with B horizon formed by alteration processes other than weathering. Their color does not have chroma stronger than C horizon and they differ from C horizon due to structure formed by swelling-shrinking and bioturbation. These horizons can originate within several decades or few centuries (as it was documented in young soils of anthropic origin).
The presented subdivision of Cambisols with weathering and Cambisols with structure can be used as complementary critherium for classification and land evaluation of soils in mountainous areas of Central Europe.

P040
Pedogeochemical correlation of evoluated soils on secondary volcanic products from Gurghiu and Hargita Mountains (Eastern Carpathians, Romania)

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The researches regarding the genesis and the evolution of soils from Neogene’s vulcanite area from Gurghiu and Harghita Mountains (Eastern Carpathians, Romania) have evidenced the existence of large variety of typology (Luvisols, Dystric Cambisols, Andosols, Entic Podzols and Umbric-entic Podzols) and of range in tiers specific tendency of soils, with differentiations in function of rocks and parental material types, relief particularities (with different forms of volcanic type, succeeded between an altitude of 800 and 1800 m) and climate particularities (mountainous boreal kind). The parental material of these soils is represented by andesitic volcanic rocks and products associated with eructation (piroclastes materials), derivate deposits, volcanic ash and mixed weathering products from the slope level.
The geochemical characteristics of mineral phase and the chemical-structural properties of organic matter and of some organic-mineral complexes have evidenced several new aspects regarding the pedogenesis and the evolution of soils formed on secondary volcanic products. Their genesis was realized in two or three steps demark by gradual modifications of minerals paragenesis, the distribution of some minor elements and the geochemical differentiation degree of aluminosilicated gels.
The pedogenesis and evolution of Dystric Cambisoils, Andosols and Entic Podzols have been development in competitive regime, the processes being controlled by the activity of Al, Fe, Si and organic matter, and by the variation of physic-chemical conditions. If have exists thermodynamic conditions favorable for the formation of Andic-dystric Cambisols and Andosols, in situation of an intense kaolinization of surface deposits (below volcanic plateau and small depressions with 800-1000 m altitude), the soils have evolutes on another directions, with the formation of Luvisols and still Stagnic Luvisols. Some parental materials with fin texture (volcanic ash) have been sediment in lacustrine environment and not subairian, which open a new perspective about the evolution of soils from marginal areas of the region.

P041
The mineralogy and geochemistry of some hortic antrosols - case study: glasshouses from Iasi and Bacau Cities (Romania)

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The pedological and chemical-mineralogical studies of hortic antrosols from glasshouses from Iasi and Bacau cities (Romania) have evidenced several new aspects about the pedogenesis and the evolution of this type of soils. In comparison with another soils type, the hortic antrosols present distinct physic-chemical properties: intense modification of soil profile, particular distribution of organic matter, carbonates and micro-elements from profiles, etc. From pedological point of view, they are characterized by an intense modification of superior part from soil, in many cases being conditions for the apparition of some new pedogenetic horizons by neopedogenesis processes. From chemical point of view, the studies hortic antrosols are characterized by high saturation in bases, relative high content of accessible phosphorus and a high value of ratio between humic and fulvic acids (which indicate that in the organic matter dominant is the fraction intense humificate). The studied hortic antrosols are composed by an A hortic horizon with a cca 50 cm grossness, follow by B and / or C horizons. Usual, the hortic antrosols profile from studied perimeters present the following composition: Aho - AC - C or Ck, Aho - B-C or Ck. In function of initial parental material type and of specific exploitation conditions, frequently appear diagnostic horizons of association (hyposalic-sc, hyponatric-ac) and / or transition A/B, A/C, C/A, A+C, ABk etc.). Characteristic for hortic antrosols are intense modifications of soil profiles, relative large variety of mineralogy and chemistry, salinization processes (by progressive accumulation of soluble salts), formation to cca 50 cm deep of a compact and impermeable horizon.
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P042
The contetnts of easily mobile forms of Mn, Cr and Ni in rankers on the serpentinite masiffs in Serbia

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Seprentinites, or, more precisely, peridotite rocks serpentinized in different degrees, represent one of the most wide-spread groups of ,,silicate" rocks in the hilly and mountainous areas of Serbia. According to our estimations, they occupy the area of around 280.000 ha.
This paper demonstrates the results of the contents of easily mobile forms of Mn, Cr and Ni in rankers on the serpentinite massifs in Serbia. Samples were taken from severn widely distributed locations (Zlatibor, Kopaonik, Miroc, Maljen, Bukovi, Suvobor and Bubanj Potok) at the altitude between 100 and 1700 m above the sea leavel.
The contents of easily mobile forms of Mn,Cr and Ni, has been established applying the method of atomic absorption spectrophotometry.
The results of the research have shown that the contents of easily mobile Mn in the tested soil samples was 184 - 2830 mg/kg, in the majority of samples > 400 mg/kg. The contents of easily mobile Cr was 16 - 216 mg/kg and the contents of easily mobile Ni was 68 - 920 mg/kg (in approximately 70% from the total number of samples, it ranged from 200 to 600 mg/kg).
Based on the obtained results, we can conclude that the tested soils contain increased quantities of easily mobile forms of Mn, Cr and Ni as the result of their extremely high contents in the geological substrate - serpentinite.
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P043
Shrinkage behaviour of organic soils in a North German catchment affected by water table drawdown

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An increasing depth to water table and related variations of water content in the unsaturated zone in fens can result in changes of the surface morphology due to subsidence, mineralisation and shrinkage. The combined subsidence of the soil surface frequently is of different local occurrence in dependence of peat composition and thickness as well as depth of the mineral substrate, which can lead to complications in cultivating these areas if agricultural use is intended. This study was carried out in a small catchment in North Germany, which is characterized by the occurrence of organic soils and now degrades continuously due to water table drawdown after drainage. Sand, peat clay and fen peat can be found here in different thickness and depth so that varying volume changes could lead to the formation of subsidence morphology. Structure formation within the drying peat clay and peat, respectively, and hydrophobic behaviour furthermore have an impact on the water balance. Undisturbed core samples ($V = 470\ cm^3$) were taken from these soils and analysed in the laboratory with regard to their shrinkage behaviour. Total shrinkage was highest in the peat clay with maximum volume decreases from more than 60 % subsequent to complete drying, whereas the fen peat reached a maximum value of approx. 50 %. The structural shrinkage component was more developed in case of the fen peat, as the measured maximum previous drying intensity in the field was higher compared to the peat clay, which almost started with proportional shrinkage at the beginning of the drying process. These volume decreases due to shrinkage were found to be not entirely reversible, as drainage to a matric potential of -50 kPa, following saturation and re-drainage indicated, that the original soil volume will not be reached again.

P044
Assessing the soil structure dynamics under sustainable agricultural management, by the identification of biogenic and physicogenic features

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Spatial and temporal change of soil structures is one of the open tasks for Soil Sciences. In addition, to develop some sustainable agricultural management, soil users need to predict the evolution of the soil structure. Many methods as micromorphological approach by image analysis or direct field observation were used to assess the quality of soil structure. However, these methods gave only a passive picture of soil structure, and moreover they overlooked the biogenic soil structures. In order to model the fluctuation of soil structures, we first wanted to identify the processes that produced the diversity of soil structures (the pedoclimate, the anthropic activity or another biological activity).
So, to appraise soil structures, we carried out different studies those integrated many levels of spatial soil organisations.
Consequently, we considered the variability of the soil structures by the identification of different units and then by the creation of

one typology that integrated both physicogenic and biogenic soil structure features. This study demonstrated (1) the importance of biogenic structures and their inner variability (different state of cast disintegration) (2) the possibility to assess the spatial distribution of soil structures.
As a result, we have then investigated the temporal dynamic of the disintegration of fabric soil structures (as assembling of cast aggregates) under different agricultural treatments and according to depth localisation of earthworm biostructures.
These data on spatial and temporal soil structures variability should be integrated in a model of soil structure dynamic.

P045
Mineralogical contents of Vertisol type soils from the South of Serbia

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The paper demonstrates the results of research of mineral contents of vertisol type soils from the South of Serbia formed on different geological substrates.
Mineralogical contents has been determined by x-ray diffractometric method in powder fraction (0.02-0.002mm) and clay fraction (<0.002mm).
The results of research have demonstrated that the silt fraction contains the contents of minerals from the group of smectites (37.4 - 56%), followed by mineral mica(18.8 - 35%). In clay fraction the contents of minerals from the group of smectites (19 - 67%) is also the greatest, followed by minerals from the group of illites (15 - 40.3%) and mixed stratified minerals.

P046
Some aspects of the soil cover in the eastern part of the Romanian Plain

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The soil cover of the eastern part of the Romanian Plain is characterized by the large extension of areas with calcic and haplic chernozems, formed on loess deposits.
On the plain surface there are developed many negative microforms ("closed depressions") named in the Romanian geographical literature "crovuri". These microforms are various size and density (distribution) and maintain more moisture than the surfaces around.
The soils formed in these areas are well developed, and differ from the calcic and haplic chernozems by one or more of the follow characteristics: great thickness of humus horizon, removal of carbonates, textural differentiation and presence of an argillic horizon, deterioration of physical characteristics (compactation, bulk density).In the deeper microforms phreatic water intersect the soil profile and gleysols and solonchaks are formed.

P047
Influence of podzolization soil-forming process on physical and chemical transformation of the quartz grains surface

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The purpose of research was determination of quantative and qualitative physical and chemical transformations on the quartz grains surface (0,5 - 0,25 mm diameter) at the podzolization soil-forming process.
The study were carried out in two profiles of umbric podzols forest soils, developed from sands dunes of Kampinoski National Park. The research was conducted using Bull's method (1978) with employment scanning electron microscope (SEM) and qualitatively - quantitative microchemical analysis of chemical composition of quartz grains surface using microprobe EDS. Field work and basic analysis of soils were elaborated using methods commenly applying in soil science laboratories.
The podzolization soil-forming process causes stronger and more differentiated chemical than physical transformations on the quartz grains surface in the majority of diagnostic -genetic horizons, only amount of physical transformations predominate in parent rock horizons (C). In the humus and particularly *albic* (Ees) horizons among of chemical transformations processes on the quartz grains surface the etching and corrosion as ,,destruction" processes quantitatively predominate the amounts of incrustation and encrustation as ,,accumulation" processes. However, in the *spodic* horizons (Bhfe) and in smaller degree in parent rock the incrustation and encrustation quantitatively dominate the amounts of etching and corrosion. Microchemical analysis of chemical composition indicated the highest contents of aluminum, iron and calcium on the quartz grains surface in the *spodic* horizons (Bhfe). The amounts of incrustation and encrustation (according of statistic analysis) is correlated with the content of free iron and amorphous aluminum in the investigated soils.
Obtained results of research indicate, that essence passing of podzolization soil-forming process, particularly intensity of weathering processes, specificity and intensity translocation of weathering products have predominating influence on chemical and physical transformations of quartz grains surface.

S23 Rhizosphere Processes

P048
The effect of *Rhizobium phaseoli* and Plant Growth Promoting *Rhizobacteria* (PGPR) on Yield and Yield Components in Bean [*Phaseolus vulgaris*] Seeds

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Nitrogen is the most material that whole plants need it. for evaluate seeds inoculation effects on bean (*Phaseolus vulgaris* L.) cultivars with different strains of *Rhizobium leguminosarum* biovar *phaseoli* with Plant Growth Promoting Bacteria (PGPR) on yield, N_2 fixation rate and determining the best bacteria * cultivar's combination, a spilt plot experiment in randomized complete block design was conducted in the field at Shahrekord, Iran on 2006 and 2007. The factors were six bacterial strains Rb-133, Rb-133* *Azospirillum*, Rb-133* *Pseudomonas*, Rb-136, Rb-136* *Azospirillum*, Rb-136* *Pseudomonas* and non-inoculated controls including application of nitrogen fertilizer treatment (100 kg N ha $^{-1}$) and without application of nitrogen fertilizer in main plots. Three bean cultivars Sayad, Akhtar and Goli were assigned as factor B to subplots. The results revealed that there were significant differences among factor A in grain yield, number of pods per plants, number of seeds per pods, number and weight nod at early flowering (45-50 days after emergence), shoot nitrogen content and N_2 fixation rate. Treatment of inoculated seeds with strain bacteria* *Pseudomonas* and non-inoculated control (without N-fertilizer application) demonstrated the highest and lowest grain yield, respectively. The interaction between strains * cultivars effects in seed yield were no significant difference, but the results of mean comparison by DMRT (at 5% level) showed the highest and lowest seed yield were associated to Akhtar * Rb-133* *Pseudomonas* and Goli* control respectively. However, Akhtar * Rb-133* *Azospirillum*, Akhtar * N fertilizer (non-inoculated strain) combinations were similar observed in seed yield with N fertilizer treatment (non-inoculated strain). The results showed that all treatments of bacteria were capable of nodulation, however, strains Rb-133 gave highest nodule dry weight, N total (shoot) and percent of fixed N_2. An efficient symbiotic was achieved with strain Rb-133 .

P049

Changes in inorganic phosphorus fractions and availability in rhizosphere of rice in P-fertilized soils

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In a greenhouse experiment, changes in inorganic phosphorus fractions and availability in the rhizosphere of rice (*Oryza sativa L.*) with 40mg P/kg of soil as MCP application in paddy soils of north of Iran were investigated. The study was performed as a 14×2 factorial experiment in a randomized complete block design with two factors of soil at 14 levels (10 calcareous and 4 non-calcareous) and cultivation at two levels (cultivated and uncultivated), each level with two replicates. After a period of three months, specially designed soil tubes which had been buried in the beginning of the experiment, were simultaneously drown out of the cultivated and uncultivated pots and were immediately analyzed for P fractionation using methods of Jiang and Gu (1989) for calcareous and of Kuo (1996) for non-calcareous soils; available-P was also determined by Olsen method. The results indicated that: 1-In all 14 soils, the available-P in the rhizosphere of rice was significantly lower than the non-rhizosphere soil. While, if the plant P uptake was added to Olsen-P in the rhizosphere soil, the available-P in the rice rhizosphere soil was higher than the non-rhizosphere soil. 2- In calcareous soils, 0.25M $NaHCO_3$-P (dicalcium-phosphates), 0.5M NH_4OAC-P (octacalcium-phosphates), and 0.5M NH_4F-P (Al-P) in the rhizosphere of rice were significantly lower than the non-rhizosphere soil; whereas 0.25M H_2SO_4-P, CBD-P and Fe-P in the rhizosphere of rice were not significantly different from the non-rhizosphere soil. 3- In non-calcareous soils, 1M NH_4Cl-P, 0.1N NaOH-P (Fe-P), and 0.5M NH_4F-P in the rhizosphere of rice were significantly lower than the non-rhizosphere soil; whereas 0.25M H_2SO_4-P and CBD-P were not significantly different from the bulk soil. 4- In all soils, the pH of water on the surface of the soils in cultivated pots was significantly lower than uncultivated soils at the end of growth period.

P050

Screening different wheat genotypes for improving Fe and Zn efficiency

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Fe and Zn efficiency of different durum and bread wheat was investigated with measuring shoot dry matter production (SDM) and phytosiderophore (PS) exudation. In order to screening of wheat genotypes in terms of Fe and Zn efficiencies, two experiments were run as randomized complete block designs using 12 bread and 4 durum wheat genotypes with 3 replications. At first experiment a solution culture was used in sand culture contained in Leonard Jar at growth chamber. Treatments included complete (+Fe/+Zn), low Fe (-Fe/+Zn) and low Zn (-Zn/+Fe) nutrient solutions. The concentrations of iron and zinc and plant dry matter were measured on day 45. In second experiment plants were grown under hydroponic condition with the same nutrition solution. The PS release was evaluated on day 19 after germination through Fe-binding assay. The bread wheat genotypes showed more efficiency than the durum genotypes with regard to the uptake of Fe and Zn. More specifically, Tabasi, Tajan, Kavir, and Pishtaz bread genotypes with Fe efficiencies of 95.3, 93.68, 92.89, and 92.37 per cent respectively, were introduced as the Fe-efficient; and Rasoul, Tabasi, Darab-2, Kavir, Roshan, and Tajan genotypes with Zn efficiencies of 95.34, 94.73, 93.41, 90.71, 90.45, and 90.33%, respectively, were introduced as the Zn-efficient genotypes. Durum wheat genotypes (Yavarous, Shovamald and Taru-3) were Fe and Zn-inefficient. Also the results indicated that the bread wheat genotypes produced more PS than durum varieties under both Fe and Zn deficiencies. The highest rates of PS production for 15 plants were measured to be 1.66, 1.64, 1.60, and 1.60 μM in 3 hours for the Tabasi, Alborz, Cross-Azadi, and Roshan genotypes, respectively, under Fe deficiency while under Zn deficiency conditions Tabasi, Zarin, Roshan, and Alborz genotypes released the rates of 1.39, 1.05, 0.92, and 0.87 μM, respectively, as the most efficient ones.

P051

Using stable isotope techniques to investigate above- and below-ground carbon transformation processes in model plant-soil ecosystems

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Climatic changes like elevated CO_2 and O_3 concentrations in the atmosphere, due to urban and industrial expansions, are known to have a great influence on plants, mainly on trees and changes in their metabolism have been described by many authors. It is likely that these changes also lead to shifts in root exudation, and consequently influence the microbes in the mycorhizosphere and in bulk soil. Examining fluxes between shoot, root and mycorhizosphere, stable isotopes have attained high application: In a low enriched ^{13}C-CO_2 atmosphere (+170 ‰ V-PDB ^{13}C) we labelled young beech trees (*Fagus sylvatica* L.) for 20 days to follow carbon fluxes from the plant into the mycorhizosphere. By connecting carbon-ratios ($^{13}C/^{12}C$) with molecular and biochemical biomarkers, it is possible to gain knowledge about kinetics of exudate allocation in the (microbial) food web.
^{13}C-Allocation in leaves, shoots and roots was detected immediately after initiation of labelling. Using liquid chromatography linked with Isotope ratio mass spectrometry (LC-IRMS) $\delta^{13}C$-measurements in microbial biomass (C_{mic}) and dissolved organic carbon (DOC) were carried out. Statistically significant ^{13}C enrichment in rhizosphere microbial biomass and dissolved organic carbon was detected after 10 days of labelling. Microbial communities were specified analysing phospholipid fatty acids (PLFA). Isotope ratios in lipids were examined using gas chromatography / mass spectrometry coupled with isotope ratio mass spectrometry (GC/MS-c-IRMS). Individual biomarker fatty acids show significant ^{13}C-enrichment after distinct time periods indicating fungi, bacteria and possibly protozoa involved in the degradation of the exudates.

P052

Evaluation of phosphorus efficiency in Iranian cereals in a P-defficient calcareous soil

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A factorial completely randomized block design experiment with 3 replications was carried out to evaluate cereal genotypic variation in P efficiency in a calcareous soil with low available P (4.5 mg P kg^{-1} soil) during 2006. Treatments were 8 bread wheat (*Triticum aestivum* L.), 3 durum wheat (*Triticum durum* L.), 3

barley (*Hordeum vulgare* L.), 1 rye (*Secale cereale* L.), 1 oat (*Avena sativa* L.) and 1 Triticale (*X Triticosecale* L.) genotypes at two levels of P (0 and 84 mg P kg^{-1} soil).
Genotypes showed significant differences in chlorophyll content, number of tillers, shoot P concentration and content (the total amount of P per shoot), and fresh and dry weight (wt). Phosphorus efficiency (relative shoot yield) significantly differed among genotypes and ranged from 0.42 for barley line M-80-16 to 0.97 for bread wheat cultivar (Azadi), with the average of 0.71. Shoot P concentration increased significantly from 1.9 to 4.7 mg g^{-1} dry wt and shoot P content from 3.31 to 11.5 mg $plant^{-1}$ by applying P. With no P supply (P_0), durum wheat Yavaroos with 5.04 mg P $plant^{-1}$ and barley line M-80-16 with 1.46 mg P $plant^{-1}$ had the highest and lowest P content, respectively, among all the genotypes. Bread wheat Azadi (0.45) and durum wheat Yavaroos (0.43) had the highest relative P content. Therefore, P acquisition should be most important mechanisms for high P efficiency in such genotypes. Oat produced the highest dry weight per unit of P uptake and hence was very efficient in P utilization. There was no correlation between P efficiency and shoot P concentration of genotypes (r= 0.12), but the relationship between P efficiency and shoot P content (total amount of P per shoot) was highly significant (r= 0.66**).

P053
Biocontrol of Gaeumannomyces *graminis* and *Rhizoctonia solani* by *Azotobacter chroococcum.*

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Absract
Azotobacter chroococcum is a gram negative bacterium belonging to the family"Azotobacteriaceae". This bacterium can produce antifungal substances which control pathogenic fungi.The fungi " *Gaeumannomyces graminis*" and " *Rhizoctonia solani*" which cause sheath blight and take-all , respectively, have been used in our research. Antagonistic effect of bacterial strains was evaluated according to Keal et al., on potato dextrose agar- nutrient agar medium. Results showed that strains Az 3 and Az 40 completely inhibited, degradated and deformed mycelium of *Gaeumannomyces graminis*. Az 13 completely inhibited and Az 30 partialy affected *Rhizoctonia solani*.The later isolate suppressed *Rhizoctonia solani* compared to control, but after removing upper part of petridish , natural fungal growth observed. Antifungal volatile substances results was negative.
Keywords: biocontrol ; *Gaeumannomyces graminis* ; *Rhizoctonia solani* ; *Azotobacter chroococcum.*

P054
The impact of PGPR on soybean plants development

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Considering the benefits of intensive agriculture practice in our time and the negative impact of chemical fertilizers and pesticides against the environment, usage of PGPR (plant growth promoting rhizobacteria) like biofertilizers is one of the most promising biotechnologies for growing the primary production with less quantity of chemical fertilizers. Usage the isolated bacteria from crop-plant's rhizosphere for productivity increase may be an alternative to organic fertilizers. The main goal is to reduce the pollution and to preserve the environment in the spirit of an ecological agriculture.
In this context, was studied the impact of several PGPR strains, isolated from *Glycine max* (L.) Merr rhizosphere, on the soybean plants development in field conditions (a bio-preparation with a concentration of 64 x 10^6 CFU/ml was used) - in case of unapplying organic fertilizers conditions.
The results indicate a stimulation of growing and development processes (biometrical parameters and the harvest were significantly higher on the test, also the number of nitrogen-fixing nodules and modification of lipids and saccharides beans content).
The PGPR beneficial influence was recorded before flowering when majority metabolical processes intensity is highest, probably, because of stimulation radicular nutrients exchange mediated by rhyzobacteria.

P055
Effects of crops on solute transport in undisturbed soil

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Models predicting movement of surface applied chemicals incorporate knowledge on the water velocity field and moisture content distribution. Although the influence of root water uptake on solute transport is commonly recognized as important, it has been studied sparsely. Yet, plants may take up a large part of the infiltrating water, thereby influencing the water flow pattern in the soil and concurrently solute transport processes. For this reason, experiments are required to investigate the relationship between plant root water uptake and flow field variability.
The role of root water uptake on solute transport will be elucidated in two undisturbed soil columns. During three consecutive experiments, the influence of growing barley on tracer movement through a silty soil in two lysimeters will be followed. At the first stage, an inert tracer is put on the two bare lysimeters and leached with constant irrigation. As steady-state flow can be assumed, it is possible to follow the tracer movement in the column by ERT and to identify regions of preferential flow and solute transport parameters. During the second experiment, the tracer will be applied to mature barley grown in the lysimeters. Combining the information about the water content obtained with TDR with the relation between water content, soil solution salinity and bulk electrical conductivity, the soil solution salinity distribution can be derived from images of bulk electrical conductivity obtained with ERT. Root growth will be monitored using a minirhizotron. By comparing the transport parameters obtained after these two experiments, the effect of root water on the transport process can be quantified. When the columns are washed out and the barley is harvested, the third phase will be carried out under the same steady state flow conditions as in the first experiment to investigate the effect of dead roots on soil structure.

P056
Micro push-pull tests to investigate rhizosphere processes

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The rhizosphere differs from the bulk soil due to the effect of plant roots, microbial and fungal activities. Most mechanistic rhizosphere research is undertaken in microcosms, often in the absence of soil. This has resulted in a fragmented understanding of many rhizospheric processes. The use of micro-techniques for the collection of soil solution enables non-destructive *in situ* observation of soil solution chemistry at high spatial and temporal resolution. This permitted the targeted sampling of soil solution adjacent to roots. Suction cups not only enable the

removal of soil solution but also the injection of chemicals, for example tracers, into the rhizosphere. On a larger scale, single-well injection-withdrawal tests, called push-pull tests have been used extensively for the investigation of chemical, physical and biological phenomena in aquifers. In a push-pull test, a solution containing reactive and non-reactive “tracer” agents is injected into an aquifer. The test-solution/groundwater mixture is then extracted from the same location.
This project aims to combine micro-suction cups with the push-pull test to create a miniaturized system that will be applicable to study reactions in the rhizosphere. The new micro push-pull test is expected to yield new *in situ* information not only of concentrations in solution but especially of reaction and exudation rates under conditions as undisturbed as possible. As a first step we developed and validated a micro push-pull test procedure under saturated conditions in sand-filled boxes. We were able to succesfully inject about 250 µl solution and extract 770 µl solution in increments of about 70 µl. As conservative tracers Acid Red 1 and bromide were used. The data were successfully modelled considering advection, dispersion and molecular diffusion. In a next step the method will be adapted to unsaturated conditions and be used with reactive tracers in rhizosphere investigations.

P057

WWTF-project “Mathematics and rhizotechnology. Mathematical methods for upscaling of rhizosphere control mechanisms“

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The project “Mathematics and Rhizotechnology. Mathematical methods for upscaling of rhizosphere control mechanisms“, funded by the Austrian WWTF (“Vienna Science and Technology Fund”; start: March 1st, 2008; http://www.wwtf.at/wwtf/), is presented. Aim of the project is to develop a mathematical model which represents the most relevant rhizosphere control mechanisms at the scale of a whole root system, based on profound concepts for the single root scale. Experimental approaches to support model development and parameterisation include the selection of oil seed rape cultivars with differing exudation pattern, root architecture and root branching structure, determination of phosphorus exudate interactions and assessment of the effect of exudation and root architecture on plant phosphorus efficiency.
First step is the development of a mechanistic model at single root scale, describing the complex interactions between root exudates, nutrients, and microorganisms. This leads to a system of coupled differential equations, accounting for terms for reaction kinetics, complexation, transformation, decay, and diffusive/convective processes, including specific boundary and initial conditions for the respective species. We show first simulation results of a concept accounting for relevant exudate control mechanisms with regard to Phosphorus.
Mathematical methods such as sensitivity analysis, nondimensionalisation and asymptotic expansion will allow the determination of both crucial and insignificant mechanisms. Rhizosphere mechanisms might be amplified or diminished on the whole root system scale as compared to the single root scale. The transition from the latter to the more realistic model representing a whole root architecture will be accomplished by mathematical upscaling techniques. Numerical analysis using the software packages COMSOL Multiphysics 3.3A and Matlab 7 will complement the theoretical investigations. The project shall deepen our insight into the underlying processes, and lead to a reduction of both experimental costs and environmental load by an optimised performance of rhizotechnologies.

P058

Interaction of phosphate and organic acids in soil: adsorption and desorption dynamics

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Exudation of organic acids by plants is known to potentially improve phosphate availability in the rhizosphere. Previous studies have shown that the quantity and quality of the organic acids present in the soil solution determine the extent of the increase in P availability. Also soil properties such as amount of potential sorption sites for anions and pH have been found to affect the efficiency of organic acids in mobilizing P. To gain a better understanding of the impact of these factors, P desorption efficiency and the concurrent adsorption of citrate, malate, oxalate, shikimate and malonate were compared for a range of agricultural soils. The pH-dependency of organic acid adsorption was also evaluated by considering the pH buffer power of the individual soil and using citrate as model organic acid. Results showed a complex picture of interrelations with citrate being most efficient in desorbing P. Citrate adsorption tended to decrease with increasing pH. Throughout all experiments, the amount of potential sorption sites appeared to have the greatest impact on P desorption efficiency of organic acids.

P059

Does carbon flow from mycorrhizal fungi stimulate bacterial antibiotic production?

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The presence of mycorrhizal-root associations markedly alters the quality of carbon flow from roots. We investigated how antibiotic production by model *Pseudomonas fluorescens* strains was modulated by qualitative changes to C-flow. We quantified the production of the antibiotic 2,4-diacetylphloroglucinol (DAPG), a known suppressant of root fungal pathogens. For the experiment, wheat plants were grown in pots for 3 months (4 treatments), without mycorrhizal fungi, with mycorrhizal fungi, with the root pathogen *Gaeumannomyces graminis* var. tritici (*Ggt*) and with both mycorrhizal fungi and *Ggt*. The plants’ roots were homogenised, filtered and the soluble fraction collected and challenged with cultures of *P. fluorescens* strains (CHAO, P60r). In addition, soluble carbon was extracted from the soil in the pots and also used to challenge the two strains. To increase sample throughput and analytical efficiency, we used a 96-well plate Porvair Sciences Ltd Microlute® system containing C-18 solid phase extraction (SPE) medium. The analyte of interest (DAPG) in each cell in the growth plate was retained by the C-18 matrix until removed with a suitable solvent for HPLC analysis. We discuss how the presence of the arbuscular mycorrhizal fungi and *Ggt* affects antibiotic production by root associated bacteria.

P060

Characterization of plant-growth promoting diazotrophic bacteria isolated from the rhizosphere of field-grown Chinese cabbage

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Diazotrophic bacteria associated with the various crop plants can benefit plant-growth by their ability to fix nitrogen and/or produce plant-growth regulators. However, many attempts to introduce these bacteria into the rhizosphere of graminaceous plants have been unsuccessful due to the difficulties of introducing and establishing a new bacterial community. In the present study, attempts were made to isolate and characterization of diazotrophic bacteria from the rhizosphere and root interior of Chinese cabbage and their inoculation effects were assessed under pot-culture conditions. A total of 19 strains from a collection of 53, which showed the growth on NFb medium and changed the color of Congo red medium, were selected for further analysis of their 16S rDNA sequences. They were found to be the members of the genera *Pseudomonas*, *Rhizobium* and *Agrobacterium* showing 99 to 100% of sequence similarity belonging to α- and γ-*Proteobacteria* groups. These strains were further evaluated for plant-growth promoting characteristics like production of IAA, ethylene production, ACC deaminase and gnotobiotic root elongation assay. Among the nineteen strains evaluated, 15 isolates showed the positive PCR amplifications of *nifH* gene, resulting in 390 bp products. There was wide variation in nitrogenase activity of endophytic and rhizosphere isolates were ranged between 132.9 to 566.7 and 150.0 to 447.4 pmol C_2H_4/mg protein/h respectively. In association with Chinese cabbage roots, diazotrophic strains had the highest nitrogenase activity measured after 48 h of incubation when compared to uninoculated control. In addition, inoculation of diazotrophic bacterial isolates significantly increased seedling length, dry weight and total nitrogen when compared to uninoculated control. The colonization of crop plants by diazotrophic bacteria can be affected by many biotic and abiotic factors, and further studies are oriented towards investigating the factors that could influence the establishment of a selected bacterial community.

P061

Effect of Azospirillum and Azotobacter inoculation with microelements as foliar and soil application on qualitative and quantitative traits of four wheat cultivars after corn planting in Iran

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Abstract
Azospirillum and *Azotobacter* are two N2-fixing microorganisms which, in symbiosis with the roots of cereals and other gramineae, enhances growth and development of plant. In this research five bread wheat cultivars was treated with *Azospirillum* , *Azotobacter* and microelements application by using split-split plot on the basis of randomized complete block design with three replications in Shiraz region during 2004-2005. Main plots were consisted of two methods of microelements application (soil and foliar application) , sub plots included application and non application of *Azospirillum* and *Azotobacter* and sub-sub plots included five cultivars (Darab-2, Star, Shiraz, Pishtaz and Chamran). Measurement treats were plant height ,grain yield, yield component, biological yield , harvest index and grain protein percent. The results showed that soil and foliar application of microelements only increased number of spike per m^2 and 1000-kernel weight, respectively. Inoculation of seeds with *Azospirillum* and *Azotobacter* bacteria increased 1000-kernel wheat and grain protein percentage. Study of cultivars also showed that Chamran and Star cultivars were superior in quantitative and qualitative traits, respectively. As a results of this experiment , it appeared that Chamran and Darab-2 are the best cultivars for planting after corn in such area, *Azospirillum* and *Azotobacter* Inoculation was more effective in qualitative traits and both of two application methods of microelements were the best treatments for more productivity.
Key Words: Wheat, *Azospirillum* and *Azotobacter,* Microelements, Yield and yield components. Grain protein percent.

P062

Flavonoids of white lupin roots participate in Phosphorus mobilization from soil

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The impact of flavonoids released by phosphorus-deficient white lupin roots on inorganic P and soil microorganisms is largely unknown. We found that flavonoids isolated from white lupin roots mobilized inorganic phosphorus, decreased soil microbial respiration and citrate mineralization, but had no biocidal effects on soil microbial biomass. Among the measured soil hydrolases, with the exception of those extracted from senescent cluster roots, flavonoids significantly decreased the phosphatase activities regardless of citrate addition, did not affect protease and β-glucosidase activities, and significantly increased urease activity. Taken together, the results suggest that white lupin's release of flavonoids into the rhizosphere plays a significant role in its efficient P-acquisition strategy by solubilizing Fe-bound P and by limiting the microbial mineralization of citrate.

P063

Cellulase activity in rhizosphere of some agronomical plants

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Cellulase is an enzyme system that degrades cellulose and releases reducing sugars as the end products. Properties of rhizospheric soil and the microbial community composition and activity strongly depend on the plant species. The objective of this study was to study the effect of some plant species on cellulase activity of rhizospheric soil. The plants from seven plants families were utilized including; *Triticum aestivum*, *Zea mays*, *Trifolium repens*, *Cicer arietinum*, *Solanum tuberosum*, *Solanum lycopersicum*, *Ocimum basilicum*, *Satureja hortensis*, *Lepidium sativum*, *Raphanus sativus* var: *radicola*, *Petroselinum hortense*, *Anethum graveolens*, *Allium cepa* and *Allium sativum*. Samples were planted in the pots containing the same soil in the greenhouse. The experiment was considered a randomized complete block design. The three replicates of any plant were carefully excavated from the pots and the soil adhering to the roots were carefully separated and considered as the rhizospheric soil. Cellulase activity was determined in rhizospheric soil in the middle and end of vegetative growth of plants. Means were calculated. Duncan's new multiple range tests have shown that plant species can change rhizospheric cellulase activity significantly. Cellulase activity in rhizospheric soil compared to non-rhizospheric soil increased 153 to 441 percentages at the end of vegetative growth of plants. It was higher in rhizosphere of *Solanum tuberosum, Triticum aestivum*, *Zea mays*, *Lepidium sativum*, and *Raphanus sativus* var: *radicola.* Although cellulase activity increased at the end of vegetative growth of plants, however this increase was not significant.

P064

The effect of soil pollution on some rhizospheric biological properties

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Contamination of the environment with hazardous and toxic chemicals is one of the major problems facing the industrialized nations today. In this study 3 sites with 3 different densities of heavy metal pollution were selected in Irankoh region in Isfahan province via sattlite images. Rhizospheric soils of 11 native plant species were sampled in May 2005. This experiment was done in completely randomized design with 3 replicates. The bioavailability of Pb, Zn, Ni and Cd in rhizospheric soil as well as the occurrence and activity of some soil microorganisms were studied. Results showed that the effect of plant species and soil pollution on the occurrence and activity of soil microorganisms was different. The effect of plant species and soil pollution on rhizospheric soil basal respiration was relatively low compared to other soil biological properties especially substrate induced respiration (SIR). The effect of heavy metals on the occurrence of soil microorganisms was not the same. Generally the fungi and actinomycetes sensitivities were lower than the bacteria and azotobactere sensitivities. However, correlation coefficient analysis showed that the SIR and fungi sensitivity to Zn and the bacteria and azotobactere sensitivities to Pb were relatively high.

P065

Influence of ectomycorrhizae on heavy metal uptake by Populus tremula

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Phytoextraction is a promising technology for the remediation of heavy metal (HM) contaminated sites, based on the use of HM tolerant plants, accumulating large amounts of these elements in the aboveground biomass. Populus tremula is a species that efficiently recolonizes mining sites highly contaminated with Zn, Pb and Cd. Preliminary experiments also revealed its high accumulation potential for the elements mentioned above. P. tremula is further known to form symbiosis with various ectomycorrhizal fungi. Ectomycorrhizae in general influence soil HM availability, plant metal uptake rates and plant growth. Since relating investigations were mainly conducted with non-accumulating plant species, the mycorrhizal response of accumulating plant species is widely unknown.
A pot experiment was set up to determine the impact of ectomycorrhizae on HM uptake by P. tremula. Seedlings were grown on substrate mixtures spiked with five levels of $ZnSO_4$, ranging from moderate to very high. For mycorrhizal treatments either viable propagules of ectomycorrhizal fungi, or gamma irradiated inoculum was added. The community of propagules for mycorrhizal synthesis originated from a heavy metal contaminated P. tremula stand.
After four months plant biomass, plant HM concentrations and extractable HM pools of the experimental substrate were measured. Further HM translocation- and transfer factors were calculated. These data are presented and discussed regarding the potential role of ectomycorrhizae on the HM uptake by an accumulating plant species.
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P066

Rhizosphere alkalisation: a major process controlling Cu (bio)availability for durum wheat cropped in a former acidic vineyard soil

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We recently observed a rhizosphere alkalisation (up to +1.2 pH unit) in field-grown durum wheat (*Triticum turgidum durum*) cropped in Cu-contaminated, acidic soils (pH < 5) which could explain the lower Cu (bio)availability than expected.
The present study aimed at ascertaining the role of rhizosphere alkalisation in changes of soil solution Cu speciation, soil Cu mobility and bioavailability for durum wheat.
Three-week-old durum wheat seedlings were cropped in a rhizobox for 8 days with a strongly acidic, Cu-contaminated (184 mg kg^{-1}) soil which had been limed at 8 different levels to reach final pH values from 4 to 7. Rhizoboxes without plant were used as bulk-soil control. Total Cu-concentration, free Cu^{2+} activity (ISE), dissolved organic carbon (DOC) and pH were measured in the solution of the rhizosphere and bulk soils. The mobility of Cu was assessed by Diffusive Gradient in Thin film (DGT). The bioavailability of Cu was estimated as the flux of Cu taken up by the plants over the 8 days of growth.
At the most acidic pH, a considerable alkalisation is expected to occur. Such pH changes will be explored over the large pH range investigated, as well as their links with changes of Cu speciation in soil solution. Based on DOC measurements which may vary with pH and exudation, Cu^{2+} will be computed and compared with measured Cu^{2+}. We will discuss how pH changes which occurred as a consequence of rhizosphere processes drive the speciation of Cu in soil solution, the mobility of Cu as assessed by DGT, and the bioavailability of Cu to durum wheat. Discrepancies between surrogates of Cu bioavailability such as ISE-Cu and DGT-Cu usually measured in bulk soil and the actual bioavailability of Cu for the plant will be discussed in the light of the observed pH changes in the rhizosphere.

P067

Comparison of different methodical approaches to evaluate the plant root growth

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Soil contamination embraces a vast complex of problems, which are related to soil toxicity. In turn, toxicity studies perform a wide spectrum of approaches in order to evaluate the adverse effect of contaminant. Soil toxicity is influenced by many factors, most of them synergistically act to the biological object chosen as a test-organism. Application of germination and root elongation test, as well as a long-term vegetation experiment are known to be informative tests for predicting the effect of soil contamination to the plant growth. In this context, plant root development is one of the most important characteristics.
WinRHIZO is an image analysis system specifically designed for root measurement in different forms. Determination of root surface area via adsorption of methylene blue by root surface is also used. The aim of our study was to compare these methodical approaches for their further use in estimation of soil phytotoxicity.
The results indicated to the strong correlation between data obtained by these two approaches. Thus, 18 plants belonging to the Betula sp., Calamagrostis epigeios (L.), Origanum vulgare were tested. The coefficient of determination between the amount of methylene blue absorbed by root surface and the root surface measured by the WinRHIZO was found to be $R2=0.82$. Besides, other characteristics of plant roots determined by the WinRHIZO, also were analyzed. In particular, the results obtained with methylene blue correlated with characteristics determined by WinRHIZO, i.e. root projected area, volume, root branching and tip number with the coefficient of determination (R2) of 0.88; 0.79, 0.86, and 0.78, correspondingly.
Thus, two different approaches applied for the comparative study on plant root growth in the presence of contaminants, were evaluated. The conclusion was made, that both approaches can be used in further experiments on soil bioremediation in terms of comparison of soil phytotoxicity before and after treatment.

P068

Fungal denitrification in arable soil

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The biological process of denitrification plays an important role in the global nitrogen cycle, because it completes the nitrogen cycle as the reverse reaction of nitrogen fixation. Bacteria are considered as playing a predominant role in the production of nitrogen oxides. The distribution of denitrification among Prokaryotes is very variable. However, Shoun and Tanimoto (1991) showed that fungi are also able to produce N_2O through denitrification. Little is known about the importance or structure of denitrifying fungal communities in soils. Soil pH is an important factor thought to influence the ratio of bacteria and fungi in soil with fungal dominance at lower pH. To test the hypothesis if pH could be a driver of fungal denitrification we have utilised existing long-term pH plots (crop course rotation field in Scotland, SAC Craibstone Estate). The field has been managed for several years under different pHs ranging from 4.5 to 7.5. Furthermore, we hypothesized that fungi contribute a greater proportion of N_2O in soils of low pH. Earlier experiments have shown contributions of nitrification and denitrification to N_2O production to vary greatly with pH.
The application of antibiotics has given a first indication of the role Prokaryotes and Eukaryotes play in the process of denitrification. Results suggest that fungi produce a significant amount of N_2O. Terminal-Restriction Fragment Length Polymorphism (T-RFLP) analysis gave further information about the structure of the microbial community in arable soils. However, to date the possible contribution of fungi to N_2O production at low pH has not been determined. Data from potential denitrification assay (PDA) show that the activity of denitrifiers can vary in similar soil types.The recent tendency toward acidification in soil demonstrates the importance of gaining a further understanding of the ecological role of eukaryotic denitrification.

Shoun,H. and Tanimoto,T. (1991) *The Journal of Biological Chemistry* **266**, 11078-11082.

P069
Magnetic resonance imaging technique to study the distribution of nickel in rhizosphere

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Understanding the root-soil interactions has been hindered by limited experimental accessibility of processes in the rhizosphere. We developed a Magnetic Resonance Imaging (MRI) technique to study nickel (Ni) distribution in porous media and in the rhizosphere of Ni hyperaccumulator plant Berkhey coddii non-destructively. The method was tested in a glass bead medium with an ion exchange resin as a Ni sink, to map the real-time development of the Ni depletion zone around the resin, as Ni was sorbed into the resin. Then, it was applied to a Rhizobox system with a root monolayer and a Ni solution of 10 mg kg-1 and 2-dimensional distribution of Ni was mapped in high resolution. Nickel concentration was found to increase as approaching the surface of the root-plane showing a positive gradient. This result shows that at soluble Ni concentrations found in typical serpentine soils, Berkhey coddii does not need to solubilize nickel.

P070
The interactions of soil microorganisms with plant roots: implications for trace element biofortification

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Plant root exudates and root detritus stimulate microorganism growth in the rhizosphere. Bacteria and fungi interact with roots and trace elements (TEs) in soil. Some bacteria change the solubility and speciation of TEs in soil, thus modifying their phytoavailability. Others exude phytohormones that may affect root development and thus TE uptake by plants. Changes in root physiology caused by pathogenic bacteria or fungi may modify plant TE uptake pathway, resulting in an increased concentration in roots and shoots.
Many interactions occur at the soil-root-microorganism interface. Therefore, we needed a simplified system to isolate individual factors that affected plant TE uptake. We developed a sterile agar system for plant growth under controlled conditions. Thus, we could study individual, well-defined strains of microorganisms and their interaction with root and TEs in an environment where there is no influence of soil mineral and organic matter.
We screened the effect of 34 different microorganisms known to affect TE mobility and phytoavailability or to have a direct effect on root physiology. We tested the effect of these microorganisms on TE uptake by winter wheat and Indian mustard. Plants were grown in boxes containing agar spiked with non-phytotoxic concentrations of Cu, Ni, Pb and Zn. Each treatment, replicated five times, was inoculated with a different microbial strain. The effect of these root-zone microorganisms was determined by measuring shoot TE concentrations.
This screening method allowed us to select bacteria and fungi that could potentially find field application. On a contaminated soil, one could inoculate microorganisms that reduce plant TE uptake. Alternatively, in soils deficient in TEs, plant health and potentially human nutrition may benefit from the application of microorganisms that biofortify the crop with trace elements.

P071
Soil-dependent, opposite colonization tendency of symbiotic- and food-safety important microbes in the rhizosphere of green-pea at long-term sewage sludge applications

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Sewage sludge application is an increasing agricultural practice.At long-term level concern should be given for the heavy metal accumulation and the presence of “food quality and safety” microbes. The effect of increasing sewage sludge (0, 2.5, 5, 10 and 20 g.kg-1 dry soil, i.e. 7.5, 15, 30 and 60 t.ha-1 field) rates of a municipal and industrial origin, with high Zn- or Cr-content (28.450- and 5.225 mg.kg-1 dry sludge, respectively) was investigated on 4 Hungarian main soil-types (calcareous sand- and chernozem, acidic sand- and forest soils) in a 4-years-periods. Dry-matter production of pea (Pisum sativum L.), macro- and micro-element content and mycorrhiza fungi, heterotrophs, spore formers, micromycetes or food-safety important microbes (coliforms, E. coli, Salmonella sp., Listeria, Bacillus cereus) were assessed at the flowering stage of the pea at each years. A circadian daily- and weakly periodicity of the physiological-driven microbial changes was measured by a quadrupole mass spectrometer. Some of the human pathogens considered from food safety reasons are naturally present in the soils. At sludge applications their abundance could be enhanced, still due to their high sensitivities the annual accumulation was not found. At the third years of the increasing sewage-sludge-use an opposite tendency of the colonization rates was found between the microsymbionts and the “potential pathogens”. Increasing doses of the biosolids resulted a decrease of microsymbiont colonization, either as a final effect of the heavy metal accumulation and/or as the effect of improved nutrient soil-availability, which eliminates the "non-necessary" symbiosis. This latter was also found at the ripening stage of maize, measured by QMS, showing the impact of the soil-dependent nutrient availability and the interrelations between the biotic and abiotic environmental factors at the permanent sewage sludge depositions.Supported by the Hungarian research funds (OTKA T46610), and the NATO grant (ESP.NR.NRCLG 982857).

P072

Mathematical Modeling of Sorption Competition between Phosphate and Root Exudates

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The influence of competition between phosphate and root exudates for adsorption sites on the concentration of phosphate in soil solution is investigated. Phosphate is an essential nutrient in crop production but its phytoavailability is often limited due to high soil buffer power. Among numerous effects that root exudates have on phosphate in soil solution, an important one is that the phosphate adsorption rate can be decreased due to competitive reactions. Therefore it is important to accurately describe competition in mathematical models.
Three mathematical models are proposed, in which the competition is described in different ways. The models include phosphate and exudates in sorbed and solute phases, other mechanisms are neglected. The models are one-dimensional and axial-symmetric around the root. Transport of phosphate and exudate in soil solution is described with a diffusion equation, and phosphate uptake is described with Michaelis-Menten kinetics, while the exudate outflow is assumed to be constant. All simulations have been performed with Comsol, and parameter analysis has been done in Matlab.
The different mathematical approaches are compared and a sensitivity analysis of the most relevant parameters is presented. Main focus lies on the change of concentration of the phosphate near the root surface and the resulting influx of phosphate with respect to competition. The modeling techniques that have been investigated for this reduced model can be used for more comprehensive phosphorus uptake models.

S25 Memory Function of Recent and Paleosoils

P073

Memory function of carbonates: use of carbonate pedofeatures for paleoreconstructions

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A study of pedogenic carbonates was performed in order to better understand the memory function of carbonate pedofeatures and their potential for paleoreconstructions of paleoenvironment and paleoprocesses. Carbonates of various morphologies were sampled in the center and south of the European part of Russia for the further radiocarbon dating, stable isotopic compositions of C and O, micromorphology in thin sections, and scanning electron microscopy (SEM). Carbonates were sampled in modern Chernozems, Kastanozems, and Vertisols, and buried paleosols. Selected soils represent a wide variety of pedoenvironments with MAT from 4.5 to ~9^{o}C, MAP from 450-600 mm, humidity coefficient between 0.5-0.9 under steppe and forest-steppe native vegetation.
Large variety of carbonate pedofeatures was identified in soils included pseudomycelium, tubes, impregnations, soft masses and hard nodules. Two to four various morphologies were identified simultaneously in the soil profile. While the soft masses had rather similar form and size in all soils, the hard nodules strongly differentiated from ~ 1-2 cm in modern soils to 4-5 cm and up to > 10-15 cm in paleosols. Micromorphology has shown micrite to sparite size of calcite crystals and evidence of recrystallization especially in hard nodules. SEM identified rhombohedral crystals, rods, threads, needle-like crystals, coatings of various size. Many of them have the signs of secondary dissolution and reprecipitation.
Stable isotopic analyses have shown the isotopic shift about 2.5-3 o/oo between various carbonate morphologies indicating their various origin. Large forms have isotopic differentiation of O isotope between the central part and the rim. Radiocarbon dating revealed that diagenetic carbonates in paleosols may exhibit older age than expected. Various carbonate morphologies have different record potential, but the interpretation should be very careful because most of carbonate features are easily transformed and the control via a variety of instrumental methods is the most important for the correct interpretation.

P074

Subalpine-alpine soil formation during lateglacial period? Results from the archaeological site Ullafelsen in the Fotscher Valley (Tyrol, Austria)

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Within the scope of the archaeological research project “Ullafelsen” in Tyrol, interdisciplinary collaboration was strengthened in recent years. Based on distinctive features in the archaeological excavation, methods of soil science were included and some profiles in the immediate vicinity of the archaeological site were investigated.
Both in the archaeological excavation and in numerous soil profiles a noticeable light layer (LL) apparently similar to the eluviation horizon of a Podsol was uncovered close to the surface. Some morphological, physical and chemical features of LL can not sufficiently be explained by podsolation processes but indicate its sedimentary origin. Moreover, the LL minimum age of 9.500 BP could be determined with AMS ^{14}C method by means of numerous charcoal concentrations positioned directly above the LL. Below LL a horizon with high humus content can be interpreted as a former topsoil horizon covered with the material of LL and of the present topsoil. Micromorphological results from thin sections (e.g. signs of earthworms) corroborate this estimation.
Based on the results of field and laboratory work, the following preliminary synthesis should be discussed: Intensive soil formation took place during the warm stages of lateglacial period. In the course of the considerably colder phases of the Younger Dryas the profile has been covered by eolian sediments. This accumulation process continued during the Holocene but at roughly a tenth of the sedimentation rate. Thus LL may act as a meaningful diagnostic horizon to differentiate soil formation chronology in alpine regions and detect special aspects of their landscape history.

P075

An approach for studying phytolith profiles of recent soils in different landscape zones of Hungary - Methods and first results

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The demand to exploit the advantages of the *'memory function'* of soils leads to the utilisation of interdisciplinary methods. By building upon soils, precise and detailed reconstruction of Holocene environments are achievable.
The palaeoecological reconstructions based on buried soils under kurgans of the Great Hungarian Plain have pointed out that the use of anorganic plant microremains in paleosol studies are at least as imoprtant and inevitable as palinology and other analysis types. In order to complement palaeoecological studies, the investigation of phytolith assamblages of recent Carpathian Basin soils were put in limelight.
The main idea was to examine quantitative and qualitative phytolith characteristics of recent soils developed in different landscape zones, and to survey soil types under dissimilar landuse.
Aiming to compare the results, we have selected same soil types under different landuse (e.g. Luvisol under potential forest cover, plough-land and pasture-land), and different landscape zones representing the basin's significant ecological regions. Within this selection the number of sampled soil profiles already exceed 10. Sampled soil profiles include lithosoils on carbonate deposit, weathered vulcanic and metamorfic parent material, different types of brown forest, meadow, sandy soils and Chernozems.
Analyses have focused on the vertical distribution of phytolith particles along the profile. As it is influenced by various soil properties, these (pH, mechanical analysis, $CaCO_3$, salt%, TOC, humus etc.) have been measured, too.
Results have shown that vertical distribution of plant opal particles are in significant correlation with the mechanical composition of soils, though it can be 'overwritten' by human impacts, such as ploughing. Besides the turbulent effect of ploughing, specific phytolith morphotypes are found to be good indicators of recent landuse history. Results of mountain lithosoils shown that the lack of phytolith assamblages are in relation with their geomorphological position and therefore may reflect vegetation cover typical for further areas.

P076

Quantitative analysis of relief-soil memory

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The values of some morphometric variables (MVs) are stable to different types of the relief transformations. This property of MVs can be used for the quantitative investigation of the relief memory effects and their interrelation with other landscape components, namely soil. For the normal conditions the MVs power to the relief history indication can be decreased according to next gradation:
1. MVs describing the geometrical land form types: invariant to any surface rotation in the space. This property mainly establishes relief memory effects.
2. Integro-differential MVs: stability in specific land surface positions. These attributes have intermediate properties depending on site conditions.
3. MVs describing the topographical pre-requisites of the surface runoff on the land surface. They are very sensitive to any relief transformation and reflect current topography.
Due to the temporary shift between land surface formations and soil development the strongest relations of the archive soil parameters with MVs from the first group in comparison with the MVs from the third group can be expected. But up till now stable correlations have not been identified.
In present investigations first a stable result was accepted for the spatial distribution of the thickness of the colluvial horizon in soils and 18 MVs for two independent sites in Northern Germany. The quadrate of nonparametric Spearman correlation coefficients are:
-area "Bornhoeved" (0.59x0.28 km, 71 points)= 0.72 minimal curvature (group 1), 0.66 maximal dispersal area (group 2) 0.50 horizontal curvature (group 3);
-area "Ritzerau" (basin ~ 200 km2; 131 points)= 0.32 minimal curvature, 0.28 slope steepness (group 3), 0.23 maximal dispersal area.
Obtained results illustrate that the land surface formation is accomplished by soil formation and MVs - relief memory indicators are a new quantitative tool for the investigation of specific mechanisms of memory in soils.

P077

The "Red Outcrop" of Langenlois: soil and rock mineralogy, geochemistry, micromorphology and paleopedology

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The research area is located NW of Langenlois/Lower Austria at the "Schenkenbichl"-hill, where an outcrop was opened in July 2007 for the establishment of a new vineyard. In the northwestern part of the U-shaped outcrop, which has a thickness of about 5 m, a dome of amphibolite of the Rehberg Formation emerges as bedrock in this otherwise gneiss-dominated region at the southeastern margin of the Bohemian Massif. Leaning on both visible flanks of the amphibolite dome several paleosoil horizons in loess and colluvial sediments occur. These brightly shining red fossil horizons can already be seen from a great distance. According to the micromorphology the deposition of the sediments commenced during Lower Pleistocene (Cromerian) and continued until the Middle Pleistocene - Holsteinian interglacial.
Three soil profiles were examined in the part where the amphibolite occurs, and four soil profiles were sampled in the loess/colluvium/paleosoil sequence, whereas in one profile only samples for soil micromorphology were taken. The pedological features and soil systematics of the soil profiles were done in the field. The rock and soil samples were examined with a multitude of analytical techniques: soil micromorphology, mineralogy by X-ray diffractometry and thin section microscopy (rocks), major and trace elemental composition by X-ray fluorescence, C/S-analysis, particle size analysis by sedigraph, organic carbon-analysis, cation exchange capacity and dithionite- and oxalate-extractable Fe by ICP-OES, determination of the loss on ignition and pH.
This study is part of a project which aims at the geological investigation of newly established outcrops and short time excavations in Lower Austria in cooperation with the federal authorities of Lower Austria. The results of the investigations will be presented at the conference.

S27 The Influence of Soil Quality on Human Health and Food Security

P078

Evaluation of distance cultivation effects and ethylen spray on fruit and seed production in squash

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Squash is one of the medicinal plants that juice of it,is effective in remedy of cyst illness and increase of body tolerance for disease ingredient. In order to evaluation of distance cultivation effects and ethylen spray on fruit and seed production in squash, an expriment as split plot design on base of randomized complete block design was conducted in the field with 3 replications in spring and summer of 2007. Agricultural research farm of Islamic Azad University of Shahrekord was the place of experiment.The factors were three dose of ethylen (0,50 and 100ppm of 2-Chloro-ethylphosphonic acid) and Three density of planting (50*100 cm,50*150cm and 50*200 cm). For prevention of infection between different dose of foliar application of ethylen and convenience conduction, dose of ethylen spreaded in main plots and density of planting in subplot. each expriment plots inclusive 4 planted rows, elongation was 9 meter and distance between rows was 150 centimeter. Each replications inclusive 3 main plots (every main plots had 3 subplot),therefore whole expriment had 27 plots. Evaluated characters in this research were seed yield and yield components including number of fruit per plant, number of seed per fruit, 100-seed weight . Although The combinationes of 100ppm ethylen * 50*100cm and 0ppm ethylen *50*100cm made the most number of fruit in area but the most mean of weight of fruit (2831.4 kg/ha),mean of weight of fresh seed(998.7kg/ha) made by 100ppm ethylen and 50*200cm density.

P079

Antibiotic uptake by plants from soil amended with antibiotic-treated swine slurry

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One of the major routes of veterinary antibiotics entering environments is via the application of antibiotic-laden animal manure to agricultural field as a fertilizer. Although food contamination through antibiotic uptake by plants has been one of the major concerns regarding animal manure amendment to soils, it is largely unknown whether plants uptake antibiotics in Korea. Antibiotic uptake by plants was tested with three veterinary antibiotics; chlortetracycline (CTC), tylosin (TYL), and sulfamethazine (SMT) and three plants; lettuce, tomato, and hairy vetch. Antibiotic-containing swine slurry was treated to a silty clay loam soil (fine loamy, mixed, mesic family of Typic Dystrochrepts) before transplanting or sowing the plants at a rate of 17,000 L ha^{-1} and the antibiotic concentrations in the slurry were 22.9 mg CTC L^{-1}, 27.8 mg TYL L^{-1}, and 32.4 mg SMT L^{-1}. Plants were harvested after 64 days for lettuce and 94 days for tomato and hairy vetch. Antibiotic levels in leaves of lettuce, fruit part of tomato, and whole parts of hairy vetch were determined using enzyme-linked immunosorbent assay analysis. Antibiotic concentrations in plants were less than 3.8 ng g^{-1} for chlortetracycline, less than 20.1 ng g^{-1} for tylosin, and 20.9~66.2 ng g^{-1} for sulfamethazine on a fresh weight basis. The result imply that antibiotic uptake by plants may be dependent on antibiotic type and plant type. Since the antibiotic uptake by plants can be influenced by many factors including antibiotic level, soil type, soil structure, plant growth stage, plant part, climate, and manure application method, further research deserves to be conducted to examine the effect of such factors on antibiotic uptake.

P080

Distribution and biological availability of Rare Earth Elements in soils of Hesse, Central Germany

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Rare earth elements (REEs) comprise a group of 17 transition metals with very similar chemical and physical properties. They include the elements scandium (Sc), yttrium (Y) and lanthanum (La) and the 14 elements (cerium to lutetium) that follow La in the periodic table. Their average abundance in the earth´s crust varies from 0,01 to 0,02% so they are as common as Cu and Pb. Beside their widespread use in industry, REEs are applied in Chinese agriculture. Their beneficial effects both on crop yield and on animal production are reported in various investigations. As a result - by using microelement fertilisers and manure - REEs enter the pedosphere while their fate and behaviour in the environment up to now remains unexamined.
The aim of our investigation was to evaluate the concentration of REEs in agricultural used soils in central Germany (Hesse) by ICP-MS. In addition to their total concentration (aqua regia digestion) their bioavailable contents - determined by EDTA (potentially available fraction) and ammonium nitrate extraction (mobile fraction) - were analysed. Furthermore the chemical and physical properties of the investigated soils were determined.
The occurrence and vertical distribution of the three REE fractions in different soils will be presented and discussed, particularly with regard to a possible admission of the REEs in agricultural food production throughout the European Union. We evaluate the environmental behaviour of the REEs by comparing the results with the fractions and dynamics of Cd and Pb in agricultural used soils.

P081

Potential influencing factors on Nitrate accumulation in Rocket salad: Field experiment in Battipaglia, Italy

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Rocket salad is nowadays commonly used for their very spicy taste. Beside the taste and some other healthy characteristics, this plant is also very well known for its tendency to accumulate high contents of nitrate in its plant mass.
The goal of this work was to test some potential nitrate influencing factors on rocket salad, aiming to recommend practices for horticulture which are compatible with the prescriptive limits.
For this, a field experiment was carried out. In the field experiment 3 factors were tested statistically (different plant species, fertilizer types and fertilizer amounts).
Field experiment results:
a) The cultivated rocket salad specie *Diplotaxis tenuifolia* (L.) DC. accumulated much more nitrate than *Eruca sativa* (Miller) in all variables with mineral fertilizers except in variables with Urea and organic fertilizer.
b) Plant nitrate accumulation was higher in all variables with mineral fertilizers.
c) Variables with Urea and Urea + Nitrate fertilizers showed lower nitrate accumulation rates as mineral fertilizers.
d) There was no difference between nitrate accumulation of the Sulphate (60 units/ha) and Sulphate + Nitrate (120 units/ha) fertilization variables. Between the variables with Sulphate + Nitrate (60 units/ha) and Sulphate + Nitrate (120 units/ha) there

was smaller difference as expected. Since the soil in the experimental field was very salty (soil electric conductivity: 1, 263 till 2 dS/m and 7% Na-saturation) probably some additional amounts of sulphate caused the salt increase in soil which could disable the plant nutrient uptake.
e) The soil characteristics (e.g. too high salt saturation, very high clay content) were not adequate for rocket salad species, which grows naturally on very light soils. This could cause stress to plants and increase nitrate accumulation.
c) The high nitrate content in irrigation water (107 mg/l Nitrate) could also contribute to nitrate accumulation problems in rocket salad.

P082

The Effects Of MSW Compost Applications On The Yield And Heavy Metal Accumulation In Potato Plant (*Solanum Tuberosum L.*)

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A field experiment was conducted to determine the effects of MSW (municipal solid waste) compost as an organic material source on the growth and the accumulation of heavy metals in potato plant (*Solanum tuberosum* L.). MSW compost was applied to plots at 0, 20, 40, 80 and 160 T/ha rates as an oven-dry basis, and potato plants were cultivated under field conditions. Plant vegetative dry weight, potato yield and Zn, Cu, Ni, Pb, Cd and Cr contents in the leaves and tubers of potato were determined.
The effects of MSW compost applications to experimental soil on the vegetative dry weight and tuber yield of potato were found statistically important. The best application level of MSW compost for potato yield was found at 40 ton/ha of MSW compost application. All application levels of MSW compost were supplied better yield results than that of control.
However, MSW compost applications brought about a sharp increase for heavy metals in the plant material. Although MSW compost led to greater dry matter at low application rates, 160 T/ha application rate of MSW compost depressed plant growth, leaf dry matter and potato yield. In the MSW compost treatments, according to background and toxicity limits, heavy metal status of leaves and tubers were ranged in normal and high levels. But at 160 T/ha treatment, concentrations of Zn, Pb and Cd in potato tubers were exceeded limit values for edible vegetables. The resulting data demonstrate that application of MSW compost to soil, lead to harmful accumulation of heavy metals in the potato plant.

P083

The Effects Of Sewage Sludge On The Plant Nutrients And Heavy Metal Contents Of Strawberry (*Fragaria X Ananassa* Duch) Plant

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A greenhouse experiment was conducted to determine the effects of urban sewage sludge that is applied to soil, on the plant nutrients and heavy metal contents in the fruits and the leaves in strawberry. Strawberry plants were grown in pots containing different amounts of sewage sludge (corresponding to 0, 15, 30 and 60 T/ha, as dry weight basis). In the applications of sewage sludge, higher mineral contents and heavy metal accumulation were determined both in the fruits and the leaves.
Sewage sludge applications have important effects on N, P, K, Ca, Mg, Fe, Zn, Mn, Cu, ,Pb, Ni, Cd and Cr contents in the leaf. It is observed that when the application level is increased, mineral contents and heavy metal accumulation are also increased. For the fruit; N, P, K, Mg, Fe, Zn, Cu, Pb, and Cd contents were increased importantly by increasing levels of sewage sludge application; Ca, Ni, and Cr contents have not shown an important change. The quantity of the accumulation in the leaf is more than in the fruit for all nutrients and heavy metals.

S08 Soil Ecology - Soil as Living Space

P084

Effects of arbuscular mycorrhizal fungi on mineral composition and yield of tomato under salinity condition

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Abstract
The role of arbuscular mycorrhizal fungi (AMF) in the protection of tomato plants against salt stress induced by salt mixture was studied. The experiment was carried out in a glasshouse as randomized complete block design with two factors including fungi in three levels: MO (without fungi), Mi (Glomus interaradices) and Mm (Glomus mosseae). Four levels of salts mixture salinity: S1=1.2, S2=4, S3=6.5 and S4=8 (dS/m). The composition of salts mixture was NaCl, CaCl2, MgSO4 and Na2SO4 at ratio of 1:38:43:20 (w/v), respectively. The seedlings were separately inoculated with two fungi species. After two months, the inoculated plants were transferred to pots containing 4 Kg sterilized sand and salinity treatments were initiated 7 days after cultivation. The results showed significant increase in dry weight of shoot and root, potassium and phosphorous content of shoot, root colonization percent, fruit weight and K/Na ratio in the shoot of mycorrhizal plants in comparison with non-mycorrhizal plants($p<0.05$). Fungi treatments (Mm and Mi) increased tomato yield by 10% and 16% respectively ($p<0.05$), however, there were not significant difference between them. The effects of salinity on studied variables were significant ($p<0.05$) except Mg and Ca concentrations of root and magnesium content of shoot.

P085

Effects of *Azospirillum, Azotobacter, Mesorhizobium* and *Pseuodomonas* inoculants on growth, yield and nutrient uptake of chickpea (*Cicer arietinum* L.) under field conditions

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In order to evaluate the effects of *Azospirillum*, *Azotobacter*, *Mesorhizobium* and *Pseudomonas* inoculants on growth and yield of Desi chickpea (*Cicer arietinum* L.) in the field conditions, this research was carried out during two growing season (2004-2005 & 2005-2006), using a randomized complete block design (RCBD) with 3 replications and 16 treatments. The treatments included: uninoculated control and all cases of single, dual, triple and quadruplet inoculants of these four rhizobacteria. The highest dry weight of root nodules was recorded by applying the combined inoculation of four bacteria (quadruplet treatment) in both cropping seasons. At the flowering stage in both years, the treatments statistically affected the nitrogen concentration of shoots. Nitrogen uptake of plant was improved by *Pseudomonas fluorescens* containing inoculants in the first cropping season. In the second year all inoculation treatments were superior over uninoculated control with respect to nitrogen uptake. Maximum rate of grain yield, biomass, phosphorus and protein content of grains were observed by the quadruplet inoculant in the first year and by the triple combination of *Azospirillum* + *Azotobacter* + *Pseudomonas* in the second year of experiments. Group comparisons between treatment means revealed that in the first cropping season the presence of *Pseudomonas fluorescens* in the combination of inoculants played an effective role in the promotion of chickpea growth and yield and in the second cropping season the presence of *Azospirillum* or *Azotobacter* in the inoculant combination enhanced the crop performance.

P086
Changes of biological properties of soils the South of Russia under influence of electromagnetic fields

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Electromagnetic fields (EMF) - one of kinds of power environmental contamination.
In modelling experiments studied influence of electromagnetic fields ionizing and nonionising nature on biological properties of soils of the South of Russia, differing on genesis and properties. Studied influence of gamma-radiation on chernozem ordinary, variable magnetic field (VMF) and microvave-radiation on biological properties of chernozem ordinary, chernozem, chestnut soil, grey and brown forest soil, sandy soil, rendzinas, mountain-meadow soil. Dozes and levels of influence were the following: gamma-radiation: 1, 5, 10 and 20 KGy. Microvave-radiation: 30 seconds, 1, 10 and 60 minutes; VMF by industrial frequency (50 Hz): an induction 100, 500, 1000, 1500 and 2000 mkTl duration of influence 1 hour, by induction of 1500 and 6000 mkTl duration of influence of 5 days.
Enzyme activity of investigated soils is steadier against electromagnetic influence, than microflora. Gamma-radiation renders insignificant overwhelming influence on activity of enzymes, thus dehydrogenase is more sensitive, than catalase. Microvave-radiation on catalase activity of all investigated soils and on activity of all enzymes of chernozem ordinary rendered overwhelming influence. In most cases VMF does not render influence on enzymes investigated soils, behind exception of dehydrogenase sandy soil and brown forest soil where VMF rendered overwhelming influence.
The microflora of investigated soils is more sensitive to electromagnetic influence then enzymes activity. For gamma-radiation and microvave-radiation amplification of overwhelming influence with increase in a doze and duration of influence accordingly was marked. To VMF the soil microflora is steadier, in some cases number of microbes authentically did not differ from the control, over weak levels of influence (100 and 500 mkTl 1 hour) was observed by duration stimulating effect. VMF by induction 1500 mkTl rendered overwhelming influence on microflora even at 1-hour influence.
Researches are maintained by the RFBF (06-05-64722a; 07-04-00690a).

P087
The role of the biological potential of the microflora in ensuring the soil fertility in natural and anthropic influenced ecosystems

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Soil is a living space where the biological processes take place, they contributing at transforming of the organic matter and also, at ensuring the favourable conditions for plants nutrition. In this paper we present the results of the researches reffering to the biological potential of the soil in the forestry, lawn and agricultural ecosystems with an anthropic influence, located in Eastern Romanian-Moldavian Plateau, county Iasi. We analized the biotic potential (soil respiration and cellulosolythic potential), the enzymatic potential (catalase, invertase, urease and total phosphatase) and the synthetic indicators of the soil fertility (Indicator of the Vital Activity Potential, Indicator of the Enzymatic Activity Potential and Biological Synthetic Indicator), during vegetation period, on soil samples of Luvisoils Class, on the 0-20 cm depth.
Our results showed thet in forestry ecosystem there is the highest potential of soil respiration, correlated with an increased content of organic matter and a low acid soil reaction, which ensures optimum conditions for the aerobic bacteria. In the agro-ecosystems fertilized with manure there is the highest celullosolythic potential because of the additional content of organic matter and moderate values of aeration porosity in tillage, pointing out a positive anthropic impact. The analyse of enzymatic potential showed the high values in the forestry ecosystem, anthropical uninfluenced. These values are correlated with soil moisture, temperature and organic matter content. Ploughland increases oxidation capacity diminishing energetical resources, essential to the soil microflora. The added manure ensures a content of support and energy. The analyse of synthetic indicators allows the quantifying of the soil fertility and points out the role of soil microflora in ensuring soil fertility, reflecting the anthropic impact within ecosystems.

P088
Mountainous Greek soils and status of nutrients in native vegetation and perennial plants

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Soil properties and status of native vegetation were studied in the hilly and mountainous district of Mt. Olympus, Greece. The status and distribution of the nutrients in native plant species and soils were investigated. In addition, inventory of native plants was carried out and the main soil orders have been classified. The studied soils are acidic, part of the exchangeable bases has been leaced and in general they have been affected by erosion. The values of nutrients reflect the specific soil and climatic conditions that affect the leaching of cations. Results from the annual plant shown low nitrogen content, and deficiency for certain elements reflecting mainly the soil, climatic conditions and human activities. Thus, uptake of the above nutrients by plants was reduced. The content of N was lower in perennial pasture crops than in annual plants. However, the concentration of micronutrients iron, cooper, zinc and boron were found at normal levels. The recorded low content of phosphorous in plants indicates either the fixation of P in the lattice of clay minerals or can be attributed to low inhrent content from the parent material. It can be argued that overgrazing and exploitation of water resources for grazing animals have influenced the spatial distribution of soil biochemical properties including soil organic C and N and activity of microbial biomass. Conversion of parts of the native forests and pasturelands to arable land has seriously affected degradation of natural resources and this process is expressed by a decline in soil organic carbon, nutrients loss and accompanied by increased erosion risk. The recovery of soils and vegetation may be achieved by a set of measures and practices such as: application of no tillage practices in the slopping land, banning of overgrazing, introduction of cover crops in the slopes vulnerable to erosion and reforestation.

P089

Increasing incubation time enhances cadmium toxicity on soil alkaline phosphatase activity

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Little is known about the effect of incubation time on the response of enzyme activities to heavy metals. The objective of this study was to investigate the response of alkaline phosphatase to Cd as affected by incubation time. A calcareous soil was sampled from central Iran. The soil was air-dried, passed through a 2-mm sieve and was contaminated with $CdSO_4$ at different rates of 0, 3, 10, 50, 100, 300, 700, 1000 and 5000 mg Cd kg^{-1}soil. Three replications were performed. Soil samples were incubated at 25 °C and 50% water holding capacity for 3 and 60 days. At the end of the incubation periods, soil alkaline phosphatase was determined. Ecological Dose 50 (ED_{50}), the concentration that inhibits a biological function by 50%, was calculated as a quantitative index of Cd toxicity. The ED_{50} values were calculated either by a full inhibition kinetic or a sigmoid dose response model. According to the kinetic model, the ED_{50} values were 497.3 and 4.5 mg Cd kg^{-1}, for 3 and 60 days of incubation, respectively. The similar values for sigmoid model were 393.8 and 272.8 mg Cd kg^{-1}. The longer incubation period increased the extractable Cd concentration and resulted in lower alkaline phosphatase activity. This finding support the hypothesis suggesting that increasing the incubation time can enhance Cd toxicity on alkaline phosphatase.

P090

Impact of eco-physiologically different earthworms on soil water characteristics

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A laboratory experiment was performed to assess the impact of eco-physiologically different earthworms on soil water characteristics. Four earthworm species (*Lumbricus rubellus*, *Aporrectodea caliginosa*, *Octolasion sp.*, *Lumbricus terrestris*) were exposed in soil columns (30 cm in diameter, 50 cm height) for 100 days with a total fresh earthworm biomass of 22.5 ± 1,2 g per column, each in duplicate. Two columns without earthworms were treated as controls. Each column was equipped with tensiometers and FDR-probes, each in 10 and 40 cm depth, to continuously measure the temporal development of soil tension and soil moisture. Additionally, 30 g of sieved and rewetted horse manure was placed on the soil surface as a litter layer. Precipitation events (10 mm) were simulated at day 28 and 64. At the end of the experiment the water infiltration rate and the runoff in 50 cm depth were determined.The results showed considerable evidence, that eco-physiologically different earthworms modify soil water characteristics in different ways. Data from soil tension indicated, that the anecic *L. terrestris* seemed to enhance the drying of the top- and subsoil, probably due to an intensified removal of litter from the soil surface and to its deep dwelling behaviour. In contrast, the epigeic *L. rubellus* led to an enhanced storage of soil moisture in the topsoil, which might be affected by an enrichment of organic matter. Both endogeic species, *A. caliginosa* and *Octolasion sp*., showed high soil dwelling activities and thus led to considerable higher water infiltration rates and to faster water discharge in the subsoil, relative to the other species. Future aspects of this study will help to quantify the effect of different earthworm species on soil water characteristics even under different water conditions in a changing environment.

P091

Organic amendments influence nitrification and denitrification in restored semiarid soils: a genetic and functional approach

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We evaluated the application of organic amendments on key steps of the N cycle in a Mediterranean semiarid soil at a functional and genetic level. Indicators for soil microbial activity, potential nitrification and denitrification rates as well as amoA and nirS gene copy numbers were studied in experimental plots amended with sewage sludge and biosolid compost under natural conditions. Results showed enhanced potential nitrification and denitrification rates in amended soils, which could be ascribed to higher availability of N sources, enhanced microbial activity and higher number of nitrifying bacteria and denitrifiers in soil. The development of higher anaerobic microsites in amended treatments could also favour denitrication rates. Our data indicate that amendments can have a major influence on the N cycle of semiarid soils and hence may play a decisive role in restoration processes and desertification control.

P092

Shifts in soil microbial biomass and enzyme activities due to different combined additions of manure and the antibiotic sulfadiazine

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The effects of pharmaceutical antibiotics on the function and community structure of soil organisms were determined in previous studies. Many of these studies didn`t consider the impact of manure as the main carrier of antibiotics to soil. Recent findings show that effects of antibiotics on soil microbial structural diversity and function are influenced by the presence of manure. However, the effect of manure was not further investigated. Thus, effects of different combinations of manure and sulfadiazine (SDZ) on enzyme activities and microbial biomass were determined in laboratory experiments. Topsoil samples from an agricultural gleyic Cambisol were spiked with four different manure (0, 20, 40, 80 mg g^{-1}) and three different SDZ concentrations (0, 10, 100 µg g^{-1}) to obtain 12 treatments that were incubated for 1, 8, and 32 days in the dark at 10°C. The extractable SDZ concentration, basal respiration, chloroform fumigation extracted microbial biomass (C_{mic}, N_{mic}) and the enzyme activities of β-glucosidase, protease, urease and potential nitrification were determined. Additionally, ammonium and nitrate were measured for calculating the N-balance. First results showed a concentration dependent impact of manure on basal respiration, protease and urease activities. Effects were often time related. SDZ exhibited no clear bacteriostatic effect on the measured soil functions, supposing that the microbial population function is resilient to SDZ contamination. However, calculated parameters (qCO_2, C_{mic}/N_{mic}, C_{mic}/C_{org}) indicated that with increasing manure addition effects of SDZ were evident after 8 days of incubation. The metabolic quotient increased, while the two latter parameters decreased with SDZ addition compared to the treatment without SDZ. This shows that the non-uniform effects of manure and antibiotics therein cannot be evaluated separately from each other.

P093

Influence of rape oil on the phenanthrene degrading soil community structure in a Haplic Czernozem-a ^{13}C PLFA study

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A ^{13}C artificial-labelled phenanthrene study including a phospholipid fatty acid (PLFA) analysis was used to characterize the influence of rape oil application on soil microbial biomass, community structure and carbon incorporation into phenanthrene-degrading soil microorganisms. The Haplic Chernozem (Fuchsenbigl, Lower Austria) was treated as (a) control soil, (b) rape oil soil, (c) control soil spiked with phenanthrene and (d) rape oil soil spiked with phenanthrene over a period of 60 days. Rape oil application increased total microbial biomass, while the PLFAs 16:0, 18:0 (ubiquitär microbial groups), 18:2ω6,9 and 18:2ω9c (fungal biomarkers) showed the highest responses. Phenanthrene application led to lower total microbial biomass contents in control and rape oil soil than without phenanthrene application. In the phenanthrene-rape oil treated soil a microbial biomass increase and change in community composition occurred until day 42 followed by a decrease in biomass on day 60. Thus, it can be concluded that the soil microorganisms used the rape oil carbon source also under phenanthrene application. Temporal dynamics of the phenanthrene uptake into PLFAs was different in the control and rape oil soils. A ^{13}C-enrichment of the PLFAs i14:0 (gram-negative bacteria), 15:0, 18:0 (ubiquitär microbial groups), 18:1ω5 and 18:2ω6,9 (fungal biomarker) were observed in the rape oil soil, while it was also seen for the PLFAs 18:0 (ubiquitär biomarker) and 18:2ω6,9 (fungal biomarker) in the control soils. The phenanthrene incorporation was closely linked to the occurrence of individual PLFAs in the soil, e.g. the content of 18:1ω5 was higher under the rape oil application. In conclusion, ^{13}C-labelling of phenanthrene showed a higher biomass, change in community composition and higher ^{13}C carbon incorporation under the rape oil application. The work was done for the ISPAK-project "Design and development of a vegetable oil based in situ remediation technique of polycyclic aromatic hydrocarbons (PAHs) contaminated soils".

P094

Effects of Land Use Change on Soil Chemical and Biological Properties in Tropical Mexico

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SE Mexico has suffered in the past 60 years severe land use changes, resulting in the nearly disappearance of tropical forests and the pollution of the environment due to the intensive application of agrochemicals. In 2006, we studied the effect of land use change on soil chemical and physical properties, earthworm communities, and litter decomposition in three different ecosystems: (1) banana plantations, (2) agroforestry systems, and (3) succession forests, in a floodplain in Tabasco. In each site earthworms were collected (TSBF) and soil was sampled to determinate pH, texture, nutrient content and CEC. Additionally, litter decomposition rate was determined (litter bag technique) using two different leaf-litters: *Bravaisia integerrima*, a dominant tree from the region, and *Musa acuminata*.
Corg. and Ntot. content in managed ecosystems was significantly lower than in forests soils. Furthermore, pH values were significantly lower in two of the managed ecosystems, reflecting the adverse effect of the intensive use of ammonia fertilizers. Soils in managed ecosystems presented also high content in potassium and phosphorus, due to fertilization of banana plants. Moreover, high content of Mn and Zn were determined in the managed systems, as a result of the intensive use of fungicides.
Earthworm communities showed higher diversity, density, and biomass in banana plantations and agroforestry systems than in forest soils. However, most of these species were exotic, whereas in the forests most of the species were native.
Litter decomposition was not directly affected by the land use, since the activity of the soil biota was mainly determined by the microclimate. Nevertheless, banana leaves decomposed significantly slower than *B. integerrima* leaves, due to higher lignin content and higher C/N ratio retarding the reintegration of nutrients into the soil. We conclude that the intensive management practice of the banana plantations did not affect soil fertility negatively.

P095

The effect of the preparation for straw decomposition acceleration and different tillage on soil enzyme activity

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Soil quality evaluation poses a major problem due to its considerable heterogeneity of processes. Biological and biochemical processes in soil can be used as soil-quality indicators. The activity of soil enzymes is also significantly affected by the method of soil management.
Cellulolytic microflora which participates in mineralization of post-harvest remains, requires, among other things, the presence of nitrogen. Some studies recommend the use of biopreparations to accelerate straw decomposition, while such preparations can also affect changes in soil properties. We focused on this range of questions in our research on assessment of activity of selected soil enzymes, while applying BETA-LIQ preparation and using different agricultural methods. Over a three-year period the soil enzyme activity (acid and alkaline phosphatase, dehydrogenase, protease, nitrate reductase, urease and cellulase) was monitored on small test-plots in 6 variants of tillage in Troubsko (CZ). The evaluation showed the statistical difference in activity of five enzymes between the following variants: spraying crushed straw with BETA-LIQ preparation and working post-harvest remains 12 to 15 cm into the soil, and that of working the crushed straw with a cultivator 12 to 15 cm into the soil and then ploughing to a depth of 22 cm. However, the variant with BETA-LIQ application did not statistically differ from other variants without this application, where the soil was also tilled 12 to 15 cm deep. The statistics proved a difference in favour of the variant with BETA-LIQ application - in the activity of some enzymes in comparison with burning straw and consequential soil aeration to a depth of 12 - 15 cms. Results of the research suggested that the applied BETA-LIQ preparation does not negatively affect enzyme activity and could be used to start mineralization of post-harvest remains.

P096

Decomposition and diffusion of plant litter products

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Transport of dissolved organic matter (DOM) by diffusion is an essential link between different compartments of the soil ecosystem, such as sources and sinks or different pore spaces (particularly micro-sites). Especially on small scales, diffusion often is the predominant transport process. Although there is a good understanding of the basic process, much less is known about diffusion in soil, particularly diffusion of natural DOM, which is a complex mixture of mostly not identified substances.

To overcome the analytical difficulties barley plants (*Hordeum vulgare* L.) were labeled by growing under ^{14}C-CO_2 atmosphere. The resulting plant biomass was subsequently used as a source in degradation-diffusion experiments in soils by applying it at one end of 30 mm soil columns. The soil columns were kept in a desiccator for a four week time period. The system was aerated over CO_2-traps at least twice per week to determine mineralization. In the end of the experiment the spatial distribution of ^{14}C within the columns as well as within their microbial biomass were investigated. The experiments were conducted with two strongly contrasting agricultural soils, a loamy Cambisol and a sandy Arenosol, at the same density and water potential.
As expected the results show strong ^{14}C-gradients close to the source. However, for both soils significant amounts of ^{14}C could be detected through the whole soil columns as well as in their biomass. Diffusion was found to be more rapid in the Cambisol, presumably because it had a higher water content at the same water potential.
The experiments confirm that diffusion processes can provide well metabolizable substrate for microbiological processes distant from substrate sources.

P097
Establishment of ecologically safe concentration of pollution chernozem by ordinary heavy metals (Cr, Cu, Ni, Pb) in modelling experiment

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Priority pollutants of natural ecosystems in the south of Russia are Pb, Cu, Ni and Cr. In this case there is a necessity of an establishment of ecologically safe concentration of polluting substances, in particular, of heavy metals in soil.
The pollution of ordinary chernozems with oxides of Cr, Cu, Ni, Pb was simulated. The soil samples were selected from arable horizon. The influence of different concentration of polluting substances in soil (such as 25, 50, 100, 250, 500 and 1000 $mg \cdot kg^{-1}$) was investigated in laboratory experiment. For this purpose soil samples were incubated within 30 days in vegetative vessels at optimum temperature and humidity. On a basis of most informative and sensitive parameters (number of bacteria by a method of direct luminescent microscoping; an abundance of *Azotobacter*; enzyme activity such as activity of catalase and dehydrogenase; celluloselithic activity; indexes of phitotoxicity) the integrated parameter of a ecological-biological condition of soil (IPEBC) was determined. The significant decrease of the IPEBC parameter is registered at concentration: Cr - 105, Cu - 55, Ni - 80, Pb - 55 $mg \cdot kg^{-1}$. Now laboratory modeling experiments are supplemented by field experiences.
The research is executed at financial support of the President of Russian Federation (grants MD-3944.2005.4 and MD-3155.2007.4) and the RFBR (grants 07-04-00690-a and 07-04-10132-k).

P098
Influence of heavy metals (Pb, Cu, Cr, Ni) and petroleum on biological properties of brown deserted soil

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Now problem of pollution of an environment, in particular, pollution soil by heavy metals and petroleum is very urgent, in this connection to study of the given problem is given more attention.
Soil selected in area of city Astrakhan from arable horizon. The pollutants (Pb, Cu, Cr, Ni) brought in in the form PbO, CuO, Cr_2O_3, Ni_2O_3; concentration 1, 10, 100 (LAC) Limited Admissible Concentration. The petroleum was brought in in concentration with 1 %, 5 %, 10 % from weight of soil. Soil incubated within 30 days in vegetative vessels under optimum conditions, exposition - 30 day.
Most informative there were following parameters: activity of catalase and dehydrogenase; celluloselithic activity; indexes of phitotoxicity , (test-object - ridesh), contents humus.
On the basis of the investigated parameters the integrated parameter of a ecological-biological condition of soil (IPEBC) was determined. Was established, that all parameters, as a rule, reduce the meanings at increase concentration of pollutants. The greatest influence on decrease of biological parameters have rendered Cr and petroleum. At pollution of soil Cr_2O_3 the meaning has decreased to 35% at concentration 10 and 100 LAC. At pollution of soil by petroleum - up to75 %. The least influence on parameters have rendered PbO, CuO, Ni2O3. At entering into soil 1 and 10 LAC PbO was observed small stimulation of activity of biological parameters - up to 199%, and at entering 100 LAC - up to 105%.
The research is executed at financial support of the President of Russian Federation (grants MD-3944.2005.4 and MD-3155.2007.4) and the RFBR (grants 07-04-00690-a and 07-04-10132-k).

P099
Changes in soil microbial community structure during repeated vegetable oil applications and different soil water contents using [^{13}C] PLFA techniques

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Vegetable oil is used to extract polycyclic aromatic hydrocarbons from contaminated soil. To recommend its practicability as environmentally-friendly and biodegradable soil remediation technique, potential side effects of remaining vegetable oil on soil microorganisms and carbon substrate incorporation pattern need to be assessed. The study investigated the effects of one time maize oil (42 days) and two times vegetable oil (84 days) application on soil microbial communities. In addition, the influences of the soil water content corresponding to 100 and 50 % water holding capacity (WHC) were determined in the one time maize application study. To follow the usage of vegetable oil by soil microorganisms a ^{13}C natural abundance experiment including GC-c-IRMS analysis of phospholipid fatty acids (PLFAs) was conducted.
The addition of vegetable oil significantly increased the content of all PLFAs. Changes in microbial community composition from a more complex PLFA pattern (18:1ω9c, 18:2ω6,9, 10Me16:0, 18:0, 16:0, 16:1ω6c) to a more specified PLFA composition (18:1ω9c, 18:2ω6,9, 16:0) were assessed. Furthermore, a predominance of fungi over bacteria was recognized after the vegetable oil application in both studies. The 100 % WHC study resulted in 51 % lower PLFA concentrations on the 42 day and most microbial groups reached the maximum on the 7 day. ^{13}C maize oil incorporation into PLFAs was higher after the one time maize oil than after the second maize oil application. Whereas, at 100 % WHC the highest maize oil uptake was calculated in comparison to 50 % WHC and repeated maize oil addition. To sum up, stimulated microbiological growth was seen in both studies, even through a significant reduction of vegetable oil was not monitored in this short term study.

P100
Seasonal variations in soils enzyme activity

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Activity of all biological processes has seasonal dynamics. Seasonal fluctuations are a potential difficulty of using biological measurements as diagnostic index. During long-term researches and selecting of terms of sampling, it is necessary to take into account seasonal variation in the enzyme activities.
This study examined activity of catalase, saccharase and dehydrogenase in ordinary chernozem, chestnut soil, brown forest soil and grey forest soil. Enzymatic activity is changeable during the vegetation season. The character of changes is different in different years. Seasonal variation in the enzyme activities was greater in the arable horizon than in the virgin one. It is due to annual mixing of the top horizon at tillage, uniformity of conditions, and the greater uniformity of distribution of cultivated cultures in comparison with natural steppe vegetation. There was a significant seasonal effect on dehydrogenase activity. This fact is likely to be due to the nature of enzyme. Dehydrogenase should exist only in viable cells and depends on the total metabolic activity of the viable microbial populations. Microbial activity and biomass are very variable through the growing season.
Dynamics of catalase activity was higher than saccharase activity. Saccharase activity correlates with the humus content, which is a stable and poorly varying parameter. There was no connection of enzyme activities maxima with certain seasons. In different years, differences in the rate of enzyme activity were no significant in spring and autumn months. The maximal distinctions were established in the summer. Hence, seasonal dynamics needs to be taken into account at monitoring of soils. Therefore, it is essential to carry out long-term researches at an equivalent time each year. For soils of the South of Russia, this is May - June or September - the periods of the minimum variation of enzyme activity.
Research is maintained by the RFBF (project 06-05-64722)

P101
Influence of magnetic fields on germination of seeds of redish

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The interest to study of effects of influence of electromagnetic fields (EMF) on biological objects constantly grows. Researches on influence of the physical factors, in particular of electromagnetic fields, on agricultural plants now will widely be carried out with the purpose of increase of quality of a sowing material.
The purpose of the present research was study in modelling experiments of influence of a variable magnetic field (VMF) of industrial frequency (50 Hz) and constant magnetic field (CMF) by an induction of 50, 100, 300, 500 and 800 mkTl on germination of seeds of redish.
Seeds of redish placed into cups Petry (on 20 seeds in each cup) on previously humidified soils (20-30 g). Soil (chernozem ordinary carbonated) selected in v. Persyanovskiy, Rostov region (arable horizon, field of a winter wheat). The skilled cups Petry placed in installation (solenoid) creating variable and constant magnetic fields. In 4 day at skilled and control seeds measured length of runaways, length of roots. The control cups were in the same conditions, but were not exposed to influence of magnetic fields. The laboratory-analytical researches carried out on the standard techniques.
Is established, that on length of roots and runaways both variable, and the constant magnetic fields by an induction 500 mkTl and CMF by an induction of 800 mkTl have not rendered authentic influence. In other cases the stimulating influence of magnetic fields of the investigated levels on length of roots and runaways on 10-32% from the control is observed.
It is interesting to note influence of a constant magnetic field by an induction 300 mkTl - and on length of runaways and roots the stimulating influence on 100,5 ($p<0,05$) and 103,8 % ($p<0,05$) is marked in comparison with the control accordingly.
The researches were supported by RFBR (07-04-00690a, 06-05-64722a).

P102
Biological parameters of the hydrogenic soil of Caspian lowland

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Arid soil borrow the significant areas in the south of Russia, especially on its southeast part in the Southern Federal district. These soils are characterized with increasing contents of salts, because of water mode features. The purpose of the present research was to determine soil biological properties of the Astrakhan area of downturn of a relief. These downturns are located between knolls and are engaged in reservoirs with water of different mineralization. Investigated some biological parameters (activity of catalase and dehydrogenase, humus etc.) of two hydromorphic soils, located in immediate proximity from freshwater and salty reservoirs. Investigated soils differ in salt contents. Meadow saline alkali soil near fresh water reservoir contains easy dissolve salt only in the top horizon (about 1 %), saline of a salty reservoir vicinities contains 3,5-5,8 % of salts in all structure.
The analysis of catalase activity has shown, that in meadow soils near fresh water reservoir, the enzyme activity is 2,5 times higher, than in saline of a salty reservoir vicinities The research of dehydrogenase activity has shown even more essential influence of the contents of salts in a soil structure. The dehydrogenase activity of meadow soil fresh water depression in 5 times exceeds the similar indications of saline.
As have shown the further researches, contents of humus in salted soils are very low (0,2 %), while in meadow soils it makes about 4,8 %. The efficiency of the investigated soils are also strongly differs, owing to toxicity of salts for plants. The results of researches have shown, that on the salted site growing of radish makes 0 %.
The result of researches have shown strong influence of easy dissolve salt on biological properties hydromorphic soil of Caspian lowland.Researches are supported by the RFBR (projects 06-05-64722a). MD-1091.2006.4.

P103
The detritusphere as biogeochemical interface for bacterial and fungal degradation of MCPA and phenanthrene

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We present the concept of a new study that aims to clarify microbiological and physicochemical interactions during the degradation of 2-methyl-4-chlorophenoxyacetic acid (MCPA) and phenanthrene in the detritusphere. The detritusphere offers a unique opportunity to study metabolism and co-metabolism by a bacterial and fungal community along a gradient of decreasing availability of low molecular weight substances within a distance of 10 mm from the soil-litter interface. First, we will estimate the MCPA and phenanthrene degrading genetic potential by quantitative PCR of functional genes. Second, we will clarify the fungal and bacterial contribution to degradation by tracing the carbon flow into fungal and bacterial derived ^{13}C PLFAs and ^{13}C ergosterol. Third, we will combine $^{13}C/^{14}C$ techniques to elucidate the time-dependent interplay between biological and physical processes during degradation. Fourth, we will model transport and degradation of MCPA and phenanthrene as well as small-scale microbial growth using, for the first time, abundances of functional genes. The project will be carried out in close collaboration between the soil biology group (Prof. E. Kandeler) and the biogeophysics group (Prof. T. Streck) of the Institute of Soil Science and Land Evaluation (University of Hohenheim) as well as an external partner from France (Dr. Fabrice Martin-Laurent) of the Laboratory of Soil Microbiology and Geochemistry (INRA, Dijon). We will show first findings regarding the MCPA and phenanthrene degrading genetic potential of microorganisms in the detritusphere.

P104
Restoration of a soil grassland microbial community with respect to carbon accumulation and mineralization after previous fertilization

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A long-term field experiment on grassland based in 1969 was used to reveal effects of increasing level of mineral fertilization (control, PK, 80 kg.ha^{-1}N+PK, 160 kg.ha^{-1}N + PK) on soil microbial biomass and activity with respect to the carbon cycle. These results were compared with data obtained from plots that had been fertilized till 1990 (320 kg N.kg.ha^{-1}, L320) when fertilization was ceased.
A long-lasting effect of fertilization on soil microorganisms was detected as the lowest fraction of active microbial biomass (SIR, β-glucosidase activity) was found in L320 plots. The fact that the highest content of extractable C was found in these plots indicates that microorganisms were not able to use available substrate effectively. A long lag phase of growth respiration curves and the lowest values of the microbial quotient (C_{bio}/C_{org}) found in L320 soil support this hypothesis. The fact that L320 and control soil could be clearly discriminated from each other showed that the microbial community in L320 soil had not fully recovered from the negative effect of fertilization in the past.
High doses of fertilizer negatively influenced accumulation of organic matter in microbial biomass (C_{bio}) and total mineralizing activity in soil fertilized continuously from 1969.

P105
Effect of mineral fertilization with azote and phosphorous on earthworms (Lumbricidae) in conditions of a mollic preluvosoil from west of Romania

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Among the organisms with their living activity in soil, the earthworms are recognized for their important role regarding the improvement of physical and chemical characteristics of soil, and thus increasing its fertility. Knowing their dynamic in soil under the influence of different technological treatments, respectively as result of fertilizers application, are very important for soil fertility conservation.
The study intended to establish how dynamic of earthworms (Lumbricidae) is changing in soil (individuals number, biomass), in conditions of mineral fertilization with different doses (four) of azote and phosphorous, in a wheat culture. The soil of the research was a mollic preluvosoil (Romanian System for Soil Taxonomy, 2003), and takes part from a long term research experiment, by 33 years, time when the four studied doses of mineral fertilizers (N, P) were systematically applied: N0P0, N100P100, N150P100, N200P0, N200P100.
Results showed that the application of these types of fertilizers increases the number and biomass of lumbricids in soil, especially the azote treatment, comparative to the control. Results were correlated to the other characteristics of soil, like pH and humus value.

P106
Long term effects of sewage sludge disposal on organisms in an arable soil

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Heavy metal pollution of an arable soil caused by decennial sewage sludge disposal exhibited sustained effects on soil biota 16 years after the last sludge application. Application of 12 t ha^{-1} a^{-1} (DM) heavy metal enriched sewage sludge caused an increased soil content of heavy metals compared to the mineral fertilised control plots which was transferred to soil organisms. The earthworm biomass from the sewage sludge treated plots bore an increased heavy metal content. Cadmium showed the highest transfer factor from soil to earthworms. The amount of transfer into biomass is specific for each element and depends on heavy metal soil content. Despite the higher heavy metal content, the count of earthworms was increased in the sewage sludge treated plots due to the enhanced soil organic matter (SOM) content. In the control plots, 66 earthworms m^{-2} were found at 3.6 % SOM content compared to 76 earthworms m^{-2} at 5 % SOM in the sewage sludge treated plots. The microbial activities of dehydrogenase and alkaline phosphatase enzymes were reduced in soil of the sewage sludge treated plots (153 µg TPF g^{-1} d^{-1} soil DM and 889 µg p-NP g^{-1} h^{-1} soil DM, respectively) compared to the control plots (220 µg TPF g^{-1} d^{-1} soil DM and 1084 µg p-NP g^{-1} h^{-1} soil DM). The enzyme activities of cellulase and protease however were enhanced by the application of heavy metal enriched sewage sludge (89586 µg GE g^{-1} dm 24 h^{-1} and 628 µg tyr g^{-1} DM 2 h^{-1}, respectively) compared to the control plots (22772 µg GE g^{-1} dm 24 h^{-1} and 539 µg tyr g^{-1} DM 2 h^{-1}, respectively). One the one hand sewage sludge addition enhanced soil organic matter content, on the other hand its microbial decomposition was retarded by toxic effects of heavy metals.

P107
Biological and biochemical parameters in the rhizosphere at a heavy metal polluted floodplain

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Heavy metal pollution causes numerous changes in the biological and biochemical parameters in the rhizosphere. The study aimed to characterize the effect of heavy metal accumulation caused by repeated flooding on plants and their rhizospheres. Soil samples were taken around five plant species (willows, rape, maize, grass, amaranth) from 0-20 cm depth on the sediment area along the Toka-river, near the abandoned Pb/Zn mine at Gyöngyösoroszi village (North-East Hungary).
Polluted soil samples were characterised by higher heavy metal content, especially As, Cd, Pb, Zn, but lower P content, compared to the unpolluted ones situated higher distance from the stream. Significantly lower biomass of the tested plants was on contaminated site, and their element content were changed too. Characteristically enhanced shoot metal content in all species, but theirs discrepancy indicated different heavy metal uptake by plants. The highest Zn content was measured in the maize or in the willow, and the highest Cd content in the willow. The lowest heavy metal uptake was shown in ryegrass. Soil microbial biomass C decreased while phosphomonoesterase activity and water extractable organic carbon increased in polluted site. We concluded that the accumulated metals restricted the soil microbes and caused stress shown by higher specific respiration activity.

P108
Soil microbial biomass indicators and primary succession on a spoil heap

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Heaped substrata originating from surface coal mining provides objects for studying primary succession and soil formation. The objective was to study the soil microbial biomass indicators if they related to primary succession. Four serial stages with distinct vegetation, “Initial”, “Early”, “Mid”, and “Late” representing 1, 11, 21, and 43 years of succession after heaping, were investigated near Sokolov (Czech Republic). Soil microbial biomass was studied with three approaches (chloroform fumigation extraction, substrate induced respiration (SIR) and total phospholipid fatty acids (tPLFA) in the chronosequence of soil formation in two layers, 0-5 cm and 10-15 cm. The substratum was tertiary cypris clay containing fossil organic materials.
The effect of spoil age and sampling layers was significant on microbial biomass that increased with the spoil age. There was a strong significant correlation between all studied microbial biomass variables and they were all negatively correlated with pH. Fumigation extraction biomass correlated more strongly with water extractable C than with SIR and tPLFA. SIR and tPLFA, representing the active microbial biomass, significantly increased until the Mid stage, then stabilised in the 0-5 cm while a sharp increase was found between the Mid and Late stages in the 10-15 cm layer because of the significant organic matter accumulation in that period. The high water extractable C and N content in the substratum being at Initial stage was in agreement with another study showing relatively high content of fatty acids and other fossil materials, which could be important C and energy sources for the pioneer heterotrophic community that colonised the heaped mine spoil. The fresh organic materials coming from vegetation accumulated in substratum could maintain greater soil microbial biomass than the fossil organic matter alone.
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P109
Differences in soil yeast communities reflect human impact on forest biotope

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Various studies have reported the regular presence of yeast fungi in soil. Thus they are essential part of the microbial soil community. However, just a few of the isolated species have been found exclusively in soil. Due to their assimilation abilities of various lignin and cellulose derivates they are believed to be part in the soil carbon cycle. Human impact radically changes nutrient cycles in natural ecosystems and there is very little known on the influence of land use on soil yeast communities. Here we report on a first year study of soil yeast communities in forests under different human impact in Germany, as part of the German biodiversity exploratories (www.biodiversity-exploratories.de). Comparative surveys were performed in two beech forests, i.e. one near-natural (Naturpark Hainich) and one managed for forestry.
Quantitative analysis of yeast communities was based on conventional plating technique, whereas species diversity and community structure were studied both via isolating pure cultures and direct DNA extraction. Comparisons were performed using standard statistical methods. Isolated yeast cultures were tested for abilities to assimilate ligninocellulosic compounds in order to determine probable contribution to carbon cycle.
Total yeast counts in near-natural forests were not significantly different from the ones in managed forests. Thus biomass-based techniques could not provide reliable results on differences between soil yeast communities in similar plant communities under different land use. Human impact was found to cause significant and dramatic changes in yeast communities’ structure. In total, species diversity in all main taxonomic groups was higher in natural forest. Members of the dimorphic order Trichosporonales (Basidiomycota) strongly dominated community in near-natural forest with 80% isolated cultures, whereas in managed forest constituted only about 40% and the other taxonomical groups were, thus more abundant. A notable characteristic of managed forests is also the higher abundance of ascomycetous yeasts.

P110
The changes of soil reaction after application of fly ash pellets

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The aim of the project is, besides others, to produce pellets on the basis of fluid ashes and fly-ashes for agricultural and landscaping purposes, predominantly modification of soil pH. Pellets used in this way must have specific technological properties and must comply with strict ecological requirements.
Pellets used in this way must have specific technological properties and must comply with strict ecological demands for tested materials. The content of CaO and also ecological availability of materials from the point of view of ecotoxicity before their application were analyzed.
In the small plot in Domaninek in potato-growing region were studied the effects of utilization of ashes and granules produced from fly ashes from fluid coal combustion and applied into the soil with different content of free CaO. The small plot test was established in Domaninek in potato-growing cropping area in years 2006-2007, which is characterized by extreme acid soils 4.3 - 4.5. Soil reaction was increased in these years near of all experimental variants as compared to verification in both soil depths (0 - 0.10 and 0.10 - 0.20 m). The results as well hinted possibilities of utilisation fly - ashes from fluid coal combustion also in combination with next materials (above all with Dolomitic limestone) by soil reaction land use planning. Product - pellets produced from fly - ashes fluid coal combustion and intended for land use planning like backup means was patented in CR.

P111
Functional and genetic diversity of bacterial communities in reclaimed and spontaneously developing mine soils

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Microbial community characteristics may be valuable indicators of restoration of degraded ecosystems. The aim of the study was to compare diversity of bacterial communities in false-time series of reclaimed mine soils and mine soils developing under natural succession. Soil samples (0 - 5 cm) were taken in sand quarry at unvegetated site (UnS), at a site after two years of lupine cultivation, at 7, 21 and 29 years old mine soils afforested with Scots pine (R7, R21 and R29), and at sites with natural succession of Scots pine (7, 21 and 28 years old - S7, S21, S28). Two natural pine forest soils were used as references. The samples were measured for microbial biomass (C_{mic}), respiration rate (RESP) and dehydrogenase (DHG) activity. Functional diversity of bacterial communities was determined with BIOLOG assay and genetic diversity using denaturing gradient gel electrophoresis (DGGE) of 16S rRNA gene sequence. The lowest C_{mic}, RESP and DHG were measured in soil UnS (10.1 mg kg^{-1}, 0.1 mM CO_2 kg^{-1} $24h^{-1}$, and 2.4 mg INTF kg^{-1} h^{-1}, respectively). Among the mine soils the highest C_{mic}, RESP and DHG were measured in S28 (130.6 mg kg^{-1}, 0.8 mM CO_2 kg^{-1} $24h^{-1}$, and 20.1 mg INTF kg^{-1} h^{-1}, respectively) and R7 (70.7 mg kg^{-1}, 0.6 mM CO_2 kg^{-1} $24h^{-1}$, and 10.5 mg INTF kg^{-1} h^{-1}, respectively). DGGE analysis did not distinguish the considered soils as the differences in genetic bacterial profiles within particular sites were larger than between the sites. On the contrary, analysis of the BIOLOG data indicated significant differences in metabolic abilities and functional diversity between the microbial communities of the natural forest soils and the mine soils as well as between particular mine soils. The results indicated a strong influence of reclamation measures on gross microbial properties and the functional diversity of bacterial communities.

P112
Changes in bacterial communities along a Latosol-Podzol sequence of the upper Amazon basin

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In the upper Amazon basin, the spatial expansion of Podzols within Latosols is commonly assigned to the development of reducing and acidic conditions in perched groundwater, which enhance the production of organic acids, the weathering of clay minerals and the exportation of organic carbon and metals to the rivers. Drastic changes in soil hydraulic regime and biochemistry strongly alter the structure of the vegetation, which grades from forest on Latosols to shrub savannah on Podzols. They are assumed to have significant impacts on the abundance and diversity of soil bacterial communities. This was investigated through biochemical and molecular approaches within key profiles of a representative Latosol-Podzol catena.
The study of free lipids reveals changes in the relative abundances of the branched fatty acids *iso-* and *anteiso*-C_{15} upon podzolisation. Such a pattern has already been observed upon soil acidification and suggests changes in the activity and/or structure of soil bacterial communities. The latter was investigated through DNA extraction, amplification of the 16S rRNA gene fragment and denaturing gradient gel electrophoresis (DGGE).
In surface horizons, where DNA is abundant, variations in DGGE profiles suggest the presence of both generalist bacteria colonizing the whole catena, and specialist species selected in podzol following changes in physicochemical conditions and plant cover.
In deeper horizons, DNA extraction yields are low in agreement with a low biological activity. However, DGGE analysis reveals that bacterial diversity is comparable with that of surface horizons. Nevertheless, the few similarities observed between DGGE profiles show that changes in environmental conditions and substrates induce a profound differentiation in the structures of bacterial communities in deep horizons.These results are consistent with lipid analysis. Identifications of dominant populations through sequence analysis are under progress to give some evidence on specific biological processes.

P113
Uses of compost from urban refuse (CUR) to recover the soil biological activity after the afforestation of a burnt forest area.

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Forest fires have drastic consequences for soil quality in terms of loss of biodiversity, increase in soil erosion and induction of drastic changes in their physical, chemical and biological properties. Afforestation after fire would be the most efficient measure to stop erosion and to quickly establish a vegetation cover that protects the soil surface and induces a successional process that ensures soil biological diversity. However, Mediterranean soils are characterized by being depleted in organic matter and suffering strong aridic periods, which make a successful forest recovery difficult without an organic amendment. In this work, compost of urban refuse (CUR) was introduced with tree seedlings of *Pinus pinea* in April 2005 in a burnt forest area, sampled in the spring of 2006 and 2007 and analysed in terms of vegetation cover, faunistic groups, biochemical parameters and chemical properties. Two doses of compost from urban refuse, 1.5 and 3 kg/plant, and two forms of addition, mixed with the soil (M) and in the bottom of the hole (B), and a blank without organic amendment, were introduced as experimental factors in a complete block design with five replicate plots of fifteen trees.
The results showed significant differences between plots receiving organic amendment in terms of vegetation cover as well as in the total number of the different faunal groups. There was not statistical difference between doses or forms of addition, although higher values of vegetation and fauna were found in those plots in which the organic residue was mixed in the hole. Trees in M3 plots displayed high vulnerability to drought as a consequence of the high saline content of CUR and the possible presence of phytotoxic substances. The increase in the nutrients levels, mainly nitrates, could contribute positively to develop a vegetation cover and to equilibrate the soil trophic web.

P114
Soil ecosystem modelling by means of PCA metasyntactic variable evaluation of metabolomics, faunal diversity,and bioactivity screening

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In a temperate forest location near Vienna, Austria, the soils of three adjacent environments (wetland forest in a valley, oak forest on a slope, beech forest on a hilltop) were screened for their differences in metabolite pools, inorganic nutrients, faunal diversity and bioactivity. The methods employed include classic soil fauna extraction, enzyme assays, metabolic profiling and mass analysis. Results have been evaluated using PCA metasyntactic variable comparison and used to create Odum graphs in order to assess the degree of mass transfer, recycling and ecosystem function interoperability. It was shown that this approach may be used for establishing the basal mechanisms for a mechanistic modelling of soil ecosystems.

P115
Management-induced microbial dynamics in paddy soils of SE-China

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The cultivation of rice (*Oryza Sativa* L.) on paddy soils under flooded conditions has a significant influence on the release of the greenhouse gas methane. The methane production results from the anoxic decomposition of organic matter by methanogenic archaea. In paddy soils the living conditions of soil microorganisms are subject to rapid changes depending on the management-induced stages of puddling, flooding, and drainage
These management stages were simulated in a microcosm experiment under controlled conditions in a climate chamber. Therefore, undisturbed soil microcosms (25 cm in diameter)

have been taken at three sites of different soil texture in SE-China. Soil structure and microbial diversity were characterized at selected vegetation stages. This was done using methods of (i) micropedology and (ii) molecular microbiology and a combination of them. Other soil parameters (pH, redox, matric potential, temperature) were recorded continuously in the course of the microcosm experiment and taken into account for the characterization of living conditions in the microhabitats.The results show an influence of management-induced changes on the microstructure and chemical conditions of microhabitats leading to dynamic changes of the microbial population. Thus, the altering stages of flooding and drainage affect the dynamics of anaerobic living archaea and aerobic living bacteria. Depending on the soil texture, the microbial populations are varying in their composition and abundance. Furthermore, the detection of FISH-stained archaea and bacteria in the microstructure showed influences of the management stages on their spatial distribution. Several microbial hot spots were detected such as roots, pore surfaces, and interactions between methanogenic archaea and methanotrophic bacteria. Especially the colonization density is varying with respect to soil texture and the management-stages of puddling, flooding, and drainage.

P116

Characterization of soil fungal communities in samples representing different agricultural and forest soils

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The soil samples analyzed in this study represent 18 different soil types according to Soil Classification of Latvia and FAO WRB 2006. Nine samples represent agricultural soils, ten samples are from forest soils but one sample is from blanket bog peat soil.
In order to analyze soil fungal communities following methods were used: estimation of the amount of cultivable microorganisms using plate count method; determination of typical fungal genera, extraction of total soil DNA, PCR amplification of the the fungal nuclear ribosomal fragments of the obtained followed by ARDRA and calculations of Shannon - Weaver diversity index, and quantitative PCR with universal fungal primers and *Trichoderma* spp. specific primers.
The plate count on malt extract agar revealed largest numbers of filamentous fungi in the depth of 10-30 cm in the soil samples taken from Haplic Arenosols in pine forest. In the depth of 30-40 cm the laregest numbers of filamentous fungi were recorded in Histosols from the blanket bog peat soil. Low nombers of filamentous fungi have been detected in soils from forest stands that are infected with pathogenic fungi - honey fungus *Armillaria* sp. and root rot *Heterobasidion annosum*. The highest total amount of cultivable microorganisms was detected in the soil samples taken from Haplic Luvisols from agricultural land that is naturally reforesting. The lowest amount of cultivable microorganisms was again in soils from infected forests.
The ARDRA with restriction enzymes *Eco*RI and *Bsu*RI revealed the highest Shannon - Weaver index in the soil samples from Haplic Luvisols and Haplic Cambisols (mixed forest stand).
The results of quantitative PCR showed that 0,3-7.3% of the total soil DNA may be characterized as fungal DNA and 0.001-0.1% is DNA of *Trichoderma* spp. The lowest amount of *Trichoderma* spp. DNA was found in soils from infected forests.

P117

Effect of Imicyafos on nematode and microbial communities in soil

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Imysiafos is a novel non-fumigant nematicide developed by Agro Kanesho Co. Ltd. The aim of this study was to evaluate the effect of imysiafos and other non-fumigant nematicides on plant parasitic nematodes, free-living nematodes and soil microbes.
1. Toxicity of imysiafos, fosthiazate and cadusafos to non-target organisms was tested in a direct contact method. Hyphal growth of *Fusarium oxysporum* f. sp. *lactucae* and mobility of *Caenorhabditis elegans* were more suppressed by fosthiazate and cadusafos than by imysiafos. On the other hand, effectiveness of imysiafos to *Pratylenchus penetrans* was higher compared with fosthiazate, although cadusafos was more effective.
2. A pot experiment was conducted with an agricultural soil naturally infested with *P. penetrans*. The density of *P. penetrans* decreased to less than 10% after imysiafos and fosthiazate treatment at the recommended doses. On the other hand, the effect of these nematicides on the population density of free-living nematodes was negligible, suggesting that sensitivity of *P. penetrans* to these nematicides was higher than that of free-living nematode.
To evaluate the impact of these nematicides on soil microbial community, microbial biomass (ATP method), cellulose decomposition activity and number of ammonia oxidizer were measured. No significant effect was observed in these parameters in all the treatments for 28 days. Our results demonstrated that imysiafos was only toxic to *P. penetrans,* but brought little impact on free-living nematodes and soil microbial community.

P118

Thiosulfate oxidation pathway and plant growth promotion potential of Proteobacteria and Actinobacteria isolated from crop plants

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Most of the S in soil environments is bound to organic molecules, and therefore not directly available to plant. Use of S oxidizers enhances the rate of natural oxidation of S and speed up the production of sulfates, and makes them available to plants at their critical stages, consequently resulting in increased plant yield. Thiosulfate oxidation and mixotrophic growth were examined in pink pigmented facultative methylotrophic (PPFM) bacteria. Results revealed that methylotrophic bacteria use the non-S_4 intermediate (S4I) sulfur oxidation pathway for thiosulfate oxidation. Thiosulfate oxidizing *Dyella*, *Burkholderia*, *Alcaligenes*, *Microbacterium*, *Leifsonia* and *Pandoraea sputorum* could grow chemolithotrophically with medium containing thiosulfate and showed growth coupled thiosulfate consumption. These isolates accumulated intermediate products such as sulfur, sulfite and trithionate during time course of thiosulfate oxidation in the spent medium and finally these products were oxidized to sulfate. They also possessed thiosulfate metabolizing enzymes and did not show positive amplification for sulfur oxidation gene (*soxB*), suggesting that these bacteria could use 'S4I' pathway for thiosulfate oxidation. Accumulation of sulfur and the presence of *soxB* gene were noted in *Halothiobacillus*, *Pandoraea* sp. and *Pandoraea pnomenusa* strains. This led to postulation that these bacteria could operate 2 pathways such as 'S4I' and 'Paracoccus sulfur oxidation' (PSO) pathway simultaneously for thiosulfate oxidation. Of the tested strains, *D. ginsengisoli* recorded the higher sulfate-sulfur (1927, 1072 and 2526 µg $g^{-1}$of soil) and reduced the pH significantly (4.7, 3.6 and 3.4) in clay, silty clay and sandy loam soils, respectively on day 30. All the tested strains (except *Halothiobacillus* sp.), increased root, shoot length and biomass of maize in sand amended with sulfur and/or rock phosphate. The results of the present study did not support the correlation among thiosulfate oxidation, sulfur oxidation in soils and plant growth promotion of thiosulfate oxidizing bacteria with their thiosulfate oxidation pathway.

P119

Contributions to heavy metals removal from contaminated soil using acid and chelating agents

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The contamination of soils with heavy metals is a very important environment issue, given the rapid development of agriculture and industry. Heavy metals are harmful to humans, animals and tend to bioaccumulation in the food chain.
The paper presents the results obtained in heavy metals (lead, copper and zinc) leaching from contaminated soil due to the industrial activity, using nitric acid (HNO3) and as chelating agents ethylenediaminetetraacetic acid (EDTA) and nitrilotriacetic acid (NTA). These reactants are capable to extract heavy metals contaminants from soil into the solution, for soil depollution.
Before soil clean-up, was initiated a preliminary investigation to determine principal contaminants of concern, their concentration and soil type, followed by treatability studies.
Laboratory tests were performed using a contaminated soil sample collected from the contaminated site, an old industrial area in Romania. The physical and chemical characteristics of soil sample were determined in agreement with national standards.
The results from this study suggested that the strong acid and the chelating agents were both effective in heavy metals extraction, the latter compounds could be more useful in soil washing because they are less harmful to the soil environment.

P120

Characterization of cultivable methylotrophic bacterial communities associated with traditionally cultivated field-grown rice cultivars - population dynamics and potential for plant-growth promotion

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Members of the *Alphaproteobacteria* belonging to the genus *Methylobacterium* are ubiquitous in nature and abundant on plant leaf surfaces. Investigations on pink-pigmented facultative methylotrophs (PPFMs) over the last decades reveal strong interactions with plants as a plant-growth promoting bacteria. In this study methylotrophic bacteria were isolated from four rice cultivars sampled from three different field sites on media containing methanol as a sole carbon source. Cultivable methylotrophic bacterial isolates showed different morphologies and the distinctive PPFMs populations were surveyed further. Significant differences were observed in PPFMs population densities in regard to rice growth phase, cultivars, and the tissues from which the isolates were obtained. The similarity among the isolates analyzed through FAME profile and 16S rDNA analysis revealed 3 distinct groupings of methylotrophic isolates. The potential of the isolates for plant-growth promotion was evaluated by screening for production of IAA, 1-aminocyclopropane-1-carboxylate deaminase, siderophores and sulfur oxidization. The PPFMs isolates possessed at least one of these traits but their activities greatly differed with respect to the stage of the plant and the tissues from which they were isolated. The rice-associated PPFMs that showed characteristics related to plant-growth promotion (PGP) identified by 16S rDNA sequence analysis were found to be closely related to *Methylobacterium suomiense* and *Methylobacterium fujisawaense*. The other types of methylotrophic bacteria associated with rice were identified as members of the genera *Burkholderia, Methylophilus, Pseudomonas* and *Enterobacter*. The results indicate that various species of *Methylobacterium* and other methylotrophs containing PGP related properties are frequently present in various tissues and different stages of rice and they could be efficiently utilized for plant-growth improvement. These characteristics suggest that methylotrophs are highly adapted or more competitive in the rice environment, but also more efficient mechanisms other than the PGP effects discussed here could be involved in specific interactions between rice and methylotrophic bacteria.

P121

Isolation, characterization of phosphate solubilizing bacteria from the rhizosphere and their inoculation effect of encapsulated cells on plant growth and nutrient uptake

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Phosphorus (P), after nitrogen is the major plant growth-limiting nutrient despite being abundant in soils in both inorganic and organic forms. Chemical fertilizers added to the soils to circumvent the problem of P-deficiency, further the situation by the fact that almost 75-90% of added P-fertilizer is precipitated by Fe, Al and Ca complexes present in the soils. P-solubilizers in the form of microorganisms can help in increasing the availability of accumulated phosphates for plant-growth by solubilization. In addition, the microorganisms also enhance the plant-growth by increasing the availability of other nutrients and by producing plant-growth promoting substances. In this study, PSB isolated from the rhizosphere of four crop plants were characterized and their inoculation effects in different forms were assessed under pot-culture conditions. Thirteen isolates based on the solubilization of $Ca_3(PO_4)_2$, $AlPO_4$ and $FePO_4$ were identified. The isolates were clustered under *Burkholderia, Enterobacter*, *Pantoea* and *Klebsiella* species based on biochemical, whole-cell fatty acids methyl ester profiles and 16S rDNA sequence analysis. Two isolates were evaluated in terms of plant-growth promotion and nutrient uptake in maize under green-house conditions. Inoculations of PSB were applied in free cell and alginate immobilized forms with or without the addition of rock phosphate. Early N and P-uptake was significantly higher in the test plants than in the control plants. Considering the results obtained on the impact of PSB strains on maize, could recommended as a biofertilizer to match the early plant P-uptake mechanism. Thus the process prevents the soil available P-immobilization by the introduced microbes and makes it available to plants. However, information on the extent of survival of free as well as alginate immobilized bacterial cells in maize rhizosphere and their persistent P solubilizing activity till the end of crop growth is required for a complete understanding of their exact role.

P122

Colonization of plant roots and leaves by plant-growth promoting *Methylobacterium* characterized by confocal and scanning electron microscopy and its persistence in the rhizosphere

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Bacteria of the genus *Methylobacterium*, a group of pink-pigmented facultative methylotrophic bacteria characterized by their ability to utilize methanol, are more than a passive passenger on plants. They are ubiquitous on plant surfaces, potentially dominating the phyllosphere bacterial population and also occur as rhizosphere inhabitants and endophytes in plant tissue. The present work was carried out to study the colonization of plant surfaces by an introduced *Methylobacterium suomiense* strain CBMB120 and its persistence in the rhizosphere in presence of indigenous microorganisms. CBMB120, a rhizosphere soil isolate from rice had plant-growth promoting characteristics and the presence of acyl-homoserine lactone quorum-sensing signal molecules for cell to cell communication has been also documented in this strain. To facilitate easy monitoring under plant inoculated conditions, CBMB120 was tagged with green-fluorescent protein (*gfp*) by introducing the plasmid pFAJ1820 in triparental mating. CBMB120 *gfp*-29, effectively colonized the roots and leaves of rice and tomato when inoculated in the rhizosphere as observed through microscopy. The strain initially colonizing the rhizoplane was able to enter the roots of tomato inter-cellularly. Although, such inter-cellular colonization was not detected in rice, the bacterial cells were present in the leaves and stomata packed with bacteria can be visualized both in rice and tomato. Quantitative data on the survival of CBMB120-*gfp*29 in tomato and rice was obtained by selective plating on AMS with methanol supplemented with kanamycin. No background growth was observed for samples obtained from non-inoculated control plants in this media. The inoculated strain densities were higher in the rhizoplane than in the phylloplane and a considerable population was present in the rhizosphere soil also. The detailed ultra-structural study on the rhizosphere colonization by *Methylobacterium* put forth conclusively that colonizes the roots and leaf surfaces of the plants studied and is transmitted to the aerial plant parts from the seed source.

P123

Potential for nutrient solubilization and plant growth promotion by bacterial strains isolated from crucifer specialist - *Plutella xylostella* (Lepidoptera: plutellidae) gut

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Microorganisms provide the metabolic basis for nutrient cycling in soil. Many of these microorganisms are associated with habitats provided by eukaryotic organisms like plant rhizosphere or guts of herbivore insects. Compared to bulk, such ecological niches are often characterized by higher concentrations of nutrients and increased microbial biomass. Accordingly, we explored the insect diamondback moth - *Plutella xylostella* gut bacteria and tested for their potential to solubilize nutrients and traits related to plant growth promotion. Twenty bacterial strains were selected based on their growth pattern and colony morphology for molecular characterization. The results of 16S rDNA gene sequence showed that the bacterial strains were belonged to five different genera such as *Acinetobacte*r, *Brachybacterium*, *Psuedomonas*, *Serratia*, and *Stenotrophomonas*. All the strains were able to solubilize mineral phosphate, ZnO and oxidized sulfur (with the exception of *Acinetobact*er sp. PRGB15 and PRGB16); positive for ammonia production; negative for pectinase activity and HCN production and reduced acetylene to ethylene, produced indole-acetic acid as well under *in vitro*. Six of 20 bacterial strains selected based on their multifaceted beneficial traits, were evaluated for their effect on test plant species like tomato, canola, redpepper and maize. Irrespective to test plant species, seedlings from bacterially treated seeds showed significantly increased growth over control in terms of root elongation, seedling vigor and dry bio-mass. Interestingly, the siderophore producing *Pseudomonas* sp. PRGB06, cross-utilized the siderophores produced by the phytopathogenic fungi besides inhibiting their growth in plate assay. It indicates that, the bacterial strain would control pathogens either by nutritionally challenging them or inhibits their growth by lytic enzyme β-1,3- glucanase. It is interesting to speculate that nutrient solubilization and other beneficial traits of bacterial strains, which would be released through feces, might contribute to improve plant growth by increasing soil nutrient availability and providing phytohormones.

P124

Recovering of fungal wastes: a soil microscale monitoring on ammonia oxidizers

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The wastes originated from the use of microbial biomass have been used until now as organic fertilizers with beneficial effects on biological, chemical and physical properties of soil. Here, an exhausted fungal biomass producing antibiotics has been studied. In this case, it could contain large amounts of antibiotic encoding genes that could be involved in horizontal gene transfer events in soil. For this reason our laboratory and the ACS-Dobfar company have set up a procedure to degrade DNA in low molecular weight fragments and this procedure is now an Italian and European patent (IT MI2003A 002129 and EP 1 529 766 B1, respectively). This work describes the first steps of an analysis to understand if the biomass could be used as a soil amendment. In particular in evaluating the effects of this treated fungal waste on the composition of eubacteria and ammonia-oxidizing populations of soil, determined by denaturing gradient gel electrophoresis (DGGE) and gene sequencing. The fungal biomass waste was added to non sterile soil at three rates: 0.05, 0.1, and 1% per dry weight of soil. Control soil, without any amendment, was also investigated. Total DNA was extracted, purified, and amplified by using either universal (eubacteria) or specific (*amo*A) primers. Amplicons were separated by DGGE and sequencing was also carried out to better assess the diversity of ammonia oxidizing bacteria. Changes in the composition of eubacterial community were detected after 3 days only in the soil treated with the highest dose, while the ammonia oxidizing population responded more promptly (after 1 day) with evident modifications at level of *Nitrosolobus* like sequences.

P125

Linking N2O concentrations in different soil depths to denitrification genes abundances under the influence of an elevated atmospheric CO2 concentration

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The production of nitrous oxide (N2O) from agricultural soils by denitrification forms a major part of the global emission of this important greenhouse gas. Due to a lack of the nosZ gene encoding the nitrous oxide reductase, some denitrifying bacteria are not able to reduce N2O to N2. Until now, factors influencing the proportion of denitrifying bacteria having this truncated pathway are not well understood. Under a changing climate, namely increasing concentrations of CO2 in the atmosphere, plant growth and exudation as well as soil moisture will be influenced which probably also affects conditions for denitrifying bacteria in soil.
We investigated in the present study N2O production rates as well as densities of functional genes (narG, napA, nirK, nirS and nosZ) encoding reductases involved in the denitrification process in different soil depths of an oilseed rape field under both, ambient and elevated CO2 concentrations (Mini-FACE Experiment) during the growing season 2007. Gas samples were collected in soil air sampling probes installed at three different soil depths (5, 15 and 30 cm). Soil samples were collected at three depths (0-10, 10-20 and 20-30 cm) on six

dates during the season 2007. Soil temperature, precipitation and soil moisture content were monitored in the field. N2O concentrations in soil were highest in deeper soil layers under moist and high nitrate conditions. Total amounts of DNA as well as functional gene densities of denitrifying bacteria changed during the vegetation period with lower values when soil was dry. Effects of soil depth dominated over those of elevated atmospheric CO2 concentrations. However, during some periods throughout oilseed rape growth altered ratios of nosZ to napA indicate temporal changes in the soil bacterial denitrifier community.

P126
Effect of management regime on the soil enzymatic activities in a mediterranean grassland

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Grassland management, based on grazing and mowing, may substantially influence the below-ground food-web, and thus soil organic matter transformation and nutrient cycling in such ecosystems.
Soil enzymes have been suggested as potential indicators of soil quality because of their relationship to soil biology, ease of measurement, sensitivity to environmental stress, and rapid response to changes in soil management. Enzymes catalyze all biochemical reactions and are an integral part of nutrient cycling in the soil.
This study reports a one-year investigation performed in Mediterranean grassland located in central Italy. The aim of the study was to compare the effect of management based on defoliation (grazing and mowing) and unmanaged plots on soil enzymatic activity. Criteria for choosing enzyme assays were based on their sensitivity to soil management, importance in nutrient cycling and SOM decomposition. Microbial biomass C, N and C:N ratio were also measured.
Four fenced areas which prevent the enclosed plots from mowing and grazing, were established in the year 2002. Soil sampling was performed twice in the year 2006: just after the mowing at the end of June and in the beginning of October. For each sampling date 8 soil samples were taken inside each fence area and 8 samples outside the fences. The following enzymes were measured using fluorogenic methylumbelliferyl (MUF)-substrates: β-cellobiohydrolase, N-acetyl-β-glucosaminidase, β-glucosidase, α-glucosidase, acid phosphatase, β-xylosidase, arylsulphatase and leucine-aminopeptidase. The results show a general negative trend on enzyme activities induced by the management after the mowing except for leucine-aminopeptidase. Furthermore microbial biomass C:N ratio is lower in managed plots suggesting a possible shift in favour of bacteria. Defoliation has a positive effect on microbial biomass due to an increase of root exudation, leading to a larger supply of easily available C and energy sources to microbial communities resulting thus in a general suppression of decomposition activities.

P127
Abundance and community composition of nitrifiers and denitrifiers in various agricultural soil habitats

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Aimed at improving nitrogen (N) fertilizer use efficiency, rates and pathways of microbial N transformations were examined in five contrasting agricultural soils using a lab-scale test-tube system. Activities of nitrifiers and denitrifiers lead to significant N losses via nitrate leaching and the emission of N gases, which have a high potential of enhancing the greenhouse effect. Both the community composition and the abundance of nitrifiers and denitrifiers were explored in relation to specific soil characteristics and microbial N processes. Distinct communities of denitrifiers were found in the various soils based on comparative terminal restriction fragment length polymorphism (T-RFLP) profiling of copper containing nitrite reductase (*nirK)* and cytrochrome cd1 nitrite reductase (*nirS)* gene fragments, while bacterial ammonium monooxygenase (*amoA)* gene based T-RFLP patterns of nitrifiers exhibited more congruencies. Differences in microbial community composition corresponded to differences in soil pH, soil C and N contents, microbial biomass contents, and gross-mineralization rates. Quantitative real-time PCR analysis revealed a clear dominance of *nirS* over *nirK* genes with up to 9.7×10^8 copies g^{-1} soil and 6.4×10^6 copies g^{-1} soil, respectively. Bacterial *amoA* gene copy numbers ranged from 2.8×10^6 to 1.2×10^7 copies per g soil. Main determinants of functional gene abundances were soil pH, water content, and C and N concentrations. Soils showed significant differences among each other in copy numbers of all analyzed genes. These data represent baseline information for subsequent studies involving different types of N fertilizer and the use of various crop cultivars.

P128
Examination the properties of soils originating from different hungarian regions

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In the past decades, there has been increased scientific interest in the different anthropogenic effects on the soils. Physical, chemical and microbiological properties are measured as indicators of soil quality in Hungarian soil types. The agrotechnical factors could change the physical, and chemical properties of soils, resulting changes in soil fertility and in connection with it the biological activity of soils.
The biological activity of six soils originating from different places and belongs to three main types were examined in 2007. The most important physical, chemical and microbiological properties of soils were determined. The soils examined were the following: three sandy soils with different pH from Nyírlugos, Fülöpháza, Orbottyán, calcareous chernozem from Látókép and Nagyhörcsök; brown forest soil with clay illuviation from Gyöngyösoroszi. Physical and chemical properties determined were the following: moisture content, texture, salt%, $pH_{H2O,}$ pH_{KCl}, hydrolytic acidity, $CaCO_3$%, ammonium-lactate soluble P_2O_5 and K_2O; humus and total N-content.
Regarding to the biological activity of soil the following microbiological properties were studied:
Total number of bacteria, (bouillon agar medium), number of microscopic fungi (PGA medium) by plates dilution methods, the number of two important physiological groups of bacteria, (aerobic cellulose decomposing,- nitrifying), the activity of soil enzymes (dehydrogenase, urease, phosphatase), the CO_2-production and microbial biomass-carbon.
The highest amount of total bacteria, nitrifying and cellulose decomposing bacteria further enzymes activities were measured in neutral, or slightly alkaline soils (e.g. calcareous chernozem and humus sandy soil), meanwhile there was the smallest amount of microscopic fungi in these soils. The differences among the results were significant.
The biological activity of soils was influenced by humus content, texture, pH and moisture content.

On the bases of our results an environmental monitoring system is recommended for the quality conditions of agricultural and natural soils.
Study was supported by NKTH-OTKA (68636).

P129
Influence of earthworms, mycorrhiza and plant roots on soil bacterial metabolic community pattern

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Biotic interactions in soils are known to influence soil fertility via impacts on soil chemical and physical properties and furthermore on aboveground plant communities. Earthworms, arbuscular mycorrhiza fungi and roots are important components of the belowground ecosystem by their abundance and behaviour as engineers of the ecosystem. As bacteria are also essential of the soil ecosystem (i.e. plant growth promoters, mycorrhiza helpers, catalysts in nutrient cycles), the aim of this study was to assess the tripartite interaction of earthworms, AMF and roots on the establishment of bacterial metabolic community pattern. An original microcosm experiment in climate chamber including phosphorous limitation was conducted over 35 weeks by adding earthworms, AMF and roots separately or in combination. The soil was first sterilized with gamma-irradiation and the original bacterial communities were re-introduced without any fungal spore (filtration).
The bulk soil of a total of 24 microcosms corresponding to triplicates of the eight treatments was examined using Biolog EcoplateTM (Biolog Inc., Hayward, CA, USA). The thirty-one substrates of Biolog EcoplateTM were classified into four biochemical categories: carbohydrates (CH), carboxylic acids (CA), amino acids (AA), amine/amide (Am). Each substrate well was inoculated with a soil suspension containing about 103 colony forming unit per ml. Incubation of the plates was carried out in the dark at 24 °C for 72h without agitation, and the level of respiratory activity for each well was determined at the end of incubation by measuring the optical densities at 630 nm. Multivariate analysis (redundancy analysis) on the whole dataset and standard analysis of variance (ANOVA) for the analysis on the biochemical categories were performed.
Results of the RDA on the EcoplatesTM dataset indicated that earthworm mycorrhiza and roots explained together 39.2% of the variation of bacterial metabolic community patterns. The ANOVA showed significant differences of the presence of mycorrhiza and roots.

P130
Use of biological parameters for diagnostics of pesticid pollution of the south Russia soils

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Biological methods of diagnostics of negative influence on an environment, have a number of advantages before others (chemical, physical, etc.): Simplicity of performance, cheapness, efficiency, an opportunity of early diagnostics, etc. the Purpose of work - to reveal change of soil biological parameters on its pollution by different dozes of pesticides. Objects of researches were chernozems, brown wood soil, rendzins, sandy soils. We defined influence of incecticide decise and herbicide harnes within 20 day. Investigated pesticides have rendered weak enough influence on activity dehydrogenase and catalase. Only very high dozes of preparations caused their strong inhibition. Thus it has not been rendered also authentic stimulating effect at entering pesticides as it frequently happened at use of other bioindicators, for example, abundances saprophite microorganisms. Some distinctions of in operation investigated pesticides have been revealed. Activity of catalase at entering harnes was authentically lowered even with the minimal doze. At the further increase of a preparation doze activity of the given enzyme naturally did not change, though the minimal values nevertheless have noted been at the maximal entering of harnes. On all investigated types of soils catalase activity in skilled variants is less, than in control. However close communication is noted only for soils with a weak level of agricultural fertility - brown wood and, especially, sandy soils. Highly productive in the agricultural attitude soils differ a high degree of stability of catalase activity to investigated influence. Proceeding from the received results the response of parameters for diagnostics of soil pollution pesticides it is possible to use an abundance nitrogen fixer bacteria of sort Azotobacter, and at a high doze of pollution and on sour soils - activity catalase and number microbes. Researches are supported by grants of the Russian Federal Property Fund 06-05-64722 and 07-05-10101.

P131
Enhancement of soil functional stability by organic amendment and possible contribution of aggregated soil structure

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The effect of organic amendment on resistance and resilience of organic matter decomposing ability was compared between soils amended with compost and with chemical fertilizers. The impact of metam sodium disinfection on cellulose decomposing ability and the number of nematodes in three types of soil was periodically measured. In an andosol, cellulose decomposing activity was significantly suppressed by the soil disinfection only in the chemically fertilized soil (CF-soil), but not in the soils added with cow manure compost and okara/coffee compost. In a brown lowland soil, cellulose decomposing activity was significantly suppressed by soil disinfection in the CF-soil, but not in the soils added with higher amounts of cow manure compost and pig manure compost. In a red-yellow soil, cellulose decomposing activity was significantly suppressed by soil disinfection in all the soils, but its resilience was higher in the soils added with cow manure compost or coffee compost than in the CF-soil. Total numbers of nematodes were markedly decreased by the soil disinfection in all the soils. These results may suggest that soil functional stability evaluated by the resistance and resilience of cellulose decomposing activity against soil disinfection were enhanced by organic amendments while the disinfection possessed killing effects on soil nematodes. In most of the organically amended soils, their mean weigh diameters of aggregates were larger compared to those of the CF-soils, suggesting that highly structured soil pore networks may provide shelters for soil microbes responsible for cellulose decomposition against disinfection. This hypothesis was supported by the result that resistance of cellulose decomposing activity against soil disinfection decreased by destroying soil structure with grinding in a mortal and pestle.

P132
Influence of vegetation on enzyme activity of ordinary chernozem

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Purpose of the present researches - revealing of influence of character of vegetation on biological properties of soils. As bioindicators used activity of soil enzymes by the standard technique. For the period April - May, 2007 samples of soils with an interval two weeks have been selected. Samples were selected from virgin steppe site of the "Persianovka", an adjoining forest belt, nearby bushes of blackthorn, and also from arable lands being in immediate proximity, under a winter wheat. In the selected samples defined activity of dehydrogenase, invertaze, catalase, humus, pH, humidity and temperature. Researches have shown, that enzyme activity is higher on a steppe site then on a forest belt and thrickets of a blackthorn. So, catalase activity maximal has made 7,9 for a site of steppe, and for the investigated period was above 7 ml O2/g/min whereas on a processable site with a winter wheat maximal has made 4,9 and increased 3,3 in the beginning of April up to a maximum fixed in the end of May. Activity of invertaze changed in the similar image. Low activity was observed in April with increase by the end of May, at higher parameters on the virgin soil which has made an interval from 4 up to 6 glucose/10g/24h, while for a site field an interval from 3,2 up to 4,8 glucose/10g/24h. The received results show the influence of plants on the soil environment and distinctions in enzymes parameters on processable and virgin soils. Researches are planned for the period of two years, and the further researches will give more detailed understanding of changes made by plants in the enzyme a pool of soils. Researches are supported by grants of the RFFI (06-05-64722a and 07-05-10101k).

P133
In situ unsaturated transport of cow manure-borne *E. coli* through the soil

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In situ transport of bacteria through field soils has not been studied extensively in comparison with the several indoor researches. Objective of this research was to investigate the fate of cow manure-borne *E. coli* through a soil profile (clay loam over sandy clay loam), under unsaturated steady-state flow. Soil porosity decreased with depth, and structure was blocky and angular blocky in 0-20 and 20-40 cm layers, respectively. A micro-lysimeter was made by metal cylinder (with 25 cm diameter and 50 cm height) and pushed vertically into the field soil. Water flow through the columns was controlled by a tension infiltrometer at suction of 5 cm. As soon as steady-state flow was established, fresh cow manure was applied uniformly on the soil surface at the rate of 10 Mg ha^{-1} (dry basis). Soil solution was sampled from two depths (20 and 40 cm) using modified hypodermal needles under a fixed vacuum suction for a short time during leaching. The samples were taken at 1, 2, 4, 6, 12, and 24 hrs after manure application. *E. coli* concentration in the samples was determined by the plate count method. Residual concentration of *E. coli* in the soil was determined after leaching trials, too. Significant low concentration of the bacteria in flowing soil water indicated bacteria straining due to air-water interface and water meniscus around soil particles under unsaturated condition. Concentration of *E. coli* in the 20 cm depth was higher than in the 40 cm depth. The flow concentration in 1, 2, 4 and 6 hrs samplings had an increasing trend at both depths, but, decreased for the next sampling times. Top layer (a few cm) of soil filtrated many bacteria (i.e. high residual concentration). Overall, variation of texture and/or structure along the *in situ* soil (profile) could effectively alter the bacteria movement.

P134
N mineralization-nitrification indicators in 50 beech forests (*Fagus sylvatica* L.) in Northeastern France

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Soil samples were taken in a network of 50 beech forests throughout North-Eastern France to compare nitrogen availability indicators. Soils types ranged from acidic cambisol (pH 3.7) to calcaric leptosol (pH 7.2). The O and upper (5 cm) A horizons were collected and C and N concentrations, microbial biomass and $\delta^{15}N$ were measured. The potential net N mineralization (PNM_{soil}) and the potential C mineralization (PCM) were measured after 42 days *in vitro* soil incubation at 20°C. The percent nitrification (P_{nitr}) was calculated as the percentage of nitrate-N over mineral -N produced during incubation. Beech foliar N concentration and $\delta\ ^{15}N$, and various indexes for N availability based on the vegetation composition were also measured.
High altitude acidic soils mineralized more nitrogen than others soils. No relationship was detected between PNM_{soil} and soil N concentration, soil C/N ratios and vegetation based indexes for N availability. PNM_{soil} was best related to soil acidity (10^{-pH}, R^2 = 0.41***) and to microbial C/N (R^2 = 0.32***). About 68% of the variability of the percent nitrification was explained by pH and soil C/N ratio. The percent nitrification was also strongly correlated with Ellenberg N and Ecoplant C/N, and weakly correlated with leaf $\delta^{15}N$. The probability of presence of 15 plant species decreased with PNM_{soil} whereas the probability of presence of five species increased with PNM_{soil}. For 18 species, the probability of presence was significantly related to percent nitrification but not with pH. These results indicate that accurate indicators for N mineralization are still lacking although pH and microbial C/N ratio might be used. On the other hand, soil pH, soil C/N ratio, the Ellenberg N index as well as the Ecoplant C/N index are good indicators of the percent nitrification. For a given pH, some plant species may indicate the level of mineral N availability.

P135
Effect of nitrogen source and period of application on some soil biological properties under common bean

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Common bean has a key place in farming systems of Brazil. As a legume, and owed to symbiotic association with *Rhizobium*, biological nitrogen fixation is the main source of this element. However, in intensified systems of farming additional nitrogen in some form is needed for optimizing common bean yield. This may be managed with the use of fertilizers with slow release or changing the dates of fertilizer application. Therefore, the objective of this work was to verify the effect of both, nitrogen application date and nitrogen source on selected biological variables. The experiment was conducted at the experimental site of the University of the State of São Paulo (UNESP), Campus of Ilha Solteira, SP, Brazil. The experimental design was a randomized complete block design with 4 repetitions. Three different periods of nitrogen application (i. e. two weeks before sowing, at sowing and two weeks after sowing) were factorially combined with two nitrogen sources (i.e. urea with 45% nitrogen content and a slow release commercial product with 26% nitrogen) in amounts of 90 kg ha^{-1}. Basal respiration and microbial biomass were determined and used as indicators for assessing the efficiency of the studied treatments. The range of microbial biomass was between 342.3 and 645.6 µg C g^{-1} dry soil. Basal respiration oscillated between 8.6 and 9.5 mg CO2 g^{-1} dry soil. The highest microbial biomass and basal respiration figures were obtained both, with the use of urea at sowing or with the commercial product two weeks after sowing. Also these treatments exhibited the highest bean yield figures.

P136

Microbial processes in soils at the micro-scale - Finding the needle in the haystack or "Oh activity where art thou?"

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Our understanding of biological function in soils is limited by a poor grasp of processes that occur at the microbial or microbial habitat scale. Interactions at these scales directly affect the activity of individual microbes, the consequences of which for ecological function are largely unknown. This is primarily due to a lack of suitable analytical methods. Recently secondary ion mass spectrometry (SIMS) has received much interest from soil microbial ecologists. With SIMS the composition of solid surfaces can be analysed and in particular the isotopic composition of important biogeochemical elements such as C or N. However, quantitative aspects of SIMS (i.e. quantification of the in situ distribution of microbes) have not been fully evaluated in soils nor have problems identifying regions of interest (that arise due to the fine spatial scales of analysis) been resolved. Here, we present two experiments to determine validation of SIMS for use in complex media such as soils from a quantitative point of view and propose approaches for finding regions of interest. The first was carried out using a simple model: a proteobacterium (C. Necator JMP134) was grown in minimal medium with either 13C, 15N or unlabelled substrate and cells from each culture were added to sand samples to form a 13C or a 15N gradient. In the second, 13C and 15N gradients were created in soil microbial communities by addition of differentially labelled substrate. Samples were then fixed, the cells stained with a fluorochrome to identify all cells and samples embedded in resin. 13C or 15N was measured by SIMS and the proportion of 13C or 15N enriched cells was compared with the expected values determined by fumigation extraction and analysis by elemental analysis-isotope ratio mass spectrometry.

P137

Soil biological activity along an elevation gradient in the Chatkal Biosphere Reserve in Uzbekistan

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Chatkal Biosphere Reserve is protected territory in Western Tien Shan within Uzbekistan that plays a significant part in the conservation of its unique biological diversity, because they provide important habitats for endemic and rare plant species. Hydrolase activities in the soil can be quantitatively important for plant nutrition, and they are one of the most important components to evaluate functional stability of ecosystems in response to environmental degradation. The study of soil biological properties including enzyme activities in such unique environments may thus provide valuable information on microbial distribution and activities, because those areas have not been affected with anthropogenic factors. The objectives of our study where to study soil biological properties and microbial activity using 15 sites over 1500 m elevation in various ecosystems located in western Tien Shan Chatkal Biosphere Reserve of Uzbekistan. The samples were analysed for several chemical and microbiological attributes including pH, microbial population and soil enzyme activities. Soil enzyme properties such as catalyse, invertase, phosphotase, dehydrogenase and urease activities were measured using *in vitro* static incubation of unamended field-moist soil. We found that differences in soil enzyme activities among sampling locations were greatest between samples taken under plants at the three lower elevation sites. Soil biological activity influenced more by the presence of plants and it is most probably related greater transformations of organic matter by microorganisms for their increasing energy and nutrients demand for survival than assimilation in response to high temperature and other stresses.

S11 Management of Contaminated Soils (1): practical applications

P138

Serbian soil uranium contamination and complex strategy for remediation

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Pure natural apatite and synthetic organomodified zeolite (modified with quaternary ammonium ions) were investigated as materials for uranyl ions immobilization. The goal of present paper was to determine the main mechanisms for radionuclide sequestration
using two different minerals, to compare their sorption capacity in the same conditions and to check the possibility for their different combination mixture using.
Samples of natural apatite were taken in South-Eastern Serbia, near Bosilegrad. Samples of zeolite were taken in Northern Serbia, in Beocin, and modified with surface-active organic substance (octadecyl-dimethyl-benzyl-ammoniumchloride ODMBA-Cl). All measurements were done in the laboratory conditions. Samples characterizations were realized by chemical analysis and X-ray diffraction analysis, and index of uranium sorption was measured by fluorimetric method. Two main immobilization mechanisms, confirmed by obtained results, were: for apatite - slow dissolving and than precipitation of uranyl-phosphate form, i.e. autunite form with extremely low solubility constant;
for zeolite - adsorption and ion exchange reactions. The obtained results, also, showed the significant better sorption capacity of organozeolite (99.96% sorption index in period of 7 days), but also good sorption capacity of non-treated natural apatite (64.04% sorption index in period of 60 days). In all samples, made as different mixture combinations of natural apatite and synthetic zeolite, sorption index was more than 90% in only 7 days of acting. The results for these materials, obtained in our experiment, clearly illustrate the utility of amendments in reducing this important and dangerous radionuclide. Our further activities will be connected with the investigation of these materials efficiency in real natural conditions, for decontamination of depleted uranium contaminated soil in area of South Serbia.

P139

Investigation of Existence and Probability of Hydrocarbon Pollution in Groundwater around Sari Antibiotic Factory

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Groundwater is the chief resource of drinking water in Iran. Hence, its pollution is very important due to costs and time consuming. The aim of this project was to evaluate the probability of some pollutants such as phenyl acetic acid, butyl acetate, methyl isobutyl keton, 2-propanol, and isopropyl alcohol in groundwater around Sari Antibiotic factory. So, three steps sampling were applied. In first, samplings were done by EPA method and pumping till DO, pH and temperature being stable. Then sampling analysis by Head Space method was done. In next step, in order to finding types and quantity of pollutants, GC-Mass was applied. Due to the previous results and possible errors, third stage of sampling was done by serving Niskin instrument. Samples immediately were transported to two layers dark glassy vessels and placed in ice box and probability of evaporation, redox exchanges, and volatilization of pollutants was eliminated. Then samples being limped and TSS and VSS experiments were done to obtain samples features which show organic compound breaking rate by microorganisms, existence and activity index. The GC-Mass results in all stages did not show any pollutants in water except methane in ppb. As VSS amount in all sampling were very higher than standard level and expected peak of pollutants was not seen. This means leaked pollutants by broken pipes in durations 4 months (debit 65-80 m^3 per day), leakage of recovery basin floor and Ethyl acetate basin diffused to soil and ground water but due to high elevation of water table, dispersion to sea by advection, clay minerals adsorption, short half life, evaporation of volatile and semi-volatile pollutants and mainly biodegradation, component concentration reach to neglect value. So, in suitable conditions, it's possible to diminish these pollutants concentration up to 2^{-12} of primary concentration during a year by eliminating pollution sources.

P140
Methodology of rating of anthropogenic influence on soil on the basis of infringement of its ecological functions

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There are two approaches to rating of quality of the surrounding natural environment. On the one hand, it is possible to normalize the contents of polluting substances in objects of an environment, on the other hand, a degree of transformation of an environment as a result of its pollution. Positive results were given with a combination of two approaches in one methodology. As a result of research the methodology of normalization of anthropogenic influence on soil has been developed on the basis of infringement of its ecological functions. The circuit of ecological normalization of pollution of chernozems 20-¯ by chemical elements, and also oil and gasoline, with quantitative values of the contents of polluting substance in soil, causing failure of this or that ecological function, and accordingly soil division on not polluted, poorly, middle- and high polluted is offered. Accordingly for each of 20 the investigated elements, oil and gasoline are determined 3 regional specifications of the contents (in mg/kg) them in the soil (chernozem), allowing to relate this soil to one of the mentioned above categories.
On influence on a condition of soil the investigated elements do not settle down on the classes of danger developed with reference to health of people (GOST 17.4.1.02-83). Allocation of 3 classes of danger of the investigated elements in relation to soil is offered: 1 class - Se, Cr, Sn, Hg, W, Cd; 2 class - As, Sb, Co, Cu, Ni, Pb, B; 3 class - Sr, Mo, Zn, V, F, Ba, Mn.
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P141
New developments in standardisation of leaching procedures in Germany

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Associated with the new German Ordinance on Mineral Waste Utilisation and the improvement of the German Ordinance on Soil Protection, which are intended to be established in 2008, standardised and validated leaching procedures for contaminated soil and mineral waste materials with re-use potential are urgently needed, since they are not yet available on a national nor international level.
The characterisation of such materials is required if they are re-used on soils or in technical constructions in order to comply with the regulations of soil and groundwater protection.
Procedures to investigate the leaching behaviour and to determine the source term of soil and waste materials have been developed in the framework of the joint project “Leachate forecast” funded by the German Ministry of Education and Technology.
Additionally, some participants of the joint project took part in an inter-laboratory comparison in order to evaluate the reproducibility of batch and column tests. Besides the results of the joint project, the improved procedure guidelines of the inter-laboratory comparisons provided a basis for the development of two new German leaching standards for materials with a particle size up to 32 mm. Special stipulations concerning the contact time between sample material and eluent during column percolation tests have been proved and introduced to the new standard drafts DIN 19528 (Percolation method for examination of the leaching behaviour of organic and inorganic substances) and DIN 19529 (Batch test at a liquid to solid ratio of 2 l/kg for the examination of the leaching behaviour of inorganic substances). BAM was assigned to conduct a new set of inter-laboratory comparisons in order to validate these standards. Contaminated soil, demolition waste, bottom ash and steelworks slag were used as reference materials. Selected results of the inter-laboratory comparisons will be presented.

P142
Mechanochemical transformation of organic pollutants: the catalytic efficiency of phyllomanganate in catechol and pentachlorophenol degradation

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Mechanochemical treatments by grinding of polluted solid materials in mill at high energy (planetary ball mill) have attracted attention because of their possible use in the degradation of organic pollutants. The aim of this work is to estimate the catalytic efficiency of phyllomanganate (K-birnessite) in degrading pentachlorophenol (PCP) and catechol (CAT) and to check their persistence even when the phyllomanganate is dispersed in a soil matrix. Different experimental setups were adopted: 1) milling of PCP and birnessite in 1:20 ratio (binary system); 2) milling of PCP, birnessite and soil (ternary system), using a constant concentration of PCP and varying the amount of birnessite (xenobiotic-oxide ratio of 1:20 and 1:40); 3) milling of CAT and phyllomanganate in 1:20 ratio (binary system). Afterwards, grinded mixtures were incubated at 30°C for periods ranging from 24h to 7 days. After each time of milling and incubation period, aqueous and organic extracts from grinded mixtures were analyzed by HPLC-DAD, HPLC-IC and DPSAV to determine residual PCP and CAT, Cl^- and Mn^{2+} ions, respectively. X-ray diffraction (XRD) and spectroscopic analyses (XPS, EPR, FT-IR) were performed on the binary system (pollutant-birnessite 1:20) to individuate the adsorption sites most suitable for the catalytic degradation of PCP and CAT and to suggest the most probable degradation mechanisms for the organic pollutants at the birnessite surfaces.

The results obtained showed that in the binary system the whole amount of the pollutants were already removed at the end of the mechanochemical treatment. In the ternary system, it was observed that the higher the amount of birnessite added, the higher the PCP removal. Therefore the grinding treatment is an effective technology for the removal of organic xenobiotics in soils and the Mn^{4+} octahedra represent the preferential sites for oxidative mechanism of CAT, by means of the formation of a bidentate inner-sphere complex.

P143
The impact of technogenic iron compounds of industrial dusts on the formation of magnetic and geochemical anomalies of forest soils in south Poland and the border areas (Czech Republic, Germany)

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Among all constituents of industrial dusts, especially after high temperature processes (applied e.g. in metallurgy, cement-, power- and coke industry), there are iron compounds like metallic iron, magnetite, maghemite, hematite, pyrrhotite and different kind of Fe-ferrites. These minerals are characterized by high magnetic susceptibility (χ). The industrial dusts deposited on the soil surface enrich it in iron compounds which presence can be easy detected by using a simple measure of magnetic susceptibility. The magnetic susceptibility of soil is the higher, the larger is the number of magnetic iron particles in the soil samples. High value of magnetic susceptibility ($\chi > 50 \times 10^{-8}$ $m^3 \cdot kg^{-1}$) of soil testifies to the occurrence of magnetic anomaly. Because the magnetic particles are accompanied by above-average content of heavy metals, magnetic anomaly is predominantly associated by geochemical anomaly.
In the frame of present study over 3000 samples of forest soil were collected and their mass-specific magnetic susceptibility as well as the content of heavy metals was determined.
Results have shown areas where the magnetic and geochemical anomalies are located. The magnetic susceptibility distribution in the study area is very diverse. The highest topsoil magnetic anomaly of technogenic origin (χ above 500×10^{-8} $m^3 \cdot kg^{-1}$) is in Upper Silesia, Ostrava, Hoyerswerda and Zittau regions, where there are noted very high dust depositions produced by different kinds of industry. The other big magnetic anomaly is observed in the Turoszów area and it expands outside the border: in Germany and Czech Republik. The area, called “The Black Triangle” is under the influence of industrial dust emission from power plants from three countries (Poland - 1, Germany - 8, Czech R. - 4 power plants).
All above-mentioned areas are characterized by very high amount of heavy metals what attests the presence of geochemical anomalies.

P144
Effects of waterlogging and organic matter on stabilization of Zn in two Zn-spiked soils with different reaction

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Through the reports there are some indications of a possible decrease in the extractability of heavy metals after waterlogging and organic matter addition in contaminated soils. In an attempt to test this possibility, a factorial experiment as a completely randomized block design with treatments of two moisture regimes (field capacity [FC] and waterlogging [W], with and without 5% cow manure[M]) and two Zn-spiked soils (200 mg Zn kg^{-1} soil and aged for one week at FC) differing pH values ($pH_{1:1}$=8.2 and $pH_{1:1}$=3.8) was conducted (with three replications) in an incubator (25 C) for 30 days. At the end of incubation period pH, solution Zn (extraction by 0.01M $CaCl_2$) and DTPA-extractable Zn were determined. Comparison of means (Duncan, P<0.01) for solution Zn concentration apparently indicated that the stabilization ability of different treatments in both soils was in an order of: W+M>FC+M>W>FC. Although, the solution concentration of Zn in the acid soil was forty times greater than the alkaline soil. In the alkaline soil, the stabilization efficiency for DTPA-extractable Zn was in same order as solution Zn: W+M(80%)>FC+M(45%)>W(28%)>FC(19%).Whereas, in the acid soil the order was as follows: W+M(82%)> FC+M(16%)=W(17%)=FC(19%).Therefore, in the alkaline soil ,solution and DTPA-extractable data gave the same results on the stabilization ability. But somehow this wasn’t true for the acid soil. It seems that in absence of biodegradable organic matter, prolonged waterlogging of contaminated soils may not be lead to immobilize soil heavy metals. At the end of incubation period, pH of the alkaline soil was 2.5 units higher than the acid soil. This means that the stabilization ability of W+M treatment (mainly due to the formation of sulfide precipitates) may be independent of soil reaction.

P145
Ecotoxicological assessment of a vegetable oil based in-situ remediation technique for PAH contaminated soils

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In the framework of the ISPAK project an in-situ technique for the extraction of polycyclic aromatic hydrocarbon contaminated soils by the use of vegetable oil is developed. A battery of biotests will be performed before and after the remediation process in order to assess the ecotoxic potential of the soils. Bioassays including species belonging to different taxonomic and trophic groups are valuable tools to detect detrimental effects of by-products, metabolites and pollutants not considered in chemical analysis.
Ecotox-tests using a soil exclusively contaminated with PAHs showed its toxic potential to be relatively low. On the contrary a PAH contaminated soil derived from a gas plant in Vienna showed extremely high toxicity in animal- and plant-tests due to the presence of copper and zinc.
At the end of the remediation approximately 10 % of the oil percolated will remain in the soil. In a first experiment we monitored possible ecotoxic effects caused by sunflower oil using a test battery consisting of aquatic and terrestrial tests. For this purpose an uncontaminated LUFA soil (loamy sand) was amended with increasing amounts of sunflower oil (up to 10 % per dry mass). After an equilibration time of 48 h (20 °C) we performed microbiological, plant and soil fauna tests on the soil and luminescent bacteria tests on soil leachates (1:2). All soils showed the oil to have detrimental effects at relatively low concentrations. EC50 values ranged from 0.04 % oil (nitrification) to 3.84 % oil (luminescent bacteria).
Therefore we conclude that the oil remaining in the soil after the treatment has to be degraded for an effective remediation. Results of degradation experiments will also be presented.

P146
Pollution effect by black oil on biological properties of soils

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We have investigated the pollution effect by black oil on biological properties of deep chernozem and braunerde soil (Adygea, Russia). The source of pollution is a boiler-house, which is working on black oil. Samples of soils have been selected from various genetic horizons of the researched soils both from the pollutionless (background) sites, and from the sites polluted by black oil in a different degree. We determined activity of catalase and dehydrogenase, an abundance of bacteria Azotobacter, germination, the length of roots and plantlets of a garden radish, the contents of humus, pH.
As carried out researches have shown, not all the investigated parameters reduce. At pollution by black oil activity of catalase and dehydrogenase decreases, as a rule. The abundance of bacteria Azotobacter, in most cases, increases. The parameters of phytotoxicity have appeared the most stable to pollution. Observation over the vegetation on the polluted site also have shown absence of negative influence of black oil on plants.
Negative the effect from pollution has been more expressed on braunerde soil with 6,4 and lower. And on braunerde soil with 7,3 biological activity biological activity increases.
So, pollution by black oil of the investigated soils does not cause catastrophic deterioration of a nature of soil. Hence, when the layer of the polluted soil (0-2, up to 5 sm) will be removed, the remained soil will normally carry out the ecological functions, that will provide normal functioning all ecosystem. As have shown natural and modelling laboratory researches, even black oil will be collected not completely, the vegetation will not test the expressed negative influence. And in a consequence mineral oil will be recycled by edaphic microflora.
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P147
Modelling pollution of the leeching compact chernozem by black oil to establish ecological save concentration

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One of the numerous territories suffered with black oil pollution, is located under Maikop black oil from a boiler-house has been dumped for a long time, and have led to catastrophic pollution of adjoining territory.
The purpose of the work - is modelling pollution of the leeching compact chernozem by black oil with the purpose to establish ecological save concentration.
Black oil have been putted in damp soil. Investigated concentration of black oil was: 0,1, 0,5, 1, 2,5, 5, 10, 25, 50 % from weight of soil. Soil was incubated in vegetative vessels in temperature and optimum humidifying. 30 day after pollution laboratory researches had been carried out. In the selected samples defined activity of dehydrogenase, catalase, cellulase activity, an abundance of Azotobacter, phitotoxicity.
The received results allow to approve, that the investigated parameters, as a rule, are reduced with the pollution of soil by black oil. In most cases the degree of decrease parameters is in direct dependence with concentration of black oil in soil. The most sensitive cases are dehydrogenase and cellulase activity at low dozes of black oil and activity of catalase - at high dozes. The most informative parameters are an abundance of Azotobacter and catalase activity.
On the basis of the investigated parameters the integrated parameter of a biological condition of soil (IPBS) has been determinated. Significant infringement of ecological functions of soil does not occur, while values IPBS have not decreased more than 25 %. Such decrease IPBS is registered only at concentration of black oil in ground more than 2 %. As a result in the leeching compact chernozem it is possible to consider the smaller maintenance of black oil ecologically safe.
Research is executed at financial support of the RFBR (07-04-00690-a, 07-04-10132-k) and the grant of the President of Russian Federation (MD-3155.2007.4).

P148
Cu and other metals mobilization from polluted soil by various chelating agents, and their uptake by maize and Indian mustard in the experiment on induced phytoextraction

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Copper industry operation in SW Poland in 20th century, caused serious environmental pollution, of which local soil contamination with Cu and Pb is the most durable effect. According to the Polish law, remediation of soils polluted with heavy metals should lead to removal of excessive pollutants. Therefore, induced phytoextraction was examined as a method of soil remediation. We tested silty loam soil material collected from the arable land situated in the surroundings of copper smelter Legnica. This soil was contaminated mainly with Cu and Pb (395 mg/kg and 110 mg/kg, respectively). Potential extractability of Cu and Pb, and for comparison also of Zn and Fe, was tested in a batch experiment in which soil samples were treated with 6 chelating agents at broad range of pH. Three most efficient chelators: EDTA, as well as easily biodegradable: EDDS and histidine were chosen for a pot experiment. Maize and Indian mustard were used as experimental plants. Chelators were applied to soil at the stage of plant maturity, and then, two watering regimes were tested: normal and wet. A significant increase of metal solubility and phytoavailability was obtained in all the plots with chelating agents, with their efficiency in the order: EDDS > EDTA >> histidine; however, the maximum metal concentrations in plant biomass: 390 $mg \cdot kg^{-1}$ d.m. Cu and 41 $mg \cdot kg^{-1}$ d.m. Pb remained too low for successful soil decontamination. Plant uptake of metals, particularly of Cu and Pb, was much higher in the wet plots if compared with normal watering regime. The amounts of metals leached from soils were in all plots with chelating agents far much higher than those removed by plant uptake. Therefore, we concluded that none of tested chelators can be safely and successfully used for induced phytoextraction of Cu and Pb from soils polluted by copper industry.

P149
Assessing the P retention capacity of a low value soil sealant from an acid mine drainage site

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Acid mine drainage to lower parts of the Avoca Avonmore catchment in the south east of Ireland results in extensive low-value ochre (ferric oxyhydroxide precipitate) deposition. Ochre coats the stream bed and bank, sealing soils, migrating outwards in times of flooding and can be ecologically devastating. Ochre requires regulated disposal, unless uses for the ochre can be found. Results show that ochre could be excavated and used for a variety of environmental technological applications such as sequestration of phosphorus in urban and agricultural settings. In the present study, P adsorption experiments with ochre (97.7% < 2mm sieve size) showed that agitation in an end-over-end shaker improved the P adsorption capacity with 97% removals occurring within five minutes. For an initial PO_4-P concentration of 200 mg L^{-1} in solution, 4 g PO_4-P kg^{-1} of ochre is adsorbed - 39% more than the unshaken sample at the same initial concentration. A Langmuir isotherm indicates that ochre has a maximum adsorption capacity of 19 g PO_4-P kg^{-}

[1] when mixed with P-amended distilled water. For dairy farm soiled water samples, Langmuir parameters are lower with a maximum sorption capacity of 11 g TP kg^{-1} due to low initial concentrations. Based on a mean TP concentration of 20.1 mg L^{-1} in dairy farm soiled water, it would take 10 kg of ochre daily to sequester all the P in the soiled water. A double dividend is possible by diversion of ochre into sedimentation basins at acid mine drainage sites. Soil sealing could be avoided and ochre could be given an added value.

P150

Development of model substances for heavy metal contaminated soil constituents

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Many existing methods for the determination of the heavy metal fractions in soils do not characterise the bonding form of the extracted heavy metals satisfactory. Recent research has shown that so called ,,non plant available“ fractions in the rhizosphere can be depleted by growing plants. It still remains unclear, under which conditions the various bonding forms for metals present in soils can become available for plants.
The intention of the experiments presented here was to test the binding force of cadmium to various substances (calcium-montmorillonit, ferrihydride, goethit, aluminium hydroxide) produced as artificial model substances for soil constituents, which later will be used in consecutive vegetation experiments on heavy metal plant availability. The experiments aimed to obtain the highest possible Cd-contamination of the selected model substances. After synthesis of the model substances adsorption and desorption experiments with cadmium (batch experiments, 24 hours) have been performed. Finally a sequential extraction (known as the BCR procedure) of the cadmium bound to the various model substances was performed.
The re-solubilisation of cadmium with deionised water was only very low, which shows that the cadmium added as soluble salt to the soil was bond to the model substances and thereby transformed to a less soluble form. During the sequential extraction procedure of the model substances, most of the cadmium was extracted in the first step. Therefore, it can be conceived that the cadmium was mainly bound in exchangeable and therefore easily plant-available form to the model substances after our 24 h adsorption procedure.

P151

Remediation of a site contaminated with heavy fraction-hydrocarbons using biopiles

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In Mexico, oil industry has impacted negatively the environment and today there exists a lot of sites with different levels of hydrocarbons contamination. In particular, this work is about the remediation of a site in north-Tabasco, whith approximately 15,000 m^3 of soil contaminated with heavy fraction hydrocarbons (HFH) In this case, the bioremediation technique known as biopile was applied.
A set of treatability assessments were carried out using lab-scale biopiles to test different substrates and conditions for the microorganism`s growth and function: nutrients, bio-enhancer addition, nutrients+surfactant and bio-enhancer+surfactant, all working with both, active and passive aeration, in order to probe the best condition to be applied in the field. After the experimentation time, conditions which gave the best results regarding removal rates were selected. In this case the best was the addition of nutrients and the compressed air conditions.
The soil was characterized regarding initial concentration of HFH, pH, water content, dry and bulk densities, porosity, organic matter, organic carbon fraction, granulometric analysis, available phosphorus, total nitrogen, counting of heterotrophic bacteria, respirometry test and identification of specie and genera of bacteria.
At field level, remediation begun with the construction of a pilot scale biopile with 175 m^3 of soil, using the conditions selected from laboratory tests. Then we proceeded to the construction of 6 biopiles with approximately 2,200 m^3 of soil in each one. The biopiles were monitored for seven months with monthly samplings. About 21 samples were taken for each biopile per sampling. After this time, HFH levels were below what would mark the Mexican regulation for hydrocarbons contamination soils for industrial use (6,000 mg/kg).

P152

Evaluation of phytotoxicity of soils contaminated with fuel hydrocarbons by using cluster analysis method

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The reported data on phytotoxicity of soils polluted by fuel hydrocarbons are insufficient, often contradictive and thus essentially constrains the progress of phytoindication for such soils. To address this problem, we used cluster analysis to classify plants' tolerance to hydrocarbon soil contamination. Unlike many other statistical procedures, cluster analysis is of great utility when we do not have any priori hypotheses to explain obtained data, but are still in the exploratory phase of research. It reduces the number of observations by grouping them into a smaller set of clusters, groups of relatively homogeneous cases. In other words, it simply discovers structures in data without explaining why they exist.
In laboratory experiments on heavy loam leached chernozem contaminated by kerosene (10000-150000 mg/kg), seed germination and germination energy for 49 plant species, including 27 cultivated and 17 wild species were determined. As an experimental basis for cluster analysis, the computer-aided database on obtained seed germination data has been created. Next, the stored data were approximated by means of the equation reflecting the dependence of germination values on kerosene concentration. This equation contained two parameters: P_d, corresponding to kerosene concentration at which a sharp germination decrease occurred and n, describing the type of a curve of germination decrease. For a given curve, the created database allowed us to define optimum equation parameters. By using arborization clustering, both parameters of the fitting equation were analyzed. With regard to P_d, four groups of plant species according to the extent of germination decrease in the contaminated leached chernozem were settled. With regard to n, three groups based on the speed of germination decrease were defined. Finally, with regard to both parameters, relationships between plants' taxonomy and plants' incorporation in clusters were supposed.
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P153

Chrysene adsorption on a Portuguese loamy sand soil

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Leaking of diesel oil from gas stations is frequent in Europe, as well as in other parts of the world. The presence of polycyclic aromatic hydrocarbons (PAHs), which are highly toxic, is an indication of contamination by heavy hydrocarbons from diesel oil. The main goal of this work is the determination of the distribution coefficient (K_d) of chrysene (the most carcinogenic of the PAHs) in loamy sand soil from Póvoa de Varzim, in the north of Portugal, using the sorption isotherm batch tests. The sorption isotherms curves allowed the calculation of the distribution coefficient (K_d). Then, the experimental K_d values were compared with those presented in literature, in order to evaluate the influence of the soil characteristics as organic matter and clay minerals, among others. Mono contaminant solutions were used, although values determined from competitive assays are common in literature. For a better understanding of the sorption equilibrium, other isotherm models like Langmuir or Freundlich were fitted to the experimental data.

P154
Heavy metal uptake by grass biomass after amelioration of contaminated acid soil

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Heavy metal pollution of soils causes negative impact on the normal growth of plants and functional disturbance in the other environmental components. To overcome these worldwide problems of the present day different kind of amendments have been applied. A pot experiment with a grass mixture grown on heavy metal polluted, strongly acidic soil (Dystric Fluvisols) from the region of Zlatitza (Southern Bulgaria) was carried out. The purpose of this study was to obtain scientific data on the effect of different ameliorative mixtures for the improvement of plant production and low heavy metals uptake by plants grown on heavy metal polluted, strongly acidic soil. Five kinds of ameliorative mixtures - CaO, peat, coal powder, iron hydroxide and zeolite in 11 treatments have been tested. The effect of the ameliorations was assessed by comparison with the control. During the vegetation period two clear biomass cuts for one year were made. Concentrations of Cu and Zn in the biomass were analyzed and heavy metals uptake by biomass was calculated. The results of the harvested biomass amounts and heavy metals uptake by plant production show that according to Cu the most effective was the amelioration in the variant with the addition of the optimal dose of calcium oxide. At this variant the biomass increased 2 times compare to the control and the copper uptake decreased with around 26%. According to Zn the most effective was the amelioration in the variant with the combination of the optimal dose of calcium oxide, peat and zeolite. Under this treatment, the quantity of the harvested biomass increased on the average 3 times compare to the control and the zink uptake decreased with around 17%. Only the addition of zeolite doesn't show positive ameliorative effect.

P155
Mercury contamination of soil, stream and overbank sediments associated with cinnabar mineralization (Trsce, Croatia)

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There is a mono-mineral cinnabar deposit of no economic significance in the region around Trsce (Croatia). A geochemical survay was carried out over an area of 12 km^2 in order to determine pollution in this picturesque region of Gorski kotar. According to a 400 m square grid, 40 topsoil samples were collected, as well as 21 samples of stream and 35 samples of overbank sediments. Concentrations of Hg were determined in all samples by CV AAS, and 14 elements in soil using ICP-OES after aqua-regia digestion. Average Hg content in soil was 2,38 mg/kg, in the range from 0,05 to 48 mg/kg. In stream sediments avarage Hg was 0,67 mg/kg, in the range from 0,05 to 3,63 mg/kg. In the profile of the overbank sedoment Trsce 1, the avarage Hg content was 0,20 mg/kg, and in profile Trsce 2 it was 0,63 mg/kg. The age of mineral deposit is Middle Triassic, which belongs to the same metalogenetic province as Idrija (Slovenia). Soil samples were divided into two groups of Triassic and Permian age using geological map and GIS. After processing data of the Triassic group, Ba, Pb, S and Zn highly correlated with Hg. Correlation coefficients ranged from 0,86 to 0,93 ($p < 0.05$). Cluster analysis applied on the whole dataset identified three main groups. The first one comprises Hg, Ba, S, Pb and Zn, indicating influence of mineralization. The elements Co, Mn, Mg and Ni which form bonds with oxides and hydroxides of Fe and Mn contribute in the second group. The third group comprises siderophile elements Fe, Cu and Cr. Weathering of cinnabar and subsequent natural dispersion caused the increase of Hg content in soil, stream and overbank sediments. It was determined by GIS and spatial analysis that the area of 1,101 km^2 has been polluted by mercury.

P156
Field Experiments of Induced Phytoextraction - Case Study in Hungary

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Phytoremediation is a relatively new method for decreasing soil and water pollution. This method includes numerous different technologies that can decrease the pollutants' concentration of the soil or can stabilize their transport in acceptable risk level with help of special plants and related microbes. One of the most promising methods is the induced phytoextraction that increases the plant uptake by sprinkling chelating agents onto the soil.
Our paper shows the results and discussions of field experiments based on induced phytoextraction. The studied polluted material originates from one of the oxbow lakes of the Tisza river near Mártély (SE Hungary). This slurry has moderated metal contamination (Cu, Zn) which can be derived from the natural sedimentation processes. Passive phytoextraction experiments have been in process in six study plots with various plants since 2005. This investigation was completed with induced phytoextraction from spring of 2007. The main steps of the investigation were the followings:
1. Choose metal specific chelating agent to the metals with high concentration in the slurry.
2. Sprinkle with the chosen agents. The total amount of the chelating agents was calculated from the concentration of the specified heavy metal and the concentration of the agents was determined from the hydrological and physical properties of the soil. Avoid the infiltration to the deeper layers was the most important aspect.
3. Monitoring the change of metal concentration in different soil horizons before and after the treatments.
4. Monitoring the decomposition of the chelating agent in the soil.
The poster shows the results connected to the plants Helianthus annus, Brassica juncea and Brassica napus. It is focused on the changes in the different soil layers and the differences between the results of the induced and the passive phytoextraction treatments and between the control plot without treatment.

P157
Immobilization of heavy metals in soil using nanoparticles produced from zeolitic tuff

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Nanoparticles from natural materials provide new opportunities in many environmental fields. For the present study, we prepared a chemically modified zeolitic tuff in the nano-range to assess its potential to immobilize heavy metals in soil and to evaluate its influence on the heavy metals redistribution among the soil-fractions. Break down of natural zeolitic tuff to the nano-range was achieved by attrition milling. A pot experiment with barley (summer barley) was carried out. Anthropogenic polluted soil was mixed with zeolitic tuff-nanoparticles at three different rates (0.5, 2 and 5%). The results were compared with amendments of Al-oxide nanoparticles, zeolitic tuff, Fe-hydroxide sludge or vermiculite. Before and after the experiment soil was sequentially extracted for Cd, Pb, and Zn. The plants were harvested 5 weeks after planting. Subsequently, sub-samples from the roots and straw were chemically digested. Barley plants showed no significant differences in biomass between treatments. The addition of Na-zeolitic tuff nanoparticles significantly decreased the Zn concentration in barley straw by 40%, whereas applying the natural zeolitic tuff reduced it 20%. Regarding Cd and Pb content in barley straw, there were no significant differences between all treatments and control soil. The amendments affected the uptake of essential elements such as Ca, Mg, K, or Mn. The sequential extraction revealed that addition of nanoparticulate zeolitic tuff reduced the mobile fraction up to 92% for Zn, 73% for Cd, and 76% for Pb. Our results show a significant effect of decreasing the grain size of the natural zeolitic tuff to the nano-range on heavy metals content in the mobile fraction. A method for grinding and stabilizing the zeolitic tuff in the nano-range was established. We conclude that the application of zeoiltic tuff-nanoparticles for soil remediation purposes is a promising new technique for reducing the bioavailability of heavy metals in contaminated soils.

P158
Influence of experimental boundary conditions on the release of PAHs during column percolation tests

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Within the framework of a new German Ordinance on Mineral Waste Utilisation and the improvement of the German Ordinance on Soil Protection intended for 2008, the performance of column percolation tests is of increasing importance.
As an essential component of a contaminated sites assessment, the boundary conditions of column tests should be well defined. Optimized conditions are needed in order to obtain reliable results.
One objective of previously conducted column tests was the comparison of the release of PAHs from contaminated soil using three different filling heights (12.5, 25 and 50 cm) of columns and uniform column diameter (5.86 cm) as well as flow rate (0.22 ml/min). However, these settings resulted in different contact times between the sample material and the eluent (10 - 35 h), which resulted in different equilibrium conditions and quantities of contaminant release. Consequently, a modified approach has been tested applying different flow rates (between 0.075 and 0.3 ml/min) but uniform contact times (approximately 30 h) for the various filling heights of the columns. A good agreement between the tests has been achieved. The results of these experiments investigating the cumulative release of PAHs from a contaminated soil will be presented. In addition, degradation by microbial activities has been taken into account for column experiments.

P159
Effects of N and P on degradation of crude oil in two soils

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Contamination of soils with crude oil is of major international, environmental concern. It has been shown, that the establishment of plants and/or the application of fertiliser can enhance the crude oil degradation in soil. However, plants and degrader-microorganisms may compete for nutrients in soils. The application of optimised amounts of nutrients may therefore result in maximum degradation rates of crude oil. In this experiment we investigated the effects of fertilization with N and P on the degradation of crude oil in two contaminated soils in comparison to quartz sand.
Experimental soils (E, G) were derived from non contaminated arable land (haplic phaeozems) in Austria. Both soils and in addition quartz sand were mixed with OMV A crude oil (OMV, Vienna) and left to equilibrate/age for two years. 100 g soil/sand was mixed with nitrogen and phosphorus at three different individual single rates and combined applications. Soils and sand were incubated at 30 % max. WHC and 30 oC for four weeks. For an extra set of soil samples we investigated the effect of regular agitation and the effect of fresh spiking on hydrocarbon degradation in comparison to aged contaminations without agitation. After incubation heptane-extractable hydrocarbon concentrations were determined in the range of C10 to C40 by gas chromatography. Additionally we assessed the quantity and quality of microbial biomass in the soils/sand. Results showed that the incubation significantly (LSD-test, at $p < 0.05$) decreased the concentration of hydrocarbons in soil E, G and the sand. In contrast to soil E and the sand, the application of fertilizer did not result in further improvement of hydrocarbon degradation in soil G. Detailed results on effects of single treatments on microbial soil biomass and hydrocarbon concentration in fresh versus aged contamination with hydrocarbons will be presented at the conference.

P160
Heavy Metals in Hortisols of the Holy Mountain Athos, Greece

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The Holy Mountain Athos (Agio oros) is a peninsula in the North-East of Greece. For many centuries it has been solely inhabited by monks. Access to Athos is restricted to male visitors with permits. Thus, for a long time the area was frequented only by a community of a few self-sufficient practicing individuals living there in isolation. Accordingly, for a long time there was no car-traffic. Movement was only possible by animals or by foot. Presently, around 20 monasteries with numerous outposts are still in use.
This investigation is aimed at determining the heavy metal contamination of the Hortisols in the monastery gardens far away from industrial emissions, car traffic and with no mineral fertilizer inputs. In contrast to the many investigations done in remote areas, we focussed on the impact caused by extensive land-use with respect to ‘Creation’ and in harmony with nature. Sampling was done in the monasteries: Dionysiou, Grigoriou, Megalo Lavras, and Simonas Petras, as well two outposts.
The heavy metal contents vary within a broad range. Pb-contents were, for the most part, greater than 100 mg/kg. Maximum values were greater than 500 mg/kg. Cd-contents ranged from 0,5 to 4 mg/kg. The mean was greater than 1 mg/kg, indicating that the background level of Cd in soils is exceeded significantly as well. The assessment for the other heavy metals (Ni, Cr) is similar. In comparison with remote areas far away from civilization, the level of the contents was significantly increased. However, with regard to the tolerable heavy metal levels and the background values for hortisols, contamination is moderate. The results show that even with only slight human impact, i.e. no car traffic or extensive horticulture with mineral fertilizers, a certain level of heavy metal contamination is unavoidable.

P161

Monitoring of heavy metals contents (Cu, Zn, Pb and Ni)in the surrounding soils of thermal power plants in Romania

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Soils normally contain low background levels of heavy metals. This are natural constituents of the Earth's crust. They are stable and cannot be degraded or destroyed, and therefore they tend to accumulate in soils and sediments. Human activity affects the natural geological and biological redistribution of heavy metals through pollution of the air, water, and soil. The principal man-made sources of heavy metals soil contamination are energy-production processes, by fuel combustion emissions in thermal power plants, due to generation of huge amounts of ashes, which are disposed off in large ponds in the vicinity of the thermal power plants. Since the thermal power plants are located in densely populated areas, there is potential chance for contamination of soil and groundwater of the surrounding areas from the toxic trace elements in the ash.
Soil pollution by pollutant emissions from the thermal power plants results in soil acidity, soil heavy metal, modification of the cationic composition of soil, mobility of some ions in metals having a noxious result on the fauna and human health.
The objective of this study was to investigate and monitoring the regional distribution of heavy metals in soils in the areas of thermal power plants in Romania. This study was developed between 2005-2007 and soil samples were collected from the same thermal power plant, same locations, at the depths of 0-5 cm and 25-30 cm. Aqua regia extractable amounts of Cu, Zn, Pb and Ni were analysed by flame atomic absorption spectrophotometry (AAS).
It is essential to monitor the evolution of soil quality in the areas influenced by the thermal power plants, as well as to avoid the loss of the soil functions and possible cross contamination of water by introduction of contaminants, such as heavy metals (which must not exceed certain levels), without any irreversible negative consequences.

P162

Effects of methill-parathion, carborfuran and lambbacyhalotrina insecticides on soil biological activity

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Excessive insecticide use in agriculture is a serious problem, because their residues cause negative effects on water and soil quality. To evaluate the effects of Methil-Parathion, Carbofuran and Lambbacyhalotrina application in a non-cropped soil' biological activity, a Greenhouse experiment was carried out. The experimental design was completely random with factorial treatments. The factors evaluated were: Insecticides; Methyl-Parathion, Carbofuran and Lambbacyhalotrina; and doses: 2 L ha^{-1} and 4 L ha^{-1}. These six treatments and 1 control were evaluated, using 3 repetitions for a total of 21 experimental units. The treatments were applied on the soil and a test incubation was done during four dates: 7, 14, 30 and 45 days after application. Soil's respiration and microbial biomass were evaluated and also, viability tests were performed to determine the residual effects of the insecticides on larvae of *Trichogramma pretiosum Riley* in each date. Results were analyzed by ANAVAR and with a Tukey test. The probability value used was (P<0.05). Results showed that higher doses of Methyl-Parathion and Lambbacyhalotrina had and inhibitory effect on soils microrganisms, which resulted in reduction of soils' respiration and microbial biomass during the first 7 days of incubation. However, by the 14 day, and increase in the microbial biomass and soils respiration values was observed, reach a maximum to day 30. The reduction in biological activity indicates that in the first days of incubation, there occurs an adaptation period of the xenobiotic compounds. This reduction that produce and inhibitory effect in soils' microorganisms, which resulted in a blockage of the insecticides degradation. The lowest degradation occurred with the insecticides Lambbacyhalotrina and Carbofuran were applied... Survivor rates were lower in soils treated with higher doses of Lambbacyhalotrina and Methyl-Parathion. The higher mortality produced by Lambbacyhalotrina and Methyl-Parathion might be due to their higher residuality.

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Effects of Oxifluorfen, Fluaxifop and Pendimentalin Herbicides on soil biological activity

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Excessive herbicides use in agriculture is a serious problem, because their residues cause negative effects on water and soil quality. To evaluate the effects of Oxifluorfen, Fluaxifop and Pendimentalin application in a non-cropped soil' biological activity, a Greenhouse experiment was carried out. The experimental design was completely random with factorial treatments. The factors evaluated were: Insecticides; Oxifluorfen, Fluaxifop and Pendimentalin; and doses: 2 L ha^{-1} and 4 L ha^{-1}. These six treatments and 1 control were evaluated, using 3 repetitions for a total of 21 experimental units. The treatments were applied on the soil and a test incubation was done during four dates: 7, 14, 30 and 45 days after application. Soil's respiration and microbial biomass were evaluated and also, viability tests were performed to determine the residual effects of the herbicides on germination of onion (*Allium cepa)* in each date. Results were analyzed by ANAVAR and with a Tukey test. The probability value used was (P<0.05). Results showed that higher doses of Fluxifop and Pendimentalin had and inhibitory effect on soils microrganisms, which resulted in reduction of soils' respiration and microbial biomass during the first 7 days of incubation. However, by the 14 day, and increase in the microbial biomass and soils respiration values was observed, reach a maximum to day 30. The reduction in biological activity indicates that in the first days of incubation, there occurs an adaptation period of the xenobiotic compounds. This reduction that produce and inhibitory effect in soils' microorganisms, which resulted in a blockage of the herbicides degradation. The higher degradation occurred with the herbicides Oxifluorfen was applied.Germination rates were lower in soils treated with higher doses of Fluaxifop and Pendimentalin. The lower germination produced by Fluaxifop and Pendimentalin might be due to their higher residuality.

P164

Immobilization of As(V) in aqueous solutions by zerovalent irons

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Objective of this research was to assess efficiency and mechanism of zerovalent iron(ZVI) for As(V) immobilization in water employing kinetic model, adsorption isotherm and instrumental analysis. Batch experiment was conducted to assess immobilization of As(V) by ZVI under various conditions such as pH, time and temperature. Aliquot of As(V) contaminated sample was treated with ZVI(1, 2 and 3 %, w/v) for 12 hours. The remaining As was analyzed by ICP-AES equipped with a hydride generator. Efficiency of ZVI for As(V) immobilization was determined by kinetic model. The XRD and SEM-EDX were employed to identify structure and morphology of ZVI before and after the reactions. Bioassay using plant seedlings was also conducted to evaluate biotoxicity of As before and after the ZVI treatments. The immobilization of As(V) by ZVI followed first-order kinetic model. Reaction rate constants sharply increased from 0.16 hr^{-1} at 1% ZVI to 0.34 hr^{-1} at 3% ZVI but decreased from 0.39 hr^{-1} at pH 3 to 0.07 hr^{-1} at pH 9. Adsorption of As(V) onto ZVI followed Langmuir isotherm with the maximum adsorption capacity of 2.05 mg g^{-1}. The SEM-EDS and XRD analyses revealed that As was incorporated into ZVI mainly as $FeAsO_4\ 2H_2O$ and Fe^0 was mainly oxidized into Fe_2O_3 and FeOOH. Bioassay using *Lactuca sativa* L. indicated that toxicity of As after treating with ZVI was equivalent to the control to based on the germination and growth of lettuce.

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The estimation of the pollution degree in the vicinity of the industrial area near Bucharest

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The diffuse pollution of soils by heavy metals is a major environmental problem world-wide. An important input pathway of diffuse pollution is the atmospheric deposition of industrial, traffic and household emissions. The risk of heavy metal contamination is pronounced in soils adjacent to large industrial complexes. In this case study we investigated an industrial site in Romania, which is thought to be the major source for heavy metal deposition in the surroundings. The site stands as an example for many similar industrial activities in Romania. The study site includes two plants recovering heavy metals such as lead from solid wastes. In a combined study the pollution of environment was related to public health in vicinity of this area. In this paper we will present the assessment of water, soil and air contamination by heavy metals and a few proposals for a limitation of environmental pollution.

P166

Gold mining in Apolobamba (Bolivia) and heavy metals pollution: Diagnosis according to different legislations

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In Bolivia, metal mining activities since historical times have been one of the most important causes of the environmental degradation. This is the case of the Natural Integrated Management Area of Apolobamba (Department of La Paz, Bolivia), where intense gold mining activities have been carried out from former times to present days, with very little gold extraction and scarce mineral processing technology. In Apolobamba even mercury is still being used in the amalgam processes and this might conduct to high Hg contents and environmental pollution by other heavy metals. The Technical University of Cartagena, Spain, carried out a research; it was developed in the most intense affected gold extraction zones in Apolobamba. The aim of this work was the evaluation of the heavy metals impact, with emphasis on mercury, taking into consideration different country legislations such as Canada, Holland and Italy. Five representative mining districts located in Apolobamba were selected: Sunchullí, Suches, Viscachani, Katantika and Sural. These districts have altitudes above 5000 m.a.s.l, and they consist, mainly, of little cooperatives. Water, soil and sediments samples were taken, and total, DTPA and water extractable heavy metals (Pb, Cu, Zn and Cd) and total mercury were determined. Preliminary results show in some extent the presence of metals such as Pb, Cu, Zn and Cd in soluble and bioavailable forms, standing out the concentrations of mercury. Most polluted soils are near Sunchullí mining site and they showed very high levels of mercury. In Sunchullí and Katantika mining sites, Hg contents are above the threshold levels, according to the Canadian, Dutch and Italian legislations; however Pb, Cu, Zn and Cd levels were not high enough to consider those as polluted areas. In Suches and Sural zones, Hg, Pb, Cu, Zn and Cd contents were below the maximum values allowed according to the aforementioned legislations.

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Effect of salinity on the plant germination in the context of soil toxicity

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Soil toxicity is one of the most essential criterions to estimate the process of bioremediation. Plants are widely used in toxicity studies as test-organisms.
Seed germination in soils samples before and after bioremediation was determined using the standard method (EPA 712-C-96-152). As our previous results showed, addition of M8* mineral medium to soil considerably increased an efficiency of bacteria consortium, which was inoculated into contaminated soil for degradation of nitroaromatics.
The seed germination test with different plant species was performed to compare soil toxicity before and after treatment mentioned above. In our study, wheat, barley, radish, cress salad, cabbage, and peas were used. It was shown that an initial plant development was influenced not only by targeted contaminant, but also by M8* medium. Additional experiments with different concentrations of M8*, i.e. in the range of 0.1 % to 1.9 %, resulted in the species-specific inhibition effect. An excess salinity in soil water can decrease plant available water and cause plant stress. However, addition of M8* salts in the concentration below 0.4 % showed a tendency to stimulate the growth of radish root and shoot upon germination.
A role of salt composition in this process was studied. In experiments with NaCl a significant inhibition of seed germination was found at the concentrations of 0.9 % NaCl and higher. The growth of radish root and shoot also was stimulated by the presence of 0.1 ÷ 0.3 % NaCl.
Summarizing, in case of soil treatment, both, the targeted contaminant and other compounds amended to soil, can influence the process of seed germination. These results also indicated to the problem of soil salinity, which should be taken into account, when the technology for soil remediation is developed in order to overcome the problem of secondary contamination.

P168

Biogeochemical approaches to estimating permissible inputs of acidifying compounds and heavy metals in the urban ecosystems

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Russian legislation in the nature management doesn't still take proper account of the functional use of urban lands when assessing their ecological status and planning permissible tenseness of economic activity. As a result, the soil quality standards developed in the eighties for arable lands have to be applied for decision making in many large cities. When pollutant concentrations in urban soils are higher than permissible levels a further expansion of man-caused impacts in local area are confined or might be permitted only after replacing "contaminated" soils. But, soil replacement is very expensive being often unjustified in respect to ecological risks for human health and urban biota. The aim of our study was to elaborate the biogeochemical approaches to estimating the permissible inputs of air contaminants in the urban lands taking into consideration the features of pollutants migration and accumulation in different functional zones. Risk Analysis methodology and the methods of critical loads (CLs) calculating have been used to determine the ecological safety levels of air depositions of acidifying compounds and heavy metals (HM) in Moscow. Previous soil contamination and functional specificity of the lands have been taken into account. Spatial distribution of acidity CLs depends on some natural and anthropogenic factors (air depositions of base cations, soil texture and pH, vegetation type and compactness). The range of acidity CLs is 1000-3000 eq/ha/yr. Minimal values are calculated for forest park zones whereas maximum CLs are accounted for industrial areas. The values and special distribution of HM CLs are in greater correlation with present soil contamination which is peak in central and south-eastern parts of Moscow. For example, CLs of Pb estimated for most polluted parts of the city equal 10-15 g/ha/yr, and 25-35 g/ha/yr for "cleaner" areas.

P169
A model of pollutant transport along the land surface

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An algorithm for the calculation of the catchment (dispersal) area using a Digital Elevation Model (DEM) opens many directions for the use to simulate the transport of pollutants along the land surface. The modified method take into account multiple flow branching and confluence. Out-of-date algorithms describe only one main flow direction and precision of their results is insufficient. Another problem of liquid pollutant's distribution simulation is calculation of minimal catchment area. In this model, the flow terminates in each depression's bottom. It is enough for some purposes, but usually flows move through numerous depressions, e.g. due to a pipeline damage. In the maximal catchment area algorithm, flows are continuous from depression outlets independently of number of depressions.
The general model of flows streams based on the maximal catchment area computation algorithm has been developed by P.A. Shary. This model simulates flows distribution along the land surface from one point (pixel on DEM). A researcher defines the volume of the liquid material and coordinates of point for the flow start. This model uses one empirical coefficient for the description of the quantity of a liquid material is lost during the movement. The final data from this model can be observed as a gridded DEM map image. As a result, various scenarios can be tested.
In our studies, this model has shown good results not only for contamination topics, but also for landscape studies, such as studies on flow directions, sub-catchment water divides, water erosion tasks. Based on this model, an overflow map of the lake El Junco (S.Cristobal island, Galápagos, Ecuador) has been created.

P170
Effect of a large copper ore tailings impoundment on heavy metal concentrations in soils

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Anthropogenic emissions of metals from copper smelters are well documented, but there is limited published information on emissions from tailings impoundments, containing ground wastes obtained from an enrichment of ore bearing rocks (by flotation). Fine - grained wastes, stored in a large over-ground reservoir near Lubin, SW Poland (total area ca 1500 ha, height of dams up to 60 m), are periodically blown off from dried beaches. Regular soil sampling from 65 monitoring sites started in 1995 to control an impact of tailings impoundment on soil contamination with heavy metals (Cu, As, Pb, Zn, Ni, and Cd) within surrounding arable and forest lands. Concentrations of Cu and As in soils developed from parent materials containing very low amounts of trace elements, considerably increased during first 10 years of impoundment operation (1985-1995) to reach the values of 150 and 30 mg kg^{-1}, respectively, at the beginning of observation period. Metals are retained in forest litter and in surface mineral horizons of soils whereas their concentrations in deeper horizons are much lower, as in uncontaminated soils. The concentrations of Cu, As, and Cd in soils are related to wind direction and distance from the reservoir. The results of 13-year-long observation indicate statistically significant reduction of soil contamination with heavy metals. Decrease of Cu concentrations, up to 60% of the initial values, is more significant in the case of contaminated soils as compared to unpolluted sites, and under forest as compared to arable soils. Decreasing concentrations of metals in soils around the impoundment indicate that tailings stabilization effectively reduces the wind erosion of metal-bearing particles. Higher concentrations of heavy metals identified presently in some monitoring sites confirm greater pollution at initial phase of impoundment operation, when tailings were not stabilized.

P171
An approach to diminish ecological risks of soil contamination by a liquid pollutant

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A model of a lateral transport of liquid or dry migrating pollutants is based on a generalization of maximal catchment area, MCA, a hydrologically important topographic variable which is calculated using only a gridded Digital Elevation Model (DEM) as an input data. MCA can be represented as a sum of inputs from each grid cell with any input equal to the cell area. One obtains a maximal spread area, MSA, by replacing these inputs to MCA with initial quantity of a pollutant. In MSA, both DEM and initial pollutant spatial distribution is used as input data (e.g. from a single cell). Pollutants may disappear from the soil layer of interest (e.g. due to infiltration), and this is described by empirical coefficients that take the pollutant loss into account and depend on both soil and pollutant properties. Clearly, real spread area, RSA, always lies inside MSA. This approach has been checked in experimental study of oil spills (Shary et al., 2005). All depressions are filled in MCA and MSA, so that interrupt points of flows are absent. Also, pollutant flows in both MCA and MSA have multiple flow branching and confluence. This approach was also applied by the authors to radio-nuclides (137Cs, 90Sr) and to water solution migration.
An oil pipeline may be damaged at any location, so that multiple locations need testing. A usual practice in oil industry is constructing of small ridges (to re-direct oil flows) and/or dams (to form reservoirs). Nevertheless, multiple oil flows branching results in essential difficulties of intuitive solutions. To diminish ecological risks, numerous locations on pipelines may be calculated together with the choice of artificial changes of land surface in a computer. This approach is that of a virtual reality. The best results came from scales of about 1:2000 or finer.

P172

Phytoremediation of polluted soils: interactions between roots and heavy metals

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The contamination of soils by heavy metals has become a really important problem, especially in some highly industrialized areas such as north of France. One of the ways of treatment is the remediation using metallophyte plants able to trap pollutants from soils. The aim of this work was to follow the evolution of a plot of polluted land in the presence of metallophyte plants (Arabidopsis halleri) and of a phosphated amendment. The contents in metals observed in plants after culture are about 2 % for cadmium and of 4 % for lead. Moreover, the contents in metals contained in the superior parts are much more important than those determined in the absence of amendment (5 and 8 % respectively for Cd and Pb). Samplings of ground were besides realized and prepared in order to observe root / soils contacts by ESEM. To try to understand the impact of this amendment on the behavior of metals contained in the sediment, elementary cartographies were made on these polished sections. These observations tend to prove that the zinc seems diffuse and integrated within the root. In the case of a stake in culture in the absence of amendment, we observe a gradient of rather weak concentration with only the presence of a zone more concentrated in periphery. In the presence of amendment, the cartography brings to light a more important concentration, with a gradual increase towards the heart of the root. A very clear border rich in lead is set up in external border, whereas this element is absent in the heart of the root. Besides, the lead distribution on the edge of the root seems to be correlated to the type of substratum of culture. So in the presence of amendment this border appears more continuous and thicker

P173

Dynamic of metals (Ni and Cr) in elution waters from ultramafics ores columns, implications in the revegetalisation of nickel mining sites

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Ultramafics soils display both high trace metal contents and low fertility (low level of nutrients (N, P, K and Ca), generally Mg/Ca>1). The high metal content of these soils has two implications, (1) the development of a native hyperaccumulator flora and (2) the possible mining activity that implies the destruction of the native ecosystem. The use of the native hyperaccumulator flora to rehabilitate the mining sites (e.g. spoils) could make this activity sustainable. In order to evaluate the adaptability of these endemic species to the mine spoils conditions, it is essential to understand previously the biogeochemical behaviour of metals in the spoil materials. The objectives were to characterize the evolution of the availability of metals in different types of spoil material as influenced by (i) hydrological conditions (controlled rainfall) (ii) fertilisation practices (N, P) and (iii) addition of organic amendments.
In the Niquelandia ultramafic complex (Goiás, Brazil), the lateritic weathering of the peridotitic bed rock gives two types of alterites corresponding to two different stages of alteration: the garnierite (first stage), enriched in smectites, and the limonite, enriched in ferrous oxides, leading to different spoil types. Lysimeter columns filled with one spoil type or different proportions of the two spoil materials were designed to monitor the composition of eluted waters. On pure-ore columns, the limonite was much more stable than the garnierite which released nickel (mean concentration = 1.37 mgL-1), and, relatively high level of chromium (mean concentration = 1.05 mg L-1), regarding to its total content. The mixed spoil (30% garnierite and 70% limonite) that mimicks average spoil composition was almost as stable as limonite, the latter buffering strongly the system. The effect of both mineral-N and organic fertilisation consisted in a strong release of cations (Ni, Mg) into leaching water. Phosphate did not affect the soil solution content.

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Spatial distribution and vertical gradient of Cu and Zn near a valley rim in grey forest soil

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Valley rims in Moscow region (Russia) are characterized by relatively steep slopes (19.2 degrees on average), resulting in relatively fast horizontal soil migration caused by water erosion. In contrast, diffusion of heavy metals is relatively slow. Cu and Zn concentrations were determined by the X-ray fluorescence technique. Topography was represented by a digital elevation grid of 1 meter resolution for the grassland test area of 40 m by 100 m.
The trace elements Zn and Cu are known in chemistry as ‘antagonists’ because of a high distinction in their redox potential. This refers mainly to small distances; a little is known on the relation of their spatial distribution to topography and diffusion in soil. The purpose of this investigation was to study factors influencing their 3D spatial distribution near valley rims. 47 soil cores were sampled from two soil layers (upper: 0-10cm, lower: 10-20cm).
High negative correlations between Cu and Zn were observed in both the layers, taken singly (-0.79 and -0.71), thus confirming the displacement of Zn by less mobile Cu in soil at short distances. No significant correlation was found between Cu and Zn of the different layers. The vertical gradient of Cu (or Zn) was defined as the difference between its concentration values in upper and lower layers, so that the gradient is signed. It was positive at about 50% of points for both Cu and Zn. Nevertheless, a high negative correlation was observed between gradients of these elements (-0.77, $P<0.000001$). Correlation between Cu(0-10cm) and gradient of Zn was negative (-0.57, $P<0.0001$). These indicates that the time for establishing a local equilibrium is much smaller than the time characteristic of diffusion.
High correlations between topography and Cu (and Zn) in the upper layer permitted to use multiple regression for predictive mapping of the metals’ horizontal spatial distribution.

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Vertical migration of heavy metals in soils contaminated by sewage sludge

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Application on agricultural lands is a popular method for the disposal of sewage sludge (SS), as it represents at the same time a low-cost fertilizer. Excessive load of low-quality SS in suburban regions of Russia affected soil fertility and led to strong soil contamination by heavy metals (HM). Considerable uncertainty exists about the long-term fate of polluting HM. In sandy soils with time the so called «selfpurification» occurs due to the vertical migration of HM. The influence of lime and SS on vertical migration of Cd, Cu, Pb, Ni in sandy soddy-podzolic soil was investigated in long-term field experiment, which started in 1984. SS was applied annually in doses: 15, 30, 60, 120 t/ha, lime - every 5 years in doses 3, 6, 9 t/ha. SS application was finished in 2001. It was shown, that organic mater of SS rapidly migrates in soils profile. Liming lowed vertical migration of SS and soil organic matter, that led to HM accumulation in plants root zone. The investigation of soil solution from topsoils (0-20 cm) of all plots showed that the highest concentrations of HM were revealed in first 2-3 weeks after SS application, lime was not that effective in this period. Later, concentrations of HM water soluble forms dramatically lowed, especially on limed plots. A strong correlation was found between water soluble HM concentrations and lime doses only after 1 month of SS application. HM profiles were sampled to estimate vertical migration after 17 years of SS application. On all plots soil was contaminated by HM to the depth about 60-70 cm - the depth of moraine layer, witch is the natural watercatch. Thus, it can be proposed that the mostly intensive HM migration in soil occurs just after SS application. Later insoluble compositions of HM are formed, that reduces vertical migration.

P176
Speciation and phytoavailability of copper from vineyard soil as influenced by bacterial siderophores

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Trace elements management in agrosystems has become more and more relevant today, with the increasing need to develop strategies for sustainable agriculture and avoiding environmental contamination. Trace elements show various fates when they are used in agriculture: storage in soil with or without physico-chemical and/or biological modifications, loss by volatilization or via accumulation in crop productions, loss by infiltration and/or runoff. In vineyards, runoff may causes erosion during storm events accompanied by leakage of copper via both water and soil particles. The use of storm basins may help prevent subsequent environmental contaminations although they are almost designed to avoid flood at the urban belt. Despite bioattenuation phenomenons sometimes observed in storm basins, optimization is needed since copper concentrations at the outlet of storm basins usually exceeds legal threshold limits for natural water.
Phytoextraction is an emerging soft technology, the only one able to extract in situ metals from soil or sediment. Unfortunately, phytoextraction needs time as a consequence of the low metal availability. This can be enhanced by means of soil bioaugmentation by microorganisms producing siderophores.
Our study aims at assessing how the phytoavailability of Cu in storm basins depends upon bacterial siderophores, which may enhance Cu solubility and change Cu speciation in soil solution. In this study performed in laboratory in batch and continuous conditions, small-scale storm basins were inoculated by bacteria able to synthesize siderophores. Effect of bacteria was studied in the course of the time on (i) the concentration of chelatants (e.g. siderophores) in sediment solution using the Chrome Azurol S (CAS) assay, (ii) the free ionic Cu2+ activity in soil solution using an ion-selective electrode and (iii) the phytoavailability of Cu using diffusive gradient in thin films (DGT).

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Heavy metal contamination and health risk assessment in soils from Portman bay

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A study on metal mobilization (Zn, Pb, Cd and As) and analysis of the health risk represented by the ingestion of contaminated soils in Portman Bay (SE Spain) was carried out. This zone has suffered a great impact from mining activity, since million tons of mine tailings were dumped into the bay and surrounding zone for a long period, giving as a result the filling of the bay with them. A three-step sequential extraction procedure, modified from the BCR method, as well as selective extractions (H_2O, 0.1 M HNO_3, citrate-dithionite and 1M NH_4OAc after H_2O_2 attack) were applied to selected samples in order to evaluate the potential mobility of fixed metals. Acid volatile sulfides (AVS) and simultaneously extracted metals (SEM) were also determined. X-ray diffraction (XRD) and scanning electron microscope equipped with an energy-dispersion spectrometer (SEM-EDS) techniques were applied to the characterization of both raw samples and the residues remaining after each extraction, thus providing additional information about the sediment phases carrying the metals studied. An extraction process simulating the physiologically acid stomach phase of digestion, was used for providing information on heavy metal bioaccessibility.
The total heavy metal values were generally high, especially in the case of Pb. Although somewhat lower, the Cd levels were also quite high given its mobility. As regards the soluble metal values, Cd and Pb show opposing tendencies. The fraction of metals associated with jarosites presented a high stability under different physicochemical conditions, while metals associated with mineralogical phases that are undergoing supergenic alteration processes presented a high mobility.
The results obtained represent a basis for the pre- operational risk analysis associated to the recovery process of the soils which is now in progress.

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Biodegradable product using for enhancincing the bioremediation efficiency of petroleum hydrocarbons polluted soils

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Applying knowledges about microorganisms methabolic biodegradative pathways could provide the most efficient and low-prised remediation technologies of contaminated sites, the most effective and acceptable being the total conversion of pollutants in anorganic compunds as CO_2 and H_2O. The crude oil beeing a complex mixture of different fractions, its biodegradation requireing a bacterial community with high diversity, every species of bacteria having, generally, a degradative ability limited to a specific petroleum fraction. For bioremediation technology applying a good knowledge of biodegradation process optimisation is necessary.
The paper present the results of a crude-oil polluted soil bioremediation experiment carried out in the green house. Un-polluted soil and soil polluted with 5% and 10% total petroleum hydrocarbons we used to constitute experimental variants. For each pollutant concentration a biodegradable product named ECOSOL were added into soil in three different doses (50, 100 and 200 kg/ha), each ECOSOL dose treatment received or not bacterial inoculum. For reflecting the pollutant disappearance dynamics and the bacterial communities dimension and diversity fluctuations, at different time, we have been analyzed the total petroleum hydrocarbons, total bacterial number and bacterial diversity in soil. The analytical results reflected that the stress period manifested through a strong depression of bacterial community dimension, was longer for inferior oil concentration (45 days) than for superior once (30 days). Thus, starting with the 30^{th} day after soil pollution, in treatment with 10% TPH, there was an abundant bacterial proliferation expressed in TBN values with two-order degree higher than those recorded in the first determination stages. After the 30 days acclimatization period, at 10% TPH, a massive bacterial multiplying in treatments with bacterial inoculums and the highest ECOSOL dose (200 kg/ha) was occurred. Experimental dates proving that the tested organic product ECOSOL reducing the substrate adapting necessary period for petroleum hydrocarbons breaking down microorganisms.

S01 Soil Organic Matter

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Tillage-induced carbon inputs in soil in rice-wheat cropping system - Farmer's participatory studies

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For sustainability of the rice-wheat production system, several resource conservation technologies are being promoted across the Indo-Gangetic plains of south Asia, where this cropping system covers an area of 13.5 million ha. The practice of burning the rice-straw for vacating the fields is common for timely seeding of following wheat crop. Burning of rice straw deprives soil its major source of OM and recycled plant nutrients. It has also become a source of atmospheric pollution. Zero tillage is one of such technologies which affords to recycle crop-residue in soil, thereby, helping not only to sequester OC but also prevents huge amounts of CO_2 emanating to the atmosphere due to burning of rice-straw in the fields. Farmer's participatory experiments were conducted at several sites across Punjab and Haryana states to compare the tillage effects on the carbon sequestration through efficient crop residue management. Results of 132 trials demonstrated a significant productivity increase in wheat by strategic tillage using zero-till-seed-cum-fertilizer-drill (ZT). The mean grain yield of wheat planted with ZT and conventional tillage (CT) were 4.25 and 3.52 t ha^{-1}, respectively. This is mainly due to advancement of sowing with ZT, which ranged from 12 to 14 days. ZT technology reduced the turn around time for sowing of wheat with residual moisture (no pre-sowing irrigation) having anchored rice-straw, by an average of 13.25 days. This practice helped incorporation of more than 2.0 tonnes of C ha^{-1}. Changing to ZT saved approximately one million liters ha^{-1} of irrigation water from sowing till harvest of wheat crop. Decrease in soil (5-10 cm) temperature by an average of 3°C as a result of mulching effect of anchored rice straw in ZT plots during end March and till the harvest of wheat, is helpful in decreasing the rate of depletion of SOM through oxidation.

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Physical protection of soil organic matter in aggregates of forest soils with mechanized harvesting and site preparation techniques

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Understanding the effects of harvesting and mechanical site preparation in forest soils under intensive forest management systems is crucial for developing organic C conservation strategies. Intensive forest management affects the quality and quantity of organic matter (OM) inputs to soil, and disturbs the soil physical structure, mainly affecting the processes of aggregate formation. In this study, physical protection of readily mineralizable C against mineralization in undisturbed aggregates was studied in second rotation mechanized pine stands (of 0, 7 and 20 years) and also in unmechanized mature pine stands (> 35 years). All stands were developed on a Typic Udorthent (SSS, 2006), with pH values that ranged from 4.2 to 5.2, and had a loam-clay loam texture.. The mean annual temperature of the area is 14ºC and the mean annual precipitation 950 mm. Soil samples from the first 5 cm depth were fractionated into 3 mega- (20 - 10 mm, 10-5 mm and 5-2 mm), macro- (0.25 - 2 mm) and micro-aggregates (250 - 53 µm), and also into silt+clay fraction (<53 µm), and incubated at 2/3 of field capacity during 28 days. In addition, aggregate size distribution, total C and N, uncomplexed OM (POM) and OM associated to mineral fraction (MOM) of each aggregate size were determined. The two oldest pine forests showed a higher ratio of macroagregates (31-23%) than younger mechanized forests (14-16%). However, the two youngest stands showed the largest ratio of large megaggregates (45-34 %), which was attributed to the compaction induced by heavy machinery, as reflected by 15% higher bulk densities. We are currently analysing the rest of parameters studied.

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Oxidability of soil organic matter of forest soils with potassium permanganate. Application to the fractionation of organic carbon forms

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Soil organic matter (SOM) has an important influence on soil properties and processes, and small changes in its content and/or composition can have a great effect on the soil ecosystem. Unfortunately, detection of small changes of SOM concentrations is difficult. At present, several techniques are being used - such as sequential hydrolysis, respiration incubations or oxidation with different agents - with the purpose of achieving a better comprehension of SOM, its composition and stability. The main objective of this research was to study the oxidability of organic C (OC) of forest soils developed from different parent materials (limestones, sandstones, mudstones, marlstones, and basalts) with $KMnO_4$, and to determine whether this fraction represents labile SOM. A total of 52 surface horizons (0-20 cm) of forest soils in the Basque Country (N Spain) were sampled (forty four soils under *Fagus sylvatica* L., six under *Pinus radiata* D. Don., one under forest of these two species and one under *Chamaecyparis lawsoniana* Parl). The oxidability of soil OC by 33 mM $KMnO_4$ (Per-OC) was determined in air-dried soils at different incubation times (1, 3, 6, and 24 h). For all soils, routine analyses and other more specific analyses (e.g., dichromate oxidizable OC, pyrophosphate extractable Fe and Al) were carried out. The cumulative amount of Per-OC increased with time, following a logarithmic trend although the reaction rate decreased. The fraction of Per-OC per unit of total OC was significantly higher ($P<0.05$) in those soils with a total OC concentration > 40 g kg^{-1} (0.09 vs. 0.07 g g^{-1}). The latter soils also had a higher percentage of the silt and clay fraction than those with a total OC concentration < 40 g kg^{-1}. This could confer them a greater physical protection of the labile SOM against microbial degradation. The project (SUM2006-00013-00-00) was funded by INIA

P182

Study of the relationship between oxidability of soil organic matter of forest soils with potassium permanganate and main functional groups

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Many studies on soil organic matter (SOM) focus on the identification of fractions with different degrees of resistance against microbial decomposition. The most labile fraction of SOM can be a sensitive indicator of the organic C (OC) dynamics of the system, as it is more easily and rapidly affected by management practices than those more recalcitrant. For this reason, it is of great interest the development of simple techniques that would allow the easy identification of this fraction, so that they could be used by the non-scientific community (e.g., extension service, farmers). In this study, the degree of oxidability of SOM by a mild oxidant reagent ($KMnO_4$) is tested as possible technique for labile SOM identification. We tried to relate the oxidability of OC of forest soils developed from different parent materials with $KMnO_4$ with its composition, by means of the detection of the main functional groups of SOM, as determined with FTIR. A total of 52 surface horizons (0-20 cm) of forest soils in the Basque Country (N Spain) were sampled. The oxidability of soil OC by 33 mM $KMnO_4$ (Per-OC) was determined in air-dried soils at different incubation times (1, 3, 6, and 24 h). For all soils, routine analyses and other more specific analyses (e.g., dichromate oxidizable OC, pyrophosphate extractable Fe and Al) were carried out. FTIR spectra (400 to 4000 cm^{-1}) of all samples were obtained, and differences between samples were determined by both (i) the presence/absence of shoulders and bands, and (ii) when present, by measuring their depth. These data are currently being analysed with the objective to relate them with the Per-OC data. We expect that the results obtained will improve our understanding on the relationships between the degree of SOM oxidation and its composition and lability.The project (SUM2006-00013-00-00) was funded by INIA

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Influence of compost on morphological and chemicalproperties of sandy soils, Egypt

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Compost material not only improves the structure of fine-textured soils but creates the structure coarse-textured soils as well. Compost was applied at the rates of 0 (Control) and 20 ton/ feddan /year to sandy soils (Typic Torripsamment) in order to investigate its potential for improving the soil properties. The experiment was conducted for two years in Wadi El-Natrun, El-Behaira Governorate, Egypt .The chemical and physical properties of the soils were affected directly by the compost application. Results from this study indicate that the soil structure and the cation exchange capacity were improved. Increasing in organic matter content and reduction in calcium carbonate content were due to the compost which is rich in humic acid. Thin sections of treated sandy samples were examined by polarized microscope. Macro and micro soil morphology were improved, especially the soil structure. Compared with the control treatment, the treated soil with compost had better aggregation in the surface layer due to change in fabric of ground mass and the altering changing of related distribution (C/F) from enaulic to chitonic and partly gefuric. The dominant voids (large vughs and chambers) were modified to simple packing voids. Organic materials can be seen as coatings on pore walls.

P184

Soil Organic Matter and Aggregate stability as affected by land-use and soil management

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Soil aggregates and organic matter are considered to be important indicators of soil stability. Several land-use systems do respond rapidly to changes in carbon supply but much less is known on the impact of different land-use on soil organic matter (SOM) fractions. The objective of this study was to estimate land-use and land management effects on the distribution of SOM fractions in a one meter soil profile and develop a new model to determine SOM turnover. Three land-use types: fruit-tree orchards established in 2003, 1995, 1980, 1987 and 1963; Cropland and Grassland were studied. Soil samples collected from these plots were analyzed for aggregate stability after wet sieving into four aggregate size classes (>2000 μm; 250-2000 μm; 53-250 μm and <53 μm). The concentration of organic carbon (OC), and total nitrogen (TN) were determined in each size fraction. Density fraction separation methods were used to isolate free light fraction organic matter (LFOM), heavy fraction organic matter (HFOM), and particulate organic matter (POM). We also determined the microbial biomass carbon (MBC), using the fumigation extraction method. The total weight of aggregates varied in the order Grassland>cropland>fruit-tree land. Large amounts of aggregates were accumulated in the 250-2000 μm size class and the smallest amount was found in large macro-aggregate size (>2000 μm). Total organic carbon, and light fraction organic Matter decreased with increasing soil depth, but were higher under Fruit-Tree orchards than under Grassland or cropland, and were mainly concentrated in the top soil layer (0-20cm). For this research, the proportion of aggregates with diameter <53 μm appeared to be a suitable indicator of organic matter accumulation. Our data supported the hypothesis that new microaggregates are formed within existing macroaggregates.

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Comparison of composting and vermicomposting processes during decomposition of solid wastes

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Vermicomposts application to the fields and potting media usually results in a higher plants growth responses than to conventional composts. To compare the chemical changes of organic wastes during these processes, fresh dairy cattle manure and litter were filled in pots and placed in a chamber with controlled temperature and moisture condition. 100 mature earthworms (Eisenia foetida) were added to half of the pots. Samples were collected at 0, 10, 20, 40, 80 and 120th days of incubation and used for analysis. The temperature of the pots increased to maximum 34 °C at the 10th day of incubation, and then decreased. After one month, the temperature of pots even higher in the presence of earthworms and the population of earthworms was higher in manure compare to litter. The EC of manure was elevated during the processes and its value was higher in vermicompost, but the EC of litter did not change during processes. Vermicompost had insignificantly lower pH than compost. Concentration of most nutrients (N, P, K, S, Mg, and Mn) in the manure was higher than litter, except of Al, Ca, Fe, B, Zn, Cu, and Pb. There was no difference in the concentration of Cd, Co, Cr, and Ni in manure and litter. The C content of manure in the vermicomposting process was lower than composting. Earthworms activity was increased the concentration of N, P, S, Mg, Fe, Mn, B, Zn, and Al; but there were no significantly differences in the concentration of other elements (K, Ca, Cu, Cd, Co, Cr, Ni, and Pb) between the processes. The similar trend was observed in the litter; but not in the extent of the manure and in most cases the differences of elements concentrations between vermicomposting and composting were not significant.

P186

Changes in organic carbon distribution in different sizes of soil aggregates in semi-arid regions of Iran

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Nutrient and organic carbon losses are important component of the soil degradation processes produced by cultivation. According to the types of vegetation and soil, 25 soil profile samples (0 - 30, 30 - 60 and 60 - 90 cm) were collected from different regions of highland of Zagros mountain range, central Iran, to approach the distribution of organic carbon pools in different sizes of soil aggregates. The results showed that the organic carbon content and storage in all sizes of soil aggregates were decreased with increasing soil depth. For each soil layer, the organic carbon content had an increasing trend in the aggregates with the sizes from > 5 mm, 2 - 5 mm, 1 - 2 mm to 0.25 - 1 mm, and a decreasing trend from 0.25 - 1 mm to < 0. 25 mm. Because of the different proportions of each size of soil aggregates, the organic carbon storage and content in different sizes of soil aggregates were not the same, i. e., the storage was decreased with the sizes from > 5 mm, 2 - 5 mm to 1 - 2 mm, while increased from 1 - 2 mm, 0.25 - 1 mm to < 0. 25 mm. Except Typic Xerorthents that had the highest organic carbon content in its aggregate of < 0.25; Typic Calcixeralfs had a peak value in their aggregate of 0.25 - 1 mm. The organic carbon storage was the highest in the aggregate of < 0.25 mm in Typic Xerorthents, and in the aggregate of > 5 mm in Typic Haploxerolls. The soil organic carbon content and storage under different types of vegetation had the trend of natural grassland > bare land > artificial forest land > farming land.

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Spatial variability of different soil organic carbon pools in a high-elevation Norway Spruce forest

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The variability of different organic carbon (OC) fractions (HF-soluble OC fraction, representing mineral associated OC; HF-resistant OC fraction, representing the non-mineral associated OC in forest soils) is largely unknown. The same is true for their relation to site specific factors (e.g. bulk density, pH, content of pedogenic Fe and Al).

We studied a Dystric Laxic Leptic Cambisol site (0.09 ha) stocked with Norway spruce in the Nationalpark Bayerischer Wald, Germany. Soil samples from the Ah and the Bw1 horizon were taken at the knots of a rectangular grid with distances of 5 m. Small-scale variability was determined using a nested sampling scheme with a minimum sampling distance of 0.5 m. Mineral-associated and non-mineral-associated OC stocks in the soil were characterized by ordinary statistics and geostatistics. To examine spatial relations between soil OC stocks and site specific factors, experimental crossvariograms were calculated. Additionally, we compared the spatial variability of different OC species of the HF-soluble and non-soluble fraction as determined by ^{13}C CPMAS NMR spectroscopy.

Only the HF-soluble OC stock exhibited a spatial pattern. HF-soluble OC stocks were significantly negatively spatially correlated with the pH, but positively correlated with the amount of Fe_o and Al_o in both horizons. Bulk density showed a significant spatial correlation with the HF-soluble OC stock only in the subsoil. Comparison of the spatial variability of different HF-soluble OC species showed an increasing spatial variability in the order aryl C < carboxyl C < alkyl C < O/N-alkyl C.

Our results indicate that the spatial variability of soil OC stocks is mainly caused by the spatial variability of the mineral-associated OC. HF-soluble OC stocks are elevated at micro-sites with large amounts of Fe_o and Al_o and low pH.

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Organic compounds related to soil hydrophobicity in total extracts from accelerated solvent extraction (ASE)

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Soil hydrophobicity has major implications for plant growth, surface and subsurface hydrology and soil erosion. Research on chemical causes of hydrophobicity so far has focussed mainly on extraction of organic compounds in amphiphilic solvents, which eliminate repellency, with subsequent analysis in a lipophillic solvent, leaving behind higher polarity compounds. Few studies, however, have examined the entire extract and characterised higher polarity compounds. Also, comparison of compounds in solvents with contrasting effects on hydrophobicity following extraction has not been conducted. The aims of this study were to (i) separate and characterise also compounds with higher polarity in soils affected by different levels of hydrophobicity, and (ii) distinguish differences in compounds from two solvent mixtures which have contrasting effects on soil hydrophobicity.

We characterized the extractability of organic compounds from soils (sands and sandy loams) under eucalypt stands in dichloromethane:methanol (95:5) and isopropanol:ammonia (95:5) by GC/MS analysis. Hydrophobicity increased in all the soils after extraction with dichloromethane:methanol and was eliminated by isopropanol:ammonia. DCM/MeOH had higher extraction efficiency for alkanes and fatty acids.

Patterns of lipid compounds and compound classes, as well as extraction efficiencies varied between the soils analysed. The total lipid extracts from the soils with sandy texture were dominated by terpenoids from the lupane, ursane and oleanane groups, palmitic acid, C_{29} alkane, β-sitosterol and polar compounds such as glycerol, monosaccharides and glycosides. Fatty acid signatures in the sandy soils were characterised by the presence of (C_6 - C_{26}) n-alkanoic acids, while the sandy loam soil was dominated by a range of shorter chain length fatty acids. Alkane patterns in all soils studied were characterized by the predominance of C_{21} - C_{31} homologues, maximizing at C_{29}. Based on the patterns of the hydrophobic, amphiphilic and polar compounds present we discuss a probable cause of repellency expression in the soils studied.

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Soil organic matter stabilization and land-use change in tropical ecosystems

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Replenishment of soil organic carbon (SOC) and nutrient stocks is dependent on the biophysical characteristics of the soil, quantity and quality of applied organic matter (OM) and the level of ecosystem degradation. A study was established to investigate how status of pre-existing SOM, quality of added OM and soil texture influence stabilization of added OM. In SOC-poor soils, biochar (low quality organic) and tithonia green biomass (high quality organic) application increased whole SOC by 45 and 27% respectively above fully fertilized (NPK) control treatment. With biochar application, both free light fraction (FLF) and intra-aggregate fraction (IAGF) organic C content increased 4-fold with 13% increase in the organo-mineral fraction (ORGM). Though tithonia application doubled organic C in IAGF and increased ORGM by 42%, there was no significant impact on FLF. Biochar application reduced the rate of CO_2-C loss by 27% while tithonia increased C losses by 20% in the SOC-poor soils. Nature and content of the various functional groups in the FLF OM distinctively changed with time of continuous soil use. C=O conjugated ketones and quinones decreased by 29% within 10 - 20 years of continuous soil tillage. In SOC-poor soils, biochar application enriched aromatic-C, carboxyl-C and traces of ketons and esters mainly in FLF and IAGF. Additions of tithonia biomass enriched conjugated carbonyl-C such as ketons and quinones as well as CH deformations of aliphatic-C mainly in the IAGF. Biochar application had greater impact on IAGF (>4-fold) in the clayey soil compared with sandy soil (≈100% increase) above control soil. In this study we demonstrate that highly weathered tropical soils possess great potential for C increase and greater SOC increases could be attained with low quality organic resources whose stability in the soil is greater compared with high quality organics.

P190
Effects of tillage and N fertilization on soil respiration in a mediterranean semiarid agroecosystem

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In agroecosystems, long-term field experiments are a useful tool to identify optimal agricultural practices, predict changes in biogeochemical cycles, and to build and validate models of main biogeochemical cycles. Soil CO_2 flux (Soil Respiration, SR) is a key part of the C cycle and together with harvest is the main output of C from agroecosystems. Soil management affects root growth and microbial activity due to changes in soil microclimatic conditions. At the same time microbial activity is affected by changes in soil organic matter (SOM) content and distribution. Hence SR is related with soil management.
The SOM content in cropped soil in the Ebro valley (NE Spain) has decreased as a consequence of cropping system and intensive tillage practices (conventional tillage, CT). The use of conservation tillage, minimum tillage (MT) or no-tillage (NT) together with a rational use of N fertilizer can improve soil water conservation and soil fertility leading to changes on SOM content and distribution, consequently affecting SR as a response.
In 1996 at Agramunt (Ebro Valley (NE Spain)), a long-term field experiment was established, comparing three N fertilizer levels (zero, medium -60 kg N ha-1- and high -120 kg N ha-1-) and three tillage systems (NT, MT and CT) in a factorial experiment. The field is annually cropped to winter barley. During the 2006-2007 cropping season, *in situ* SR, soil water content, temperature regimes, root length density and crop biomass production were frequently sampled. Differences on SR were mainly observed among tillage systems, and least differences were observed among N fertilizer doses. At present cropping season (2007-2008) we are also measuring microbial activity at different times. We are presenting trends of SR together with a regression analysis of SR as related to studied factors. Integration of these factors will help understanding C dynamics in this agroecosystem.

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Soil aggregation as affected by tillage in mediterranean semiarid agroecosystems

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In Mediterranean semiarid agroecosystems, where water is the most limiting factor affecting crop production, soil organic carbon (SOC) is a key factor in the preservation of soil quality and productivity. It is well established that soil aggregates physically protect SOC from microbial decomposition. In these areas, intensive soil tillage, with moldboard plowing and depth subsoiling, have led to the breakdown of soil aggregates and therefore to faster aggregate turnover rates. Nevertheless, the most part of the literature have focused their investigations in the upper 20 cm of soil. The aim of this study was to determine the influence of tillage systems on soil aggregation and to evaluate the importance of deep soil sampling in understanding SOC stabilization by soil aggregates under semiarid Mediterranean conditions. Soil samples were taken from the 0-5, 5-10, 10-20, 20-30 and 30-40 cm soil layers of conventional tillage (CT) and no-tillage (NT) systems at four long-term tillage experiments located at three different sites along the Ebro valley (NE Spain). Representative sites were chosen with different establishment year, mean annual precipitation, transpiration rates and crop residue production. The SOC content and the water-stable aggregate size distribution were measured at each site, tillage system and soil layer. Differences in soil aggregation were found between tillage systems especially in soil surface where greater SOC was found. The amount of stable soil macroaggregates (> 0.25 mm) correlated well with the SOC levels found. Differences among sites resulted from differences in crop residue production and time since the establishment of the experiment. From our results, it is important to extent soil sampling below tillage depth in order to corroborate the magnitude of tillage on C sequestration by soil aggregates.

P192
^{1}H-NMR and ^{13}C-NMR spectroscopy of chernozem soil humic acid fractionated by tandem SEC-PAGE

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Humic acid (HA) from chernozem soil has been fractionated by combination size exclusion chromatography-polyacrylamide gel electrophoresis and three fractions showing distinct electrophoretic mobilities (EM) and molecular size (MS) have been obtained. Unfractionated HA, all fractions and HA after 7 M urea treatment (HAU) were examined by both solid ^{13}C and ^{1}H in D_2O and DMSO-d_6 NMR. The ratio $C_{ar\ (165\text{-}108ppm)}/C_{alk\ (108\text{-}0ppm)}$ increases by a factor of 5 from highest to lowest MS fraction. This suggests that there is significant heterogeneity of molecular structure and functionality among the various fractions, which differ in both EM and MS. A considerable contrast in aromatic range has been observed between ^{1}H-NMR spectra of the original unfractionated HA and HAU in DMSO-d_6 solvent. Taking into account that high MS fraction consists mainly of aliphatic components it is reasonable to suggest that these associations are capable of organizing into micellar structures.

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Tandem ultrafiltration - PAG electrophoresis as a tool for isolation of soil humic acid fluorescence species

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It is well known that soil HA fluorescence is the sum of many different fluorophores presented in humic molecules. However, due to the chemical complexity and variable molecular size polydispersity of soil HA, the separation of soil HA fluorescence on the different species have not been realized still. In this study ultrafiltration (UF) in 7M urea following by polyacrylamide gel electrophoresis (PAGE) detection in white and UV-light was used for separation of chernozem soil HA fluorescence on different species. In white light the original not fractionated HA sample originated in PAGE matrix four discrete naturally colored electrophoretic fractions, while in UV light it revealed the new additional electrophoretic fraction, which shows overlapped red, yellow and blue fluorescence. The UF of HA was carried out in

7M urea solution using 5 kDa retention size membrane. It should be suggested that humic material which came through the membrane (nearly 20% of the hole weight of HA) and possess yellow-blue fluorescence had nominal MS less than 5 kDa and connected with HA matrix through intermolecular hydrogen bonds. On the other hand the detained on the 5 kDa membrane humic material demonstrated only red fluorescence. The combination of UF in 7M urea following by PAGE detection in white and UV lights is very promising for the rapid and visulizable investigations of HA fluorescence and separation of fluorescence species.
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P194
The role of photo-degradation in the global carbon cycle

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A long term litter decomposition experiment from sites around the world indicated that moisture and temperature predict decomposition rates well for most sites, but fail in semi-arid grasslands. Other studies have indicated that photo-degradation, particularly UV, may be important in litter decomposition in some arid and semi-arid environments. With global change, photo-degradation may become more important as many areas are expected to become drier, and a thinner ozone layer may also increase UV-B-exposure. The chemical process of photo-degradation has also been studied in the lab, and the process has been described mathematically.
No simulation model includes the effect of photo-degradation on carbon or nitrogen turnover. In this project available data and theory as well as new experimental data are used to find simple ways to introduce UV-degradation into simulation models, and test the predictions. The aim is to assess the significance of UV-degradation in the global carbon cycle, and how it will be influenced by predicted global change.

P195
Impact of applaying different tillage and residue management systems after 16 years on soil carbon using δ^{13}C abundance

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Improved prediction of long-term changes in soil organic carbon (SOC) contents and their turnover rates should help to identify more intensive and productive sustainable crop systems and predict carbon sequestration potentials in soils. Few studies have been carried out on ^{13}C in temperate regions or semi-arid lands. The present study quantified SOC (% and pool), the gross SOC turnover, and C in the soil derived from C_3 and C_4 species, using the δ^{13}C abundance of soils with 16 years of continuous application of zero tillage (ZT) as compared to conventional tillage (CT), crop rotation (monoculture (M) -wheat or maize- and rotation (R) -wheat and maize-) and crop residue management (with and without residues) in an experimental field in the Transvolcanic Belt of Mexico.
The highest percentage SOC was found in the soils (0-5cm) under the ZTM (wheat and maize) and ZTR with residues. The soils with maize showed higher SOC content in plots plus residues (0- 10cm) than without them; and from 10 to 20 cm for those managed with CT plus residues. The SOC pool (0-20cm) was significantly greater (p=<0.0001) in soils with ZTM (wheat and maize) and ZTR cultivated with residues (mean 3800gm^{-2}). The gross SOC turnover was significantly lower (p=<0.0001) in soils with residues (from 4 to 7 years) than without residues (from 60 to 100 years). After 16 years, all the soils had higher percentages of C-C_3 (wheat residues or early forest) than of C-C_4 (maize residues). Soils with maize subjected to ZTM and CTM with residues showed the highest δ^{13}C values and percentages of C-C_4: from 0 to 5 cm (-16.56‰ and -18.08‰), (33% and 13%); from 5 to 10cm (-18.41‰ and -18.02‰), (9.13% and14.3%) respectively. ZT with residue retention and rotation with wheat are practices with potential for retaining the SOC.

P196
Use of NIRS technology for the determination of δ^{13}c in soils with 16 years of application of different tillage and residue management systems

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The aim of the present work was to determine δ^{13}C in unknown soils using NIRS technology with a remote reflectance fibre optic probe. The soils studied (100 samples) were from the International Maize and Wheat Improvement Centre (CIMMYT) in the State of Mexico and have been subject to different tillage regimes over the past 16 years. The effect of different management systems -type of tillage (zero and conventional), the management of crop residues (with/without) and crop rotations (wheat.-wheat, maize-maize, wheat-maize and maize-wheat)- providing variability for the study of the environmental impact of different agricultural regimes was examined using NIRS technology. Discriminant Partial Least Squares (DPLS) of the NIR spectral data allowed the classification of soils with and without residues, regardless of the type of tillage or rotation system employed, with a prediction rate of 90% in the internal validation and 94% in the external validation.
The NIRS calibration model, using modified partial least squares regression (MPLS), allowed the determination of δ^{13}C in soils with and without residues, with multiple correlation coefficients (RSQ) and corrected standard errors of prediction (SEP(C)) of 0.83 and 0.50%^{o} in soils with residues and of 0.93 and 0.21%^{o} in soils without them. The ratio performance deviation (RPD) values obtained were 2.5 and 3.8 for the quantification of δ^{13}C in soils with and without residues. These findings show that the capacity of prediction is adequate for determining the δ^{13}C of unknown soils in the -16.15 to - 20.39 %^{o} range. It may be concluded that the results obtained with the NIRS method are comparable to those obtained using analytical methods. NIRS spectrometry is a rapid, non-destructive and cheap method that does not require previous sample treatment.

P197
Vermicomposting influences solid wastes decomposition kinetics in soils

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The effect of vermicomposting on kinetic behavior of the solid waste decomposition in soil is not well recognized. An incubation study was conducted to investigate C mineralization kinetics of cow manure, sugarcane filter cake and their vermicomposts. Two different soils were treated with the four solid wastes at a rate of 0.5 g solid waste C kg^{-1} soil with three replications. Soils were incubated for 56 days. The CO_2-C respired was monitored periodically and a first-order kinetic model was used to calculate the kinetic parameters of C mineralization. Results indicated that the percentage of C mineralized during the incubation period ranged from 31.9 to 41.8 and 55.9 to 73.4% in the calcareous and acidic soils, respectively. The potentially mineralizable C (C_0) of the treated soils was lower in the solid waste composts compared to their starting materials. Overall, it can be concluded that decomposable fraction of solid wastes has decreased due to vermicomposting.

P198

Elemental composition and molecular weights of humic acids physically independent components

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Humic substances (HSs) have been extracted out of granul-densimetrical fractions (fine silt, 2.0-2.4 g/cm3,typical chernozem, depth of 40-45 cm,Alekhin's Central Chernozemic Reserve). Using a highly selective method of Hydrophobic Interaction Chromatography HSs have been preparatively separated into components with hydrophilic(I,II fractions) and hydrophobic(III,IV fractions) properties.
These fractions have been used to prepare samples of humic acids(HAs). For HAs with hydrophilic and hydrophobic properties there have been carried out evaluation of elemental composition(C,H,N) and of molecular weights(MW) by gel filtration.
Carbon content(atom percent) increases from 26.9 and 38.3 in hydrophilic HAs up to 42.4-41.6 in hydrophobic ones. There is a correlation between an increase in HAs ability to come into hydrophobic interactions with gel matrix and H:C (1.63-0.82-0.68-0.79), O:C (0.93-0.71-0.60-0.54) and C:N (7.6-12.0-13.3-15.3). HAs of the HSs most hydrophilic fraction are represented by low-molecular weight compounds (MW 1100 and 2300). MW of the second hydrophilic fraction of HAs is 5300. Hydrophobic HAs are represented by compounds having MW of 72000 and 69500.Therefore, in the initial extract of HSs there is a mixture of organic compounds dissolvable in alkaline and precipitable by acid but different in elemental composition and molecular size.
HAs are referred to polydisperse compounds of a variable composition having a general structure principle-aromatic rings crosslinked by aliphatic chains. This conclusion is based on integral characteristics of non-fractionated HAs.
One must admit that it is not known at present whether physically independent components of HAs in the alkaline extract are individual chemical compounds,supramolecular complexes or polymer formations of an undetermined structure having close parameters of chemical and physical-chemical properties. It is not yet known where and how separate components of HAs are located in soil. Wherein its individual specificity is confined at soil formation? Is there an evolutionary relationship between them?
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P199

Cropping system effects on carbohydrate content in two soils of central Iran

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The effect of humus, readily decomposable organic matter, and carbohydrates of a nonspecific nature on the formation of water-stable aggregates in field rotation members of two calcareous soils in central Iran, Isfahan *(fine loamy mixed thermic typic haplargid)* has been studied. The study was carried out at Lavark experimental farm in plots receiving 0 (T1), 25 (T2), 50 (T3) and 100 (T4) Mg/ha of manure for five years successively with a cropping rotation of wheat (*Triticum aestivum* L.) -corn (*Zea mays* L.) every year and plots under similar chemical fertilizer management but three different cropping rotations (T5, T6 and T7) that has been the prevalent cropping systems. Three replications of soil sample in each treatment and at the depths of 0-5 and 5-15 cm were used to measure organic carbon, hot water soluble carbohydrate, dilute acid hydrolysable carbohydrate, cold water soluble carbohydrate. The highest amount of carbohydrate (700 mg/kg) was obtained in plots treated with 100 Mg/ha manure (T4). The amount of carbohydrate extracted from soil samples decreased in the order of hot water, dilute acid and cold water extracts. This study showed that the carbohydrate extracted by hot water and dilute acid may be a suitable indicator for showing soil quality.

P200

Study of organic matter effects on physico-chemical changes of different Soils

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Laboratory and pot culture experiments were carried out to assess the impact of various organic carbon sources (City compost, FYM, Glyricidia and Pongamia litter) during and after decomposition on the nutrient availability, humification process and finally, the growth and nutrient uptake by maize plants in different soils. The incorporation of various organic materials indicates a significant increase in the organic carbon content due to treatments Higher N values were recorded in FYM, City compost and Glyricidia as compared to other treatments. Addition of organic materials at one per cent C level significantly increased the content of micronutrients in all the three soils over respective controls. During the decomposition process, different organic materials generated different quantities of humic and fulvic acid. Maximum total humic fractions yield was observed in ALF + FYM treatment and most of the total humic acid extracted was in humic acid form. In Vertisol, maximum THA yield was recorded in VER +FYM and most of it was HA form.

P201

Determination of soil organic carbon using near-infrared spectroscopy

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The usefulness and limitations of near infrared reflectance spectroscopy (NIRS) for the analysis of soil are still not sufficiently explored. The objective of this study was to evaluate the ability of NIRS for determination of organic carbon on a diverse set of soils.
A total of 138 soil samples of Vertisols, Chernozems, Fluvisols and Luvisols, were taken from 0-60 cm layer. The organic carbon content was determined by Tyurin method. Soil spectra were collected using InfraAlayzer 450 spectrophotometer within the range 1445-2348nm. Calibration equations for determination of soil organic C content were derived by MLR using two/third of the samples as calibration set and tested with rest of the samples as independent validation set. In order to compare spectral characteristics of the samples from different soil units principal component analysis was used.
Soil samples were separated in a space of PC according to their NIR spectra into several groups. The samples of Vertisols and Chernozems formed clearly separated groups. Fluvisols and Luvisols samples were spectral similar and formed one group.
For the global calibration, containing the samples of all soil units, the standard error of calibration (SEC) and of prediction (SEP) were 0.32 and 0.37%. The ratio of the standard variation of the reference data to the SEC or SEP (RPD), indicating the performance of the calibration, was 2.13 and 1.92, respectively. Dividing the samples into groups according to their spectral similarity improved prediction accuracy. For example, for group of spectral similar samples of Fluvisols and Luvisols SEC and SEP was 0.18, RPD for validation was 3.00.

This study shows that NIRS can be used as a fast and routine method for prediction of soil organic C.

P202

Managing soil organic carbon in irish agricultural systems

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World soils play an important role in carbon (C) cycling. Being a principal terrestrial C pool, soils contain more than twice the C than in the atmospheric, land plant or biotic pool. Carbon sequestration implies transferring atmospheric CO_2 into long-lived pools and storing it securely so it is not immediately re-emitted.
Particularly, perennial bioenergy crops, established on cultivated land, seem to be able to sequester carbon in the soil. Studies have begun in *Miscanthus*, which is a bioenergy crop, as it is a convenient replacement of conventional cropping system and it is likely to increase the soil organic matter (SOM). Therefore, the principle aim of this study is to measure the amount and rate of C sequestered under a *Miscanthus* stand following the movement, partitioning and turnover of carbon.
Soil organic matter is a complex entity consisting of different fractions characterized by different physical and chemical proprieties, microbial degradability and turnover time. Therefore, to evaluate changes in soil C and SOM dynamics correctly, it is necessary to distinguish the different SOM fractions in relation to their functionality. For that reason in this study, we have decided to fractionate SOM by size and density. Moreover, stable C isotope studies have been successful in elucidating belowground C dynamics. We will than combine SOM fractionation techniques with the ^{13}C natural abundance technique to investigate small shifts in soil C stores that would be significant in the long term, but that might not be detected by conventional methodologies.

P203

Impact of litter quality on mineralization processes in top soils of South Ecuador

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Understanding mineralization processes in soils is the key to manage soil fertility. Our objectives were to quantify impacts of different litter quality on organic matter turnover, soil microbial activity and community structure in two top soils of a mountain rainforest region of South Ecuador. Hence, a microcosm experiment was conducted over 28 days at 22°C to examine soil microbial biomass, microbial respiration activity, δ13C of respired CO2 and community structure of soil microorganisms (PLFA) in different time intervals. Grass (C4 plant) and bracken (C3 plant) litter were incorporated and incubated in top soils (0-5cm) of their corresponding origin sites (pasture and bracken-dominated succession site) and vice versa. Furthermore, individual soil and litter treatments were used as control. The 13C natural abundance tracer technique enabled the distinction of CO2-C derived from C4 and C3 originated organic matter during the mineralization process to consider the source of carbon utilized by the soil microbial biomass.
The incorporation of grass litter in the soil of the bracken site resulted in a decrease of soil-derived CO2-C compared with the control soil, indicating a negative priming effect. Apart from this, no priming effect occurred in the other treatments.

P204

Concentrations of carbon, nitrogen, phosphorus and sulphur and activities of some hydrolytic enzymes in a Luvisol fertilized with farmyard manure and mineral nitrogen

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Concentrations of organic carbon (Corg), total nitrogen (Nt), available phosphorus (P_{E-R}), sulphate sulphur ($S\text{-}SO_4^{2-}$) as well as activities of alkaline (AlP) and acid phosphatase (AcdP), and arylsulphatase were assayed in a Luvisol fertilized with various doses (0, 20, 40, 60, 80 $t \cdot ha^{-1}$) of farmyard manure (factor I) and mineral nitrogen (0, 45, 90, 135 $kg \cdot ha^{-1}$, factor II). Soil samples were collected in 2004 three times (June 2, July 24, Sept. 14) during vegetation of corn cv. 'Nimba' grown for silage. A significant effect of the experimental factors on biochemical parameters was found. The Corg content ranged 8.16-11.67 g $Corg \cdot kg^{-1}$ increasing proportionally to the manure dose used. Average concentration of Nt for all manure doses and mineral nitrogen was 0.803 g N $t \cdot kg^{-1}$. Using the Corg and Nt values the Corg:Nt ratio were calculated (range 5.16 - 11.4). The differences found indicated a varied rate of mineralization of carbon and nitrogen compounds in the studied soil. P_{E-R} and $S\text{-}SO_4^{2-}$ concentrations were significantly affected by fertilization with manure and mineral nitrogen, with the highest increase noted for soil samples taken from the objects with the manure dose 60 $t \cdot ha^{-1}$. Mineral nitrogen used in the dose 135 $kg \cdot ha^{-1}$ increased significantly $S\text{-}SO_4^{2-}$ and decrease P_{E-R} content as compared with their concentrations recorded for lower doses of this fertilizer. Concentrations of phosphorus and sulphur as well as activities of hydrolytic enzymes changed over the corn vegetation period. The highest concentration of available phosphorus of 90 mg $P \cdot kg^{-1}$ was found in the sample collected in September. However, activities of phosphatases observed in the same sample were the lowest (alkaline - 0.437 mmol $pNP \cdot kg^{-1} \cdot h^{-1}$ and acid 0.914 mmol $pNP \cdot kg^{-1} \cdot h^{-1}$, respectively). The lowest arylsulphatase activity (0.292 µg pNP $kg^{-1} \cdot h^{-1}$) was noted in July, while sulphate sulphur concentrations in the same sample was the highest (18.22 mg $SO_4^{2-} \cdot kg^{-1}$).

P205

The fate of phenolic constituents during peat humification processes

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Peatlands are waterlogged areas where the rate of biomass production is greater than the rate of decomposition, thus resulting in effective sinks of atmospheric carbon (these ecosystems are estimated to store about one-third of global soil C pool). Models of peat accumulation assume that decomposition occurs mostly above the water table (mass loss of 80-90%), while, once the peat has become submerged in the anoxic catotelm, it decomposes at only 0.1% of the rate of the acrotelm.
Ombrotrophic bogs are domed peatlands supplied only by atmospheric depositions. Such deposits allow to reconstruct environmental and vegetational changes by analysing the constituents derived from plants contributing to peat formation, such as lipids and lignin. The latter, in particular, is an abundant and relatively recalcitrant phenolic macromolecule found in vascular plants, and it is also implicated as major source for terrestrial humic substances.
In this work, phenolic constituents (PCs) in peat and corresponding humic acids (HAs) along a bog profile were estimated using alkaline CuO oxidation in order to investigate their fate during humification processes.
The PCs variations with depth reveal that most of the degradation takes place in the upper oxic layer, while, in the

deeper anoxic one, PCs tend to accumulate. The diagenetic alteration of these PCs during peatification involves a significant demethoxylation and an increasing yield in vanillyl oxidation products. Syringyl phenols tend to be particularly resistant to diagenetic alteration and are significantly enriched within the HA fraction with respect to the bulk peat. This, together with the higher degree of oxidation, implies that the HA fraction is enriched in more resistant but nonetheless diagenetically altered PCs, thus underling that this organic fraction constitutes a refractory pool of organic C with relatively low turnover rates and that relatively intact but modified phenolic material are a major component of HAs.

P206
Influence of the peat humic fraction on Br and Hg cycles

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The distribution of Br and Hg in bulk peat and corresponding humic acids (HAs) has been studied along a profile in order to investigate the role of the humic fraction on Br and Hg accumulation in ombrotrophic bogs, i.e. domed peatlands supplied only by atmospheric depositions.
The present study underlines the greater affinity of Br and Hg for HAs rather than for corresponding peat samples. In particular, data show that most of the total Br and Hg present in peat is retained by HA molecules (40% and 66%, respectively).
In addition, plotting Br concentrations against the Hg ones in HAs along the core, it is possible to observe a similar shape ($R^2 = 0.78$, $p<0.001$), especially in the upper part of the profile. Even though these two trace elements have different chemical features and different modes of transport and deposition, the observed correlation underlines a main role of HAs in accumulating these elements. In particular, the observed correlation could indicate that: *a)* a fraction of Hg was deposited as Hg-Br containing molecules (e.g., pesticides, especially in the last decades), and then incorporated into HA molecules, and/or *b)* the similar concentration trend might be the result of common humification pathways that promoted Br and Hg accumulation in HAs. Thus, during humification, both trace elements seem to behave similarly, becoming enriched to the same extent.
This complexing behavior may greatly limit their mobility, thus subtracting part of the atmospheric Br from ozone depletion phenomena, and most of the Hg from volatization processes.

P207
Soil organic matter content in top-soils of Germany

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Recent legislative activities related to soils have been initiated at both, the European level (Soil Directive) and the national level (German soil protection ordinance under revision, national implementation of cross-compliance), all of them requiring sound data on soil organic matter (*SOM*) at a country-wide scale. Against this background, a comprehensive evaluation was carried out to provide a Germany-wide baseline on typical SOM contents in top-soils under different land uses. The evaluation is based on analytical data for SOM of about 9.000 soil pits provided by the national and the federal states soil surveys of Germany. In a step-wise procedure, the data on SOM were harmonised and stratified according to three climatic regions, 15 groups of soils parent material and three main land uses. The plot data were connected to a soil parent material map at a scale of 1:1 Mio. Climatic regions and land use were also considered. The SOM contents were grouped into six classes according to the national soil taxonomy and subsequently evaluated statistically.
With this data bases, the first Germany-wide representative information on SOM content in top-soils could be compiled in terms of statistical characteristics and a map of SOM referring to the mean values of the sample distributions. The statistics are stratified according to a total of 79 strata covering 88 % of the area of Germany. Land use, soil formation and climatic conditions could be clearly identified as main landscape scale factors for SOM storage in top-soils. SOM increases from soils under arable land to forest soils to soils under grassland. Dryer regions e.g. in East Germany exhibit significantly lower SOM levels compared to more moist areas in north-western Germany. The results can be used as the baseline for SOM in Germany, e.g. as needed for the landscape scale modelling of SOM dynamics.

P208
Quantification and characterisation of aerial and underground litter of *Miscanthus*, a perennial energy crop: ability to soil biodegradation

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The concerns of global fossil fuel depletion and environmental pollution from its combustion are driving the search for renewable energy sources. The use of ligno-cellulosic plant biomass as an energetic source is fully investigated nowadays. Substituting fossil fuels with crop biomass will require selection of the most suitable plant species and adequate management to meet the environmental constraints. Several species that produce high biomass from low inputs would be good candidates for energy production. Amongst these, the genus *Miscanthus*, which is a perennial rhizomatous grass, with a great adaptability to different environments and a high yielding potential (C_4-plant) appears as a good candidate. New practices and/or the development of new energy crops will also modify the quantity and quality of crop residues entering the soil and therefore affect the nutrient cycles (mainly Carbon (C) and Nitrogen (N)). The aim of our study was therefore to establish the relationships between *Miscanthus* litter quality and their rate of decomposition in soil as a function of the agricultural practices (date of harvest and N fertilization rate).
Miscanthus sampling was realized at the INRA experimental station of Mons en Chaussée (North-East part of France). Plants were two years old, and two N treatments were selected (without [0N] and with N [100 kgN.ha^{-1}.year^{-1}]). Rhizomes and associated roots were sampled in the field at two stages: i) the first stage was in autumn before N remobilization from leaves to rhizome occurred and ii) the second stage was in winter at plant maturity, after N remobilization from aerial parts to rhizomes. Senescent leaves were collected between the two sampling stages. Biochemical characterisation (Klason lignin, soluble content, sugars and C/N ratio) of the different plant parts was determined. An incubation experiment was performed to determine rates of decomposition and C and N mineralization. First results are shown.

P209
Humification degree in Chernozems determined by fluorescence spectroscopy

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The inherent fluorescence of HS is an extremely sensitive measure, which allows for non-destructive analyses of samples. Therefore synchronous fluorescence spectra (SFS) have been widely used for evaluation of HS quality. Object of our study were the different subtypes of Chernozems that formed about 25,5 % of arable soils in the south Moravian region. These soils have been cultivated for a long period and are much more humified to compare with native vegetation in this region. It is

also supposed that they approached presently equilibrium levels depending on climate, pedogenesis and agricultural practices.
In the topsoil of ten different subtypes we followed total carbon content (TOC), fractional composition of HS and optical indexes in UV-VIS and SFS spectral ranges. We compared data of fractionation with measured optical indexes. HS were extracted by mixture of 0.1M sodium pyrophospate and sodium hydroxide solution at pH=13. UV-VIS spectra were measured by VARIAN CARRY PROBE - 50 within the range 300 - 700nm. SFS spectra were mesured by Spectrofluorimeter AMINCO BOWMAN Series 2 within the range 320 - 620 nm (at $\Delta\lambda$=20 nm).
Results showed there were no statistically significant differences in TOC content to compare with data of the Systematic Soil Survey in 1965. Humification degree calculated from fractional composition humus was middle. $Q_{465}/_{665}$ indexes measured in UVVIS spectral range were < 4 except Arenic Chernozem. In SFS spectral range we identified six main fluorophore peaks for HA at 502, 487, 470, 465, 399, 359 nm (at $\Delta\lambda$=20 nm). The shift in the maximum fluorescence intensity from shorter to longer wavelength to compare with 1S102 Elliot Soil Humic Acids Standard (IHSS) was associated with an increasing number of aromatic compound.RFI I_{465} /I $_{399}$ varied from 1,26 to 2,11. The last indicated that humification degree varied from middle to high (RFI < 1).

P210
Influence of different types of organic matter on the soils reducing conditions

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Soil organic matter is an important factor in determining the onset of reducing conditions, as it represents the main electron donor in soils.
Different kinds of organic matter may have a diverse influence on soil redox potential, according to their molecular weight, electron-transfer capacity, and availability to microorganisms.
Microorganisms that utilize oxidized species as terminal electron acceptors mediate the decomposition of organic matter. Under equilibrium conditions, a theoretically well-defined sequence of reduction of electron acceptors should take place when the soil goes from oxic, to suboxic, to anoxic conditions.
Anaerobic activities are important in microbial transformation of organic matter at a global scale, and therefore receive increasing interest.
Aim of this study was to evaluate the influence of different kinds of organic matter on the onset of soil reducing conditions in the presence of an anaerobic inoculum.
Three soils (urban, agricultural and natural) were selected for this experiment. A portion of these samples was pre-treated with H_2O_2 to remove the organic matter. The experiments were conducted with oxidized and untreated soil. Samples were submerged with a $CaCl_2$ solution in dark-glass bottles, under an oxygen-free atmosphere. An *inoculum*, obtained from a submerged paddy-soil, was added to all samples. Different electron donors were also added to each bottle (humic acids, dissolved organic matter, glucose, sewage sludge, starch). The progress of the reducing conditions was monitored measuring Eh, pH, and the release of Fe(II) and Mn(II) in solution for a period of 30 days.
The release of Fe(II) appears to be related to the molecular structure and weight of the electron donors. The time needed to reach an Eh threshold value is different as well as the final potential value. The pH varies accordingly.
Results show that different kinds of organic matter influence the redox potential of soils in very different ways.

P211
Estimation of DOC fluxes under Miscanthus and Lolium pasture; effects of land use change

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Conversion of agricultural land to energy crops has been identified as the land use change with the greatest potential for carbon mitigation across Europe.
The impact of land use change and management on soil organic carbon (SOC) stocks has considerable implications for soil quality improvement and sustainability, as well as the potential to mitigate carbon emissions.
Establishment of biomass crops such as *Miscanthus x giganteus* (*Miscanthus*) can increase carbon (*C*) storage in the soil, promoting increases in soil organic matter (SOM). Knowledge of the processes governing the downward movement of *C* i.e. leaching or deep storage of dissolved organic carbon (DOC) is scarce. Research has been conducted on maintaining soil quality in Ireland; however, there is a need for research on the impacts of crop type on *C* cycling in the soil.
The effects of conversion from agricultural land to *Miscanthus* on DOM will be investigated at Teagasc, Crop Research Centre, Carlow, Ireland. An adjacent *Lolium* plot will be used to represent the pre-establishment soil scenario (i.e. a ‘time zero’ reference).
DOM concentrations under *Lolium*, newly established *Miscanthus* stand and a well established (13 years) *Miscanthus* stand will be assessed by collecting leachate using tension lysimeters placed within the O horizon (~25cm) and mineral B horizon (~60cm). DOC will be tracked through the soil profile using *Miscanthus’* natural σ^{13}C tracer. This will enable us to identify the amount of ‘new *C*’ in the soil under the bioenergy crop.
The hypotheses are a) that DOC and DON are significant components of the *C* and *N* cycles of terrestrial ecosystems and are influenced by land use change, b) that DOC and DON concentrations under *Miscanthus* will increase relative to the reference ‘time zero’ *Lolium* soil and c) that DOC in the soil under *Miscanthus* will predominantly be C_4 derived (i.e. ‘new *C*’).

P212
Fluorogenic assay of N-acethylglucosaminidase and its spatio-temporal variability in the litter layer of coniferous forest

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The litter layer of coniferous forests represents a major sink in the global cycling of carbon (C) and nitrogen (N) which in turn is one of the key processes governing climate change. However, the spatio-temporal dynamics of N-mineralization and the related enzymes in the litter layer are poorly understood. Our study has the objective to investigate the spatio-temporal dynamics of N-mineralization related enzyme activities in the litter layer of a coniferous forest. For one year we analyzed the Of and Oh layers of the litter in a pine stand near Hannover in Germany. Most methods to analyze enzymes in soils suffer from the interference of the measurements with phenolic compounds. Also, enzyme activities are regularly measured at neutral pH and with constant substrate concentration. Using fluorogenic 4-methylumbelliferyl as enzyme substrates, we developed a site specific calibration with “quench-correction”. This minimized the interference of the measurements with phenolic compounds. The enzyme activities were measured under in situ pH (~3-4) and sample-specific optimal substrate concentrations. We found significant correlations between the enzyme activities and mineralized N (Nmin) amounts, and with the total N storage. The degree of correlation of the enzyme activities with Nmin was higher in the Of and with the total N storage in the Oh layer. The seasonal variability of temperature and moisture in the litter layers was not significant to predict the enzyme activities. This supports the assumption that the litter quality is more important as a source of variability. Using the N-acethylglucosaminidase activity measurements of the entire year we analyzed their omnidirectional spatial structures. The Of layer had no spatial correlation and the Oh layer showed a structure with a range of 2,5m. On our poster we will discuss our findings and draw some conclusions.

P213
Rendzins humus conditions of the Black Sea coast

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Object of research are rendzins - of the Northern Caucasus. The analysis of humus conditions of subtropical rendzins shows strong disorder of quantitative characteristics at the same process of humufication, and exactly - grassy vegetation of a light forest, turfen process. Process of humification proceeds in conditions of the high maintenance of carbonates (alkaline reaction of environment, due to domination in soil solutions Ca(HCO3)2. The grassy vegetation of the calcium character provides humification with prevalence of humus acids and dark colouring of a soil structure, similarly to brown and chernozem to soil formation. The genetic type of humification is defined as fulvo-humin with an average saturation of humin acids at very low maintenance free humin acids, average saturation anion Ca is characteristic at high quantity of strong connected forms of humuts. Such type of humification is characteristic for soils of high potential fertility. However for rendzins of the studied territory have the strong variation of quantitative characteristics of humus horizon capacity , the maintenance of humus and its stocks. Researches are maintained by the RFBF (projects - 06-05-64722a).

P214
Content of total carbon and nitrogen in fractions of humus after long-term fertilization

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The objective of the study was to evaluate the influence of manure fertilization and various doses of nitrogen applied on the content of humus in podzolic soil on which plants were cultivated in simplified crop rotation. The research was accomplished on the basis of a long-term field experiment established in 1979 at the Wierzchucinek Agricultural Experiment Station. The soil was defined as typical podzolic clay, sand on light clay, with the soil fraction <0.02mm constituting 18 %. However contents of organic carbon and total nitrogen were respectively, 6.63g/kg and 0.78 g/kg. The experimental factors were manure fertilization (factor I, n=2.0 and 0, 30 t/ha and varied nitrogen fertilization (factor II, n=4, 0, 46.6, 93.3, 140 kgN/ha. Soil was sampled in 2005 and analyzed for total organic carbon (TOC) - with the Skalar TOC Primacs analyzer, and total nitrogen (TN) content using the distillation Kjeldahl method. Organic matter fractions (humic and fulvic acids) for the experiment were isolated with the use of Schnitzer method. Organic carbon and total nitrogen contents were assayed in these fractions. In the field where no manure was used lower content of C_{HA} and the lower ratio C_{HA}:C_{FA} were observed. In general introduction of nitrogen in the ammonium nitrate form on the plots with manure resulted in a decrease in the C_{HA}:C_{FA} ratio. An increase observed in soil acidity could have been the reason for the production of lower quality humus. The humus of the soils where manure was applied is characterized by a higher content of humic acids carbon and a higher ratio C_{HA}:C_{FA}. A close relationship between the manure and the humus fractions isolated were described by the corresponding correlation coefficients.

P215
Soil organic matter stability and radionuclides availability to plants

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The less is soil organic matter stability the more is radionucleides (RN) availability to plants from soil. Agricultural land-use increase “new” organic matter income into soil with plant residues and organic manures. This “new” soil organic matter (NSOM) to a considerable extent is not stable, and, under such destabilizing factors as fertilizing, tillage etc., can undergo intensive mineralization, which, as it was shown in our previous investigations, is accompanied with increased RN plants uptake. The aim of this work was to evaluate influence of accumulated during long-term field experiment NSOM on RN plant uptake under nitrogen fertilization. The investigations were carried out on soddy-podzolic sandy soil, contaminated by ^{137}Cs. For 25 years on the background I (NPK) in soil was accumulated 3.6 t C ha^{-1} of NSOM and on the background II (NP + manure) - 9.0 t C ha^{-1} of NSOM. Soils of both backgrounds contained equal quantity of exchangeable potassium which controls ^{137}Cs plant uptake. Ammonium nitrate was added at the rates of 0, 45, 90 and 135 kg N ha^{-1}. Our results demonstrated that under nitrogen fertilization specific ^{137}Cs accumulation (Bq kg^{-1}) in oats grain and straw increased in 1.1, 2.2, 3.0 and 1.1, 1.2, 1.4 times on the background I, and in 1.7, 3.7, 3.9 and 1.5, 1.9, 2.3 times on the background II, respectively. This increase was caused by mineralization of organic compounds of soil. The more NSOM was accumulated due to the long-term fertilizing, the less was the extent of total soil organic matter stability against mineralization and the more was ^{137}Cs plant uptake.The work was supported by Russian Foundation of Basic Research, project Bel_a.

P216
Characterization of Soil Organic Matter (SOM) from Brazilian Umbrisol by 13C NMR spectroscopy and oxidative degradation

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Considering the role of SOM as a C sink, a better understanding of its stabilization is needed to mitigate the effects of the global climatic change. Specially, in tropical and subtropical regions where climatic conditions allow for intense mineralization of SOC and fast C-turnover rates. Because those soils present an advanced pedogentic stage, the maintenance of SOM is critical because of its importance for soil fertility, CEC, aggregate formation. Therefore, our intention was to characterize the SOM of Brazilian soils by oxidative degradation and solid-state ^{13}C NMR to reveal size and quality of the C pool.
Two Cambic Umbrisols (CU-1; CU-2) from S-Brazil were studied. Samples were collected from each horizon, air-dried, ground and sieved (<2 mm). The pH (H_2O) and total C content (dry combustion) were measured. Samples were analysed by solid-state CPMAS ^{13}C-NMR spectroscopy after demineralization (HF, 10%). In addition, HF-treated fractions were oxidized (acid $K_2Cr_2O_7$) and the chemical oxidation resistant elemental carbon (COREC) was analyzed by solid-state NMR. Also, the degree of oxidizability of SOM was established by wet chemical oxidation ($K_2Cr_2O_7$; $KMnO_4$).
The C contents in the studied profiles decrease with depth. Concomitantly, the relative contribution of O-alkyl-C descends in favour of aryl-C and alkyl-C. Oxidation with $K_2Cr_2O_7$ and $KMnO_4$ confirms an increase of the resistant C-fractions in the B horizons, indicating stabilization of C.

Solid-state ^{13}C-NMR spectra of HF+ $K_2Cr_2O_7$-treated samples demonstrate chemical differences in the composition of COREC of the individual soils. Whereas in deeper horizons of CU-1 dominated carboxylic-C and carbonyl-C, in CU-2 the contribution of aromatics increases with depth revealing that a part of the stabilized SOM occurs as *black carbon*. Our results confirm that such black carbon represents an important fraction of subsoil SOM.

P217

15N-DNA Stable isotope probing and active soil microbial community in plant residue decomposition process

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Knowledge of soil organic matter (SOM) turnover is essential for understanding nutrient cycling. SOM turnover is largely controlled by microbial communities, however most of soil microorganisms are still unknown and very few have been directly related to their function in specific soil processes. The recently developed DNA-Stable isotope probing (SIP) technique allows direct observations of substrate assimilation in microbial communities and represents an interesting new tool for linking microbial identity and function. To identify the active microbial community involved in the decomposition process of crop residues, an incubation experiment was conduced with highly 15N-enriched residues (90 atom %) incorporated (1%) in a Vertisol soil, taken from a long-term field experiment carried out in Venezuela since 1997. The residues were incubated for 30 days (25 oC) at 40 % WHC. A control without residue was also used. Microbial activities (CO2 evolution, ergosterol content, enzymes activities, C and N biomass) were measured after 3, 7, 15 and 30 days. DNA was extracted and the active and passive community was analyzed by using the 15N-DNA stable isotope probing (SIP) and molecular (DGGE, cloning and sequencing) techniques. The results showed that residue additions stimulated soil microbial activities and the 15N-DNA stable isotope probing technique allowed the isolation of the active bacterial and fungal community involved in the decomposition process

P218

Fertilizer type and rate: effects on labile carbon and nitrogen pools in a long-term trial on a sandy Cambisol

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Type and rate of fertilizers influence the level of soil organic carbon (C_{org}) and N markedly, but the effect on labile C- and N-pools is open to question. Objectives were to investigate the impact of fertilizer type and rate on labile C- and N-pools on a sandy Cambisol. From the 27 year old long-term experiment in Darmstadt, six treatments were compared: application of mineral fertilizer with straw-yield incorporation (MSI) and application of farmyard manure (FYM), both at high, medium and low rate.
Soil microbial biomass C (C_{mic}) and N (N_{mic}) were determined. In an incubation experiment (266 days, 10 °C, 55 % WHC), we assessed CO_2-C and netto-N-mineralization. An exponential two-pool model was fitted to the mineralization data for separating labile C- and N-pools (C_1, C_2, N_1, N_2).
In all treatments, stocks of C_{org} declined since 1982. N stocks were maintained in the FYM treatment at high and medium rate. MSI treatments had lower C_{mic} (308 - 361 kg ha^{-1}) and N_{mic} (42 - 48 kg ha^{-1}) stocks than FYM treatments (404 - 520 kg C_{mic} ha^{-1} and 60 - 68 kg N_{mic} ha^{-1}). After 266 days, mineralized C (1132 - 1817 kg ha^{-1}) was significantly different between rates and increased in the order low > medium > high. Netto-mineralized N (91 - 125 kg ha^{-1}) increased in the same order. The pools C_1 and N_1 were small (1.3 - 1.8 % of C_{org}, 0.5 - 1.0 % of N) and independent of treatments. The pool C_2 comprised 7.1 - 12.5 % of C_{org} and increased with increasing input. Between 3.8 and 4.9 % of N were stored in the pool N_2.
Our results indicate that the sizes of labile C- and N-pools were governed by the rate and those of the non-labile pools by the type of fertilizer.

P219

Soil organic carbon and nitrogen dynamics in soils amended with organic residues

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The application of organic residues to soils have received considerable attention recently, due to the sequestration of atmospheric carbon and the subsequent increase in soil productivity and fertility. Added organic matter is beneficial especially in the case of soils susceptible to degradation (with low organic matter content). Such soils are typically found in the Southeastern Mediterranean zone. Thus in an incubation experiment, a soil from Greece with low organic matter content was amended with four different organic residues (cattle manure, pig manure, poultry litter, and sewage sludge) at a rate equivalent to 200 kg N ha^{-1}, and was tested for a period of one year. During that time organic carbon, as well as nitrogen mineralization were monitored. Inorganic fertilizer was also added to the soil at similar nitrogen rate. For comparison, a second soil from Romania, with high organic matter content was also amended with the same organic residues and inorganic fertilizer and was incubated along the other soil. It was found that soil organic carbon increased significantly in both amended soils. Although organic carbon decreased over the time, at the end of the incubation period organic carbon was still higher in the amended soils compared to the unamended. Nitrogen release was slower in the amended samples than in the samples with inorganic fertilizer, and this showed the agronomic benefits of using organic residues.

P220

Decomposition of tropical tree litters: Impact of litter quality on C mineralization kinetics and soil organic matter characteristics

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Tree litters and more particularly the tropical ones are recognized to have high levels of polyphenols and lignins. Polyphenols are the most abundant class of plant secondary metabolites and are mainly distributed in the vacuole of cells (soluble fraction) while lignin is an important polymer of plant structural C (cell walls). These compounds are both recognized to slow down litter decomposition and N mineralization rates. However, this relationship between litter quality and rate of decomposition is not quantified and moreover not fully explained yet. In addition the impact of initial intrinsic quality of such litters on soil organic matter chemical characteristics was not reported. For instance, is there a qualitative continuum between the initial characteristics of lignin polymer in the tree litter and that found in soil after decomposition?
The aims of our study were to i) better characterize the role of litter composition in slowing down C and N mineralization

kinetics and ii) to investigate the relationships between the nature of lignin in the litter residues and that found in soil organic matter after decomposition. To do so, nine tropical litter species were sampled in a 22 years old plantation near Kourou in which species were installed as monocultures. Leaves were incubated in a tropical soil (sampled from a juxtaposed plot without tree) under controlled conditions of temperature and moisture. The kinetics of C and N mineralization were monitored during more than two years. Litter quality was determined by measuring the C to N ratio, Van Soest fractions, total polyphenols, condensed tannins and quality of the lignin polymer (S to G ratio). On residue amended soils (with litter) and control soils (without litter) the quality of lignin in soil organic matter was determined after 2.5 years incubation.

P221

The Role of Organic Matter in Improving the Physico-chemical and Biological Properties of Agricultural Soils

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The increasing demand for food requires that we use soils more effectively and prevent its degradation at the same time. Soil is considered to be a living ecosystem of mineral components of soil, mostly ulic and humic acids and humics are also the most important features of soil physical structure crumbs that are soil particles bound together by organic molecules and materials. Good physical structure means good root environment and good aeration and water permeability, and stability against erosion and water runoffs and a suitable medium for microbial growth as well. High organic matter content is often recognized by dark color. Organic matter also improves the CEC of soils and supplies balanced amounts of nutrients to plants and microorganisms except that decomposed organic substances and manures contain too high a C/N ratio for this reason nitrogen fertilizers should be added to soils that receive organic fertilizers. Organic matter improves the biological characteristics of soil environment as it improves its physical and chemical mature and therefore increases the population densities. The chemical and biological processes that involve soil organic matter reactions and microorganisms activities in chide, hum function, mineralization and mineral cycling, and immobilization. The rate of conversion of organic fertilizers in soil is a function of soil management, soil texture, climate, Landscape position and Vegetation. Organic fertilizers include some sources such as animal manure, Green manure, Composts. Therefore the application of animal and green manures and combined with chemical fertilizers, production and application of biological fertilizers, protection of rangeland against overgrazing and erosion and of forests, and discouraging stubble burning and finally farming without unnecessary plowing and cultivations, and protecting natural vegetation are among the issues that should be promoted in order to improve the productivity of our soils and to prevent there degradation.

P222

Mineralization rates of SOC in forest Andosols of the Canary Islands

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Volcanic soils, and particularly Andosols, are usually rich in organic matter, which usually appears in them as stable, organomineral compounds or organo-metallic complexes. Nevertheless, very few studies have been carried out so far to evaluate the less-stable, simpler fractions of SOC in Andosols and their dynamics.

This study was performed on Andosols and volcanic Inceptisols, under different forest types of Tenerife (Canary Islands, Spain). Soil samples were collected seasonally in eight plots at two depths (0-15 and 15-30 cm) over two years. Incubation of fresh soil samples was carried out at optimum conditions of temperature and moisture during 10 days, in which the release of C (as CO_2) was measured.
Organic C mineralization was fitted to a first-order kinetics, with R^2 coefficients close to unity:
$C_t = C_0 (1 - \exp(-kt))$
where C_t is the accumulative CO_2 concentration (expressed as mg $C.kg^{-1}$ sediment) at time t (days), whereas C_0 represents the initial, potentially mineralizable carbon (mg $C.kg^{-1}$ sediment) and k is the daily flux rate constant.
On average, 30-50% of the potentially mineralizable organic C is turned into CO_2 after the incubation time. The CO_2 flux, or mineralized C per biomass unit reaches its highest values in summer, showing a low interannual variation. Potentially mineralizable C (C_o) is significantly higher in winter when the CO_2 flux is low, but it shows a much higher interannual variation. Both CO_2 flux and C_0 are significantly higher in surface soil samples. Significant differences between the different forest types and the degree of disturbance are also observed. The CO_2 flux seems to be tightly related to the climate, whereas the mineralizable organic C was shown to depend on the seasonal patterns, like those of litterfall.

P223

Effect of temperature and depth on peat soil ability for methane oxidation

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Methane is one of main greenhouse gases responsible for global warming. Although its concentration in the atmosphere is low, compared to CO_2 (1.745ppm versus 0.367ppm), the ability of CH_4 to absorb and radiate energy back to Earth make it 21 times more efficient than CO_2. Wetlands, including peatlands, are the main source of natural CH_4 emission, with on estimated 100-200 Tg per year. Microbial activity is almost exclusively responsible for methane production. In peat soils opposite processes took place: methane production and oxidation, therefore CH_4 emission is the result of their balance.
Under laboratory conditions, we examined methane oxidation in poor decomposed peat soil (pH 6.5-7.1) sampled from different depths (0-20, 20-40, 40-60 and 60-80 cm) of Leczynsko-Wlodawskie Lake District (Poland). Soil materials at natural moisture (84-87% w/w) taken from every depth were incubated at 20, 10 and 5°C with 5% v/v CH4 addition, in order to detect methanotrophic bacteria activity by GC technique.
The methanotrophic activity was highest at 20°C (in the range1.4 - 2.1×10^{-3} cm^3 kg^{-1} s^{-1}) and dropped with temperature from 4.54 to 8.2×10^{-4} cm^3 kg^{-1} s^{-1} and at 10°C from 1.8 to 3.97×10^{-4} cm^3 kg^{-1} s^{-1} at 5°C respectively.
The maximum methane oxidation at the deepest layer (60-80 cm) equalled 2.0×10^{-3} cm^3 kg^{-1} s^{-1}) at 20°C and 3.97×10^{-4} cm^3 kg^{-1} s^{-1} at 5°C were registered. Surface layer (0-20 cm) was the most active at 20°C, whereas the lowest level of methane oxidation at 5°C were noted. Similar values about 1.4×10^{-3} cm^3 kg^{-1} s^{-1} of methanothrophic activities at 20°C and 20-40, 40-60 cm were observed. The lowest activity showed the samples taken from the surface layer (0-20 cm) and incubated at 5°C.

P224

Effect of soil tillage systems on soil organic matter (SOM). Evaluation with traditional and advanced analytical techniques

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In the Mediterranean area, SOM decline is more stressed than in other regions, since the climatic conditions involve a larger SOM depletion, due to higher mineralization rate and lower accumulation intensity, resulting often from intensive and non-conservative agronomic practices. Deep ploughing is widely adopted to improve soil structure, permeability and aeration on silt-clayey soils, especially in the hills of Central Italy. Sod-seeding and chemical weeding or minimum tillage are replacing this practice, which is considered one of the main cause of soil fertility decline, including SOM depletion, besides erosion, sub-soil compaction and high energy requirements. However, it is not yet clearly assessed how continuous sod-seeding can affect soil fertility and crop yield sustainability. This paper compares the effects of deep ploughing and sod-seeding on SOM, in a long-term field plot system with a two-years rotation (durum wheat-sunflower 1994-2001; durum wheat-corn 2002-2006).
The experiment was established in 1994 at the farm "P. Rosati" of the University of Ancona in Agugliano, in a hilly area with a silty-clay soil. A split-plot with two randomised blocks was designed to compare three tillage techniques (P: conventional 40 cm deep; M: minimum tillage at 25 cm; S: sod-seeding) and three nitrogen fertilisation rates (0-90-180 kg N ha-1). SOM was determined on samples collected after 12 years of continuous ploughing and sod-seeding with 0 vs 90 kg N ha-1. Winter and summer crops were grown in two blocks each year, so four replications were available for each treatment.
SOM was characterised according to traditional analytical approaches (Walkley-Black) and 13C-Solid State Nuclear Magnetic Resonance (13C-CP-MAS-NMR). Measurements were performed on untreated samples, as well SOM was extracted by separating the different components: humic and fulvic acids, carbohydrates and humine. The NMR analysis gives information about the functional groups of SOM, i.e. carbonyl moieties, aromatic rings, aliphatic chains etc.

P225

Influence of long organic and mineral fertilization on soil fertility

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Under the conditions of Leached Chernozem during 10 years period triple addition of mineral and organic fertilizers do not change significantly pH in soil. i Just a year after fertilization it is created mobile mineral compounds. The highest quantity of nitrate nitrogen (3.6 kg/da) it is observed in the treatments with manure (6 t/da) and the lowest in those treatments with organo-mineral fertilizers.There is a positive balance of humus which could be create not only with the application of organic (6 t/da manure but also with mineral fertilization (equivalent to the content of N, P, K in 1.5 t /da manure). It is obtained the same effect in treatments with combined organo-mineral fertilization (6-4.5 t/da manure and N, P, K equivalent to their content in 1.5-3 t/da manure). In treatments with organic and mineral fertilization with the increase of organic fertilizers there is the decrease of humus loses. Contrariwise, with the increase of norms of mineral fertilizers there is the increase of intensity of mineralization in soil.There is positive balance of soil nitrogen in all treatments during 10 years of experiment. The highest (41-39%) increase is observed in treatments with N, P, K equivalent to 3-4.5 t/da manure, followed by 1.5 t/da manure -29%. The lowest is the increase in treatments with combined fertilization (1.5 t/da manure and N, P, K equivalent to their content in 1.5 t/da manure. Fraction composition closed to the initial level, which is show that it reached equilibrium between mineralization and humification. Coefficient of use of nitrogen from manure by maize, established according to method of differences consist 31% during the first year and 55%- during the third year in treatments with 1.5 t/da manure. These coefficients are higher - 49.3% and 82% for the treatments with equivalent norms of mineral fertilizers.

P226

Advanced solutions for non-invasive spectroscopic techniques for the characterization of soil organic matter (SOM) quality - Investigation on the lipid fraction composition in soils from the Grand-Duchy of Luxembourg

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There is great concern about soil quality degradation in the EU. Optimum soil quality is the basis for environmentally sustainable farming, but it is also a prerequisite for the equilibrium of the ecosystems. To maintain and improve soil quality, the spatial distribution and changes of the underlying relevant soil properties have to be known. The amount and composition of SOM are major factors affecting soil quality. Determining the composition of SOM is very work-intensive and measuring soil quality parameters at a high spatial density still remains too expensive. Non-invasive methods like near- and mid-infrared spectroscopy show promising results in measuring SOM quantity and may be used to determine the SOM composition at lower costs. Consequently, results should be accessible for a broad audience to enable their widespread use in practice. By this, a substantial contribution for preserving soil quality in the future would be made.
The project we started recently focuses on the characterization of the lipid fraction of SOM. This SOM component has a major effect on the stability of soil aggregates, the water storage capacity and the pollutant retention. The first objective of this project is to determine for the first time the variability of lipid fraction composition in the soils of Luxembourg. We work on various particle sizes of different soil types and on different land-use classes using an ultrasonic methodology, accelerated solvent extraction, solid-phase fractionation and GC-MS detection. The second objective is to compare these results with laboratory hyperspectral analyses (MIR) using a spectral fingerprinting approach. The benefits and constraints of infrared spectrometry for the determination of such advanced soil characteristization are still insufficiently investigated. This study may contribute to develop new methods for a fast detection of soil chemical composition and to develop guidelines for the implementation of hyperspectral techniques for a multiscale soil mapping.

P227

The effect of climatic conditions and whole tree harvesting on the properties and stability of soil organic matter, application of pressurized hot water extraction

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Changes in temperature and moisture conditions will change also the carbon assimilation and decomposition processes, but it is not well understood how the changing climate will effect on the stability and decomposition of different chemical fractions of soil organic matter. Because the soil organic matter contains twice as much carbon as the atmosphere, processes reducing or increasing soil carbon pool size are essential factors determining the atmospheric CO2 concentration and thus also for the climate change itself.

For the mitigation of the effects of CO2 emissions from fossil fuels, the use of logging residues, branches, needles, tree tops and stumps for energy production has increased rapidly. When the biomass is transported out of the site both nutrient elements and organic matter is lost. In addition, when stumps and coarse roots are harvested, most of the humus layer will be broken and mixed with mineral soil droppings. Our understanding of the possible effects of whole tree harvesting on the stability of soil organic matter storage in changing climate is limited.
Here we present some preliminary results of the advantages of PHWE as an extraction method in fractionating different chemical compounds of soil organic matter. The chemical analysis applied here are mainly GC and LC-MS, common also in wood chemistry. Material from a European network of Norway spruce stands and sites where whole-tree harvesting has been carried out will be studied. The aim of this study is to separate soil organic matter in fractions the rate of decomposition can be determined separately in order to estimate the effects of climate on these fractions.

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Potential of organic products from the peri-urban area of Antananarivo (Madagascar) for crop production in a low fertility soil

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The strengthening staple food needs of urban population gave impetus to agricultural production in urban or peri-urban areas of developing countries as Madagascar. Regarding the high price of industrial fertilizers, small-holder farmer traditionally use manure. However, organic wastes derived products generated in the urban and peri-urban areas can be considered as valuable nutrient sources for crop production.
After a survey, twelve organic products of interest have been collected in the suburbs of Antananarivo (Madagascar) to be tested for their quality and potential to improve soil fertility: Manures from cattle (CM), pig (PiM) or poultry (PoM); a bat guano (bG); commercial composts, one derived from slaughterhouse wastes and green residues *(*VE, *Vohitra Environment Compost)*, two generated from municipal dump (TA, CA), and one sold as a biological fertilizer (Pm, *Prochimad)*; composted urban wastes incinerated or not (UWi, UW); a green residues compost (GC); and sugarcane residues compost (SCr). The organic products have been analysed for their biochemical composition (van Soest analysis) and C-to-N ratios. They have been incubated during 6 months in the laboratory with a ferrallitic soil at 65% of the water holding capacity. CO_2 emissions and mineral N generated by the mixture were measured. After 90 days, the respiration rate was the lowest for soil incubated alone and the highest for soil amended with cattle manure, followed by soil+VE and soil+UWi. All results help to compare the decomposition rate and soil fertility potential of each product, and point out some solutions regarding farmers' strategies in soil fertility management.

P229

Dynamics of soil aggregation and stability in soils under organic manure application and conservation tillage

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Agricultural management practices that alter soil organic matter contents are expected to cause changes in soil aggregation and stability. Over short time scales, organic amendments and conservation tillage have been demonstrated to increase macro-aggregate formation and stability separately, notably by facilitating biological activities. A field experiment was conducted to study the influence of conventional tillage (CT), reduced tillage (RT) and no-tillage (NT) with or without organic fertilization on soil aggregation and aggregate stability dynamics under wheat during one growing season. Aggregates were sampled at 2-7 cm depths in February, March, May and July 2007. The mean weight diameter of dry aggregates (MWDd) was measured by the dry-sieving method. Aggregate stability was evaluated under three treatments corresponding to different wetting conditions and energy levels. To characterize soil biological properties we measured microbial activity by hot-water extractable carbohydrate-C and earthworm activity by the proportion of biogenic macro-aggregates (fresh casts 2-4 mm in diameter).
Aggregate stability increased with organic manure application and conservation tillage. The highest values of aggregate stability were observed under RT, but this increase generally was related to microbial and earthworm activity. The greatest MWDd was observed in soil under organic manure application and NT. MWDd was positively correlated with microbial activity and aggregate stability. Aggregate stability and MWDd increased from February to July under all treatments. Aggregate stability increased linearly with microbial and earthworm activity. The positive correlation between MWDd and aggregate stability during the growing season indicates that settling was not the only process responsible for the increase in aggregate size. Biological activities were efficient as well, since we observed a positive correlation of MWDd with microbial and earthworm activities. Our study demonstrated that biological activities can initiate and stabilize soil aggregation directly during spring and summer through the adoption of conservation tillage and manure applications.

P230

Soil organic matter storage in tropical soils under no-tillage systems (Madagascar)

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Soil organic carbon (SOC) plays agronomic and environmental roles in sustaining agricultural systems and in participating in carbon budget. SOC stocks were quantified and its protection mechanisms studied in Madagascar for tropical soils with different texture (clay + fine silt fractions from 130 to 780 mg.g^{-1} soil). Soils were collected in 4 sites (Manakara, Lac Alaotra, Tuléar, Antsirabe), under no-tillage (with mulch or cover crops) and conventional tillage systems.
Results showed that SOC stocks ranged from 8.1 to 61.6 Mg C. ha^{-1} soil at 0-20 depth, and were positively correlated with clay+fine silt content (R=0.53 , n=26, p=0.005,). High values of SOC stocks were found for no-tillage systems and low values for conventional tillage systems. The rate of SOC storage in no-tillage systems ranged from 0 to 1.816 Mg C. ha^{-1} $year^{-1}$. Soil macroaggregate contents ranged from 72 to 729 g. kg^{-1} soil, were generally higher in no-tillage systems than in conventional tillage systems and were positively correlated with SOC (R=0.81, n=26, p=0.0001). The SOC physically protected inside stable macroaggregates (Cpro) ranged from 13 to 145 µg C-CO_2.g^{-1} soil, and was positively correlated with SOC content (R=0.71 , p=0.05, n=8). Cpro was < 52 µg C-CO_2.g^{-1} soil for conventional tillage while no-tillage systems had values higher than 55 µg C-CO_2.g^{-1} soil. Cpro was correlated neither with soil stable macroaggregates amounts or soil texture.

These results showed that soil texture and aggregation influence SOC dynamic and SOC content impacted SOC protected physically inside aggregate structure. SOC physical protection can explain the difference in SOC content between tilled and not tilled systems.

P231
Isolation of humic acids from SOM by use of soil microorganisms

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The humic substances are the mixture of organic compounds such as aminoacids, sugas, ash and various compounds with unknown structure. The separation of humic acids from the aggregate mass of humic substances is a great task of soil science. It may be suggested that soil microorganisms have a specific mechanism for the “recognition” of these chemical structures at neutral pH, when humic acids have a form of specific polymer. It is, therefore, possible to use soil microorganisms for the purpose of isolation of humic acids from natural sources.
We have suggested a method for isolation of humic acids as a fraction of humic substances resistant to transformation by soil microorganisms. Other organics compounds included in humic substances are transformed by the microbial cultures to CO_2 and H_2O. Our investigations demonstrate that the samples of himic acids from different environmental sources contain 20% of compounds diluted by soil microorganisms in some weeks and which cannot qualify as humic acids.
The comparative study of humic substances and humic acids isolated by way of microbial treatment has shown that humic acids (resistant to microbial transformation) are responsible for intensive absorption of light in visible part of spectra (dark colored) and the formation of water-insoluble complexes with heavy metals. In the tests for growth-regulating activity, including stimulation of grains germination and stimulations of plants’ growth and development, the humic acids isolated by microbiological method appeared to be inactive. This means that growth-regulating activity of humic substances depends on the part of such substances, which is utilized by soil microorganisms.
The humic substances contain near 80% humic asids resistant to microbial transformation, which ensure their accumulation in soils. We believe that the term “humic acids” should, therefore, comprise this specific group of compounds, standard samples of which can be obtained with help of soil microorganisms.

P232
Soluble organic carbon in solutions of various soils inhibits phosphatase activity ; quantification and identification of inhibitors using fluorescence spectroscopy

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Phosphatase activity plays an essential role in the mobilisation of organic soil phosphorus. The catalytic activity in soil solution can also be inhibited by humic substances. We have investigated the activity of potato acid phosphatase (E.C. 3.1.3.2, Sigma) in solutions extracted from 10 contrasting soils (soils from A and B horizons at 5 sites). Aqueous extracts were obtained at a range of pH, using either acetate or MOPS buffers. Phosphatase activity was measured using para-nitrophenyl phosphate as a substrate. Fluorescence spectra of all the extracts was also obtained. The inhibition was measured with respect to activity in the initial buffer solution, after corrections for colour in the soil extracts. Catalytic activity was inhibited in extracts of all of the top soils and two of the sub-soils. There was no correlation between the inhibition and soil organic carbon content, water-extractable organic carbon, or the intensity of the colour of the extract. We attempted to remove the inhibitor by various chemical treatments (HCl to precipitate humic acids, trichloroacetic acid, to precipitate proteins, polyvinylpolypyrrolidone or casein to remove polyphenols. Casein was most effective in decreasing the inhibitory effect. The effect of each of the treatments on the kinetic parameters of the catalytic reaction at pH 6 were compared to the fluorescence spectra of each solution. Spectra differed between soils and the treatments modified both the intensity of the two peaks observed and to a lesser extent their position. Kinetic parameters (both Vmax and the ratio Vmax/Km) were significantly correlated to the intensity of one of the two peaks (excitation at about 350 nm and emission at about 420 nm) seen for all samples. These findings have important consequences for both the measurement of enzyme activities in soil and the prediction of the expression of catalytic activity *in situ*.

P233
Soil humic substances and microbial communities as functions of parent material, slope exposure and stand age in spruce forests

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Soil is the product of different forces exerting their gradual effects through time. The factors involved in determining the pedological outcome include bedrock type, topographic feature influencing local site microclimate, and different forest ages. This study was conducted to determine if these same factors are important in shaping soil chemical and microbial properties. Slope aspect, parent material and stand age attributes have been investigated in six spruce (Picea abies (L.) Karst.) forests located in the alpine range of Northern Italy. Soil samples from A horizons were collected for humic substances (HS) analyses. In the same sites soil clods were collected and Amplified Ribosomal DNA community Restriction Analysis (ARDRA) profiles and microbial biomass carbon and nitrogen content were obtained. Chemical data were analyzed by canonical discriminant analysis (CDA) while the ARDRA fingerprints were ordered in clusters using image analysis software. Geologic parent material and site slope aspect revealed significant effects on the examined variables whereas stand age resulted in minor influence on both soil properties and microbial community. In particular both soil and dissolved organic matter pHs, HS molecular size fractionation, dissolved organic carbon content and its phenolic components were among the most important variables in discriminating sites according to substrate and aspect. We concluded that the composition of the deeper humus layers (OH, A) was stable within a spruce forest cycle time while the geologic parent material, controlling site nutrient capital, and the aspect-dependent microclimate characteristics (features) play a major role in defining both soil and microbial community.

P234
On the possibility of a low-temperature LOI method to an assessment of soil organic matter

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Two frequently used methods of the soil organic matter (SOM) and the soil organic carbon (SOC) determination have been compared. The SOC determination was performed by the volumetric Walkley-Black method. The SOM value was determined by the loss-on-ignition (LOI) method, at three different temperatures and four time intervals. Both methods were applied to not too populated (n = 42), however heterogeneous enough set of soil samples. Ten grams of a soil sample was weighed into a porcelain crucible. After drying in air oven at 100 °C and re-weighing, the crucible was ignited in muffle furnace for 1 and/or 10 hours at 373 °C, for 8 h at 460 °C and for 6 h at 530 °C. LOI values were compared both mutually and with the Walkley-Black method. None from so provided LOI method show significantly positive increase of SOM content due to a thermal decomposition of soil carbonates ($CaCO_3$, $CaCO_3.MgCO_3$). Their content ranged from 1 to 38 % in the most of samples. The same held true for possible influence of interstitially present water due to presence of higher clay content in some samples. Clay content varied from 9 to 51 %. There was a very close correlation among LOI values at any three temperatures (R^2 = 0.975-0.997), but their relation to SOC value (Walkley-Black method) was looser than it was expected (R^2 = 0.827). The LOI value attained during one-hour ignition gave similar, only by 16 % lower (however significant) results, comparing to ten-hour ignition (R^2 = 0,940). On the basis of a regression equation between one-hour LOI at 373 °C and SOC, determined by Walkley-Black method it seems that this economically advantageous ignition procedure would serve after a verification on a large, representative soil set, at least, as a screening method for the soil organic matter assessment.

P235
Changes of content of soil organic matter of chernozems in Middle Moravia region

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In this work, there are presented changes of content of soil organic matter in chernozems stated following the set of results of Systematic Soil Survey (1961-1970) soil analyses and contemporary soil analyses (2004 - 2005). Both of the compared sets of the soil samples were taken away from the same localities. The chernozems are the most quality soil type in the Czech republic. This soil type occurs approximately on 12% of the Czech republic area.
The soil samples for the analyses and consequent statistical evaluation were taken away in the Middle Moravia (districts Uherske Hradiste, Zlin, Prerov, Prostejov, Kromeriz, Vyskov). The soil type chernozem (only in the Middle Moravia region) appeared suitable for statistical evaluation regardless the soil subtype. The analysis of one character was determined for the set of analyses results in topsoil (0 - 30 cm) and subsoil (30 - 60 cm). The comparison between average content of organic matter in Systematic Soil Survey and nowadays was made by the t-test (N=27).
Content of soil organic matter stated in Systematic Soil Survey is in topsoil 2.70 ± 0.34 % and in subsoil 2.05 ± 0.56 %. Recent content of soil organic matter in topsoil is 2.67 ± 0.48 % and in subsoil 2.00 ± 0.51 %. There is no significant difference in content of soil organic matter in topsoil. However there is significant difference in content of soil organic matter in subsoil. Observed differences in soil organic matter content in topsoil and subsoil, whose level is distinctly decreased, are caused by cultivation, not complying the crop rotation and by erosion presumably.

P236
Evaluation of 1H NMR relaxometry for the assessment of SOM swelling in soil samples

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Changes of soil moisture affect transport, sorption and desorption of nutrients and organic contaminants. Changes of the physico-chemical properties of soil organic matter (SOM) due to swelling are most probably responsible for these effects. Conventional methods are hardly useful to study the swelling of SOM, because only physically measurable changes of soils can be detected. Proton nuclear magnetic resonance (1H NMR) relaxometry can give information about mobility and distribution of water and about pore size distributions in porous materials. It is a fast and nondestructive method to study changes of porous materials due to interactions with water. For successful interpretation of NMR data in terms of SOM swelling, the impact of soil solution and internal field gradients on the proton relaxation are essential.
In this study, the impact of the aqueous phase on the NMR signal was examined using soil solutions and model solutions with dissolved organic and paramagnetic compounds. Effects of internal field gradients on transverse relaxation times (T2) were studied by increasing the echo times in the CPMG pulse sequence.
Dissolved Fe(III) and Mn(II) affected the NMR signal in all soil solutions. The impact of both ions on the proton relaxation is affected by the presence of organic compounds and by ion speciation and can be estimated from the amount of dissolved Fe and Mn. Internal field gradients considerably accelerated the proton relaxation in the soil samples. The acceleration was stronger for smaller than for larger T2 and the contributions to the total proton relaxation can be separately estimated. As a result, changes of NMR data in the course of soil water contact due to swelling can be distinguished from additional effects. This enables the study of SOM swelling kinetics and swelling-induced effects on soil pore size distribution using 1H NMR relaxometry.

P237
Does the Rothamsted Carbon Model (RothC 26.3) properly predict soil carbon turnover and storage in arable soils under Pannonian climate conditions?

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Despite the actual knowledge of soil C dynamics, very few long-term data concerning soil organic C dynamics are available for calibrating and evaluating C models. The long-term ^{14}C turnover field experiment, established in 1967 in Fuchsenbigl, Lower Austria, offers the unique possibility to follow the fate of labeled C under different crop management systems (bare fallow, spring wheat, crop rotation) over a period of more than 35 years. In this work the Roth-C-26.3-model was calibrated for the Pannonian climatic region based on the field experiment results. Decomposition rates were modified regarding the possible climatic influence on carbon sequestration in soil C pools. The modeled output based on the calibrated model fitted better to measured values than data obtained with the original Roth-C-26.3-model parameters. The main change was in the decomposition rate for HUM (humified) soil C pool which is now ~ 0.009 y^{-1} (0.0095 to 0.01) instead of 0.02 y^{-1} as it was determined in original Rothamsted field trial. This resulted in higher soil organic matter accumulation in HUM pool because of the longer half-life of ~105 years (100 to 111) instead of 50 years.

P238
Estimation of the lignin content in plants and soils - literature review and experimental approaches

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Lignin is an important component of the plant organic carbon inputs to soil, since it represents the second most abundant natural polymeric material. Also, lignin has properties that

suggest a slower decomposition than other plant compounds in soil. Soil lignin is often quantified by cupric oxide oxidation (CuO) under alkaline conditions. This method is particularly useful in turnover studies, because it is possible to measure the isotopic signature of the lignin monomers that are separated with this method. However, this method is considered as strictly qualitative by many workers dealing with plants. In this study we tried (i) to estimate the quantification potential of this method, through a review of lignin quantification in plants and (ii) to determine the recovery potential of the CuO method by an experimental approach.
We compared data from 14 publications, where lignin is quantified simultaneously by the Acid Detergent Lignin method (ADL) and another method in biomass (legumes, grasses, hard- and softwood). Klason lignin (Klason) and Acetyl Bromide Soluble Lignin (ABSL) quantified an average of 2.7 and 2.9 times more lignin than ADL. Conversely, CuO recovered an average of 20 % of the ADL value.
In a second step, we designed an experimental approach to estimate the quantification potential of the CuO method in soil. Three substrates (commercial lignin, wheat straw and chestnut wood) were added at increasing rates (from 0 to 75 % Csubstrate/Csoil) in a soil. The lignin in the mixtures was analysed using CuO and ABSL methods. First results show that the recovery of the added lignin quantity by the CuO method is not complete and that the type of the added substrate affects the proportion that is actually recovered. This study will provide insight into the potential of CuO extraction for quantification of lignin in soil.

P239
Soil Organic Carbon Fractions and Aggregate Stability in Carbonated and No Carbonated Soils in Tunisia

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Abstract
In Tunisia, soils that support agricultural activities, was carbonated and no carbonated horizons. There are few studies concerning organic matter effect on aggregate stability in these sub soil horizons. This research aimed to study the relationship between different organic matter fractions and aggregate stability in carbonated and no carbonated soils in Tunisia. Samples were taken from A or Ap horizon at twelve carbonated and ten no carbonated soils. Aggregate stability was tested by Le Bissonnais method. Total soil organic carbon (SOC), particulate organic carbon (POC), hot-water-extract-polysaccharides (HWEP) and humic compounds (HC: humic acids (HA) and fulvic acids (FA)) were analysed.
Both carbonated and no carbonated horizons showed high SOC and POC contents, notably under forest. While, HWEP and HC (HA and FA) contents were greater in no carbonated soils. Across all horizons, positive correlation was found between SOC and POC. Soil stability test showed that horizons were affected by fast wetting rather than mechanical breakdowns (MWD_{FW} < MWD_{MB}). The most stable horizon was a carbonated soil with important SOC content. However, there was a significant and positive relationship between SOC, POC and HC and aggregate stability only in no carbonated topsoil. Consequently, relationship between organic matter fractions and aggregate stability changes when soil properties vary. Accordingly, the present work may be useful to suggest practices that improve soil aggregate stability and organic matter sequestration to help retard soil loss and degradation.
Keyword: Organic carbon, particulate organic carbon, polysaccharides, humic compounds, aggregate stability, calcium carbonate.

P240
Effects of soil organic matter conformation on the formation and release of bound residues of xenobiotics

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Supposed that the structural conformation of soil organic matter (SOM) by cations at the exchange sites affects sorption and desorption kinetics of xenobiotics and thus influences the formation of bound residues. Also the addititon of substrates can enhance biodegradation of bound residues, either through co-metabolism or through enhanced degradation of the sorbent. Based on these hypotheses our study is aimed at determination of the effects of SOM structural conformation on the bioaccessibility and biodegradation of the two ^{14}C-labelled model compounds nonylphenol and phenanthrene.
For experiments will be used cleyless soils with high organic content. The structural modification of SOM will be altered by removing or adding specific cations from/to the SOM matrix. Strongly hydrated monovalent cations (i.e. Na^{+}) cause SOM to expand and thus make it more accessible to xenobiotics. Polyvalent cations (i.e. Ca^{2+} or Al^{3+}) reduce the volume and flexibility of SOM through cation bridging, which can thus limit diffusion of xenobiotics into the matrix and back out again.
The sterilized samples will then be used to perform short-term sorption studies and a long-term aging experiment with the ^{14}C-labelled nonylphenol and phenanthrene. The main focus of the sorption studies will be on kinetics, since the changes in SOM conformation are expected to mainly affect the rapid and slow sorption-desorption and the accessibility of the sorption sites. For the long-term aging experiment sterile soil samples with ^{14}C-labelled compounds will be stored in sealed containers at room temperature. After 0, 3, 6 and 12 months of aging the DSC and ^{1}H-NMR analysis of SOM conformation will curried out. Also the $^{14}CO_2$ evolution from re-inoculated samples will be analyzed to assess biodegradability of nonylphenol and phenanthrene. In addition the incubation of aged soil samples with substrates (i.e. glucose, alanine, catechol) will be carried out to determine priming effects on xenobiotic mineralization.

P241
Composition and distribution of physical organic matter fractions in steppe soil profiles (Calcic Chernozems) as influenced by grazing intensity

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The effects of different grazing intensities on the amount, composition and distribution of functional soil organic matter (SOM) pools were analysed in semiarid sandy steppe soils (Calcic Chernozems) on four plots with different grazing treatments (continuously grazed, winter grazing, short-term ungrazed since 1999, long-term ungrazed since 1979) in Inner Mongolia, China. Three soil depths within the A horizon were sampled in three representative soil profiles at each plot. Bulk soil material was sieved to three different aggregate size classes (6.3-2.0 mm, 2.0-0.63 mm, and <0.63 mm). Particle size and density fractionation was applied to separate particulate (POM) from mineral associated organic matter. Elemental concentrations (C, N) and 13C CPMAS-NMR spectroscopy were used for the quantitative and qualitative characterisation of soil fractions.
Highest SOM amounts were located in the upper soil layer, especially in coarse and medium-sized aggregates. Both aggregate size classes showed highest SOM amounts in the long-term ungrazed plot. With increasing soil depth, total SOM amounts decreased and differences in SOM amounts between aggregate size classes and grazing intensities disappeared. Grazing-induced differences in SOM amounts in upper soil layers were caused predominately by differences in POM amounts, contributing up to 70% to the total SOM content in

coarse- and medium-sized aggregates. In deeper soil layers and with decreasing aggregate size, an increasing contribution of SOM was associated with clay-sized particles, resulting in 50 to 60% of total SOM. Chemical composition of POM fractions (C/N ratios, alkyl/O-alkyl C ratios) showed a clearly higher degree of decomposition with decreasing aggregate size class and a slightly lower degree of decomposition in deeper soil layers, but no significant trend between different grazing intensities. Conclusively, intensive grazing leads to a reduction of SOM due to lower POM amounts in upper soil layers, but the chemical composition of these fractions remains unchanged.

P242
Soil carbon dynamics in a 200-years forest chronosequence

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Accurate estimates of forest soil organic matter (OM) are now crucial to predictions of global C cycling. This work addresses soil C stocks and dynamics throughout a managed beechwood chronosequence (up to 197 years old, Normandy, France). Throughout this rotation, we investigated the variation patterns of (i) C stocks in soil and humic epipedon, (ii) macro-morphological characteristics of humic epipedon, and (iii) mass, C content and C-to-N ratio in physical fractions of humic epipedon. The fractions isolated were large debris (>2000 mm), coarse particular OM (cPOM, 200-2000 mm), fine particular OM (fPOM, 50-200 mm) and the mineral associated OM (MaOM, <50 mm). Our results showed that soil C stocks remained unchanged between silvicultural phases, indicating a weak impact of this even-aged forest rotation on soil C sequestration. While humic epipedon mass and depth only slightly varied with beech development, C stocks in the hologanic layers were modified and the use of physical fractionation allowed us to discuss different aspect of quantitative and qualitative changes that occurred throughout the silvicultural rotation. Hence, changes in humic epipedon composition may be attributed to the modification of beech life-history traits with its maturation (growth vs. reproduction). Our results also showed that C-POM can reach very high values (68%) in organo-mineral layers of older managed forest. Furthermore, C-MaOM did not significantly change revealing the resistance of humified fractions of humic epipedon to logging and regeneration practices. C-to-N ratio results indicated that N was probably not a limiting factor to litter degradation and explained our findings that OM did not accumulate in O horizons. This work confirms that forest harvesting and regeneration practices may have few effects on soil and humic epipedon C stocks, and that short and long-term effects can be complex and may imply mechanisms with opposite effects.

P243
Interactions of colloidal silver with soil and dissolved organic matter

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Among noble-metal nanomaterials, silver nanoparticles have received considerable attention due to their attractive physicochemical properties. In addition, the strong toxicity that silver exhibits in various chemical forms to a wide range of microorganisms is very well known, and silver nanoparticles have recently been shown to be a promising antimicrobial material. The use of colloidal silver in medicine is well documented but not undisputed, especially in the field of alternative medicine. Because of their widespread use silver nanoparticles will find a way into the environment and therefore into soil. Little is known of the behaviour of such nanoparticles in the environment, especially in soil. Although colloidal silver is expected to reach the soil, it's ecological, chemical and toxicological effects are largely unknown.This study aims to investigate the interactions between the soil matrix, DOM and colloidal silver (particle size 1- 100 nm) and to explore the range of colloidal stability, the potential carrier function for organic and inorganic contaminants as well as the immobilisation potential in soil. We will present first results on the interactions DOM-colloidal silver and organic soil contaminants.

P244
Antioxidant capacity of soils as related to the chemical composition of their organic matter and net N mineralization rates

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Recently it was shown that soils contain plant-derived and newly synthesized antioxidants. These were hypothesized to slow down biodegradation of soil organic matter (SOM). However, possible influences of antioxidants on N mineralization are largely unknown. Therefore, research was undertaken to determine the activity of soil antioxidants, relate it to net N mineralization and explain these parameters by the chemical composition of SOM at a molecular level. Nine sandy arable soils from Northern Germany (Podzols, Gleysol, Cambisol) covering a wide range of SOM contents (ca. 2 to 9 %) and C:N ratios (12 to 35) were studied. The Trolox Equivalent Antioxidant Capacity (TEAC) was determined in two different NaOH-extracts. The net N mineralization rate of a slowly mineralizable organic N pool was quantified in long-term laboratory incubations. The chemical composition of SOM was determined using pyrolysis-field ionization mass spectrometry (Py-FIMS). The TEAC ranged from 1.6/2.8 to 4.1/5.4 µmol (g soil)-1, depending on the extraction. The TEAC was positively correlated with the concentration of organic C, suggesting that a high TEAC results in SOM accumulation. However, N mineralization rates were not closely correlated with TEAC, which could originate from the relatively strong extractant for TEAC. Multivariate statistics of Py-FIMS data revealed significant differences in SOM quality between all soils. More than 50 m/z-signals discriminated the soils, many of which could be assigned to indicator signals of N containing compounds. The TEAC in both extracts was significantly positively correlated with total ion intensity from Py-FIMS ($P < 0.05$) and with the absolute counts of 68 m/z-signals ($P < 0.01$). Some of these m/z indicate SOM accumulation whereas others may have antioxidative potential. Interestingly, net N mineralization rates per total N were negatively correlated with indicators for sterols ($P < 0.01$) which are known as antioxidants in food.

P245
Dynamics of the evolution of carbon in the soil and of co2 emissions, under two cropping systems

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Organic matter is a dynamic component of the soil, which undergoes a continuous transformation process. The OM variations in a certain type of soil depend on: climate, vegetation, use, and management practices. Harvesting causes the removal of OM supplies, and the effects of tillage accelerate mineralization. Erosion processes, which take away the most fertile layer of the soil, contribute to these losses.

A study has been carried out on the dynamics of soil carbon and of atmospheric CO2 emissions in a dryland rotation of wheat-sunflower-legumes under two management systems, traditional tillage and direct drilling.
For this purpose, monthly soil samplings have been made, determining their content in organic carbon, active carbon, particulate organic carbon (C-POM), humic and fulvic acids. Together with these soil samples, CO2 emission readings have been taken.
POM is a labile OM which is protected while the soil aggregates are intact, but, as soon as they are altered, as in tillage or when there are erosion agents in bare soils, the POM becomes accessible to microorganisms and is rapidly mineralized. The variation in the carbon content associated with soil particle size is considered as being one of the best indicators for the supply of information on the degree of degradation or of improvement in quality of the soil.
In the first results obtained, it was observed that C-POM had significantly higher values in soils under direct drilling than in tilled ones. This indicates an improvement in the structure and quality of the soil with respect to erosion agents.
It was observed that the gas fluxes were generally slightly smaller in non tilled soils compared to those managed traditionally.

P246
Long- term land use and landscape effects on aggregate stability and carbon fractionation

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Increasing tillage intensity enhances the turnover of soil organic matter and decreases C and N sequestration in agricultural soils. This study was carried out to investigate soil aggregation and C concentration under different management practices. Soil sampling unites were defined on the basis of land use (Cultivated and Pasture) and slope. Soil samples were taken from 0-5 cm depth on two lands adjacent to each other on the same slope at the end of 50 years of treatment imposition in Chaharmahal & Bakhtiariy province, Iran. The soil was silty clay in both summit and footslope and a silty clay loam in backslope in cultivated soil only. Wet sieve analysis and gravity fractionation techniques were used to separate samples in aggregate and particle size groups respectively. Land use treatments significantly influenced the water stable aggregate fractionation and C concentration within aggregates, so that, the higher water stable aggregates were found for the macro-aggregates (2-4.75 mm) in pasture and for the meso-aggregates (0.25-2 mm) in cultivated soils respectively. The C/N ratio in clay is significantly lower than in silt and sand fractions. The C and N concentration within aggregates and particle size fractions were higher in pasture than in cultivated soils.The percent of macro-aggregates(2-4.75 mm) in pasture were found 71.47% at the footslope, 65.07% at the summit and 54.3.7% at the backslope, compared to cultivated soils with 30.15% at the footslope, 25.62% at the summit and 12.05% at the backslope respectively. The C concentration within the macroaggregates in pasture were found 2.26%, 2.18%, 2.07% at the footslope, summit and backslope positions compared to cultivated soils with 1.42%, 1.25% and 1.11% at the footslope, summit and backslope positions respectively. The C/N ratio was higher in pasture soils than in cultivated soils.

P247
Contribution of microbial biomass carbon to the formation of soil organic matter

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Soil organic matter (SOM) is the largest terrestrial C pool. Understanding its transformation and stabilization will therefore substantially increase our knowledge about the global C cycle and its control. As the direct precursors of SOM determine its chemical composition and its reactivity, it is important to identify these precursors. In general, plant residues are regarded as the main source of C for SOM, but microbial biomass may be an alternative source. We therefore investigated the fate of microbial biomass C in soil and its contribution to the formation of non-living SOM. We incubated ^{13}C-labeled *Escherichia coli* cells in an agricultural soil and traced the fate of the isotope label in the bulk C as well as in fatty acids and amino acids. After 224 days of incubation only about 50% of the added bulk ^{13}C was mineralized. The rest remained in the soil and could be detected in the biomolecules. Fatty acids and microbial amino acids were degraded to about 10-25% of the initial values, but total amino acids remained constant (< 5% degradation). Both fatty acid and amino acid analyses showed that some labeled C remained in the microbial food web, although we could not detect any living *E. coli* cells after 100 days. The chemical analyses showed that a part of the labeled fatty acids and amino acids was found in the non-living fraction. This proves that microbial biomass components are stabilized in non-living SOM. We therefore conclude that microbial biomass is an important source for non-living SOM and thus an important pool in the terrestrial C cycle.

P248
Does animal manure fertilization enhance DOM-leaching and co-transport of veterinary antibiotics? A risk assessment for Luxembourg

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Manure amendments on arable fields provide substantial amounts of highly mobile Dissolved Organic Matter (DOM) to agricultural soil systems. Manure also contains variable concentrations of antibiotics that are administered for prevention or medication of diseases in pig breeding. Recent investigation showed that manure derived DOM has the potential to facilitate the leaching of antibiotics in soils. In order to be able to assess the risk of antibiotic leaching to ground water of highly vulnerable aquifers at landscape level, the following topics need to be elucidated:
• The amount of DOM amended to field plots plus the subsequent release potential of DOM from manure solid phase. Does it vary according to breeding practices and pig population composition?
• The composition of the DOM. The molecular weight distribution, the aromaticity and the refractory character of DOM govern its leaching potential.
• The association between antibiotics and DOM in different molecular weight fractions. Does DOM structure influence K_{DOC} of antibiotics and are these comparable to solid phase K_{OC}?
Here, we report an investigation on carbon and antibiotics mass balances in different breeding stages of two pig farms where DOM, the solid phase of manure and the DOM release potential of the latter were characterized. Solid and dissolved organic carbon were investigated with chemical and spectroscopic analyses in the bulk phase and for molecular size fractions of DOM. Antibiotics were quantified for each of the above mentioned fractions. A considerable proportion of antibiotics and rather labile DOM were detected in the size fraction < 1000 Da. This has strong implications on the dynamics of DOM and concomitant antibiotic leaching and the simulation with current model approaches in agricultural soil systems. A first mass-balance will be presented for the Luxembourg Sandstone aquifer based on measurement data, agricultural statistics and a medication use poll among farmers.

P249

Role of humic and fulvic acids toward the mobility of PTE (Pb, As, Zn) from mining contaminated soils

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The soil organic matter (SOM) constitutes a heterogeneous fraction of organic compounds playing an important role in the fate and transport of potential toxic elements (PTE) in terrestrial systems. The heterogeneity of these organic matter pools induces large differences in the dynamics of PTE in soil. The dissolved organic matter (DOM) which is a mixture of heterogeneous and complex organic molecules, is the most mobile fraction among SOM, and can be operationally fractionated into non-humic and humic substances (i.e. fulvic and humic acids). Thus the presence of soluble organic matter (as fulvic acid) can be the origin of the solubilization of PTE, to further their mobility, whereas the non-soluble organic matter (as humic acid) contributes to trap the PTE in soil.
The objective of this study is to characterize the role of humic substance toward the PTE mobility in contaminated soils by mining or metallurgical activities. Three pedons were selected for this study: (i) two soils developed from anthropogenic mine deposit with high contents of As and Pb (~ 1%), and (ii) one soil situated in the vicinity of industrial site and contaminated by Pb- and Zn-rich (~ 0.1%) atmospheric emissions.
Humic and fulvic acids were extracted according to the standard method recommended by the International Humic Substances Society (IHSS). The evaluation of the distribution of PTE and C_{org} between non-humic and humic substances was realized. Moreover, elemental composition (C, H, O), and spectroscopic investigations (UV-visible, FTIR and NMR) were also used in the way to characterize the structural and functional properties of these organic fractions.

P250

Mineralization of microbial carbon and nitrogen in soils

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In order to further understand the fate of organic nitrogen in soils we must consider microbial structural nitrogen. Microorganisms contain a diverse range of organic N-containing structural components, including D-amino acids such as D-alanine and D-glutamic acid. Most amino acids occur in D- and L- enantiomers, which are non-superimposable mirror images of each other, and most naturally occurring amino acids are L-isomers. The D-forms are found in bacterial cell walls as components of bacterial peptidoglycan. More complex microbial structural compounds include N-acetylglucosamine, which is the structural unit of fungal chitin and is also found in bacterial peptidoglycan. Much of the N mineralized in soil passes through these compounds. In order to understand better the mineralization of N, it is necessary to consider also the mineralization of C that accompanies decomposition of these compounds.
The C mineralization of microbial structural compounds was investigated in soils with contrasting texture and land management. The objective was to compare mineralization rate of microbial and non-microbial structural compounds. This showed that the pattern of mineralization is different with D- and L- amino acids, with L- amino acids initially mineralized at a faster rate. This led to further work using 13C-labelled D- and L-alanine to identify any differences in the mechanisms involved using nuclear magnetic resonance and mass spectroscopy. Liquid-state NMR analysis of soil extracts did not identify different pathways for the mechanism of mineralization of D- and L-amino acids. Mass spectroscopy showed that the C respired as CO2 came directly from the substrates added.
These results lead to further work to establish the mechanism of mineralization of these compounds in soil, including: solid-state NMR on 13C-labelled amino acids in soil; 15N NMR; assaying of enzyme activities following the addition of microbial-N compounds; examining the effects of the addition of fertiliser nitrogen on mineralization rates.

P251

Ectomycorrhizal roots and litter decomposition as part of the forest soil carbon pool

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The importance of fine roots and ectomycorrhiza for the sequestration of carbon in the soil and their function as carbon storage pools is mainly based on estimates. From results on diversity of ectomycorrhizal types studied in a closed canopy and in a forest gap (clearcut) in a mixed silver fir - beech forest stand from the Ko[[Unable to Display Character: č]]evsko region, and data on quantity of fine roots in selected forest ecosystems focusing on beech dominated forests we calculated their contribution to the overall carbon storage and established putative correlation of the speed of decomposition and selected environmental factors and ectomycorrhizae. Focusing on decomposition of beech roots and litter, a simple modelling approach was applied to calculate long term decomposition dynamics. The obtained decomposition rates will be multiplied with litter input to get the estimate values for decomposition rates, at different beech forest sites and management practices. The higher decomposition in most analysed young and regeneration plots in our study could be attributed to different conditions in young stands compared to old stands. The variability of fine roots at different plots vary severely so the expected contribution of fine roots to the soil carbon is expected to be variable and site, tree partner and local condition specific. The role of fine roots and common mycorrhizal / mycelial networks in forest soils will be discussed in scope of carbon, water and nutrient cycling in time and space in forest ecosystems.Acknowledgements: The study was part of the research programme Forest Biology, Ecology & Technology, financed by the Ministry for science, higher education and technology RS.

P252

Effect of organic substrates based on sugarcane phlegm and composted coffee pulp over the coffee vegetative growth initial phase

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With the purpose of evaluating the effect of organic substrates on the initial phases of the vegetative growth of the varieties Catuaí and Caturra, an investigation was carried out in a coffee area of the Lara state, Venezuela. Treatments consisted on 12 substrates conformed by four volumetric proportions (25, 50, 75 and 100%), composed by soil of the area, coffee pulp compost (CP) and sugarcane phlegm (SP) alones or in cocktails. The use of 25% CP and 75% SP presented the most stable behavior and the higher value of total porosity (TP) at the end of the trial. Likewise, alone CP presented the best stability of aeration porosity and the lower initial value of bulk density (0.35 Mg m^{-3}), condition that was inverted at the end, situation that was improved by the mixture with 25% SP. In general, all substrates increased the capacity of water retention and tendency to diminish the TP at the end of the evaluations. The treatments where the biggest proportions of CP were used in mixture with soil, showed the best values of electric conductivity, pH, cationic exchange capacity and organic matter, offering an appropriate balance between water readiness and aeration. With respect to the vegetative variables, in a general way, starting from the 102 ddt until the end, Catuaí showed the best development in relation to the height, diameter of the shaft, number of pairs of leaves, foliar area, length of the roots and dry biomass. The foliar level followed an accumulation of N> K> P, additionally the biggest contents in N and the promotion of the vegetative development are associated with the biggest tenor of this element in the substrates. The application of CP and SP, alones or as cocktails, increased the foliar content of P and K.

P253

Arable (C_3) to *Miscanthus* grassland (C_4); derivation of carbon within soil fractions

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Land-use by C_4 plants alters the composition and turnover of soil organic matter (SOM). These alterations to SOM dynamics can be traced using mass spectrometry (MS) due to the higher natural abundance of ^{13}C in C_4 plant material. This study focuses on the conversion of arable land (C_3) to *Miscanthus x giganteus* (C_4), a biomass crop.
Soil cores were taken from three replicate plots of nine-year old *Miscanthus* stand at two depths; 0-23 (topsoil) and 23-50cm (subsoil). A control nearby wheat field was also sampled. Soils were homogenised for each depth and the SOM physically divided by density separation (“fractionation”) to isolate the free, between aggregate (FLF) and intra-aggregate (IALF) light fractions.
For each depth three replicates were analysed using MS to measure differences in ^{13}C abundance ($\delta^{13}C$) and the amount of carbon (kg/tonne soil). Statistical analyses across depths and fractions were performed using residual mean likelihood (REML).
Miscanthus soils at both depths were significantly different in $\delta^{13}C$ ($P<0.001$) from corresponding control wheat soil depths. Under both land-uses the topsoil had more carbon (kg/tonne) than subsoil. Compared to the wheat fractions, *Miscanthus* topsoil FLF had 6% more carbon whilst IALF had 75% more. In contrast, overall light fraction subsoil carbon under *Miscanthus* decreased significantly ($P<0.001$).
The *Miscanthus* topsoil is most affected by the large organic matter input of root/shoot material. This, together with SOM formerly being “mixed” through tillage mean the most rapid incorporation of C_4-material can be expected within the topsoil. Between topsoil fractions the FLF (mainly plant debris) derived more C_4-material than IALF (microbial metabolites).
The data forms part of a timeline from planting to the present in which SOM composition and turnover can be studied. The further applications of this work involve the bacteria associated with the SOM and their location within the soil.

P254

Quantification and characterisation of charred materials in two recently burned pine forest soils in Tuscany, Central Italy

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Pine forests are common in the Mediterranean basin. Wildfires are both a threat and a main factor for their survival. In fact they can destroy entire forests but they also promote pine renovation by allowing the opening of the cones and by enhancing seed germination. The release of charred materials to soil during wildfires is a relevant stabilization process for soil organic matter in Mediterranean soils, but only when the land use do not change and the vegetation recovers the pre-fire status. In addition, not all of the charcoal released to the soil represents a lasting net increment of stable C. Actually, a not negligible fraction of charcoal is preferentially eroded or undergoes to biotic and abiotic degradation processes that are still relatively unknown. Even though fire-prone coastal pine forests of Italy are carefully preserved, the effects of wildfires on soil organic matter have been rarely examined in these biomes. We studied two recently burned forests of *Pinus pinaster* Ait. and *Pinus pinea* L. of Tuscany, Central Italy, both growing on sandy soils developed on marine deposits. The two forests have different fire histories, the first one being burned several times in the last 30 years while the second was never burned in that period. The comparison of paired burned and unburned plots in both sites allowed assessing the effects of fire on the quantity and quality of soil organic matter by dry and wet oxidation and solid state ^{13}C NMR spectroscopy.

P255

The dynamic of organic matter in hortic antrosols conditioned with polymeric materials

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The studies regarding the dynamic of organic matter in hortic antrosols are important both from scientific point of view and for the implementation of durable ecological technologies of amelioration, conservation and superior capitalization of soil resources from protected areas. In case of hortic antrosols, the application of intensive technologies for plants cultivation determined intense perturbations of equilibriums between organic and mineral components of antrosols, which is reflected by a fast degradation of morphological and physic-chemical properties.
The experimental modelling of interaction between some organic materials with mineral components of hortic antrosoils conditioned with different polymeric materials, supplemented with the field studies realized in glasshouses from Ia[[Unable to Display Character: ş]]i and Bac[[Unable to Display Character: ă]]u cities (Romania), have evidenced a particular evolution of organic matter, and of distribution and interaction way with mineral components of antrosols. In comparison with non-perturbed hortic antrosols, in those conditioned with polymeric materials the organic matter decomposition is restricted, the processes rate is lower and the diversity of the compounds formed by decomposition is reduced. The physic-chemical conditions from hortic antrosols, in presence of polymeric materials, restrict the organic matter decomposition until simple compounds, which favourite the mineralization and retention in soil of carbon and nitrogen. In case of non-perturbed hortic antrosol the formation of compact and impermeable horizon, responsible in most part by the degradation of hortic antrosols, assert sever segregation in organic matter evolution. In most of cases, the organic compounds situated above of this horizon are develop in oxide conditions, while the compounds situated bellow of this horizon are develop in anoxidic conditions. In case of hortic antrosoils conditioned with polymeric materials the formation rate and the extension of this horizon are significant limited.
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P256

The effect of intrinsic soil properties on satiability and instability indices of aggregates

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Intrinsic soil properties are expected to case change in soil stability and aggregation. The objective of this study was to evaluate the clay (C), organic matter (OM), lime ($CaCO_3$), sand

(S), silt (Si) and electrical conductivity (EC) on stability indices of aggregate using 33 series of soils collected from west Of Iran. The aggregate stability of mean weight diameter (MWD), geometric mean diameter (GMD) and relative slaking index (RSI) were determined by Yoder method and the index of De Boot- Deleenheer (DDI) was used to asses the instability of aggregate. Measurements were made on the aggregates < 8 mm in diameter. The highest correlation was found between DDI and intrinsic soil properties. Among the intrinsic properties, the OM played the highest role in aggregate stability.

P257
Organic matter stabilisation as affected by land use

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Changes in land use and management affect soil organic matter (OM) dynamics and may turn the soil from a sink into a source of CO_2. We studied the influence of different forest management on soil OM accumulation in result of incorporation into aggregates and by interaction with minerals.
Soils from sites converted to short rotation of poplar 40 years ago were compared with adjacent soils under 200 years old pristine deciduous forest relicts (UNESCO-Biosphere Reserve). Samples were collected by horizons from four profiles at each site and analysed for their chemical and physical characteristics. Soil OM fractions were separated by density using Na polytungstate at 1.6 g cm^{-3}, combined with ultrasonic dispersion. The procedure yields three fractions: free particulate OM (FPOM), occluded particulate OM (OPOM), mineral-associated OM (MOM). All the fractions were analysed for their C and N content.
The different management of the two sites affects the amount and distribution of OM. The C content (g C kg^{-1} soil) of the soil under pristine forest decreases strongly with depth while under poplar, all the horizons showed similar values. Consequently, the C stocks (g C m^{-2}) under poplar were considerably lower than under forest in the topsoil but comparable at the profile scale.
Under the pristine forest the OM was well distributed between the three fractions, with more FPOM in the uppermost horizons and more MOM in the deeper soil. In contrast, under poplar MOM was dominating in all horizons, which suggests rapid decomposition of poplar residues, leaving behind mineral associated material.
The change to poplar cultivation had little quantitative effect on the C stock but influenced the distribution within the soil profile and among fractions.

P258
Effect of burning and addition of municipal waste compost on carbon forms of a forest soil

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The objective of this study was to quantify the effect of fire in a *Pinus pinaster* burned area, and the addition of urban refuse compost for soil reclamation, on the different forms of soil organic C. A laboratory incubation experience was carried out on a burned soil and another adjacent not burned one, sampled at a 0-5cm depth, with three compost dose (1%, 2% and 4%) and controls. After 92 days of incubation a sequential extraction with cold water, hot water, 0.1 M pyrophosphate acidified to pH=7, 0.1 M pyrophosphate (pH10) and 0.1 M NaOH (2 successive steps for this) was performed. Finally the residue was resuspended and sieved at 50 µm to separate particulated organic matter from transformed organic matter in the clay + silt fraction. The absorbance at 280 nm was measured in the extracts.
The burned sample had lower extracted organic C than the unburned one in the fractions of cold water, hot water and NaOH, but higher in the pyrophosphate pH 7 and similar in the pyrophosphate pH 10 ones. In the burned sample the percentage ratio of residual not extractable organic C to total organic C was enhanced due to a higher decrease in the fresh organic matter by burning, but not the total amount of this pool.
The degree of aromaticity of the dissolved organic matter, as indicated by the specific absorbance at 280 nm was higher in the burned sample.The changes produced by the compost addition in the fractions studied was basically additive, increasing the C amounts in the different fractions and decreasing C/N ratio, but only with significant differences for the highest dose. This increase was more significant for the burned soil in almost all the extracted C pools.

P259
Large-scale validation of the Roth-C model for Japanese paddy soils

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Arable soils can either emit or sequester CO_2 due to its management. It is important to predict changes in soil organic carbon (SOC) using models with various managements as well as environmental conditions. National inventories of long-term changes in arable land SOC in Japan have recently been published. It includes the data on SOC dynamics in paddy soils from 1979 to 1997 at 9320 sites over Japan. In this study, we firstly examined the applicability of the improved RothC model (Rothamsted Carbon model) for paddy soils (Shirato and Yokozawa, 2005) based on the 432 long-term data. We compared the observed data with the model estimation in terms of time changes in SOC and summarized it as the root mean square errors (RMSE) and the relative errors (E, Smith et al. 1997) by 12 soil types and 8 regions over Japan. As a result, over all RMSE was about 19% and there were not remarkable biases referred to as E between regions. However, the model estimation overestimated for Andosols, Gray upland soils and Yellow soils. We also used the data to calibrate the RothC model parameters for the prediction of large-scale SOC changes with future climate and management changes.
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P260
A system approach to investigation of waterstable soil aggregates and comprising physical components thereof

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Integrated study of the role of organic substances in organization of soil aggregates waterstability has been carried out on a typical chernozem soil under virgin steppe land and under perennial black fallow.
Samples used are undisturbed and pulverized aggregates of different waterstability, granule-densimetric fractions obtained from bulk soils and all the above mentioned samples after treatment with hydrogen peroxide for removal of organic carbon.
Methods applied are measuring specific surface area by nitrogen and Methylene Blue dye adsorption, granulometric analysis by laser diffraction analyzer, elemental analysis (of C, H, N), humic

substance fractionation by hydrophobic interaction chromatography. Concurrenty methodic research on condition selection has been performed to obtain comparable measurements of granulometric composition and specific surface area for organic, organo-mineral and mineral fractions.
Comparative analysis of specific surface area measurments has been made for the two methods. Specific surface area of aggregates measured according to nitrogen sorption is found to be inversely dependent on total organic carbon content, aggregation and waterstability. We have described principle differences in humic substances composition of granule-densimetric fractions, their individual contribution into total organic carbon content and changes occuring in their granulometric distributions after removal of organic matter. Using a system approach all investigated parameters are applied in structure-functional modelling of waterstable soil aggregate, which components are present in form of granule-densimetric fractions markedly differing in their characteristics. In an entire aggregate, as in a complex system, these characteristics do not come to a straight sum of the characteristics of its comprising components. Aggregate waterstability, resulting from interaction of physically independent parts of the aggregate, is greatly dependent on carbon mineralization and specific changes of relative organic substances composition in its components.
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P261
Relationship between soil density and soil organic matter in first and second rotation areas with *Pinus taeda* L. in Rio Grande do Sul-Brazil

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Mineral and organic fractions are soil components that may, along the time, suffer changes, so that, some deficits or increases can happen in soil components. This study was conducted in two distinct areas, a first rotation (native grass) and a second rotation (clear cutting) area, where seven plots (48 m x 50 m) were allocated, three in the second rotation area and four in the first rotation area. The collections for soil density analysis were done through a trench opening, where samples were collect in two depths (0-20 cm and 20-40 cm For chemical analysis, samples were collected with a screw auger in the same depths for physical analysis. They were collected from 2000 to 2006, always annually. This way, the profiles were compared in each place, for bulk density and organic matter for whole evaluation period and a Pearson correlation was obtained as -0,997, since the first general average for both analyzed depths during 7 years of evaluation. In 0-20 cm depth in second rotation area the bulk density was 0,87 g cm^{-3} and the organic matter was 6,22%, while in the first rotation are, the bulk density was 0,98 g cm^{-3} and the organic matter was 5,43%. Although in 20-40 cm depth in second rotation area, the bulk density was 0,97g cm^{-3} and the organic matter 5,35%; in the first rotation area the bulk density was 1,14 g cm^{-3} and organic matter was 4,19%. In the second rotation area, due to residues decomposition from the first cycle, showed higher organic matter values and consequently lower bulk density values when compared to the first rotation area with pinus. So, along the forest cycles there is an increase in soils physical structures, not influencing in a negative way the formation of them.

P262
Litter mass loos and nutritional variation, during the deccomposition process, from *Eucalyptus urophylla* x *E. globulus maidenii* in Rio Grande do Sul - Brazil

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The study had as objective to evaluate the biomass loos release and nutrients release from the leaves fraction in litter from 6 years old *Eucalyptus urophylla x E. globulus maidenii,* in Eldorado do Sul/RS/Brazil. 12 grams of the evaluated litter was stored in litter bags (20 cm x 20 cm) which were installed upon the soil area, where they stayed for 7 months. After the collection, the material was cleaned, dried, weighed, milled and chemically for macro and micronutrients amounts. During the evaluated period, a biomass loss was observed as 29, 6%. The macronutrients concentration, respectively, for N, P, K, Ca, Mg and S, of 7,03, 0,35, 2,06, 7,25, 1,49 and 0,72 g kg^{-1} for fresh fallen leaves and 6,47, 0,27, 6,18, 10,33, 1,42, 0,37 g kg^{-1} for the concentration in the remanescent biomass. It was verified a decrease in N, P, Mg and S concentration and an increase in K and Ca. The micronutrients B, Cu, Fe, Mn and Zn showed 33,56, 2,64, 94,44, 561,75 and 12,94 mg kg^{-1} in fresh fallen biomass and 24,40, 5,47, 644,36, 1186,14 and 25,71 mg kg-1 in remaining biomass, respectively. The decrease in concentration, mainly N and B, can be explained by the consumption done by the decompositors microorganisms, in energy production for decomposition. The increase in K can be related to canopies wash. The Ca, as a less mobile element, probably will have its amounts decreased when the decomposition process will be older. The increase in Fe concentration can be related to sampling contaminations caused by soil particles.

P263
Soil organic matter under no-tillage and minimum tillage at the field scale in tropical humid climate

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Maintenance and improvement of soil organic matter (OM) content is generally accepted as being an important objective for sustainable agriculture. Soil OM is a critical component for maintaining soil quality and productivity of agricultural soils in the southeastern region of Brazil. Soil tillage can have major influences on OM content. The aim of this study was to compare the effect of minimum tillage (MT) and no-tillage (NT) on OM contents at the field scale. A field experiment was carried out in the experimental farm of the University of the State of São Paulo (UNESP), Faculdade de Ciências Agronômicas, at Botucatu campus, SP, Brazil. Latitude, 22° 49' 31" S, longitude, 48° 25' 37" W, altitude above sea level, 770 m and slope 3%. Climate was classified as Cwa according to Köppen. Differences between MT and NT were evaluated in two experimental units of 120 x 100 m, i. e. 1. 2 ha each field. During the last eight years before our experiment the two study fields were under NT. Sampling was performed seven months after the experiment was established. Soil samples were taken at 0-10 and 10-20 cm following a regular grid, so that 130 points per depth were monitored. Mean organic matter content at the 0-20 cm depth was 28.92 $mg.dm^{-3}$ under no MT and 30.27 $mg.dm^{-3}$ under NT. Therefore, OM content in the top 20 cm of soil under MT was 5 % lower compared to NT. Mean OM values were significantly different between tillage treatments ($P<0.05$). It is note worthing that these differences in OM content arose in a seven month period. The spatial structure of OM content under the two tillage treatments was also analyzed using geoestatistics.

P264
Soil organic matter under long-term cereals growing

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Long-term effect of different organic amendment and straw management in conjuction with different tillage systems on the

soil organic carbon content (SOC) under one-species culture of cereals were evaluated. The research was based on the soil samples assessment with sampling in long-term field experiments were are located in two growing conditions: in sugar-beet growing re[[Unsupported Character - Codename]]gion in Ivanovice na Hane (IH) and in maize growing region in Zabcice (ZB). Experi[[Unsupported Character - Codename]]mental treatments included organic amendment in IH locality - experiment is carried out since 1965 (variants: straw harvest - SH, straw incorporation - SI, straw harvest + green manuring - SHG, farmyard manure - FM) and straw management variants in conjuction with different tillage in ZB locality - experiment is carried out since 1970 (variants: straw harvest - SH, straw incorporation - SI, straw burning - SB; conventional tillage - CT and minimum tillage - MT). In Ivanovice na Hane value of SOC content documented the best value of SOC under SHG variant. SOC content under SI variant (only straw) is similar with variant of FM. The lowest value was detected under SH variant. In Zabcice value of SOC content was generally higher under variants with SI and SB than SH; the results from CT and CM variants, didn´t indicated single relation.
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P265
Chemical characterisation of soils using near-infrared reflectance spectroscopy

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The main objective of this work is to determine whether results from conventional chemical analyses of a range of soils can be correlated with near-infrared reflectance spectroscopy (NIRS) determinations. NIRS is a rapid, non-destructive, quantitative analytical technique which can relieve the constraints of time consuming chemical analysis. Despite twenty years of application in agriculture for the analysis of animal feed, few soil characterisation studies have made use of this technique. This study will test the accuracy of NIRS prediction of the following soil parameters: total carbon and nitrogen contents and the proportion of alkyl, O-alkyl, N-alkyl, aryl, phenolic and carboxyl carbon groups. A wide range of different archived soil samples previously characterised using CHN analysis and ^{13}C NMR spectroscopy as appropriate, will be used for NIRS calibration and production of regression equations.
Characterised soils (n ~ 100) were scanned from 700-2500 nm at 2 mm intervals using a FOSS NIRSystems 6500 spectrometer. Spectral reflectance data and reference values will then be used to create regression equations for the various soil parameters. Statistical software (Win ISI v1.5) will perform calculations using partial least squares regression analysis. Preliminary results for generated regression equations for the various chemical parameters will be presented.

P266
The soil organic matter content related to soil tillage, culture and field slope

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Humus is an extremely important constituent of soils and is so vital to the many hydrological, biological and chemical reactions required for sustaining plant life. The organic matter content of a typical Phaeozem, in a 4 year rotation: corn - soy bean - autumn wheat - rape, shows a very dynamic increase on plane field, tilt in a conventional system. The humus content of soil has a tendency to grow by applying the minimum tillage systems. This is first because of the bigger quantities of remaining vegetal material (minimum 30%), in different decomposition stages, at the soil surface and in the first 10-20 cm; secondly, because of the trimming in the mineralization / humification ratio, done in a specific physical, thermal and biological regime. By determining the humus content after 4 years, it can be observed an increasing tendency when applying the minimum tillage systems (the increase is up to 0.41%). The registered values were 3.11% in the plough variant and 3.12-3.52% in the minimum tillage variants. The field slope diminishes the intensity of accumulations, especially at slopes higher than 12%. The culture plant has its influence, through the quantities of vegetal remains in and on soil.

P267
The role of compost use in food security improvement and climate change mitigation: the case of small holder farmers in Ethiopia

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The aim of this study was to investigate the level of major nutrients in the soils of the study area and different compost types produced by farmers, the effect of compost on grain yield and also assess the potential of the compost for sequestering carbon in some moisture stress and degraded parts of Tigray (northern Ethiopia). To assess the nutrient status of the soils of the study area soil samples were taken from three locations, from a depth of 25 cm, Compost samples from farmers were analyzed for pH, EC, OM and NPK with four treatments (1. 0-variant, 2. compost with farmers' standard, 3. compost double of the farmers' standard, and 4. chemical fertilizer). The land holding of farmers, which are nearly half a hectare and the amount of compost prepared by farmers, which about 1 tone per farmer, are assessed. The compost prepared by farmers is composed of cattle manure, water, urine, chicken manure, straw, ash, grass, leaves, etc. It is prepared by the pit method.
The result of the soil analysis revealed that the soil fertility level is very low with NPK . This implies the soil requires an addition of more organic material to produce good crops and improve their fertility.
There is much scope for mitigating and adaptation climate change, and improve food security through using compost. Using compost with the farmers' standard and the double of the farmers' standard improved the soil organic matter content; improve water-holding capacity; increase yield without becoming dependent on external input, which reduce the vulnerability of farmers. Moreover, the potential organic carbon of the compost is as high as 13.29 percent, which is very high to sequestrate carbon to the poor soil by individual smallholder farmers (details will be on the main paper).

P268
Pyrogenic transformation of soil cover and dynamics of carbon pools in open forests of North-East Eurasia

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The studies carried out in larch open forests of the Kolyma River Lowland (Russia) showed that fires are among major factors influencing vegetation and soil successions. All loamy cryohydromorphic soils (Turbic, Turbi-Saprihistic, Gleyi-Turbic & Endogleyi-Turbi-Histic Cryosols; Gelic Gleysols) formed at watersheds on loess-icy complex sediments represent various stages of postpyrogenic development. The most mature ecosystem of the study site is old larch open forest (~ 200 years old). Postpyrogenic recovery of vegetation occurs through various non-stable ecosystems - highly productive dense larch forest (30-60 years old), larch open forest (60 years old), treeless areas (15-40 years old) and others. Intensity and strength of fires determine the type of plant succession, active-layer thickness, intensity of cryoturbations, development of gleyic processes and organic carbon (OC) stocks. “Expected” postpyrogenic reduction of OC density is most significant in organic horizons (from 3,9 to 0,5 kg C/m^2). However, in 60 years after the fire OC density reached its initial values in larch open forest and even exceeded initial values in highly productive ecosystem of dense larch forest (Δ=1,7 kg C/m^2) with thick moss cover stimulating active peat accumulation. Alteration of OC densities in mineral horizons is less evident. For the larch open forest ecosystem in 30 years after the fire the reduction was fixed (from 7,7 to 6,1 kg C/m^2), however in the next measuring point (60 years after the fire) intensive increase has been revealed (Δ=2,5 kg C/m^2). Such “unobvious” change was primarily induced by two factors: active-layer thickness and cryoturbations. According to our data in 30-60 year period after the fire the active-layer thickness decreases to its initial values, at this time cryoturbations reach the highest intensity. Cryoturbations in the presence of two conditions - close permafrost table and already formed thick organic cover, most intensively enrich mineral horizons with OC.

P269

Changes in dissolved organic carbon (DOC) in upland catchments in Scotland

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A large body of evidence has been gathered over the last two decades which reports an increase in Dissolved Organic Carbon (DOC) concentrations in UK upland waters [Worrell et al. 2003]. [Freeman et al. 2001] observed a 65% increase in DOC concentrations in freshwater draining upland catchments in the UK over a 12 year period (1988-2000).
This increase is not restricted to the UK. [Grunewald, et al 2003] reported increases in the foothills of Central Europe and [Skjelkvale, et al. 2000] in North-Eastern US.
Consequences of increased DOC

- Possible destabilisation of the carbon store via transfer of locked carbon from peat.
- In UK. 50% of terrestrial carbon is held in Scottish peat.
- A shift in the carbon store could contribute CO_2 to the atmosphere with implications for global warming and climate change
- DOC-rich brown waters require higher levels of chlorination.
- Water treatment problems for the water authorities.
- Chlorination produces potentially carcinogenic trihalomethanes.

Recent analysis by [Chapman, et al 2005] has identified a clear, inverse relationship between DOC and sulphate (SO_4^{2-}) such that doubling the SO_4^{2-}, concentration decreases DOC by a factor of 1.5. This could be explained by the decrease in pH associated with an increase in SO_4^{2-}. DOC is known to be more soluble at a higher pH.
The aim of this study is to determine whether DOC increases are related to reduced sulphur emissions which have lead to the recovery of acid soils.
Sulphate deposition has decreased over the last two decades in the UK with tight controls being set on SO_2 emissions from large combustion plant. With the associated increase in pH which is known to increase the dissociation of organic acids, what effect if any will this have on DOC concentrations in upland streams catchments?
This project has concentrated on two upland stream catchments in the Trossachs area of Scotland UK. Water and soil samples have been collected over the past two years and analysed for DOC and sulphate concentrations. Historic data from the past 20 years has also been used and an inverse relationship has been established at both study sites between reduced SO_4^{2-} concentrations and increased DOC concentrations.
This poster/presentation will concentrate on this background work and one laboratory experiment aimed at further testing the hypothesis that DOC increases are a result of the recovery of acidification in soils. The experiment has used 24 peat soil cores form the two study sites. The peat soil cores have been dosed over a period of 3 months with different levels of SO_4^{2-} . DOC concentration has been analysed weekly after dosing. The results will be presented here.

P270

Carbon sequestration by soil aggregates under different management practices

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Investigations on carbon sequestration in soil aggregates, in relation to the tillage system and the aggregate size were carried out on long term field experiment plots of the agricultural school of Pixendorf (lower Austria). The aim of our investigation was to determine the impact of the management practices on the distribution of the sequestrated carbon, according to the aggregate size. Treatments included non tillage plots (NT), reduced tillage plots (RT) and conventional tillage (CT). Three classes of aggregates were obtained after dispersion, using the ultrasonic device: 1000-630µm, 630-250µm and 250-63µm. The amount of carbon sequestrated on soil aggregates was determined in the laboratory, using a gas chromatograph with a pneumatically driven injection vent, equipped with a thermal conductivity detector (TCD).
In the NT plots, a comparison between aggregate classes from the same management practice showed that the carbon sequestrated in the aggregate class 1000-630µm was significantly higher than in the aggregate class 250- 63µm. There was no difference between aggregate classes 1000-630µm and 630-250µm.
In the RT plots the amount of carbon sequestrated was higher in the aggregate class 1000-630µm, followed by the aggregate class 630-250µm. The aggregate class 250-63µm had the lowest amount of carbon sequestrated, but these differences were not significant. The same trends were noticed in the CT plots.
Comparing aggregates from different management practices, the amount of carbon sequestrated in the NT plots were significantly higher than in the RT plots. CT plots had the lowest amount of carbon sequestrated in the aggregate classes 250-63µm and 630-250µm.

P271

Agricultural valorisation of de-inking paper sludge as component of substrates

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Paper pulp manufacturing separates cellulose fibres using both, mechanical and chemical process and generates important amount of waste materials. In recent years, an increasing proportion of recycled fibres are used in paper industries due to their important environmental and economical benefits. A ton of pulp produced from recycled paper requires 60% less energy to manufacture than a ton of bleached virgin kraft pulp [1]. However, paper recycling results in the production of large amounts of de-inking paper sludge composed by removed inks, clay fillers, coating of used paper, chemical additives and some cellulose fibres. In Spain, more than 200.000t of DPS were produced during 2006. Due to their high organic matter content, DPS could be used as amendment to improve or restore soil fertility and biological functioning [2, 3]. Nevertheless, it is necessary to add a supplemental N due to the high ratio C/N of DPS. One of these sources could be sewage sludges (SL). The present works deals with the study of feasibility of using DPS to produce substrates for plant production. The substrates tested were four mixtures of DPS and SL: 100% HP, 90% HP + 10% L (v/v), 80% HP + 20% L (v/v) and 70% HP + 30% L (v/v). Experimental results shown that the substrate 70% HP + 30% L presented the best hydrophysical properties while the others treatments presented limitations mainly due to their low available water values. Also, the biological activity was higher in the substrate 70% HP + 30% L according to its lower ratio C/N.

S13 Buffering Function of Soils

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Geochemistry of major and trace elements in tropical serpentine soils

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Background levels of trace elements have been a first step to evaluate their chemical behavior in soils and to determine their input as pollutants. The vertical distribution of 14 geochemical elements (Si, Al, Ti, K, Na, Ca, Mg, Fe, Mn, Cu, Cr, Ni, Pb, and Zn) in 9 soil pedons has been investigated for three serpentine areas in the Costal Range, eastern Taiwan to understand gain and loss involved in the distribution of trace elements based on the quantitative method of enrichment factor (EF) calculated with Ti as immobile element, and to discriminate the inherited and pedogenic factors on comparison of the trace element concentrations based on principle component analysis (PCA). The relative abundance of major elements is as follows: Si > Fe > Mg > Al. Additionally, Cr, Mn, and Ni contents in these soils are higher than in soils from other parent materials, with considerable variation between pedons on different landscapes. Titanium is enriched in all soils and appears to be the best index element in calculating EF value of mobile elements. The EF values varied with the soil development degree and with landscape. The pairs of Si-Fe, Si-Mn, Si-Pb, and Si-Zn showed significantly ($p < 0.05$) positive correlations. However, the close relations among Fe, Mn, Cr, and Ni were observed herein. According to the eigenvalue in PCA, the metals most responsible for separation along PC1 axis are Si, Fe, Mn, Zn, Mg and Ca, whereas Cr and Ni are the trace metals responsible for separation along PC2 axis. A practical perspective of this study is to draw possible geochemical indicators for predicting vertical distributions of siderophilic metals in the serpentine soils. Furthermore, Cr and Ni can be grouped the pedons for each serpentine area with respect to the scores plots of PCA.

P273

Enhanced *in situ* degradation of chemicals in soils

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Chemicals leaching to groundwater represent a severe problem especially in cases where groundwater is used as a drinking water source due to the very low potential for microbial chemicals degradation in the saturated soil horizons. Several chemicals already can be found in groundwater and some reports have documented their concentrations exceeding the critical approved values for drinking water (0.1 µg l^{-1}). Further more, the increasing amount of organic chemicals, which are in parts unintentionally spread into the environment (e.g. PAH´s) by combustion or flooding processes, result in an accumulation of these substances in soils. Thus, this concern refers both to contamination of soils in itself and to the risk for other compartments, mainly water and food production, which affects ecosystem and human health.
The main focus of our work is to affect soil functions in such a way that unwished chemicals can be eliminated from soils faster and to a greater extent.
We isolated several chemicals degrading microbial communities as well as the “key-microbes” (= degraders) from soils which are able to mineralize certain chemicals (isoproturon, chlorinated benzenes, triazines, PAHs) intensively. We applied these microbes via four various approaches to different soils: mixing isolated strains and microbial communities separately with contaminated soils, and attaching isolated strains and microbial communities separately to specific surfaces before applying them to soils in form of so-called “hot spots”. Applying the microbial communities as “hot spots” showed the highest accelerated mineralization of the contaminants, the highest efficiency per applied microbial cell, and we also observed a high sustainability of this approach. Beside accelerated chemicals mineralization by the applied microbes, mass transfer of the contaminants towards the degrading microbes was observed as the main process of this remediation approach.

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A composting process model coupling organic matter and organic micropollutants dynamic

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A dynamic model for composting process has been developed to simulate the interactions between organic matter decomposition and organic micro-pollutants dynamics. The aim of the model is to predict the amount of remaining micro-pollutants in the final product that will be applied to soil. Most reactions are described using first order kinetics. Organic matter is divided into pools with specific decomposition rate for each. Decomposition of organic matter pools is based not only on their intrinsic ability to be decomposed but also on the ability of microbes to consume it. Several microbial populations can be activated according to a temperature growth-limiting function. The model describes also the dynamics of organic micropollutants including weak sorption on organic matter, the formation of bound residues and the degradation by microorganisms. The model makes the partition between the parent compound and the pool of metabolites. Two links describe the interactions between organic matter module and organic micropollutant module. First, the sorption coefficients are function of the nature of organic matter (biochemical composition and degradation state). Second, the micro-pollutants are degraded by microorganisms whose presence and quantity are mainly driven by organic matter decomposition. The model produced realistic simulated results when compared with data in the literature in terms of the carbon mineralization and carbon content in each organic pool. We simulate organic micro-pollutants dynamics taking into account or not organic matter decomposition. We find, as in literature, that organic matter decomposition enhances micro-pollutants mineralization and bound residues formation. A sensitivity analysis was performed to determine the key parameters of the model.

P275

Dynamic (redox) interfaces in soil - Carbon turnover in microbial food webs and impact on soil organic matter

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The stabilization of soil organic matter (SOM) in soil is related to the interaction of organic compounds with interfaces, in particular those with mineral surfaces. For continuous stabilization of C, we hypothesize that dynamic interfaces are needed which can be created in soil by variations in water content and redox potential. Therefore, these factors are crucial for organic compound transformation by microbes in soil and their effects will be studied.

In our experiments, hexadecane and phenanthrene will be used as representative examples of aliphatic and aromatic compounds, respectively. Their transformation in soil and how this is affected by water content and redox potential will be studied in isotope tracer experiments.

The effect of different water contents and redox potentials as well as the effect of redox potential oscillations on their transformation will be studied in batch experiments with constant or oscillating water contents and redox conditions. In soil column experiments, we will study the transformation of the same compounds in a gradient of water content and redox potential.

The data will reveal the distribution of the compound-derived C on mineralization, biomass formation and SOM related residue formation. They will also provide information on the flux of the C in microbial food webs related to the activity of selected functional genes.

The combined results will introduce a new dimension into research on organic compound transformation in soils by relating microbial community structure and activity to C fluxes under different environmental conditions.

P276

Buffering function of soils in prevention of ground water contamination by pesticides

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Groundwater contamination caused by pesticides used in agriculture is a worldwide environmental problem. Pesticides and other contaminants can be monitored. Monitoring of the groundwater pollution in the Czech Republic is carried out by the Czech Hydrometeorological Institute (http://hydro.chmi.cz/ojv). Since, such monitoring is quite expensive and time consuming, only selected pesticides are analyzed. However, wide pesticide utilization requires monitoring of larger number of substances. To extend a number of evaluated pesticides, the monitoring network setup and sampling frequency for specific pesticides must be optimized. Optimization reflects many factors and conditions. One factor is a soil cover that has a very significant impact on water flow and pesticide transport and consequently on groundwater contamination. The goal of this study was: 1) Selection of representative soils of the Czech Republic and determination of soil properties (soil specific density, pHKCl, pHH2O, CaCO3 content, salinity, organic matter content, organic matter quality as a A400/A600, CEC, base saturation and particle size distribution). 2) Measurement of adsorption isotherms of selected pesticides (metribuzin, chlorotoluron, terbuthylazin, prometryn, trifluralin). 3) Determination of pedotransfer rules for estimation of adsorption parameters base on measured data. 4) Application of pedotransfer rules and the Czech soil information system PUGIS for the estimation of the adsorption properties of soils in two selected regions of the Czech Republic. 5) Localization and quantification of possible pesticides application in selected regions during specific period based on crop cover evaluated from remote sensing data (multi-temporal Landsat-type). 6) Assessment of possible ground water contamination by pesticides using GIS based on soil properties distribution, localization of frequent application of specific pesticides and in addition on hydrological, hydrogeological and climatic conditions. 7) Confrontation with monitoring results and monitoring network evaluation.

P277

Do buffer methods predict lime requirements for Greek soils?

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Thirty nine acid surface soils (0-30 cm) were collected from W. Greece in order to determine the lime requirement (LR) to increase the pH value up to 6.5. The samples were titrated with stepwise addition of 3 ml 0.022M $Ca(OH)_2$, up to the value 6.5 (pH_t). Then the samples were separated in groups, with criterion the total volume of 0.022M $Ca(OH)_2$ that was consumed. The following equation was used to determine the b: $pH_t = \mathrm{bx}V + pH_\alpha$, where pH_a is the initial pH value, V is the volume of $Ca(OH)_2$ that was consumed and b is the factor related with buffer capacity of soil. The LR was calculated according to proposed pedotransfer function LR=((pH_t - pH_a)/b)x0,495 Mg $CaCO_3$ ha^{-1}, for b=0,2168. The validation of the results was confirmed by incubation of samples with 0.022M $Ca(OH)_2$ for 24, 48 and 72 hours. No differences were detected between the proposed equation and the incubation results. The results of the proposed method were compared with other methods used in Greece. The comparison indicated differences in LR amounts between all methods. Nevertheless, the method that is proposed, can give a rapid and a good estimation of LR without using toxic chemicals and complicated laboratory equipments. Further research is needed for the precise determination of LR for the Greek soils.

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Vapor phase sorption on soil organic matter components: Influence of moisture and type of organic contaminant

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The components of soil organic matter (SOM) may play a different role in realization of soil barrier functions towards volatile organic contaminants (OC). The different retention properties of SOM are mainly caused by their chemical structure and also essentially depend on the OC type and environmental conditions, in particular on moisture content. For instance, under low humidity humic acids reduce soil buffering functions concerning hydrophobic OC as compared to soil minerals. Opposite, at higher humidity OC linkage by soil humic acids prevails. In this connection, vapor sorption of OC of various types (aromatic and aliphatic hydrocarbons; nitriles; ketones; amines; and aliphatic alcohols) on SOM components (sol lipids; humic acids; as well their precursors, cellulose and lignin) in the wide humidity range (0-20 %) by use of static headspace gas-chromatographic method was studied.

The analysis of sorption isotherms of hydrocarbons that are capable only of unspecific Van-der-Vaals interactions revealed essential differences in the degree of "rigidity" of the phase structure of studied sorbents. The most rigid phase structure was found for cellulose and humic acids. With regard to sorption isotherms of alcohols capable of specific interactions, on

cellulose and humic acids, a significant increase of sorption values after P/P_0 0.25 indicated a positive “cooperative” sorption effect. Such a sorption “jump” suggests that even in a "rigid" SOM component, OH-containing OC can generate some reorganization of sorbent phase structure, causing the appearance of new sorption sites.
The influence of humidity on OC vapor sorption was dual and resulted both in blocking a sorbent surface because of hydration and in changing the phase structure of sorbents. In the latter case, water molecules acted similarly to alcohols by breaking off intermolecular specific bonds in a sorbent and thus changing its phase structure.
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P279
The influence of soil reaction change after application of fly ashes from fluid coal combustion on the humus content

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In the testing locality Zemservis - testing station Domaninek the experiment with observing of humus movement in soil depending on changes of the soil reaction after application of pellets from fly ashes from fluid coal combustion was established in the year 2005. The small plot experiment was established in potato growing region on arable soil, where four variants with different application of limestone and fly ashes were tested: 1st variant - control (without application), 2nd variant - application of dolomitic limestone (0.52 kg.m-2), 3rd variant - application of fly ashes (in the pellet form, 1.48 kg.m-2), 4th variant - application of fly ashes (in the pellet form, 1.48 kg.m-2) and dolomitic limestone (in the pellet form, 0.92 kg.m-2). The dues of applied materials were based on the content of CaO. Pellets used in this way must have specific technological properties and must comply with strict ecological demands for tested materials. The content of CaO and also ecological availability of materials from the point of view of ecotoxicity before their application were analyzed.
In the autumn of the year 2005 the soil samples for input analyses of the humus content and soil reaction were removed. It was found, that by the beginning of monitoring the soil reaction was 4.4 - 4.5, which shows, that the soil was extremely acid. Humus content was 3.56% on average. In the years 2006 and 2007 soil from all the variants (in four replications) from two depths 0 - 0.10 m and 0.10 - 0.20 m by two crops - winter wheat and spring barley - was evaluated.
It was found, that the increasing level of pH had positive influence on humus content. Among single variants significant differences in humus content were found. Further significant differences among years and vertical allocation of humus were ascertained.

P280
Changes in PO_4^{3-} and NO^{3-} concentrations in sulfide mine wastes flooded during 17 weeks with eutrophicated water

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Mine wastes were taken from two polluted salt marshes (pH ≈ 6.5, < 1 g kg^{-1} of $CaCO_3$; and pH ≈7.8, ≈ 35 g kg^{-1} of $CaCO_3$, respectively) to fill 15x12 cm pots flooded during 17 weeks with eutrophicated water (NO_3^- ≈ 220 mg L^{-1}; PO_4^{3-} ≈ 10 mg L^{-1}). Pore water was regularly extracted from the pots and soluble organic carbon, PO_4^{3-} and NO_3^- concentrations were measured. The pH and Eh were weekly measured in each pot. The treatments assayed were: pots planted with *Sarcocornia fruticosa*, pots planted with *Phragmites australis* and bare pots.
The PO_4^{3-} concentrations in pore water had decreased by 50% twenty minutes after the addition of the eutrophicated water, and until 95% in the following two hours. No differences were obtained among treatments for both types of wastes. An increase in the concentration of total-P in the wastes was observed at the end of the experiment, being P-fixation at soil components the main mechanism to reduce soluble P concentration.
The NO3- concentrations decreased during the first 13 weeks in planted pots filled with free carbonate wastes but not in bare wastes. Only when Eh was lower than +200 mV in bare pots (between weeks 13 and 17) NO3- concentrations fell at similar levels than in planted pots.
The NO3- concentrations decreased by 80% two days after the addition of eutrophicated water in carbonated wastes, and there were not differences between planted and bare pots.

P281
Compost amendments affects on retention and leaching of isoproturon in soil

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Urban compost application to cultivated soils offers an alternative to the elimination of organic municipal wastes through ultimate disposal in landfills or incineration. The immediate benefit of such a management practice is the increase of soil organic matter content and fertility. The incorporation of organic amendment modifies soil physical properties, decreasing soil bulk density and increasing soil aggregate stability, macroporosity and soil moisture retention. Application of organic amendments is thus likely to affect leaching of solutes through soils owing to soil structural changes. As a consequence of an increase of soil organic matter content, organic amendments are reported to increase the sorption capacity for pesticides and delay the leaching of pesticides through soils. However, dissolved organic matter (DOM) from organic amendments can alter pesticide sorption and either facilitate leaching, or increase pesticide sorption. The objective of this study is to quantify the effects of two urban waste composts application in a cultivated soil on isoproturon retention and leaching. The composts were a co-compost of sewage sludge and green wastes (SGW) and municipal solid waste compost (MSW). Batch sorption experiments of isoproturon showed increased retention capacity for amended soils in the order: control (non-amended) soil < MSW-amended soil < SGW-amended soil. Isoproturon was simultaneously leached with a water tracer, Br, in undisturbed soil columns under unsaturated conditions. The one-dimensional transport model HYDRUS-1D was used to quantify the physical and chemical transport processes. Retention of isoproturon in dynamic conditions was lower compared to static conditions, in the order: control soil < MSW-amended soil < SGW-amended soil. Non-equilibrium retention processes occurred in the control and SGW-amended soils.

P282
Buffering capacity of drainage canals and phytoremediation potential for agro-pollutants

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Drainage canals are areas of accumulation of organic debris due to erosion and growth of plants such as Phragmites australis. Denitrification is one of the main biological processes responsible for the buffering capacity against diffuse nitrate pollution due to anaerobic conditions and suitable electron donors. In addition, nitrates and phosphates decrease due to plant uptake. It has been shown in the literature that plants like reeds uptake phosphorous through out the year and then (March - April) release it back in the aquatic environment and their roots. Cutting the reeds the proper time, results in the reduction of P in the receiving surface water bodies. This work aims to estimate the efficiency of drainage canal's sediments to reduce nitrate pollution from ground water as well as the timing of the cutting of the reeds that will maximize the removal of phosphates by plant uptake. The drainage canal is located in Evrotas River Basin, Greece. To monitor the 3-dimensional variability of hydrology and chemistry of surface and ground water in the drainage canal, eleven multi-level (3, 4 and 5 m) wells were installed. The water depth was monitored on a monthly basis. The hydraulic characteristics of the subsurface were determined by conducting single well injection-withdrawal tracer studies. The probes and the drainage canal water were sampled every 2 months (based on the velocity of movement of contaminants). The samples were analyzed for inorganic nitrogen species, phosphates, phenols, dissolved organic carbon and nitrogen and chemical oxygen demand. Plant (reed) samples were collected on a monthly basis to determine the uptake rates by the plants. Laboratory studies on sediment samples were conducted to study the predominant processes in the nitrogen and phosphorous cycles. Drainage canal management is suggested as an efficient low cost - high gain agri-environmental measure to reduce diffuse nutrient pollution.

P283

Thermodynamical properties of benchmark hydrogen-bonded systems using molecular dynamics and Monte Carlo methods

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Hydrogen-bonded systems occur ubiquitously in the nature and play a central role in many environmentally important chemical processes. These processes mostly take place in aqueous systems where the solvent has a significant impact. Molecular dynamics (MD) and Monte Carlo (MC) methods based on classical interatomic potentials (force-field methods) permit the usage of many explicit solvent molecules allowing therewith a correct evidence of local interactions between solute and solvent molecules. Thermodynamical properties of solvation are computed by combining the classical force-field MD and MC simulations with the free energy perturbation (FEP) theory. A comparative study between MD/FEP and MC/FEP is carried out investigating a selected set of hydrogen-bonded benchmark systems: acetic acid dimer and the complexes of acetic acid with acetamide and methanol in different solvents including water (polar), chloroform (less polar) and n-heptane (nonpolar).

P284

Effects of pH, Ca- and SO_4-concentrations on surface charge properties of goethite and hematite - consequences for sorption properties

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Reactive surfaces are a prerequisite for the immobilization of organic pollutants in the soil system and part of ground water protection strategies. Especially of concern are anionic contaminants as they have only weak interactions with the predominantly negatively charged soil compounds. In this way iron oxides are of high importance, as their point of zero charge (PZC) is between pH 6-8. There is well established knowledge about the effect of pH on variable charged sites, whereas the effect of Ca^{2+} and SO_4^{2-} and other ions in the soil solution on charge properties is poorly addressed.
The effect of solution chemistry on surface charge (SC), flocculation and sorption properties of synthetic goethite and hematite was analyzed at different electrolyte concentrations and pH-values. For SC determinations the streaming potential combined with charge-compensating polyelectrolyte titrations was used. For goethite and hematite the PZC was observed at pH 7.8 and 6.5 respectively. For goethite no negative SC is observed at Ca-concentrations >1.0 mmol L^{-1} in the pH-range from 3 to 10. SC of both oxides is increasing with increasing Ca-concentration and decreasing pH. SC at pH 3.8 for goethite and hematite at Ca 0.1 mmol L^{-1} is 70 and 16 $mmol_c\ kg^{-1}$ and at Ca 1.0 mmol L^{-1} it is 95 and 32 $mmol_c\ kg^{-1}$ respectively. In contrast addition of 0.1 mmol Na_2SO_4 induces a strong decrease in surface charge and a shift in PZC of approx. 0.8 to lower pH for goethite and hematite. Charge density was found to be higher for goethite than for hematite. A positive correlation between surface charge and the adsorption of dissolved organic matter was observed. The results suggest that soil solution chemistry has a strong effect on the surface charge properties of pedogenic oxides and should be considered when predicting transport of organic contaminants in soil systems.

P285

Cylinder experiment with *Lepidium sativum* to assess the bioavailability of arsenic in contaminated alluvial soils

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An arsenic contamination of the Elbe, Mulde and Saale floodplains in Germany is at least known since the big flood in august 2002. These floodplains are partly agriculturally used as grassland. Background of the study was the fact that the threshold level for grassland of total arsenic concentration shows no relation with the easy soluble As fraction and respectively the As plant availability. The risk assessment for a transfer in the food chain is not sufficient with sole determination of total arsenic concentration. The availability of arsenic in soil is also important for the soil-plant transfer. In periodically flooded alluvial soils with regular occurring redox cycles influence the bioavailability of arsenic. With increasing water saturation sorbed arsenic can be desorbed and reduced, what potentially increase the bioavailability of arsenic. To assess the bioavailability of arsenic in contaminated alluvial soils a cylinder experiment was created in laboratory with 18 alluvial soil samples from the Mulde floodplain. In a period of 34 days after water saturation soil solution was sampled every second day and the concentrations of arsenic species, iron species, phosphorous, sulphur and manganese were determined. Redox potential and matrix potential were measured *in situ*. 28 days after water saturation *Lepidium sativum* was sowed in the cylinders. Seven days later the experiment ended and the above grounded plant material was harvested and analysed for arsenic concentration. Destructive soil extraction methods were made to determine fractions of arsenic sorption in soil.
As expected no relationship was found between the total arsenic in the alluvial soil samples and the arsenic concentration in the plant material. The redox potential develops different in the soil samples and subsequently the arsenic concentrations in soil solution develop different. These differences were partly reflected in the arsenic concentration of the plant material.

P286

Sorption of organic compounds in soil: modifications by their molecular characteristics and the soil solution

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These experiments are part of a research project where we aim at the description of adsorption processes in soils based on a combined approach of nanoscale quantum chemical calculations, microscopic modelling and experimental sorption studies.
To elucidate the effects of cation bridges, hydrogen bonds and hydrophobic interactions we chose naphthalene, aniline, 1-naphthylamine and 1-aminoanthracene as model substances. Furthermore, the adsorption studies are carried out at pH 3 and 6.6 (so in the first case the aromatic amines are protonized, in the other neutral) with 0.01M $CaCl_2$, 0.02M NaCl and 0.005M $Na_4P_2O_7$ as background solutions to investigate different chemical environments allowing or disabling major sorption mechanisms.
To study the influence of organic carbon two soils from a long term field experiment with different amendments (Animal Manure, 3.6% OC and mineral fertilizer NPK, 2.4% OC) and Ca^{2+}-saturated montmorillonite are used as sorbents.
First, kinetic studies were performed to see if/when equilibrium is reached. Except for naphthalene no sorption plateau could be achieved within three weeks, but due to the possibly limited stability of aniline and 1-naphthylamine, we agreed on an incubation time of three days, for naphthalene of one week for all isotherms.
As expected, adsorption increases with OC-content and decreasing pH, what applies also to the not protonizable substance naphthalene.
The NH_2-group has a great impact on adsorption, what can be shown by comparison of naphthalene (K_f = 21; 1/n = 0.88; S_W = 31.47 mg L^{-1}) and 1-naphthylamine (K_f = 38; 1/n = 0.67; S_W = 1,298 mg L^{-1}), but also the hydrophobic part of the substances plays an important role: K_f aniline = 11; 1/n = 0.61; S_W = 35,300 mg L^{-1} (results are obtained with AM pH > 6). Independent of the sorbents, 1-aminoanthracene seems to be totally adsorbed.

P287

Speciation of zinc in solutions extracted from different Zn-polluted substrates

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Plant roots readily absorb zinc as an essential nutrient from their liquid environment dominantly as free ion Zn^{2+}. Excessive Zn uptake from polluted substrates is the first step of food web contamination.
Here we study zinc speciation in solutions extracted from three substrates and Zn mobility as measured through Zn concentration in substrate leachates. The substrates were a clayey calcareous soil (CaS), a loamy shale-derived soil (ShS) and a gravelly slag deposits (SD). The solutions were collected *in situ* through zero-tension lysimeters buried under organic horizon (O) and organo-mineral horizon (Ah). Leachates were collected from substrate columns *in vitro*. We measured pH, concentrations of cations, anions and DOC. Zinc speciation was determined with VisualMINTEQ.
The substrate Zn concentrations amounted to 3.8-4.8 g kg^{-1} in ShS and 11.5-81 g kg^{-1} in CaS and SD. Aqueous zinc dominantly occurred as free ion Zn^{2+} (60-95 %) in solutions from CaS and SD, and as organically-bound Zn in solutions from ShS (50-88%). Based on literature data, we propose that microbial activity was strongly reduced in CaS and SD because of strongly inhibiting Zn substrate levels. Lower Zn content in ShS substrate had a lesser inhibiting impact on microbial activity. This likely explained the relatively large DOC concentrations in both extracted solutions and substrate leachates, and thereby Zn complexation by DOC. In CaS, Zn was massively leached out as Zn^{2+} from O to Ah. In CaS-Ah, ion exchange process of surface Ca^{2+} against aqueous Zn^{2+} led to exceptional Zn accumulation on the exchange complex. This process did not occur in ShS-Ah because of its very low cation exchange capacity.
Ion exchange and microbial activity thus played a key role in zinc speciation and thereby on zinc mobility in our Zn-polluted substrates.

P288

Assessing the effects of preferential flow in grassland soils

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In the interest of achieving good water quality status in Ireland, it is of increasing importance to understand and predict the capacity of different soils under grassland based livestock production to filter agricultural waste applications. One question which has arisen is whether preferential flow through soils may be contributing significantly to diffuse pollution from agriculture. Assuming that soil texture is an important indicator for infiltration mechanisms, an initial experiment was carried out on three grassland soils with contrasting textures, using FCF brilliant blue food dye to visualize infiltration paths into the soil. A second experiment was conducted on existing undisturbed zero-tension grassland lysimeters containing four soils with similarly contrasting textures. A grass cover was maintained on the lysimeters for the entire experiment. Bromide, mixed into animal waste slurry, was applied to the lysimeters in August and in February. Fluxes of water, Bromide and Chloride were monitored for up to 560 days after application under natural rainfall conditions. Water fluxes and solute concentrations were analyzed in conjunction with daily and hourly rainfall data. Information from the initial dye experiments is being used to help explain the emerging breakthrough patterns from the lysimeters, and leaching is being modelled using the vadose zone model, MACRO. The results from the dye infiltration experiment showed the occurrence of preferential flow in all three soils, although the characteristics of the flow differed between the soils. Results from the lysimeter experiments show characteristic breakthrough patterns for the different soils and some evidence of preferential flow in the finer textured soils.

P289

Effect of citric acid on the amounts of Mn and Co species desorbed from soils developed on two different serpentinite rocks

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The objective of this work was to evaluate the effect of citric acid solution 0.05M on the amounts of Mn and Co species desorbed from the contacting solid surfaces of the soil samples of two autochthonous profiles. The soil profiles (Profile-1 and Profile-2) were developed in serpentinite rocks of North Evia, Greece. For each Profile four horizons were investigated. As far as it concerns these Profiles, the serpentinization degree in their parent materials is: Profile-1 > Profile-2. Desorption experiments were conducted with a batch method at 25°C for different predetermined times. PH values for all soil suspensions show an increasing tendency from about 2.50 for 0.5h to about 2.90 for 48h. The total contents of Mn and Co for each horizon were measured. With the subtraction of the experimental values of desorbated Mn and Co species from the relative total values, the Mn and Co species remaining sorbed were calculated respectively. These values divided by the total content are presented as the percentage of the species of the remaining sorbed metal-($M_{r.s.}$) to the total value ($M_{r.s./total}$). The results for both metal and for the two Profiles show that all desorption isotherms, $M_{r.s./total}$ vs. time, were expressed satisfactorily by power equations. During desorption, the experimental values for all horizons show a tendency to achieved equilibrium after approximately 24h. The experiments show that values of $Mn_{r.s./total}$ near equilibrium range from 15.2 to 27.1 for all the horizons of Profile-1, while they fluctuate from 11.5 to 28.7 for Profile-2. The respective values of $Co_{r.s./total}$ vary from 49.4 to 58.9 for Profile-1 and from 41.0 to 52.2 for Profile-2. Finally, the horizons near parent material of Profile-2 show greater values of $Mn_{r.s./total}$ and $Co_{r.s./total}$ near equilibrium compared to the respective values of the horizons near surface. Generally, the opposite observation is noticed for Profile-1.

P290

Impact of hexachlorocyclohexane in agricultural soils of Galicia, NW of Spain

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Abuse of organochlorine pesticides in agriculture has led to soil contamination. Hexachlorocyclohexane (HCH; 1,2,3,4,5,6-hexachlorocyclohexane) is an organochlorine pesticide of high toxicity and persistence. The initial HCH mixture of isomers (technical-grade HCH: α-, β-, γ- and δ-HCH) has been employed as insecticide since 1940s. The γ isomer presents the main insecticide activity; it has been used during decades in crops as a commercial product (Lindane: 99% enriched γ-HCH). Production of Lindane has now ceased worldwide due to severe legislation, but the associated residues have been routinely found in soils elsewhere. There are not current studies regarding on historical usage of pesticides or contemporary residues in soils in the region of Galicia (NW of Spain), where a manufacturing plant of Lindane was located.
In this study, concentrations of HCH isomers (α-, β-, γ- and δ-HCH) were measured in topsoil samples (0-25 cm depth) of agricultural soils distributed in the entire region of Galicia (n=252; grid: 8x8 km). Samples were air-dried, sieved (2 mm), ground and extracted with hexane:acetone (1:1) in an ultrasonic bath, then analysed by GC-ECD. Additional chemical data were obtained from routine soil analysis.
Results indicate that residues of HCH isomers can still be found in the topsoil layers of agricultural soils at concentrations ranging between 1 and 2500 ng g^{-1} (dry weight). In general, α-HCH was the predominant HCH isomer (67%); γ-HCH was also important (26%). The distribution of HCH isomers in agricultural soils is discussed, in relation with chemical soil properties and spatial data, trying to identify the trends observed. The results obtained indicate that there is no single parameter able to explain the present residue distribution. A special focus must be regarded considering the impact on soil and/or food chain transfer of this type of pollutants, due to the land-use influence on pesticide behaviour.

P291

Effects of grass species diversity on soil nitrate leaching

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Growing mixtures of grass species may reduce nitrate leaching in pastures due to the varying competitiveness, phenology, and growth rates of different grass species. The nitrogen-conserving function of four sward types was tested in a plot experiment on a rapidly draining sandy soil under cool temperate, humid conditions in Truro, Nova Scotia, Canada (45°22' N, 063°15' W). Main plots comprised a control and repeated seasonal applications of ammonium nitrate at medium and high rates in 2006 and 2007. The sub plots represented a white clover (*Trifolium repens*) sward and three sward types of varying grass species richness growing in mixture with voluntary white clover. Ceramic suction cups were installed 0.5 m deep for repeated sampling of the soil solution. The swards surrounding the solution sampling points were clipped for biomass, botanical separations, and tissue N analysis. In the control plots, the white clover sward leached approximately twice as much nitrate than the three grass swards. Fertilized treatments showed a pronounced seasonal increase of NO_3-N in the soil solution from a mean value of 5 ppm NO_3-N in spring to 30 ppm NO_3-N in mid-summer across sward types. The seasonal increase of nitrate leaching was most pronounced for the single species sward of timothy (*Phleum pratense*) compared to the binary mixture of timothy and blue grass (*Poa pratensis*). The most diverse mixture of timothy, blue grass, meadow fescue (*Festuca pratensis*) and reed canary (*Phalaris arundinacea*) leached the least mineral N. The seasonality of sward productivity and N yields was similar across swards. However, a seasonal increase in the relative dominance of white clover occurred in both years and was most marked in timothy plots with an increase of approximately 30%. High clover content and application of mineral N each appeared to exceed plant uptake and substantially increase nitrate leaching.

P292

Effect of soil properties on bioavailability and phytotoxicity of nickel and copper in soils

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Buffer capacity of soils diminishes harmful effects of polluting heavy metals to plants and soil biota. A pot study was carried out to investigate the response of resistant plant species to increasing concentrations of heavy metals in soils depending on soil properties. The phytotoxicity experiments with *Deschampcia cespitosa* and *Lolium perenne*, important restoration grass species, were conducted in a wide range (1-34 mmol/kg) of Ni and Cu added as aqueous salt solutions to six different soils. The effective substrate concentrations of Ni and Cu resulting in 50% biomass reduction (EC_{50}) were used as toxicity indexes.
The experiments resulted in EC_{50} values of 0.37-4.4 mmol kg^{-1} for added Ni, of 0.39-3.8 mmol kg^{-1} for potentially available Ni and of 0.04-0.24 mmol kg^{-1} for water soluble Ni depending on soil properties. Cu was more toxic comparing with Ni. These EC_{50} values were in the same range as the metal concentrations in soils in the surroundings of nickel-copper smelters in the Kola Peninsula, Russia, thus supporting the possibility of direct phytotoxic effect of polluted soils.
Bioavalability and toxicity of heavy metals in soils were to a large extend determined by their concentration in soil solution which in turn were related to metal contents in the soil solid phase and soil properties (pH and organic matter content). Due to huge accumulation of heavy metals in the acid surface soil there may be a significant long-term risk of their phytotoxic effects.
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P293
Rainfall pH comparation in two different locations in south Brazil

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The pH is an important indicator for chemical conditions, because it has the capacity to disturb some elements availability which is essential to vegetal development, favoring or not its release. When the pH is very acid, it can cause the dissolution of some elements like iron, aluminum and manganese, which it may sometimes, became toxic. When the pH is too high, some elements become less available to the plants, disturbing its development. The study was conducted in two distinct areas; one located in Itaara center of Rio Grande do Sul State and the other located in Candiota south part of the same State. The annual average (Sept/06 to Aug/07) in the first area was 6, 28; showing the highest value in January/07 (9, 02) and the lowest in October/06 (4, 74). In the second area, the average was 6, 65, being the highest value in September/2006 (7, 73) and the lowest in March/2007 (5, 66). It is possible to verify that in the first area there was acid rain in some periods (< 5, 65), this may cause, along the time, soil acidification and environmental degradation. Comparing the averages in both places, it is possible to assert that pH variation was not strong between the sites. It is important to monitore continuously pH values in rainfall, once it is possible ton check the environmental conditions in the studied places and its surroundings.

P294
Assessment of nickel availability in natural and serpentine soils from the North-east of Portugal

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Nickel, a potentially toxic metal, is present in soils with an average concentration of 20 to 30 mg/kg, sometimes exceeding 10000 mg/kg in serpentine soils. Serpentine soils are known to be unfavourable to plant growth and productivity. Commonly they have high levels of trace metals like Ni, Cr and Co and low Ca/Mg ratios. In addition serpentine soils have low concentrations of important nutrients like K and P. Elevated soil concentrations of Ni and Mg, combined with low Ca concentrations are considered to be the main cause of serpentine soil toxicity. In the north-east of Portugal the serpentinized area is about 8000 ha with characteristic geology and flora. The availability of Ni in soils and its subsequent transfer to plants depends on its mineralogical origin as well as on soils characteristics. In this work, different soil samples from serpentine and non-serpentine areas were characterized in terms of pH, total organic carbon, cation exchange capacity, exchangeable cations, particle size analysis (sand, silt and clay), mineralogical properties and total chemical composition. The capacity of the soils to retain Ni was studied by voltammetric titrations at the soils pH and ionic strength, I = 0.1 M and average formation constants, and binding capacity for Ni adsorption have been estimated. Different extraction procedures were also used in order to have additional information on Ni mobility and availability.

P295
Geochemical and microbiological controls on the fate of depleted U in soil

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The fate of uranium (U) in soils is of major interest both for practical reasons (for example, the fate of depleted U released from munitions) and because it is something of a curio having complex redox, speciation and sorption behaviour, and being influenced by soil biological processes. The latter effects are not well characterized, but potentially include redox transformations; solubilization by excretion of complexing agents, including respiratory CO_2; sorption on external surfaces of living and dead microbes; intracellular accumulation by microbes; and transport mediated via fungal mycelia.
In an experiment to study the effects of microbiological factors upon the movement of U, the microbiology of four soil types was manipulated to provide four treatments, viz. sterile (by gamma irradiation), and three non-sterile treatments based upon additional of glucose alone, or in combination with either fungal- (cycloheximide) or bacterial- (streptomycin).inhibiting antibiotics. We then measured concentration-distance profiles of U in columns following a pulse application of U to one end. Data are presented comparing the results with the predictions of a mathematical model allowing for diffusion and sorption of U species using independently-measured parameter values.
We found that the spread of U into the soil was least in the sterile soil and greatest in the soils treated with antibiotics (for which the concentration-distance profiles were similar), and intermediate in the glucose-only soil, but with far greater variance. The concentration-distance profile in the sterile soil roughly matched the predictions of the model using a unique, concentration-dependent U sorption curve measured separately in shaken soil suspensions. We hypothesise the main effect of microbes was via their differential effects on the CO_2 pressure in the soil.

P296
Chemical and biological responses as induced by a biomimetric catalyst for enhancing carbon sequestration in soil: a microcosm experiment

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Enhancing carbon sequestration in soil can be considered as an efficient strategy for balancing the atmospheric CO_2 enrichment due to anthropogenic emissions, which is the main factors causing the global warming. Humic compounds are major components of soil organic matter and are of paramount importance in controlling the biogeochemistry of organic compounds in the global ecosystem. Naturally occurring phenolic monomers in soil can undergo oxidative coupling reactions that originate high-molecular weight polyphenols. Recently a synthetic, non-toxic, water-soluble iron-porphyrine has been studied for potential use as a biomimetic catalyst in the process of oxidative polymerization of the naturally occurring phenolic compounds in soil. Thus, following its distribution a decrease in the efficiency of microbial mineralization and an increased middle-term storage of soil C can be expected. The aim of the present study is to investigate changes in chemical and biological properties in microcosm soils amended with the biomimetic catalyst. To this aim soil microcosms were located in a greenhouse, under controlled growth conditions (temperature, relative humidity, light period), and were planted with wheat seedlings. Compost-amended microcosms soil were also included in the experimental design in order to reveal synergistic effects as due to freshly added organic materials. A variety of soil chemical and biological properties are currently being investigated during the growing season of the wheat crop. Among biochemical properties, soil CO_2 fluxes will be also measured over the whole experimental period. Data from the microcosm experiment could greatly help for developing descriptive models for evaluating C storage efficiency in treated soil.

S21B Soils and Societies in History

P297
A Study of Soil Formation in Colluvial Layers

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Anthropogenic factors create special conditions for the formation of soils. In this case colluvial layers as a geoindicator play an important role as a record of the effects of human activity on soil formation. According to this idea the age of colluvial layers combined with laboratory and field data, regarding the historical land use changes , were used to study the nature and behavior of pedogenesis in late Holocene colluvial layers.The results in general show that human activities, such as deforestation and then agricultural practices have had an effective influence on soil formation processes and on the changes of soil properties. In this case the soil properties and soil formation processes have a significant relationship with land use. The results also show that in our investigation areas time and the characteristics of the parent material (characteristics of the colluvial layers) are two main factors of natural soil formation. Moreover land use changes as an anthropogenic factor have usually accelerated and/or changed or prevented the natural processes of soil formation. This study also indicates that the use of soil age information with geomorphological, physical and chemical soil properties provide the database which is necessary to study the types and rates of soil formation in colluvial layers. Therefore the monitoring of soil formation in mid and late Holocene colluvial layers tells us about past soil genesis in different duration of time under different land-use systems. The results help us to evaluate the future of soil formation and soil degradation.

P298
Economic, political and social factors in changes in the Czech agricultural landscape (1970-1989)

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The more than 40 years of collectivized agriculture (1948-1989) in Czechoslovakia dramatically changed the Czech agricultural landscape. The majority of these landscape changes had severely negative environmental impacts such as increased water erosion, soil aridification, and an overall loss of landscape stability. These negative impacts intensified during the 1970s and 1980s as the result of attempts to reach self-sufficiency in foodstuffs. In this period large-scale land consolidation and the practice of compensatory land reclamation resulted in the creation of enormous fields, the removal of woody vegetation and other scattered vegetation from fields, reorganization of field paths and roads, and large-scale hydrological amelioration (primarily drainage and watercourse straightening).
The driving forces behind the implementation of these environmentally damaging policies are explored. Economic, political and other factors which contributed to the resulting environmental damage are examined as well.

P299
Aliphatic hydrocarbons (n-alkanes) as molecular markers in soils for prehistoric biomass burning

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Thermal degradation of biomass during a fire results in a modification of lipid distribution patterns different from microbial degradation. The incorporation of plant biomass into soil usually leads to long-chain n-alkanes with a relative predominance of odd carbon-numbered homologues. Contrastingly, an increase in short-chain even-numbered alkanes was found in charred biomass. The decrease in chain-length and in predominance of odd n-alkanes correlated with progressing charring temperatures or thermal degradation.
We applied lipid analysis to fossil soils (NW-Germany) that contained charred organic matter. 14C-ages of charred materials indicated fires during Mesolithic to Neolithic periods. The aim of the study was to investigate if the patterns of n-alkanes detected in freshly charred biomass or recently burned soils is also detectable in soils after several thousands of years, and if n-alkanes might be applicable as fire-biomarkers for archaeological or palaeoenvironmental research.
The lipid extract yields vary between 19 to 324 g kg-1 soil organic carbon (SOC). In most cases the proportion of lipid extracts to SOC was lower in the dark pit fillings than in the control samples, although the pit fillings showed higher carbon concentrations. The lower proportion of lipids in the pit fillings indicated an advanced degradation of organic matter, e.g. by heating.
All samples displayed a particular pattern of short-chain and even carbon-numbered n-alkanes (maximum at n-C16 or C18). The ratios CPI (carbon preference index) and ACL (average chain length) for the investigated soil samples matched the ratios found for maize and rye straw charred at 400° or 500°C, respectively. These molecular ratios indicate the presence of charred biomass in the samples.
The predomination of short-chain and even carbon-numbered n-alkanes is a result of thermal degradation or incomplete combustion of biomass. The degradation products were preserved in fossil soils and can therefore indicate past fire-events.

S21A Society´s Demands for and Perceptions of Soil Conservation

P300
Landslides and soil distribution, soil conservation and the risk of landslide remobilization. Geba-Werei water divide, Tigray, Ethiopia

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In the Geba-Werei water divide in Northern Ethiopia, soils on basalts show a markedly higher crop production than soils on limestones. Farmers prefer soils on basalts and try to use the land on limestone only as rangeland, according to the population pressure. In a 400 km² study area, it has been shown that landslides have a significant impact on the landscape, not only topographically but also pedologically and even economically. The slopes and piedmont plains of the table mountains and ridges are garnished with landslide lobes, mostly debris flows, which contain a considerable amount of basalts, derived from the top of the hills. It has been calculated that the original extent of basalt and dolerite in the study area amounts to about 101 km². But debris flows during Holocene times increased the basalt extension with another 48 km². In this way, landsliding in

the geological past has increased the fertile area by 48% and has contributed to an improved agricultural potential of the study area and its sustainable development today. Farmers occupy most of the landslide lobes.
In the semi-arid environment of Northern Ethiopia, the risk of remobilisation of parts of old landslides increases as a result of improved soil conservation techniques aiming at storing more water in the soil. Two cases of renewed landsliding have been reported in exclosures where the infiltration of water is enhanced by the development of grasses, scrubs and trees. Furthermore, the massive construction of stone bunds is known to regulate spring discharges and, therefore, to increase seepage water pressures. Drastic changes in land use, implying strong increase in water infiltration should be carefully monitored. In this context, the introduction of runoff collectors, small ponds, locally called 'horoyo' should be mentioned. Their impermeable bottom of clay or plastic folio meets this problem.

P301

Soil evaluation and evaluation of areas in landscape planning as a contribution to reduce soil sealing and improve sustainable land use planning

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This poster presentation gives an overview on the REFINA-Project (Forschung für die Reduzierung der Flächeninanspruchnahme und ein nachhaltiges Flächenmanagement / Research for reducing land consumption and sustainable land use management), and shows the integration of evaluation landscape and urban planning processes.
Most research in urban planning focusses on a higher density of building sites. This leads to increased soil sealing in exchange with a surplus of reduced numbers of construction sites in the countryside.
But also in settlements with increased soil sealing, soil quality and soil functions should be taken care of. Some urban areas are still of interest for green places like parks, e.g. for recreational needs. Furthermore brownfield sites could temporarily or permanently fulfill ecological functions. The project focusses on concepts of area protection taking soil functions of urban soils and different requests of planning scenarios into account.
The interdisciplinary project integrates the knowledge of soil scientists, urban planners, landscape planners, environmental protection and geoinformatics under participation of local authorities, the Federal State Authority for Mining, Geology and Energy of Lower Saxony and the University of Applied Sciences Osnabrück, Department for Agriculture and Landscape Architecture.

S26 Pedometrics and Digital Soil Mapping

P302

A precision farming application - spatial distribution in an onion field in El-Saff district, Giza governorate, Egypt

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The maim objective of this study is to determine spatial variability in a dry onion field in EL-Saff agricultural farming village, Giza Governorate, and to produce a management strategy, which is based on spatial variability of yield and soil components. The onion field properties were determined and given in maps. Soil samples were taken to determine properties of soil such as salt (EC), pH, available N-P-K and onion yield. Longitudinal slope was also measured. Results were used to produce maps. Most percentage of the field soils was determined as sand to sandy loam textured soils and loamy sand in lower depth. Their surface is covered with many fine and medium gravel. Yield of dry onion increased by decreasing of total soluble salts. Available Nitrogen, Phosphorus, and Potassium in the field reflecting the good nutrient power supply of the studied soil as well as onion dry bulbs according to the related maps.

P303

Comparison of spatial variability methods for mapping soil properties in Arsanjan plain, southern Iran

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There have been many conflicting reports concerning the use of basic statistics to predetermine both interpolation methods and their parameters. In this research, we implement and compare the accuracy of ordinary kriging (OK), regression kriging (RK), inverse distance weighting (IDW) and splines for interpolating some soil properties such as pH, electric conductivity (EC_e), exchangeable sodium percentage (ESP), organic matter (OM) and phosphorous (P) that have been demonstrated to affect yield production. The primary data was collected from 85 soil samples in three depths (0-30, 30-60 and 60-90 cm) in Arsanjan plain, southern Iran.
The choice of the exponent value for IDW and splines as well as the number of the closest neighbours to include was decided from the root mean squared error (RMSE) statistic, obtained from a cross-validation procedure. Overall, the spatial distribution model and spatial dependence (moderate to strong) level varied within soil properties and depths. All of the methods gave different RMSE values. OK performed best for pH, OM and P in the 0-30 cm, while RK gave the best results when applied to EC_e and ESP in the 0-30 cm. This is because of the incorporation of regression residuals within the kriging system. IDW interpolated pH, EC_e, ESP and P in depths of 30-60 and 60-90 cm with the greatest accuracy, while splines surpassed OK, RK and IDW for interpolating OM in three depths. In all uses of IDW, the power of one was the best choice, which may due to the low skewness of the soil properties interpolated. In all cases, a value of three was found to be the best power for splines. By the way, we conclude that many parameters would be better identified from the RMSE statistic obtained from cross-validation after an exhaustive testing.

P304

Spatial prediction of surface soil properties in Arsanjan plain using terrain and remote sensing data

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Spatial prediction with the presence of spatially dense ancillary variables has attracted research in pedometrics. The main objective of this research is to enhance prediction of soil properties such as electrical conductivity (EC_e), exchangeable sodium percentage (ESP), available phosphorus (P), organic matter (OM), total nitrogen (TN) and pH by making use of the ancillary variables as covariates. Methods that was used for this purpose may be divided into two groups: (i) those that use only a single variable in the prediction process (simple linear regression (SLR), ordinary kriging (OK)) and (ii) another that make use of additional variables as a part of prediction (simple kriging with a locally varying mean (SKLVM)). The study area is found in Arsanjan plain that located in Fars province, southern Iran. The primary data was collected from 85 soil samples from topsoil (0-30 cm) and the secondary information from remotely sensed data "LISS-III receiver from IRS-P6 satellite). Mean square error (MSE) was used to evaluate the performance of the map prediction quality. It was concluded that SKLVM method provided the most accurate predictions based on the summary statistics of prediction errors from cross-validation for mapping OM, pH and EC_e. MSE for different methods for pH, ECe and OM showed that the generic geostatistical technique, such as OK, exhibited the highest MSE because it does not take into account the secondary information and only uses the primary soil variable. Comparing the other prediction methods, higher prediction errors were obtained when only OK was considered for ESP, P and TN. Maps from these kriged estimates showed that a combination of geostatistical techniques and digital data from LISS-III receiver could improve the prediction quality of soil management zones, which is the first step for site-specific soil management.

P305
Estimation of the soil particle size distribution based on the electrical conductivity of the soil

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Information concerning field characteristics, e.g. the soil particle size distribution, is of great importance for practical farming. By using geoelectrical systems to record the electrical properties of the soil the mapping expenditure for e.g. the determination of the soil texture may be reduced. The measured electrical conductivity correlates directly to the soil texture. Hence different conductivity values reveal differences in soil properties. In that way soil particle size may be determined by means of electrical conductivity measurements.
Here we report on a comparative study using three different measurements systems: the multi-sensor system of the University of Applied Science Osnabrueck and two commercial sensors (ARP03 and EM38). The measurements have been carried out on an agricultural field of the University of Applied Sciences Osnabrück. The field is divided into 10 metre * 10 metre grid cells, each of which is pedologically mapped. Altogether the number of all grid cells is 224. The soil samples have been taken from a depth of 0 - 30 cm. The soil particle size has been determined based on a sedimentation analysis.
For estimating the soil particle size seven grid cells were selected. Based on the measured electrical conductivity and the determined soil particle size at these seven grid cells a regression equation is computed. Using this regression equation the soil particle size of the remaining grid cells may be estimated. Allowing for an acceptable error value, the soil particle size of the predominant part of the remaining grid cells may be estimated satisfactorily. For example, accepting a deviation of ± 3 basis points for the clay content, the results for 65% of the remaining grid cells were satisfactory based on the data from our sensor system. The corresponding results using the ARP03 and the EM38 were 60% and 54%, respectively.

P306
Ground tests and ENVISAT images interpretation for SMOS validation

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Soil moisture (SM) and ground cover are key factors to understand water cycle and energy exchange. Nevertheless, the knowledge about relations between these properties is strongly limited to particular types of environment. Therefore, extending it in the range of environmental diversity and large scales is a good motivation for interpreting satellite data. It provides relevant definition of long distance trends, but paid by the increased uncertainty in absolute measures. This creates a need of the ground based data for validating the data from space. The work employed Advanced Synthetic Aperture Radar (ASAR) images, from the ENVISAT mission. First, two ASAR scenes of Western Polesie, Poland (taken 24 May 2007 and 30 August 2007) were used to split this region on five basic classes: water, forest, meadow, urban area and swamp. Results were also confronted to observe changes during the vegetation season. Special attention was paid on Piaseczno Lake and Usciwierz Lake because their shores are different. The images allowed on proper recognition that Piaseczno Lake has dry shores, covered by high vegetation. Similarly the Usciwierz shores occurred in interpretation being moist and covered by low vegetation. Four different subsets of satellite images were selected, covering wetland, meadow, cultivated field, and forest. Several advanced methods for interpreting polarimetric data were employed: filtering of edges and gradients (Sobel method), and then, employing first two Stokes parameters, as they are provided by the tool program Beam ver.4.1. In parallel, the work was provided with ground based measurements of soil moisture and temperature and some other meteorological conditions. Soil moisture was measured on the days of satellite image acquisition in 89 places on May and 72 places on August. The program is aimed to provide validating data for the ESA SMOS (Soil Moisture and Ocean Salinity) Mission, in the frame of the Cal/Val campaign.

P307
Digital mapping of trace metal concentrations in regional top soils in the Swiss Plateau

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Regional-scale heavy metal pollution in soil is mainly caused by diffuse anthropogenic inputs and by the chemical composition of the parent material for soil genesis. Digital mapping of regional-scale soil pollution provides important information for soil protection and related disciplines such as land use planning, water protection and agriculture. To this aim we carried out geostatistical analyses of trace metal concentrations in different regions in the Swiss Plateau. For mapping the top soil concentrations we applied a kriging approach (external drift kriging) combined with a robust regression analysis. Besides the soil data that have been gathered in numerous sampling campaigns on arable land, grassland, forest, orchards and vegetable sites, we acquired and processed auxiliary data from available GIS databases, e.g. digital terrain model, maps for climate, soil type and land use. By combining the external drift kriging approach with robust regression, we give extreme trace metal concentrations, which appear as outliers in the data set, a small weight. Thus, we try to separate as well as possible soil pollution resulting from local point sources from diffuse regional-scale soil pollution.

P308
Spatial variability of soil texture and wetness: effects on thermal conductivity

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Variable weather conditions and different cultural practices, cause that physical properties of soil are substantially diversified from place to place, by the texture, density, wetness and other heterogeneities. The changes are modified by the plant cover, intensity of evaporation from the soil surface, natural subsidence of the soil and area configuration. The thermal conductivity is influenced by variable soil water content, bulk density, temperature and by relatively stable mineralogical composition and organic matter content. Recognizing the spatial and temporal variability of texture and wetness based on a large number of soil experiments and their effect on the thermal conductivity may be helpful for estimating and control of soil heat flux. This paper presents results of soil texture, wetness and bulk density that were measured in regular networks in surface layer (1-10 cm) on two cultivated fields. The measured values were employed to assess thermal conductivity of soil by means of the physical and statistical model. The model was calibrated and verified based on data from the experiments and literature. Spatial characteristics of the experimental data for each soil property were determined using semivariograms. It was found that the thermal conductivity was mostly influenced by soil wetness, mineralogical composition, bulk density and organic matter content and less by soil temperature and air pressure and humidity in the soil. At similar soil texture, the thermal conductivity was mostly influenced by soil wetness and bulk density. Differentiation in sand content had significant effect on spatial variability of the thermal conductivity. The semivariogram parameters of the thermal conductivity were related with spatial distribution of soil wetness, texture and bulk density. The study is being conducted in the project Soil Water Energy Exchange (SWEX AO-3275) in the framework upcoming Soil Moisture and Ocean Salinity (SMOS) Mission and in part funded by the Grant No. N30504631/1707.

P309
Comparison of techniques used in GIS for DEM generation from contours

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Contour elevation data still remain the most common terrain data source for DEM generation. The conversion of contours to regular elevation grid is basically a problem of interpolation. From a number of interpolation methods only such should be used providing a physically correct and plausible surface. In each GIS, there are usually preferred methods for this task. For example, in GRASS GIS, it is the interpolation by regularized splines with tension, while in ArcGIS, the iterative finite difference interpolation technique with incorporated drainage enforcement algorithm is used. It is based on a discretized thin plate spline technique. The choice of the conversion method and its input parameters can have a significant impact on the target DEM and its interpretation, on which the variety of environmental models are very sensitive. In the contribution, a review of the conversion methods is given, and their quality is examined by applications to sample artificial cases and a case study of a region in the Czech republic.

P310
Application of multi objective regression models to map the resilience characteristics of soil

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The resilience of soil defines its ability to recover from external stresses. We measured biological and physical resilience of soils across Scotland. Biological resilience was measured as CO_2 evolution from soil with added plant residues after either a transient (heat) or a persistent (copper) stress. Measures of physical resilience were compression and expansion indices; and porosity changes following an overburden stress and subsequent wet/dry cycles. This study found no clear relationship between physical and biological resilience, or between resilience and other soil properties.
A recently developed methodology of multi objective regression modelling was applied to examine underlying relationships between different attributes describing soil resilience. The dataset consisted of ten attributes describing soil physical properties (soil texture), chemical properties (pH, C, N, soil organic matter), FAO soil classification, and indicators of physical (compression,overburden stress) and biological (heat, copper) resistance and resilience. The resulting flat table of data consisted of 26 by 18 data entries.
We produced a number of models depending on different combinations of dependent attributes. We applied Leave One Out validation, which is commonly used when the number of cases is small. The final model selection was based on best performance measured by Root Mean Squared Error and Correlation Coefficient. Models were used as filters for existing GIS datasets of Scottish soils. The maps produced defined remarkably distinct areas in terms of physical and biological resilience.
Multi objective regression modelling has been confirmed as an advanced technique to overcome problems of single attribute modelling. This new approach has identified relationships between biological and physical soil resilience, which were integrated into regression models and applied to GIS datasets to produce soil resilience maps. The research found causal links between properties and functions of soil, which is an important step toward sustainable land use.

P311
Digital soil mapping in forest reserves: towards the development of forest site mapping

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The development of close-to-nature or continuous cover forestry requires a better understanding of forest dynamics, for which a better representation of abiotic factors is needed. We prepared site- and soil type maps of a forest reserve using digital site- and soil mapping methods at a scale of 1:10 000. Discriminant analysis, classification trees, and other classifications were used to derive soil-type maps of the study area. The results showed that the occurrence of dominant soil types was strongly correlated with relief variables, which were derived as predictors from digital elevation model. We found that the different methods of mapping had produced different soil maps while the same relief parameters, and soil samples were used. Rare soil types were missed but the frequent types remained roughly the same. The maps slightly changed according to changing the learning and test sample. Grouping the soil types, which are in close relation to each other improved the results of classification. Our conclusion was that digital soil maps should be made by all kinds of possible methods. The outputs have to be evaluated on the sound basis of expert knowledge. At last, decision has to be made on the reproducible information level, and the most likely spatial pattern of it before finalizing.

P312
Different approaches to spatial prediction of soil properties in mountainous areas

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The Jizera Mountains located in the northern part of the Czech Republic belong to high acid deposition affected areas. Detailed maps describing spatial distribution of soil properties are important for understanding the relationships between the soil acidification level and other environmental factors. A number of mapping techniques (simple and multiple linear regression, regression trees, regression-kriging, ordinary kriging, etc.) based on several types of input data (98 soil observations, digital terrain model, satellite images) were applied and evaluated using independent data sets. Results showed that there is a clear difference among tested approaches. Using of more advanced mapping tools generally leads to higher precision level in final maps.

P313
Multi-layer soil description for crop management by electric conductivity mapping

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Efficient crop management by farmers requires an understanding of soil distribution patterns within the fields. Due to the correlation between soil electrical conductivity (ECa) and clay or salt content, the patterns of the apparent ECa are generally aligned to the soil distribution. This relationship is often used to delineate a field in crop management zones. In doing so, it is assumed that the respective ECa-profiles and the clay profiles within a management zone are sufficiently similar. The objective of the investigation was to clarify whether this hypothesis can be verified for a 28-ha field.
The experimental field is situated in the north-eastern part of Germany in a glacial drift area. It features loess sediment deposits overlying glacial sediments. The Veris 3100 and the EM38-DD were used to collect the ECa at two depths simultaneously on a dense grid. By classifying the ECa readings, ECa maps with EC zones were generated. A mobilised vehicle-pulled variant of a fixed-electrode array equipment was developed consisting of a 20 electrode array in a Schlumberger configuration. Using this equipment the field was sampled on a 27 x 40 m grid collecting the ECa in 9 depths. A specialized inversion program estimated the conductivities of four successive depth increments to a depth of 1.8 m.
The ECa profiles differed not only between different ECa zones, but also within them. Therefore, the allocation of one ECa profile to an ECa zone produced from ECa measurements collected for only one depth is a generalisation which characterizes just roughly the true distribution of the ECa profiles. To conclude, for the characterisation of soil concerning crop growth; the production of soil maps should focus on accurate soil layering. In doing so, a requirement of a collection of ECa in various depths and its interpretation by an inversion program is essential.

P314
Feasibility of bioindication approach to soil spatial variability

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Bioindication approach has some advantages over the usual description of chemical and physical features of a soil. The most interesting feature is the close relation between ecological communities and the soil microenvironment, which leads to fine variations of organisms populations related to small but significant changes in chemical or physical parameters.
Here we propose the use of different microarthropod groups communities as a bio-indicator for different soil properties. The subdivision of these organisms in groups is based on taxonomical considerations, along with the degree of adaptation to the edaphic environment, expressed by organism morphological adaptations.
The study was performed on a doline site in a pasture area in the Italian Alps, at an altitude of 1900 m a.s.l. To model soil chemical and physical variability, a total of 110 samples were collected over a surface of 1.5 ha; within the area a subgroup of 40 soil sampling points was selected to study the spatial variation of micro-arthropod communities.
Different kind of multivariate statistical and geostatistical analysis were performed to study the spatial distribution of soil microarthropod populations. Soil properties were interpolated by means of regression kriging, and ecological distribution was studied by means of multivariate statistics. The results of the study show a good degree of correlation between the variations of soil properties and the microarthropod population ecology, evidencing the feasibility of a bioindication approach to monitor soil changes and degradation.

P315
Chernozems data set analysis: implications for a detailed soil allocation model

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Legacy data represent still an important source of information on soil cover and soil properties. In the Czech Republic, a detailed Systematic soil survey was carried out in the 1960s. In this study, a set containing data on 338 Chernozem profiles from all over the Czech Republic was analysed in order to assess and highlight differences between particular subunits (haplic, luvic, endogleyic; clayic, arenic). Data on soil textural classes, humus content, pH, cation exchange capacity, and base saturation for individual soil horizons were analysed. Mean values, variance, and statistical distribution of data in each subunit were determined. Analysis of variance was used as the first test of variation between classes. It was shown that biggest differences were in the textural composition. However, significant differences between soil subunits were found also in chemical characteristics of the soils. Cluster analysis as an unsupervised classification was applied and the resulting clusters were compared to the traditional classification. The effect of locality and parent material was also considered. Finally, representative profiles were calculated as the subunits centroids. These representative profiles can be used as the basis for a fuzzy soil allocation model.
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P316

Digital soil mapping at regional level using the knowledge derivate from existing soil maps at medium and large scales

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When performed using conventional mapping techniques, soil survey at regional level is time and means-consuming. The recent developments in digital soil mapping, Geographical Information Systems and remote sensing afford new opportunities for soil surveyors to produce maps of soil types or properties optimizing the ratio quality vs. cost. The French national program "Inventaire, Gestion et Conservation des Sols" (IGCS) aims to provide digital soil landscapes maps at regional extent (scale 1:250 000). In the region Brittany (northwestern France), soil maps pre-exist for 40% of the total area at scales ranging from 1:25,000 to 1:100,000. The objective of this ongoing work was to propose a methodology to extrapolate pre-existent knowledge on spatial organization of soil properties and main soil types to unknown areas, at the target scale of 1:250,000. A three steps approach was explored: supervised classification (classification tree analysis) of known areas considering environmental factors (geological material, topography and soil occupation), extrapolation to unknown areas according to combination of soil-forming factors, and up-scaling procedure to achieve a restitution by soil landscape legible at the scale of 1:250,000. Two types of variables were predicted: soil properties estimated individually (parental material including superficial deposits, potential hydromorphy and soil thickness), and soil type units. The developed digital soil mapping approach is complementary to a sampling campaign in unknown areas and is expected to be helpful to qualify the spatial representativeness of punctual observations.

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Characterisation of the spatial variability of bare soil respiration from plot to field scale

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Soil respiration in known to be highly variable in space and time. However, little is known about the spatial variability of heterotrophic soil respiration from plot to field scale. We simultaneously measured soil heterotrophic respiration, soil temperature and soil water content at 48 locations with a nested sampling design and at 76 locations with a regular grid plus refinement for 15 measurement dates within a 14x14m bare soil plot. At field scale (190x70m) we measured at 61 locations for 6 measurement dates. Soil respiration was measured with a closed-chamber covering a surface area of 0.032 m^2. The data was investigated with geostatistics indicating a mean auto-correlation length of 2.7 and 25 m for heterotrophic soil respiration at plot and at field scale, respectively. We detected rather high coefficients of variation between 0.13 and 0.80 with an average of 0.33 for the plot scale and 0.60 for the field scale. Statistical analysis revealed that the spatio-temporal behaviour of heterotrophic soil respiration could be explained sufficiently by the state variables soil temperature and water content. The spatial variability of respiration alone was mainly driven by the variability of soil water content, which was almost one order of magnitude higher than for soil temperature. Cross-semivariances between heterotrophic soil respiration and both, soil water content and soil temperature, showed a spatial correlation structure, which could be used in a co-regionalisation method. For the given experimental setup a conditional stochastic simulation is seen as an appropriate method, since the simulation preserved the variogram and the probability density function and because a local estimation was associated with a rather high uncertainty.

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Spatial variability of available phosphorus at the one-hectare scale in Misiones, Argentine

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Phosphorus is a critical element for plant growth and it has a complex soil chemistry. Its availability depends on soil pH, organic matter content, sorption on clay and iron oxides, and interactions with secondary soil minerals such as calcium and iron phosphates. Soil phosphorus levels are critical for maintaining productivity of Alfisols and Ultisols of the Misiones province, Argentine. The aim of this study was to evaluate the P availability at the plot level in a forest stand of *Pinus elioti* at Misiones province. A total of 221 soil samples were taken on a regular grid. Total available P, as well as organic and inorganic available P fractions were determined after bicarbonate extraction according to the Olsen P test procedure. Mean values of total, inorganic and organic Olsen-P contents were 19.1, 3.1 and 16.0 $mg.kg^{-1}$, respectively. Maximum values were 53.8 14.7 and 41.3, whereas minimum values were 10.7, 0.7 and 8.8 mg.kg-1, for total inorganic and organic Olsen-P, respectively. Coefficients of variation were lower than 6% and ranked as follows: total P > organic P > inorganic P. Significant correlations were found between these P available forms. The spatial structure of total, organic and inorganic Olsen available P was analyzed using geostatistics and variogram models a nugget component and a structured component were found to fit the experimental determinations. Maps were constructed by the kriging technique allowing identification of small regions with available P deficiencies at the study scale.

P319

Soil reaction variability under forest and arable land

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Soil variability at a very detail scale under different land management and in different depth was studied. Several factors form the soils including their properties and variability. Land use is one of the very important factors influencing soil properties. Agricultural arable land is generally considered as potentially less variable due to homogenisation by management practices at the topsoil, while the forest area is usually considered as potentially more variable area due to the influence of natural vegetation. The study area (1500 m2), represented by Haplic Cambisols on granite, consists of forest (Pinus, Betula, Vaccinium, Rubus, Luzula) and agricultural arable land with traditional tillage practices. The soil reaction (pHKCl) was observed at regular squared sampling scheme (60 points). Three parallel rows (20 sampling points at each) crossing the two different landuses 5 meters apart were sampled at depths 0-20 cm, 25-40 cm and 45-60 cm. Data for agricultural and forest soils were compared at the mentioned depths. The comparison was done by ANOVA and Multiple Range test. The statistics showed significant difference between soil reaction of the forest and agricultural soil. The pH of forest soil was significantly lower than that of agricultural soil in all three depths. The pH in forest increased towards depth (from 3.3 to 3.6), while it decreased towards depth in agricultural soil (from 5.2 to 4.7). This can be explained by the fact that effect of soil management decreases with the depth, where the influence of soil substrate increases. The variability of pH was surprisingly highest in the topsoil of arable land (21 %). The variability slightly decreased with the depth to 11 %. In contrast, the variability at forest was lowest at the top layer (1.4 %) and slightly increased with the depth to 4.9 %.

P320

High resolution soil sensing of multiline transects in the Wetterau region (Hesse/Germany)

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Representative data collection plays a crucial role in digital soil mapping. In a case study in Hesse, Germany combining GPR based soil surveys and digital soil mapping of soil transition zones have been investigated on the basis of 26 representative transects.
The study area comprises 9 km2 of the north-eastern part of the fertile Wetterau Loess region. Soil forming substrates originate from loess covering tertiary basalts of the Vogelsberg volcanic complex, in various thicknesses. During the end of the Pleistocene the substrates have undergone soil mixture processes and transport resulting in periglacial slope deposits.
Focused on the soil class transitions, derived from the official soil map 1:50.000, we investigated the mapping accuracy of the boundaries by zero offset GPR surveying with 200 and 400 MHz antennas guided by 10 m step augers for validation on the transects of 50 to 200m length.
Additionally, pedophysical and -chemical characteristics were sampled and described on the basis of 15 calibration profiles for all soil units to generate high resolution digital soil maps based on the interpreted radar wavelet data.

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Mapping spatial variability of soil texture in precision agriculture

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Information about soil texture is from agronomical point of view important especially for plant nutrient management and soil tillage. This information is the criterion for assessment of soil nutrient status and it is the input information for field variable soil tillage. Traditionally information about soil texture is obtained by soil sampling and laboratory analysis. However use of this method in precision agriculture is considerably expensive and time-consuming. For these reasons there was conducted an experiment to verify use of two indirect methods - measurement of apparent soil electrical conductivity (ECa) and digital aerial imaging. In 2005 there was on 53-ha experimental field situated in the South Moravia region (Czech Republic) with arenic chernozem soil type performed ECa measurement using EM38 (Geonics Limited, Canada). At the same time 40 topsoil samples were taken for soil texture analysis. In 2007 was acquired digital aerial imagery of bare soil. After principal component analysis (PCA) were images compared with results of ECa and soil texture sampling (clay, silt and sand content). There were found moderately strong correlations between PCA images, ECa and clay content. This shows, that examined indirect methods are suitable tools for mapping within field spatial variability of soil texture and can be used for soil sampling optimization and for determination of so-called management zones on the field.

P322

Geophysical auxiliary data and soil water content spatial prediction: the multi-collocated co-kriging approach

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Soil water content (SWC) maps at farm scale with different spatial resolution are required as input information for different purposes, such as irrigation scheduling, crop management or also the use of soil-plant-atmosphere (SPA) models for addressing several practical purposes.
In this specific work spatial distribution of SWC is estimated using geophysical data; the study site is located in the Sele plain at the farm “Improsta” (Salerno, Italy).
Soil moisture was measured by Time Domain Reflectometry (TDR) in the upper 0.15 meters layer. At the same time a geophysical survey has been carried out with EM38DD arranged for both vertical and horizontal dipoles measurements simultaneously.
After site-specific calibration of field TDR survey and filtering of geophysical data, a geostatistical approach has been performed in order to make spatial inference of soil moisture. At least two types of kriging are addressed in order to evaluate the usefulness of geophysical auxiliary data: (1) the ordinary kriging and (2) the multi-collocated co-kriging.
Preliminary results show a better performance of models which incorporate the geophysical auxiliary data as emphasized by cross validation. Further investigations should highlight the feasibility of geophysical survey in routinely hydrological characterizations of soil.

S03 Soil Erosion

P323

Investigation of evaluation sediments in natural forest under management in 14 years period, Caspian forest, north of Iran

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This study has been carried out in order to determine the function of management operations in erosion and production of sediment, and also to determine the best method of foresting capable of decreasing the production of sediment. The region under study is located in Guilan province in the north part of Iran with the scope of 13284 hectares and the height slope of 50to 1900 meters above the sea level .In this study ,initially , The physical factors of basin like slope ,geographical direction ,altitude, geology, hydrology, and precipitation , soil specialist ,and vegetative covers were studied. Further more, methods of silviculture and forestry performed, rate of road construction, afforestation , and the performed methods of forest harvesting in the period of 14 years(1987-2000) went under study. Then, the amount of the produced sediment of basin in the period of 14 years (1987-2000) was estimated by the sedimentation station located in the basin.
By analyzing the statistics and examining the produced graphs , the following results were achieved :
Clear-cutting system is the worst method and single selection system is the best method for decreasing the amount of erosion and the produced sediment of aquiferous basin .with the beginning of clear-cutting system in 1993 , the amount of sediment increased 0.92 ton/heactar in proportion to 1992.
The amount of coefficient correlation of the yearly produced sediment, the amount of afforestation , road construction , forest harvesting R= 0.925 was estimated considering %5 error probability

P324

Erosive degradation of a soil cover of the Azerbaijan Republic

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In territory of the Azerbaijan Republic erosion is a major factor of a soil cover degradation. With erosion process the soil loses the fertility in connection with carrying-out of humus and mineral elements in a liquid and firm drain, the soil deteriorate physical and water-physical properties too.
The territory of Azerbaijan characterized by various geomorphological, climatic, soil-vegetative conditions which promote unequal development of types and kinds of erosion.
It is established that from a total area of republic more than 80 % are erosion-dangerous. From them 41,8 % are subject to a various degree of erosion. 48,6 % agricultural holding are eroded. From them more than 33,5 % are subject to water erosion; 6,4 % are subject to irrigation erosion and 8,7 % are subject to wind erosion.
Erosive processes in various agriculture holding take place with unequal intensity. So, on ploughed up soils the area of eroded soils is 61,2 %, on deposits-31,5 %, on long-term plantings -19,2 %, on haymakings-21,1 %, on pastures - 61,6 % and on wood fields-21,8 %. In erosion-dangerous territories of republic rapidly develop the degradation process of soils.
Calculations have shown, that annual erosive losses of soil from common territory makes 10-25 tone/hectare. From them humus - 180-500, nitrogen - 15-80, phosphorus - 40-120, potashium -60-150 kg/hectares.
On the base of analysis of erosive degradation processes of soil cover of Azerbaijan were established the modern erosive condition of the soils and estimate the intensity of wash-out soils.

P325

Analyses of relations between variable factors and water erosion changes (case study: Yamchi dam drainage basin, Ardabil, Iran)

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In this research, the relations between variable land factors and variations of some types of water erosion have studied in drainage basin of Yamchi dam, Ardabil, Iran. Main types of water erosion in the study area include sheet, rill, channel and riverbank erosions that their relations with temporally variable factors affecting their development, derived via the studies during two time sections 1968 and 2006. In addition, the mainly studied effective factors include drainage density, vegetation cover and land use. The results showed that there is a closely relationship between water erosion development and variations of temporally variable factors. Thus, during the time, the drainage density factor has increased and with its increasing, the percentages of each type of water erosions have increased, too. According to decreasing of vegetation density, sheet and rill erosions have increased, but no well-defined relations were detected in channel and riverbank erosions. Also, land use type and its changes during the time, had a significant rule in formation of different types of water erosions. Finally, with regard to land degradation condition and its transformation into inefficient agricultural lands along with vegetation cover decreasing, varieties and areas of water erosion types have increased.

P326

A decision support tool for soil erosion assessment in Switzerland

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Swiss legislation regarding soil erosion protection demands measures on arable plots where soil loss is observed regularly or where the guide value of 2 and 4 t/ha and year for soil depths up to 70 and over 70 cm, respectively, is exceeded in the long-term. A leaflet supports the farmer or the agricultural advisor in assessing the amount of soil loss by erosion. On the basis of 24 photographs different erosion features and quantities of soil loss are pointed out. A first classification of erosion damage in the field thus can be made. A guidance checklist allows estimating the quantity of eroded soil by measuring the erosion features. Eroded soil volumes of all linear erosion features deeper than 2 centimetres (rills, gullies) are calculated by multiplying the lengths of erosion features by representative cross-sectional areas (mean depth, mean width), as measured with a tape or ruler. Arithmetical examples and evaluation tables complete the leaflet and facilitate the soil erosion assessment by the farmer or agricultural advisor.
The scientific background for this leaflet originates from long-term monitoring of soil erosion in Switzerland. On over 200 arable plots, damage mapping of all visible erosion features has been carried out after every erosive precipitation event for more than 10 years. With the leaflet scientific results are converted into a practice-friendly form helping to ensure the adherence of legal regulations and/or facilitating their implementation.

P327

Quantification of erosion process through plot measurements and radioisotopic methods (^{137}Cs, ^{210}Pb)

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The magnitude of sedimentation processes was evaluated using Fallout RadioNuclides 'FRN' (^{137}Cs and ^{210}Pb) and the magnitude of erosion rates was quantified on mid term (13 years) using conventional runoff plots measurement in a small agricultural watershed under conventional and conservation cropping practices at Mistelbach located in Austria.
Seventy six samples were collected on integrated grids basis in a small undisturbed forest within the watershed. The ^{137}Cs reference value was evaluated at 1954±91 Bq m^{-2} (mean ± 95% confidence interval) with a coefficient of variation of 20.4 %.
The use of the ^{210}Pb method didn't provide expected output. Due to a similar activity of total ^{210}Pb and ^{226}Ra reflected by a very low level of unsupported ^{210}Pb ($^{210}Pb_{ex}$) coupled with a high variability of the initial fallout inventory (2.7 Bq kg^{-1} ± 115% (mean ± CV); n=11) and a high measurement error (377±210% at the 95% confidence level; n=40), it was not possible to utilize the ^{210}Pb method.
Two one meter soil profiles were collected in the sedimentation area and analysed using the ^{137}Cs approach. A sedimentation rate of 13.2 t^{-1} ha^{-1} yr^{-1} to 65 t^{-1} ha^{-1} yr^{-1} corresponding to an average layer deposition of 0.9 mm yr^{-1} and 4.7 mm yr^{-1}during the 1954-2007 period was estimated.
These results were linked and completed by long-term erosion measurements from runoff plots just upslope from the sedimentation area. The average soil erosion reached 29.4 t ha^{-1} yr^{-1} from the conventional tilled plot, 4.2 t ha^{-1} yr^{-1} from the conservation tillage plot and 2.7 t ha^{-1} yr^{-1} from the direct seeding treatment.

This study demonstrates the complementarities of both approaches in order to assess erosion and sedimentation processes under different conservation cropping practices.

P328
Use of the ^{137}Cs technique under tropical conditions: Estimation of medium-term soil redistribution rates in Ibadan, Nigeria

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Soil erosion is one of the most critical environmental problems in Sub-Saharan Africa which needs to be combated. Data on soil redistribution are necessary to guide the development of effective resource management. The use of fallout radionuclides as tracers can provide these information, since these elements are quickly and strongly adsorbed by soil particles after deposition and primarily redistributed by water and wind. The contribution represents the test of this technique under tropical conditions.
The erosion measurements were made in Ibadan, Nigeria, (7°30'N 3°54'E) in 2007. Two reference sites were sampled to characterize the spatial and vertical distribution of caesium-137 (^{137}Cs) in undisturbed soils. A field with ridges prepared parallel to slope was sampled according to a grid design to determine the spatial ^{137}Cs distribution. Cores for depth-incremental sectioning were also taken on the upper and lower slope to describe the ^{137}Cs depth profiles. All soil samples were analysed by gamma spectrometry using a high-purity Germanium (HPGe) detector. The results obtained from the reference sites show the highest ^{137}Cs concentration in the upper few centimeters of the topsoil and a decrease with depth. The analyses of the samples collected from the field are still in progress. As soil erosion was observable, it is expected that the ^{137}Cs inventories will be reduced in the soil of the upper slope and increased in the deposition zone on the lower slope. The ^{137}Cs inventories will be interpolated to visualize the spatial distribution of soil redistribution within the study area on a map. Different conversion models, including mass balance models, will be used to estimate the rates of erosion and deposition based on the measurements. Hence, the study will contribute quantitative data on the extent and amount of soil redistribution in the savanna of West Africa which is needed to promote improved soil conservation.

P329
Soil and plant responses to biosolids application in an abandoned agricultural land

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Re-establish the canopy cover is the key to the control of soil erosion in a degraded soil. The applications of biosolids are potentially a convenient means of enhance soil fertility. These materials are a valuable source of organic matter and plant nutrients which can have positive effects on soil physical, chemical and biological properties.
Biosolids (composted anaerobically digested sewage sludge) was surface-applied once at rates of 0, 30, 60 and 90 Mg ha^{-1}, to a degraded abandoned cropland located in central region of Spain. The climate of the area is Mediterranean continental, belonging to semiarid type. The soil is described as Typic Haploxeralf Calciorthid. The experimental field design was established as a randomised complete block and the treatments were replicated four time.
The spontaneous vegetation was sampled at spring to obtain species richness and total plant biomass production. Both parameters were randomly measured in spring (5 moths after biosolids were applied). Total macro nutrient and heavy metals concentration were analysed. Six composite soil samples were taken from each plot at two depths (0-10 and 10-20 cm) one year after the biosolids was applied. The soil samples were analysed for chemical properties and for total and available heavy metals.
The result of total biomass yield and % of species richness showed only a significant increased with the high biosolids application. High rate of biosolids application were also associated with increased concentration of N, P, Zn and Cu in both tissues (root and aerial part) relative to the unamended plot. The levels of plant nutrient in soil were higher than the control. Organic C levels did not significantly change with the biosolids treatments. The results confirm the usefulness of biosolids as an organic amendment for restoring degraded sites and could contribute to reduce water soil erosion in abandoned cropland.

P330
Quantitative analysis of gully erosoin and sediment yield in the Busmange Chay basin to manage it (Iran-Azerbayjan)

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The Busmange Chay basin with an area of 274.746km^2, 300 mm annually rainfall, drainage density of 1.04km/ km^2, is located on the North West of the Iran. The drainage system length of basin is 285.8 km and average gradient of it % 7.8 estimated. The soils texture and structures and some properties of this basin soils (such as, PH, Ec and etc) with laboratory and fieldworks determined. Neo-tectonic influence, impact, average high gradient of basin and runoffs from intensive rainfalls leads to soil wasting via rill and gully erosion. Some parameters of gullies such as Length, gradient, deep, width and etc are invistigated with fieldworks and morphometry of them (with obtaining aerial photos, topographic maps). Related to increasing of gradient of slopes, the unresistant soil formation and then both length and number of gullies decreased. This subject with negative correlation coefficient of %45 can be verifying. There are negative significant with %95 confident and %75 correlation between width and depth of gullies. Also between the depth and length of gullies there are reverse correlation with -%48 and verifying the average deep and number of gullies at the pidement and plains area more than steepness mountains area). According to the results of this case study gully erosion is one of the important factor to instability and erosoin of fertilizer top layer soil formation on the mountain slopes and plains area. Average annually yield of sediment in the study basin is evaluated 206.005 ton/ha/year and total yield of sediment of it 61734229 ton/ha/y and indicated high ratio of soil erosion via runoffs. Therefore some suitable methods are suggested to control of gully erosion and soil wasting in the Busmange Chay basin.

P331
Soil erosion by water in Aleppo pine stands (Pinus helepensis Mill.)after fire

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In Mediterranean part of Croatia fire occur often because of climatic conditions and vegetation stand. Soil erosion on burnt areas becomes excessive, where in a very short time after burning the layer of soil disappears. On the burnt area of Aleppo pine in the hinterland of Split (SE Croatia), a year after the fire, a stationary forest experiment was set, coordinates : N 43°31´, E 16°32´. The experimental plot (20x5 m) lies on the eroded brown rendzina soil on marl, at an inclination of 20° and sea level 212

m. During the four year experiment (2002-2005), we were observing the quantity and intensity of rainfall, the surface flowoff, soil erosion and vegetation progression on the burnt area. The results show that from 265 rainy days, 105 of them caused surface flowoff and soil erosion. The rainfall of 5,9 mm (medium intensity) to 133,7 mm (very high intensity) caused them. The yearly quantities of erosion were between 0,11 t/ha to 19,75 t/ha, the surface flowoff from 9,73 mm/m^2 to 36,31 mm/m^2, with the coefficient flowoff from 0,0026 to 0,2697. The surface flowoff of rainfall and soil loss are the greatest in the first year of observation, the second after the fire, when they were caused by rainfall of small intensity and small quantity, under 10 mm. Year by year the natural progression of vegetation on burnt areas advanced. Four years after the fire, the coverage of the plot amounted to 80% (Aleppo pine and maquis), and soil loss was not so big. On erodible soils without the forest vegetation the soil has no protection from rainfall, so the surface flowoff and soil loss are very great. The areas without the vegetation cover because of fire are liable to the greatest soil erosion in the first and second year after the fire.

P332
The effect of wildfires on soil erosion and runoff under mediterranean conditions

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Wildfire is one of the most extreme event occurring during the summer periods in the Mediterranean region. To study the effects of wildfire on soil erosion and runoff water a series of experiments using a portable rainfall simulator were conducted in the South Peloponnese, Greece.
High (60 mm hr^{-1}), intermittent (40 mm hr^{-1}) and low (20 mm hr^{-1}) rainfall intensity was applied to the soil surface. Representative severely burnt, moderately burnt and unburnt surfaces (plot size = 0.5 m^2) under dwarf oak, pine and cedar forest were selected, on slopes of comparable angle. Soil moisture, runoff initiation time, the runoff water and soil erosion were monitored for 30 minutes after the runoff initiation time, while sediment and runoff samples were collected and analyzed in the Laboratory.
Average ponding time, for the 60 mm h^{-1} rainfall intensity varied from 6.8 min for the severely burnt site to 13.2 min for the unburnt site. The average runoff as a percentage of the applied rainfall for the 60 mm h^{-1} intensity, varied from 62.2 % for the severely burnt site to 12.6% for the unburnt site, while for the 20 mm h^{-1} varied from 19.8% for the severe burned site to 3.2 % for the unburned site. Sediment yields from severely burnt terrain, standardized to events of 15 minutes duration, were estimated to be 0.96 (SD=0.67), 0.15 (SD= 0.09) and 0.03 (SD= 0.01) t ha^{-1} for 60, 40 and 20 mm hr^{-1} intensity rainstorm events respectively. These were notably higher than those from unburnt control sites with sediment yields of 0.06 (SD=0.04), 0.01 (SD=0) and 0.0 t ha^{-1} (again for 60, 40 and 20 mm hr^{-1} events). The results of this study have important implications for mitigating the downstream impacts of wildfire on water and ecosystem quality.

P333
The experience of the monitoring of erosion processes on cultivated soils of the Republic of Belarus

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Soil cover diversity, distribution and intensity of erosion served as prerequisites for the fulfillment investigations in the field of division into districts of Belarus according to soil and ecological criteria, which is completed by the Institute of Soil Science and Agricultural Chemistry of the National Academy of Sciences of Belarus. There are three provinces have been identified according to mentioned criteria: Poozerye (Lakeland), Belarusian ridge, Polesye). Each of them characterizes by their particular climate, relief, agrotechnical conditions of lands, bedrocks and soils. Erosion liability grade of soils is an important criterion for the division into districts.
Key sites along with experimental fields and stationary areas are objects of monitoring observations. Key site is a too large territories (15-20 ha), which are typical for concrete soil and ecological provinces.
Key sites for conditions of hilly-morainal landscapes of Poozerye and Belarusian ridge are presented by elementary catchment areas. Their purpose is to establish of water yield concentration sites, to assess the erosion intensity and soil cover structure investigation. Stationary fields and areas are placed within key sites and present itself as a geomorphologically solid catena including non-eroded, eroded and overwashed soils. They assigned for study of composition and peculiarities of eroded soils and determination their appropriate utilization.
Land-reclamation objects are key sites for Polesie drained lands. They serve for the study of component composition structure of the soil cover and for the quantitative assessment of deflation processes. Stationary fields and areas are presented by tracts, which are typical for key sites. They assigned for the study of composition and peculiarities of soils predisposed to deflation, the degradation rate of peat organic matter and the development of ways for its preservation.

P334
Digital erosion mapping and quantification of mass movement in tropical areas, Sierra Norte de Oaxaca, Mexico

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The tropical mountains of Sierra Madre del Sur, Mexico, were reported to have a high pedodiversity. This diversity is mainly ascribed to erosion and slope processes (mass movement, colluviation, accumulation of sediments transported by sheet, rill and interrill erosion), triggered by seismic events and rainstorms. Although, the erosion process has been accelerated due to land use changed from forestry to agricultural areas. The situation is evident in the mountainous system Sierra Norte de Oaxaca, Mexico, which constitutes a part of Sierra Madre del Sur physiographic region. The objective of this research was to evaluate (a) the landscape transformation and changes in the erosion rates during the last decades (b) the terrain morphology changes due to mass movement (volumes of soil displaced, slope morphology changes and slope degree changes). The analysis of landscape transformation and the assessment of mass movement and erosion were based on the comparison of landscape characteristics in three different periods, and on the estimated soil loss rates. Multi-temporal data (aerial photographs and digital terrain models), the Revised Universal Soil Loss Equation (RUSLE), and GIS analysis were used. Several soil groups are found in the study area: Regosols, Alisols, Umbrisols, and Cambisols. The contribution of newly accumulated sediment was previously underestimated. The effect of newly accumulated material varies from slight modification of soil properties to complete burial of a soil that forces pedogenesis to begin from “time zero”. Sediment accumulation due to slope processes should be included in a general pedogenic model for the study area.

P335

Flocculation behaviour of soil suspension in relation to the polyacrylamide application, shaking time and temperature

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Suspended solids, and especially phosphorus (P) retained by them, transported in surface runoff from agricultural soils can produce detrimental effects in recipient water. High molecular weight polyacrylamides (PAM) are used to reduce dispersion and promote flocculation of soil particles, and thereby to restrict erosion and P losses. The flocculation behaviour of two clay soils was studied subsequent to the application of anionic and cationic PAM solutions of increasing flocculant concentration (0, 10, 25 and 50 mg L^{-1}) using 1- and 24-h shaking time at temperature of 5 and 20°C. For both soils, four sets of soil suspensions (four replicates) were prepared by adding 1 g of soil and 50 ml of PAM solution to centrifuge tubes. Two set of the tubes were shaken at 5°C for 1 or 24 h, and two sets at 20°C for 1 or 24 h. Immediately after shaking, the absorbance of the suspension was recorded after 5 min, 30 min and 60 min of settling time using UV-VIS spectrophotometer. The absorbance data was expressed as the relative flocculation index, i.e. the proportion of the control sample (no PAM) to the PAM-treated sample. The results showed that the flocculation behaviour of the PAM-treated soil suspensions was particularly affected by the soil-solution contact time and the PAM dosage, not so much by the temperature. The soil of higher clay content showed better performance at all PAM dosages with the exception of the cationic PAM at the highest dosage. After 1-h shaking, the anionic PAM generally was very efficient at all dosages, however, the cationic PAM was superior at the highest dosage. After 24-h shaking, there were no statistical differences between anionic and cationic PAM treatments: neither of the polymers formed flocs strong enough to resist redispersion along with the increasing mechanical stress.

P336

Spatial rill initiation and rill development on terraced agricultural fields in Angereb Sub-watershed, Ethiopia

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Rill erosion is a commonly observed erosion feature on agricultural lands in the northern and central highlands of Ethiopia. However, there is lack of quantitative information describing its amount, initiation and development. The objective of this study is to investigate the spatial initiation and amount of rill development on terraced agricultural fields in North Gondar, Ethiopia.

During July to August 2007, rill erosion survey is carried out on twenty-seven field plots (5m x 6m) with conservation terraces constructed in the 1970's. The field plots differed in crop cover, slope gradient, and soil texture. Rill development was determined along four 1.5m long transects after each rainfall event. Rill depth, width, and rill spacing were measured. From the measurements rill density, rill volume and a newly defined rill index (RILINDX) are determined. These three parameters are more related to hydrologic and geomorphologic features of the slope profile and will be used for the evaluation. The findings are summarized in an erosion topo-sequence and shows the cause and effect relationships.

Considering all rills, the large variation in the quantitative indicators reflects the variety of factors influencing rill development. The magnitude of rill erosion parameters for different crop covers, soil texture, and slope gradients were estimated. Damaged and poorly designed soil conservation structures alone are responsible for 45 % of the rill damage observed. Such failures in conservation terraces suggest that more detailed information should be used for appropriate design of conservation measures to minimize the risk of irreversible damage and thus to make it more efficient.

P337

Effects of palm-leaf geotextile mats on the conservation of temperate agricultural soils in the United Kingdom

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Geotextile-mats constructed from *Borassus aethiopum* (Borassus palm of West Africa) and *Mauritia flexuosa* (Buriti palm of South America) leaves have the potential to decrease soil erosion. We investigated the effectiveness of employing these mats as a potential soil conservation technique. Field experiments have been conducted at Hilton, east Shropshire, U.K (52°33'5.7" N, 2°19'18.3" W). Two sets (12 plots each) of experiments were established to study the effects of Borassus and Buriti mats on splash erosion. In both sets, 6 randomly-selected plots were completely covered with mats, and the rest were bare. Ten runoff plots (10 x 1 m on a 15° slope) were established, with duplicate treatments: (i) bare soil; (ii) grassed, (iii) bare soil with 1 m Borassus-mat buffer zones at the lower end of the plots, (iv) bare soil with 1 m Buriti-mat buffer zones and (v) completely covered with Borassus mats.

Results (during 22/01/07-17/12/07; total precipitation = 670 mm; n = 20 measurements) indicate that Borassus mats on bare soil reduced soil splash erosion by ~90% compared with bare plots (198.1 g m^{-2}). Results of runoff plots (during 08/01/07-14/01/08; total precipitation = 728 mm; n = 29 measurements) showed that all treatments had statistically similar effects in reducing total runoff and soil loss compared with bare plots. Total runoff from the Borassus buffer zone plots (4.1 litres m^{-2}) was ~83% less and total sediment yield was ~93% less than the bare plots (2.39 kg m^{-2}). It has been observed that the functional longevity of the Buriti mats is nearly one year. However, the Borassus mats are still in good condition and previous experience suggests that the longevity of these mats is ~2 years at Hilton. Hence, we conclude that Borassus-mat (buffer strips) cover is very effective for soil and water conservation on these loamy sand soils.

P338

Mapping soil erodibility using geostatistics and GIS techniques in Baleghli Chay watershed, Ardabil, Iran

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In this research, soil erodibility has been mapped in the Baleghli Chay watershed of Ardabil province, Iran. Soil erodibility is described with *K* factor that is an important and very effective parameter on soil erosion. In order to providing the erodibility map, were used of geostatistics and GIS techniques, because of its spatially variability nature and high precision obtained from the results. Methodologically, at first, 42 usable soil samples across Baleghli Chay, Ardabil, were collected. For each of those samples, were obtained an estimate of particle size distribution, organic matter content, structure, permeability, and calculated soil erodibility as described by Wischmeier and Smith (1978). Then, two methods were used in estimating *K* factor including: (i) point to polygon and (ii) spatial analysis methods. In the end, the maps of them were supplied using geostatistics and GIS techniques and classified to some classes according to pixels distribution curve of the obtained maps. The results showed that using geostatistics with GIS could help providing and classifying of the erodibility maps so carefully in comparing with the traditional point to polygon methods. In addition, the spatial analysis has more precision and updating of the previously provided maps is easy in case of using GIS.

P339
Modeling and validation of rainfall erosion index in Lake Urmia basin

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Rainfall erosivity of Revised Universal Soil Loss Equation (RUSLE) is influenced by the type, amount, and the intensity of storm. In this research, rainfall data from 18 recording rain gage stations at Lake Urmia basin were analyzed and single storm, daily, monthly, and annual erosion indices were calculated and estimated by different models. Duration of each rainfall was divided to 15 minuet-intervals. Intensity and energy of each interval, maximum rainfall intensity of 30 minuets, total energy of each rainfall, and erosivity index of every single storm were calculated. Besides, Cooley's model () for single storm was validated and it's coefficients were estimated. For daily rainfall erosion index prediction, Richardson's model () was evaluated and its coefficients were also estimated. A new power model based on monthly rainfall was presented in order to predict monthly rainfall erosion index. For estimating yearly rainfall erosion index, Arnold's model () was validated and its coefficients were estimated. The values of the coefficients for all equations were also determined by the given multiple regression equations. According to the calibrated Arnold's model, iso-erosivity map was drawn for the studied area consisting of the 150 rain gage information. The obtained results showed that models of Cooley, Richardson, Arnold's, and derived model for the monthly rainfall erosion index had a good agreement with the rainfall characteristics of the studied area.

P340
Rill and interril erosion produced by a single-storm event in an olive grove in central Spain

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This study deals with the influence of tillage practices on two small basins used for intensive olive grove. Rill and inter-rill erosion were measured. Two different catchment were selected: basin A: 0.9 ha with contour plowing and basin B: 2.3 ha plowed along the slope. The study site is located on the Southeast of Madrid (Spain), under semiarid Mediterranean climate. The soil over gypsic marls is classified as Xeric Haplogypsid. The average gradient of the slope is 10.1%.
An intense storm (I_{10}=55 mm.h^{-1}) took place on October 2007. The average of width and depth of the rills formed were measured every 2 m. Moreover, the sediment transported until the base of the basins was also considered by measuring the thickness of the layer of sediment. In this case, we used a 1x1 m^2 grid in the basin A, and 2 x 4 m^2 in the bigger basin B. This was possible thanks to its different particle size and color. The interrill erosion was measured using the mean of soil loss from 16 closed plots near the basins with Gerlach troughs. The interril soil loss was 0.59 t.ha^{-1}.
The basin A showed 4.10 t.ha^{-1} soil loss from rills, and 3.33 t.ha^{-1} of sediment was deposited at the base of the catchment. The difference between the total soil loss (rill+interrill erosion=4.69 t.ha^{-1}) and the sediments deposited on the base is 1.36 t.ha-1. This amount of soil escaped as suspended matter in water runoff.
The basin B, the rill erosion was 68.48 t.ha^{-1}, and 93.47 t.ha^{-1} of sediment was deposited at the base of this catchment. Due to the plowing along the slope, every furrow served as a escape route for the soil. This results show how the plowing technique along the slope can multiply by 10 the rill erosion in sloping lands.

P341
Interrill erosion in a bare soil. An experience of 12 years

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This paper discusses the loss of soil and runoff obtained from a closed-plot type USLE (4 m wide x 20 m length) for 102 events (period 1994-2005). The plot has remained with the bare soil throughout the period mentioned by herbicide application.
The study area is in the Guadalajara province (central Spain). The trials are located on the upper terrace of the river Henares, very eroded and they present a sloping landscape in which the Miocene marls emerges frequently, with slopes 8-10%. Most of the lands are cultivated (barley, wheat, chickpea and olive). In recent years the land use has been changing, resulting on frequent abandoned lands.
The soil of the plot is a Typic Rhodoxeralf, with a clay surface horizon well-structured.
The erosion rates and runoff from the events have been correlated with the main climatic characteristics: total rainfall, I_5, I_{12}, I_{30}, kinetic energy and R-Factor. The kinetic energy and the R factor have been calculated using two models: Wischmeier&Smith and Zanchi&Torri.
We have observed that the runoff does not present a Hortonian behaviour, being strongly correlated with kinetic energy and maximum intensity (I_5) of the downpour. The short and intense events have generated more runoff than the others long and low-intensity ones, except when the water holding capacity is reached. The lack of vegetation in the plot is responsible of this behaviour, because it generates soil compaction and soil surface crust that produce high rates of runoff.
There is also a strong correlation between the amount of sediments and the kinetic Energy and the R-Factor. This correlation increases when we consider only the events for the period from May to September, in which rainfall events show higher intensities (Summer storms). In the last years, such episodes have increased their frequency, as a result of climate change.

P342
Ecologo-genetic peculiarities of soils of Ukrainian Carpathians and their protection

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In the processes of evolution burozems of the Carpathians are characterized by two opposite tendencies: stability and instability. Stability is conditioned by the presence of soil protective screen. Biota plays the main role in its creation, forming water accumulative and water permeable sod or forest litter preventing soil from runoff. Instability is caused predominantly by lithologic-geomorphologic processes and economic human activity. As a whole, ground cover of the Carpathians belongs to a category of potentially unstable.
In the course of anthropogenic activity and as a result of natural calamities, and disastrous floods in 1998-2000 in particular, burozems of the Carpathians are distinguished by the reinforcement of intensity and the expansion of areals of degraded and destructive processes leading to the increase of denudative areas.
Harmful activity of hydro- and geoanomalies increases first of all due to extensive agriculture and forest industries. Intensification of degraded processes is caused by anthropogenous genesis: continuous forest felling, protective forests in particular; Silver fir

being a monoculture; the lowering of upper layer of the forest by 250-300 m; prevalence of young plantations; insufficient forestation of slopes in the catchment areas with dangerous turbulent mud and stone streams; a considerable recreational economical loading upon the forest; absence of soil protective crop rotation; voluntary grazing etc.
To optimize and rationalize land use and to prevent, localize and eliminate degraded processes in the soils of the Carpathians, it is necessary to take antierosion and forest economical measures, as well as to take administration of continuous felling in the regions with dangerous turbulent mud and stone streams, renewal of protective forest-belts made of fast growing tree species, revival of felled pre-polonyna (pre-Alpine meadows) forests, forest-renewable work not later than in a year after felling etc. Conservation of degraded lands is an important way of land use optimization.

P343
Loss of total and organic C in a wheat crop under direct drilling and conventional tillage

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The presence of on-surface plant residues alters erosion-runoff processes, reducing loss of soil and very often of nutrients, among them C. However, conservation systems promote an increase in surface organic matter content, which could increases percentages of particulate C losses compared to those of tilled soils.
To determine the effect of conservation techniques on soil and C loss in a representative soil in the Andalusia countryside, three simulations were made in two experiment plots with 25 m2 of surface and sides 10 m long each and a 15% slope. The soil was clayey and its textural characterization (0-2 cm) was 55% clay, 33.2% loam, 11.1% of sand and 1.59% organic matter. The intensity used in the trials was of 12.5 mm h-1. Also, additional simulations were carried out with different intensities and covers in order to verify the relationship between soil and of C losses in sediment, both total and organic.
The results obtained indicate a reduction of 88% in soil loss, of 87% in that of total C, and of 98% in organic C loss, under direct drilling. The mean covers were of 56% under direct drilling and of 23% under conventional tillage.
Likewise, a decreasing relationship was obtained between the cover and the logarithm of the soil loss. The relationship between sediment production and that of the two forms of C analysed fitted a decreasing parabola. This indicates a lesser enrichment of the sediment in C in the larger erosion events. This aspect is probably related to the dragging of coarser particles, with a lower content in C.

P344
Assesement of the soil nutrients losses by sheet water erosion from Bulgarian agricultural land, value of the appropriate anti-erosion practises

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Soil erosion is a national problem with important economics and social consequences in Bulgaria. 53,2% of the agricultural land is subjected to the destructive effect of water erosion and needs to be protected by appropriate anti-erosion practices.
The loss of nutritious elements - N, P and K, is greatest in fields - 40%; 34% is the loss in perennial plants, and 26% is it in pastures. The choice of optimum anti-erosion practices and insurance of their payment is very important for realization of effective soil erosion control. The report presents the main soil protection practices and their values. The financial means necessary for reducing soil erosion processes on the arable land in Bulgaria are about 595 million lv.
Report presents a short description of the essential soil protection function of some conservation practices. Value of the recommended compensational payments, which every farmer has to receive for applying of conservation practices on his land, protecting the soil and improving its productivity, are calculated by analyzing of the additional expenses for applying and annual supporting of the conservation practices.

P345
Tillage erosion in young moraine landscapes of germany

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Soil translocation caused by different erosion forms is the most important factor of the matter and sediment translocation increasing soil landscape heterogeneity in young moraine landscapes in north-east Germany. Up to now the man-made translocation and redistribution caused by soil tillage (tillage erosion) was underestimated in erosion models and indicator systems. The landscape pattern with a high part of Kolluvisols indicated on intensive soil dislocation dependent on different kinds of erosion was investigated. The different content of tracer caesium-137 in soil profiles on arable farm land compared with the concentration in grass land profiles without soil tillage (reference profiles) allowed the calculation of sediment transport by water and tillage erosion for a longer time and the test of balance models. High caesium-137 concentration analysed in depressed area profiles characterises sediment deposition and accumulation result. Low caesium-137 concentration estimated in profiles on convex upper slope positions characterised soil loss areas. The different topography of the common catena types in Moraine Landscapes is the determining factor of the pattern development: on the uniform long slopes transport due to water erosion was dominated; on the slopes with intensive change of topography translocation due to tillage erosion was dominated. A field experiment was the basis to characterise the tillage operations with mouldboard plough, field cultivator and disk. The soil translocation was estimated about the tracer concentration (coloured gravel like soil aggregates) before and after the operation. 127 kg m^{-1} was dislocated by the mouldboard plough, 89 kg.m^{-1} by the field cultivator and 15 kg.m^{-1} by the disk tools.
Tillage erosion is a serious problem and should be more accepted in agricultural land use.

P346
Risk assessment methods of soil erosion by water in the European Union

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The objective of the EU-funded RAMSOIL project is to provide scientific guidelines for EU wide harmonization concerning Risk Assessment Methodologies (RAMs) for soil threats. This contribution focuses specifically on the soil threat soil erosion by water. Questionnaires send to erosion experts of diverse EU countries, complemented by scientific literature, provided the basis for an inventory of RAMs existing and used within the European Union.
From this inventory it can be concluded that diverse methods at differing scales are used by various countries, ranging from qualitative expert based assessments to (empirical and physical) modeling approaches, from which (R)USLE approaches are the most frequently used. The methods are subsequently evaluated concerning scale, transparency, complexity, cost efficiency and ambiguousness, after which a final statement is made about

their soundness, flexibility and acceptability, reflecting the potentials for harmonization.
Purely qualitative methods are generally simple, cost-efficient and consequently widely accessible, however they have the disadvantages that no absolute estimates can be provided and transparency of the method is sometimes questionable. Quantitative methods, specifically physical modeling, are scientifically sound and more transparent, however rather complex and often data-demanding, consequently expensive to apply. Whether at European level one should aim at risk assessment harmonization or standardization is largely depending on the desired level of accuracy, where harmonization of methods - providing comparable but no mutually exclusive results - is considered to be sufficient to provide relative erosion estimates, ranked in classes. However, when standardization of methods is aimed at, the best option is to simulate erosion rates using one and the same erosion model throughout the whole EU. In this case, the PESERA approach appears to provide the best opportunities, since it is generally regarded to be the most sound, flexible and accessible method, however provided that good quality data are available.

P347
Soil aggregate stability under two rainfall modes

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The present study concerned the zone Ras El Ain Chaouia, situated in the Northwest of Morocco. This zone is localized in the most fertile triangle of the country, considered formerly as the Morocco's attic but which is threaten today by the drought and erosion. Soils in the most part of the country are shallow, loamy-sand, less developed and with poor organic matter content. The studied zone is characterized by a slope included between 0 and 80 % with a dominance of slopes between 0 in 30 % ; the surface have a low vegetal cover quality represented mainly by cereals cultures.
For the fast evaluation of the sensibility of aggregate to the sealing and water erosion, the measure of the structural stability represents a very fast and effective technique. The soils samples were subjected to two different tests to know the behavior of aggregates under two types of characteristic rainfall conditions of the region.
The results of the stability of the soil aggregates showed that under the conditions of brutal moistening in the gravity irrigation type, or the intense rains (storms of spring and summer) 1,89% of the soils are very unstable, 28,30% are unstable, 33,96% are fairly stable, 32,08% are stable and only 3,77% of the soils are very stable ; whereas under the conditions of the wintry conditions 0% of the soils are very unstable, 5,66% of the soils are unstable, 28,30% are fairly stable, 20,75% are stable and 45,28% of the soils are very stable. The same conclusion was made about the sealing of the soils which decreases according to their stability. These results have been compared with a soil erosion risk map achieved by spatialising the RUSL Equation. The drawn map can be used to make a cost-effective evaluation of soil degradation on a regional scale.

P348
Agricultural measures for flood protection and erosion control - a comparison of different methods for visualisation and application

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Climate change will lead to more extremes in weather events including higher risks of flooding and soil erosion. Due to this fact, in three small loess areas of SW-Germany a total of twelve different agricultural measures for flood protection and erosion control were applied. The effects were simulated using different models (LISEM and EROSION-3D respectively), and tested with irrigation experiments.
In all catchment areas simulation and measurements indicated a decreasing of water discharge about to 15 % and soil loss from 55 to 96 % e.g. after conversion from moldboard plough tillage to reduced tillage. The analysed reduction of water and soil runoff due to permanent grasstrips (grassed field boundaries and grassed waterways) did range from 0 to -60 % depending on location and type of grasstrips in the catchment area, the observed scale, and the method of analysis. The costs of reduced tillage system for farmers start at about to 50 EUR ha-1a-1, but probably decrease in the long-term application. Permanent grasstrips induce costs about to 55 EUR ha-1a-1.
Both simulation models may be used to visualize the effects of measures via GIS-maps and animations. Therefore they are important tools for consulting in agriculture or spatial planning. Particular the LISEM-Model displays charts for the process of water runoff. However both models still require a huge amount of input data, which is often not easily disposable. Furthermore there is no macropore module available in LISEM. Due to this fact, the results were not completely satisfying.
The best participation in the measures by farmers (i.e. 100 %) was achieved by offering contracts with the rural district office instead of assuming liability for potential damages in the catchment area. If farmers get some subsidy for their efforts concerning the application of measures, only 44 % of the farms agreed with the realisation.

P349
Validation and further development of the EROSION 3D model for simulation of high water effecting surface runoff

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The process oriented evaluation of agricultural management practices including environmental criteria in agricultural support programs (EAFRD) as well as the keep of lawful regulations (EU-WFD) gain in importance. In order to realize these objectives the model EROSION 3D is available for the agricultural and environmental authorithies in Saxony (Germany).
For improved runoff simulations of longtime precipitation events the model is extended about a multilayer infiltration model and a kinematic wave approach.
In this study the model extensions are validated in three catchments based on measured precipitation-runoff events. The additional application of the water balance model WaSiM-ETH provides comparative surface runoff simulations and initial soil moisture states for real land use scenarios.
The kinematic wave approach improves the hydrodynamic description in the catchments. With increasing catchment area rise the deviations of measured and simulated runoff peaks, because of a rudimental consideration of the channel hydraulic processes.
The estimation of the most sensitive parameters to infiltration calculation, bulk density and initial soil moisture, is linked to the highest uncertainties.
Simulations with high and normal initial soil moistures overestimate the runoff discharges. The use of calculated initial states considerable improves the simulation quality.
The quality of the WaSiM-ETH runoff calculations can not be reached by EROSION 3D.
Additional the multiple observed infiltration supporting effect of conservation tillage practices is not exactly verifiable with the model.

These problems base on the model approach connected to the uncertainly layer parameterization from the official data sets. A plausible parameter adaptation significantly improves the simulation results. An extended process description could be reached with an integrated Bypass approach linked to an adequate layer parameterization.
With the remedy of these deficiencies an efficient tool for the simulation of soil loss and deposition on a regional scale is available for the agricultural and environmental authorithies.

P350

The role of the soil physical and chemical properties in the erosion processes dynamics. Case study: Tutovei Hills, Eastern Romania

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Soil's productive potential and its capacity to satisfy the raising demands of a more and more aggressive society have become maximum interest problems, mainly for a rural area (Tutovei Hills, Eastern Romania), where agriculture is practiced in most situations without respecting the most elementary ecological, agrotechnical or economic principles. Soil degradation through erosion processes, strongly influenced by the anthropic factor, is related to slope length and angle, climatic conditions, vegetal cover and land use, yet also depends on soil erodibility. The later parameter represents soils' susceptibility to erosion, according to the intrinsic physical, chemical and mineralogical properties, whose action is manifested in strong relation to the other erosion factors. Some of soil's properties influence water infiltration speed, thus modifying the runoff/infiltration ratio and consequently erosion intensity, while others determine soil's resistance to the direct action of disruption and transport exerted by raindrops and liquid runoff. The paper regards: the identification of the representative factors for soil erodibility, in the structural, lithologic, morphologic, biologic, soil and climatic conditions from Eastern Romania (Tutovei Hills); the establishment of significant correlations between the factors determining soil erodibility; the identification of erodibility variation according to other erosion determining factors. The problem of soil erodibility is here approached through the functional analysis of a physico-geographical component (the soil), whose evolution is realized in long time periods and whose degradation may be considered irreversible at the human time scale (for several generations), especially in the context of the global climatic changes, that introduce variables whose impact cannot yet be accurately evaluated.

P351

Statistic and simulation approaches to evaluation of erosion and nutrient content in runoff water in Italy hills agroecosystems

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Because of orographic conformation and current climatic situation, Italy is one of the countries most involved in soil erosion.
Erosion risk will be probably greater in the future, considering that recent studies show significant decreasing trend in rainy days per year and in increasing intensity of rainfall events over the last 50 years.
In agroecosystems, the knowledge of intra -event rain dynamics plays a major role and its punctual cumulated measure usually is the only one of the information available, field, although not sufficient in many applications.
The relationship between rainfall intensity, kinetic energy (KE), and its variations in time and space is an indicator of the potential ability of rain to influence erosion process, physical-hydrological soil characteristics, infiltration, water-storage and movement of mineral elements.
The aim of this study is to quantify and to model erosion and nutrient content in runoff-water from cropping systems using data from new technique of meteorological radar.
The most important algorithms for estimating the quality of surface water runoff has been evaluated, realising a new software module for the physically-based deterministic simulation of nutrients losses. The module allows to use input data including rainfall amounts and KE at different time step. Models of this type are not available today, but are needed, together with statistical approaches, to make the best use of rainfall data obtained with meteorological radars.
The achievement of this objective has been accompanied and guided by a punctual in-depth analysis of the spatio-temporal characteristics of precipitation and of the relations between properties of precipitation and soil response, both in terms of structure and erosion and phosphorus and nitrogen dynamics.The measures collected in experimental sites has been used in different model contexts in order to assess models and to define, through sensitivity studies and synergically with meteo-radars used for observations.

P352

Estimating soil erosion rates for Hungary - an application of the PESERA model

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The aim of this project was to estimate soil erosion in Hungary, using the PESERA model, updated with more accurate national data where possible. The model has been run for the whole of Europe in a 1km x 1km grid before, based on European databases, therefore this work aimed to produce a more detailed map in 250m x 250m grid, using more accurate national dataset. The national data was transformed where possible, in order to comply with harmonised datasets. The predicted erosion rates were compared with the results from an earlier, USLA-based approach. The work described was supported by the EC FP6 project ENVASSO - ENVironmental ASsessment of Soil for MOnitoring.

P353

Relationship between P surface richness and soluble P concentration in runoff in plots under conventional tillage

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High P concentrations in agricultural soil coming from fertilizer applications increase the eutrophication potential of runoff.
To determine the relationship between soil available P concentration and that of soluble P in overland flow in a representative soil of the Andalusian countryside, several simulations have been made in a tilled plot with a surface of 25 m^2, sides 10 m long and a 15% slope. The soil was clayey with a particle size distribution (0-2 cm) of 55% clay, 33.2% loam, 11.1% sand and 1.59% organic matter. The intensity used in the trials was of 25 mm h^{-1}.
In order to obtain different concentrations of soil available P, successive on-surface applications were made of diammonium

phosphate at doses of 0, 30, 60, 120 and 240 fertilizing units of phosphorus before each simulation.
The results obtained indicated a sigmoidal fit of the type:

$$y = \frac{0.4355}{1+\exp[-(x-50.36)/0.4931]};\ R^2 = 0.81$$

It was observed that, with surface richness of the order of 60 ppm, the soluble P concentrations were at least four-fold greater than those obtained with up to 50 ppm. The maximum concentration predicted was of 0.43 ppm, and the maximum value recorded in the assays was of 0.65. The 50.3 ppm point was the richness starting from which the diffusion of the P into the liquid current considerably increased.
The plateau can indicate the maximum P diffused into the runoff at the moment the simulation occurred, representing saturation in the fixation positions of P.
The correlations obtained between both variables can be used for estimation purposes in the area. Finally, it is worth pointing out that the Olsen evaluation method of available P has shown itself to be a good predictor of the soluble P concentration.

P354
Soil erosion in Albania

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The overall country's territory of 2,874,800 ha, includes agricultural land 24.4%,forests 36.9%,pastures and meadows 14.4% and 24.3% other land uses.Albania is a mountainous country and about 85 percent of its territory is located at elevations of over than 100 m a.s.l The Natural Resources, during the transition period are under stress, but erosion is the most serious environmental problem in Albania.
Materials and Methods
The evaluation of Soil Erosion in Albania, is realized by National Monitoring Program in the all country during 8 years 1999-2006, established more experimental spots throughout Albania and used Universal Soil Loss Equation. Approximately 1500 soil samples (20-30,30-60 cm depth) were collected from the different locations on the all country. The samples analysis for a series detailed as the chemical and physical analysis ,the texture. Also collection the data for slope, type of soils, geologically formation ,rainfall, land cover and fire burn areas ect.
Results:
The studies show that the soil erosion is present in the all of its forms(water erosion, gully, Bank erosion, Landslide, coastal erosion).More than 20 % of the Land area of all the country are prone to soil erosion and around 60 % almost ready threatened by erosion. Landslides is spread in about 20000 ha, mainly in sloping lands. Consequence of erosion**:** decrease of soil productivity, water pollution, landscape evolution,15-20 % of land agriculture not cultivated, actually about 25% of agricultural land is under nutrient mining conditions to a continuous reduction of soil fertility and potential production, physical degradation in the local and National Level.
Based on the used of Universal Soil Loss Equation, is verified that soil loss in the country vary 30-90 Ton/ha. In the North-Eastern part of Albania the erosion is more intense and the loss soil is about 90 ton /ha. In the place, when the slope increase to over 25 % and without Land Cover, value of soil loss is verified till 180 ton/ha.
The Majority factors of Soil/Land erosion in the country are: rainfall, reduction of Land cover, high slope, average altitude, rivers network, deforestation and overgrazing and lack investments for land protection.
• The climate and land cover take great importance. Total rainfall varies between 900 and 2200 mm/year. In the experimental sites ,studies have shown that alfalfa and vetiver ,strongly reduce soil loss ,two times more compared to maize and no vegetation cover.
• Consequently, slope is a determining factor for Land Erosion of Territory. More than half of territory has slopes 25% and greater and only 43,3 % of the agricultural land is located in the flat areas. Average altitude of the country is 708 m.
• Deforestation, and overgrazing, during the transitional period has further aggravated the situation , because illegal cutting forest for commercial purposes and fire burn large areas ,increased in 15-20 % of forest territory. In this area the level of erosion and Landslide is very high.
• Hydrographic network of Albania is very intensive. Soil loss studies using watershed sediment assessment methods indicate, that the rivers network transports in a year more than 70 millions tons of fine and coarse sediment, they flood around 50.000 ha and damage every year about 40-60 ha agriculture land.

Conclusion:
-Land erosion is a continuous threat to Albania's land resources and should be considered as a priority action for the Government. The conservation practices should be focused on: controlling soil/land erosion and implementation of strategy National and Local Action Program for land protection from erosion.
-
In the context of the association and stabilization agreement between EU and Albania, must to integrated Legislation of natural resources conservation and management in Albania.

P355
Pilot object for soil erosion protection land use in South-East Bulgaria

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In connection with fulfillment of an international project for sustainable land management and to combat soil desertification, as and with the National strategy plan for rural development (2007 -2013), building of a demonstrative object for soil erosion protection land use in the rejoin of Strandja-Sakar mountain, south-east Bulgaria begun.
The object covers the territory of a farm of 53, 1 ha area. As a result of detailed analyze of the natural and economic conditions, calculation of the erosion factor parameters and evaluation of the perspective economic development of the farm, a project for anti-erosion organization of the territory and an agro ecologic plan for implementation and maintaining of a complex of soil conservation measures is worked out.
Depending on the soil and topographic characteristics, the farm territory is divided into four parcels, where the following soil conservation practices are applied: soil conservation farming with companied winter pre-crops; strip crop rotation; buffer grass strips via 40 m, and entirely soil conservation grass. Calculations of the extra expenditure and incomes decreasing as a result of conservation farming have been done. The compensatory payments, which have to be received from the European Union funds, are calculated too. A monitoring for verification of indexes for conservation and economic efficiency of the applied measures as condition for sustainable land use is set up.

P356
Soil erosion, carbon and nutrient elements leaching control by reduced tillage on chromic luvisol

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Soil erosion is recognized as one of the most serious soil degradation processes on the territory of Bulgaria. About 64% of the country's territory and 78 % of the arable land is potentially exposed to risk of water erosion.
It is well known, that on the arable lands most effective erosion control can be realized by applying of different soil protection practices like strip farming, grassed buffer strips, conservation crop rotations and tillages. The aim of the study was to establish

the possibility of some reduced tillage to decrease erosion, carbon and nutrient elements leaching at sorghum and oat growing. The experiment was carried out during 2005-2006 on moderate eroded Chromic Luvisol. In a crop rotation sorghum - oat two tillage treatments were studied: for sorghum a_1 - deep autumn ploughing to 23-25 cm, twice disking to 10 -12 cm, two cultivations during vegetation, and a_2 - no- tillage in autumn, one disking, two cultivations during the vegetation; and two tillage treatments for oat: a_1 - double disking, and a_2 - no-tillage. For soil protection during the autumn-winter period growing of peas-barley mixture as winter pre-crop for sorghum was involved. All cultivations were done across the slope.
Runoff plots were built up on the experimental crops and tillage treatments. In runoff N0-3 and in soil loss C content, total N, and total P were determined.
The results showed best soil protection of reduced tillage at sorghum growing in comparison with conventional one, but the runoff in variants with reduced tillage was higher. Leached away with the runoff NO_3 - N was insignificant at both crops.. Leached away C and nutrients at sorghum were almost 2 times bigger than those from the oat. Decreasing the quantity of soil loss, reduced tillage at sorghum decreased and the quantity of leached away C and nutrients.

S16 Soil Indicators

P357
Enzymatic activity of forest soils and their productivity

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Summary: The purpose of this study was to determine the relationship between physicochemical and biochemical properties of soils and their productivity. The problem of a method of a quantitative estimation of forest soil productivity has been open to arguments for many years. To find an index expressing site productivity is not a simple task in the case of forest soils. In agriculture the role of such an index is most often played by size of the crop of cultivated plants, and frequently the whole produced biomass is used as an index. In the case of woody plants the application of this method is very difficult. In forestry the mean height of the stand, referred to the species and age, may be used as an index of site quality, assuming the existence of the relationship between productivity and site quality. In this study the site index determined on the basis of the height growth model of the stand [Buchwald 2000] was used in estimation of productivity. Soils of lowland sites of central Poland were the object of this study. The study plots represented fresh sites which make 70% of the total forest area in Poland. Fresh sites are characterized by moisture being optimal for most of our plant species. In study plots stand characteristics (diameter breast high, height, and age) were measured and soil pit was made. In collected soil samples the basic physicochemical and biochemical properties, including activity of dehydrogenases, proteases, and urease, were determined. This study attempted to determine the relationship between bio-physicochemical soil properties and productivity.

P358
The ecological characterization through indicators of quality of the soil resources in forestry and agroecosystems from North-Eastern Romanian

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As part of ecosystem, between biotope and biocenosis they achieve reversible and permanent changes of substances, energy and informations, depending on the local and regional ecological specific. They main climatic and pedologic constituents play the role of ecological factors and determinats, which influence, directly and indirectly, the structure and functionality of the biocenosis, according to the fundamental laws of the ecology: combine action of the factors law, tolerance law, minimum law and partial compensation law.
In this paper we present the results of the ecopedological researches reffering to the evaluation of the main qualitative features (physical, chemical and biological) of the soil resources, through eight classes of ecologic size, from a quantitative point of view and through sis classes of ecologic favourability, from a qualitative point of view in forestry and agroecosystems located in North-Eastern Romanian, Moldavian Plateau. The investigated soils are included in Chernozem, Luvisoils and Gleisoils classes, accordingly WRB-SR, 2006. As part of ecologic specificity charts, they point out the main ecological factors and determinants, pedological and climatical, stressed through lack or excess: the summer season extremely droughty, the law level of the summer rainfall, summer dry consistency of the soil, fine texture of the soil, the low aeration of the soil. These, together with the anthropic factors, diminish the complete utilization of the qualitative trophic content of the soil resources, in the local and regional ecologic context and, also, of microclimat from forestry and agroecosystems. These ecological factors and determinants will be observed and we must take them into account in the formulation of the sustainable management strategies.

P359
Soil quality evaluation indicators

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Soil resources optimisation seeking to improve its usage in one hand and reduce environment degradation on the other hand - is the task for European agro-environment policy.
Study revealed that on clay loam and sandy clay loam soil tillage (conventional - CT, reduced - RT or no-tillage - NT) and fertilisation intensity should be determined and evaluated according to soil texture and possible effect on soil properties changes.
Soil management intensity has to be changed when soil Sustainability Index is higher than 12.
The good Soil Quality Index (SQI 15-19) and Soil Sustainability Index (SSI 16-27) was determined by implementing CT. The least value of SQI (12-19) and the highest SSI (15-45) was determined to be after implementation of NT. SQI (14-21) in RT was similar to CT but SSI (10-27) was lower compared to CT and NT.
RT and NT implementation during eight years of investigation have conditioned in available P and K, pH, humus and total C stratification in soil. The alteration of P and K concentration in different soil layers has changed the character of crop nutrition. P and K concentration within top-soil layer increased risk that these nutrients could be washed out down by soil surface (rain, melting snow water, etc.) to ditches and pollute open water bodies.
The highest economic and agronomic effectiveness and in turn, the best social effect was reached when the CT has been used. CT produced and best soil physical properties. Good soil properties, in turn, positively affected SSI and SQI.
SQI and SSI supplement methodology for soil quality evaluation. Use of these indices could be valuable tool for regulation of agro-environmental measures as well.
The research has been supported by the Lithuanian State Science and Studies Foundation.

P360

Prediction of soil physical quality index by pedo-transfer functions in some saline and saline-sodic soils of Iran

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Soil physical quality index (*S*) is the slop of soil retention curve. The advantage of S index is that it provides a quantity amounts for soil quality and it's possible to evaluate the effects of different properties on soil physical quality. According to Van Genuchten equation (1980), the slope of retention curve (*S*) is: $S = -n(\theta_{sat} - \theta_{res})[1+1/m]^{-(1+m)}$. The objective of this study was: to predict S index by using of Pedo-transfer functions. So 45 samples from soil surface (0-10cm) were selected, which 22 samples were saline and others were saline-sodic soils. After measuring their physical and chemical properties, the water content of undisturbed columns (id = 5.1 cm and Height = 5.1cm) was measured at 0, 15, 25 and 55 cm H_2o by hanging column and at 10, 20, 30, 50, 100, 200, 300, 500 and 1000 *Kpa* by pressure plate apparatus. The parameters of Van Genuchten equation were determined in RETC software by using of bulk density, particle size distribution (sand, silt and clay percentage) and the above water contents pressure heads. Then by *S* equation (slope of retention curve) the value of S was determined. The correlation between S index and soil available properties was obtained. The results showed that there was a significant correlation between S index and clay, silt, and $CaCO_3$ percentage (p=0.01). In addition to there was a high correlation between Percentage of Clay, Silt and $CaCO_3$ so to avoidance of co-linearity we used the ratio of clay to silt as an independent variable in rather than clay and silt. The regression relation was determined by stepwise method and it's as follow: $S= 0.210 - 0.074(Clay/Sand)$. Also determination coefficient (R^2) between measured and predicted S by this equation was 0.751.

P361

N/S ratios in Ribwort Plantain *(Plantago lanceolata)* as indicator plant

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As a part of Croatian Gas-Energetic System Podravina (CGESP) Central Gas Station (CGS) Molve located in Northern part of Croatia refines earth gas of more surrounding boreholes. Scientists of multidisciplinary research team monitor its influence on all components of agro-ecosystem; air, water, soil (including of earthworms), plant, forest, animal (wild and domestic) during last seventeen years (1991-2007). Since 1991, soil and agro-ecosystem monitoring has made by *Department for General Agronomy University of Zagreb* on the carefully selected representative points located on different soil types of CGS surrounding.. Variations of physical and chemical properties of soil and chemical properties in Ribwort Plantain (*Plantago lanceolata*) taking as an indicator plant have been monitoring.

This paper presents results of nitrogen and sulfur content and its ratios from Spring 2000 to Spring 2007 monitoring period measured in *Plantago lanceolata* plant grown at different soil types of surroundings CGS (around of boreholes as potential sources of emission: Molve-9 (M-9), M-10, M-11, M-12 , M-14 and in the yard of CGS).

Nitrogen and sulfur as plant macronutrients differ in the forms they are absorbed by the plant, by their functions in the plant, by their mobility in the plant and by the plant deficiency or toxicity symptoms characteristic of the nutrient. Natural balance of these two elements in soil and plant could be disturbed due to some anthropogenic influences like emission from gas treatment - refination.

Result shows that nitrogen content varied between 0.452 % and 3.510 % in dry matter of plant (DM), for sulfur we observed values from 0.142 % up to 0.712 % DM and N/S ratios varied between 2.282 and 15.476 depending on sampling location (soil type) and sampling time. Minimal N/S ratio of *Plantago* we observed on Gleysol vertic but maximal one on Regosol on aeolian sand, both in autumnal periods.

P362

Estimation of Ecological Condition of Soils

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A number of parameters for ecological monitoring of soils exist today. The problem of choice of the universal indicator is quite complex, because it should be an indicator which is easily accessible (easily defined) and convenient for regular monitoring. Different opinions exist regarding agrochemical parameters (the content of available nutrients CAN). Some believe that this parameter does not reflect a real degree of soil depletion and pollution by elements-biofills. Others recommend to use the data obtained as a result of agrochemical examination as a criterion of an ecological condition of soil.

The estimation of ecological condition of soils assumes its comparison with the certain standards. The most acceptable from ecological point of view is transformation of natural landscapes without change of their biological efficiency, for this does not result in destruction of natural ecosystems. Therefore, as the criterion of background standard of CAN we used the range of their vegetative dynamics in agrocoenosis with self-supporting balance of organic matter.

Results of the conducted research have shown, that compensation of organic matter (OM) due to structure of crop rotation provides 100 percent the level of nutrients in the soil, corresponding to the tolerance zone (i.e. average area of their vegetative dynamics). This level can be accepted as the standard. At deficient balance of OM (60 % of mineralization) vegetative dynamics of CAN is carried out in the range close to the maximum or the minimum (the ecological condition corresponding to the risk level), and at the balance of OM 45 % of mineralization - outside the range typical for given soil conditions (the level of crisis). The obtained results allow development of practical recommendations of ecologically safe use of arable soils.

P363

Comparison of soil respiration, humic substances quality and optical indexes in Eutric Cambisol

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Soil respiration, humus fractionation and optical indexes are widely used for soil quality estimation. Microorganisms through their enzymes are able to mineralise organic carbon while the rate of this process is different. Biological test though referred to one of the main diagnostic methods for evaluating soil quality/health. The aim of our work was to determine basal respiration, total carbon content, fractional composition of humus and basic optical parameters in Eutric Cambisol. Our results represent a part of long-term field experiments of Mendel University followed in the Czech-Moravian Upland (locality Vatín). Basal respiration was measured using Vaisala GTM 220 apparatus. Total carbon content was estimated by titrimetric method and fractional composition of HS was determined according to Kononova-Beltchikova method. Optical indexes were measured by UV-VIS spectrometer Varian Cary Probe 50 (by fiber optic coupler) within the range 700 - 300 nm. SFS spectra were measured by Spectrofluorimeter AMICO BOWMAN Series 2 within the range 320 - 620 nm ($\Delta\lambda$ = 20 nm). Linear correlation between fractional composition of HS and optical indexes was found. Results showed that HS quality is closely connected with type of soil management.

P364

Potentially mineralizable nitrogen under different tillage systems

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Conservation agriculture (Minimum MT, No tillage NT) promotes soil water storage and increases soil organic matter content that is often related with an aggregation improvement. Nutrient availability may be altered under different soil management. Nitrogen is usually the limiting element in crop production and predicting the dynamics of its mineralization is necessary for a sustainable land management.
The objective of this study was to measure the nitrogen mineralization potential (NMP) under different tillage systems because it may be use as an indicator of the biologically active soil nitrogen and may be useful for adjusting nitrogen application.
Soil was sampled from INIA´s experimental fields in the semi-arid central region of Spain. The trial started in 1994 with a complete randomized design with 4 blocks where tillage is the main treatment. The soil is a calciortidic haplorexalf with around 14 g kg^{-1} of organic matter. Samples were taken in November 2006 and April 2007 from 0-7.5 cm depth under conventional tillage, MT and NT. The effects between wheat from a 4 year crop rotation and continuous wheat were also compared. The NMP was estimated by the anaerobic incubation method under laboratory conditions. Soil was incubated with water 7 days under 37ºC. Then the NH_4^+-N produced was extracted with 2 M KCl and measured in a FIAstar 5000.
Results indicate that tillage had varied the NMP. Both NT and MT showed significative differences in Nov 2006 compared with CT: **43.52; 37.88; 24.61** mg kg^{-1} respectively. In May 2007 NPM values were for NT, MT and CT: **50.02; 40.77; 27.00** mg kg^{-1} respectively. Crop rotation effect on the NMP presented significant differences both in November and May.

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Inorganic polyphosphates as an indicator of soil fungal activity

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Microbial origin of soil inorganic polyphosphates is well known. We studied the proportion of inorganic polyphosphates within phosphorus (P) pool in the wide variety of soils and microbial cultures using 31P NMR spectroscopy of alkaline extracts. In general, the most pronounced differences between bacterial and fungal P pools were in proportions of polyphosphates. The majority of fungi contained very high proportion of polyphosphates (up to 70% of total P) while in bacteria the contribution of polyphosphates was negligible. The contribution of different groups of microorganisms to the soil P pool depends on the relation of fungal and microbial biomass. We could expect that in acid soils fungal biomass is more likely predominant and the contribution of fungal P to soil P pool should be more significant. Three different sequences of soil samples demonstrated clear correspondence between soil and fungal polyphosphates proportion. The first was the climatic sequence of diverse soils from Russian Plain, where polyphosphate P was found in acid forest soils, but was not in neutral and calcareous grassland soils. The second was the toposequence of representative soil and plant community associations in the alpine zone of the Northern Caucasus, where polyphosphate P proportion gradually increased from the ridge to the bottom of the slope simultaneously with increasing soil acidity and decreasing base saturation. The third was the depth sequence in the upper part of the forest soil represented by Ol, Of, Oh, OA and Ah horizons, where polyphosphate P proportion increased from Ol to Oh horizon and decreased again to Ah horizon. The general conclusion which can be made from 31P NMR spectroscopy of soil alkaline extracts is that high proportions of polyphosphate P indicate significant contributions of fungal P compounds.

P366

A field spade test for visual scoring of soil structure

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The preservation of good soil structure is essential to maintain root penetration, uptake of nutrients by roots, soil water storage and flow and soil gas exchange. We present a quick and simple field spade method of determining the quality of soil structure which requires little equipment or expertise. The structural quality will determine if there are any needs to change crop or management. The technique is designed for use by anyone with an interest in soil.
The method involves digging out a block of soil with a spade, breaking it up, examining the soil and scoring the structure by comparison with photographs in a visual key. The photographs show typical samples after break-up in each of five score categories of structural quality (Sq). Each score category also has a distinguishing feature. For example, the best quality score (Sq1) has fine aggregates whereas the worst score (Sq5) often contains soil of grey-blue colour typical of anaerobism. The Sq score is also confirmed by consideration of the ease of block extraction, shape and size of aggregates and distribution of roots. The test takes 5-10 minutes per location and enough replicates are obtained for statistical comparison of datasets. Scores above three are considered acceptable. After scoring, any areas and/or layers with consistently low scores (Sq4 or 5) are identified. These could be vulnerable zones requiring improvement by tillage, drainage or different cropping.
The method has been tested to confirm reproducibility, to assess sensitivity to differences in soil management (e.g. due to compaction, tillage, residue incorporation) and to produce indicator and management thresholds. The test is also useful for guiding the depth and location of any further soil measurements required to diagnose soil problems.

P367

Phytoindication of soil conditions of mountain beech sites in Slovenia

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Soil conditions and plant species diversity as the result of site characteristics and different forest management practices have been assessed on potential beech forest sites in Slovenia. Research sites on carbonate and non-carbonate parent rocks with different forest management treatment in the past and present time have been selected, ranging from virgin forest remnant and sustainable managed forest (both Dinaric fir-beech forest, *Omphalodo-Fagetum* association) to mountain beech forest (*Lamio orvalae-Fagetum*) to acidophilic beech-forest (*Blechno-Fagetum*) and spruce monoculture on beech site (*Luzulo-Fagetum*).
At the research site established on limestones and dolomites, six WRB soil units (Lithic, Folic, Eutric and Rendzic Leptosols, Eutric Cambisols and Haplic Luvisols) were determined. Two years after cutting, the organic horizons in the man-made gaps of the managed fir-beech forest were thinner, the share of humus form groups with more intensive decomposition rate was higher and soil organic carbon (SOC) content in organic and mineral parts of soil was lower than in the gaps of virgin forest remnant and in the stands with closed canopy closure. The plant species diversity was significantly higher in the managed fir-beech forest than in the virgin forest remnant. It was low in

spruce monocultures established at the beech sites on non-carbonate parent material.
At the sites on non-carbonate parent material (sandstones and claystones, gneiss with transition to micaschists, tonalite) only two soil units (dominant Dystric Cambisols and Dystric Leptosols in spots) were found and almost a three times smaller number of species was recorded than on carbonate bedrocks. In the secondary spruce forest on tonalite the thickest O horizon and the highest SOC content were determined.

P368
Soil physical quality in the Tutovei Hills region (Romania)

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Soil quality implies a concept of fitness of soils to perform some function or range of functions. Soil physical state directly influences environmental quality and soil productivity. In this paper we focus on aspects related to productivity, since the assessment of soil physical quality is quite important in a region affected by not only by climatic excesses, but also by poverty, where crop productivity is essential for people's subsistence.
Since the characteristics of the indicators used to evaluate soil (physical) quality should be sensibility to changes in management, but also stability to modifications not related to management decisions, robustness, relevance, validity from the analytic viewpoint and cost effectiveness, we tried to evaluate the physical state of soils using such simple parameters. Among the simplest indicators of soil physical quality are texture, density, porosity, soil depth, water retention capacity. We attempted to evaluate soil quality using several physical indices related mainly to texture, and also pedotransfer functions related to soil compaction, crusting, textural differentiations, porosity, erodability.

P369
Evaluating soil suitability for vineyard in Jerez zone, Southern of Spain - Preliminary analysis of soil quality indicators

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In this paper, an analysis of the geo-edapho characteristics of an established wine region located in Jerez zone (Southern Spain) was undertaken to analysis soil quality indicators. The input data considered for the application analyses are grouped in the following categories: site, litology, physiography, relief and soil. Soil parameters were measuring within three vertical soil section, the first one was established between the surface and 30cm, the second one between 30 and 80cm, and the third one between 80 and 120cm. All data were collected from 21 selected benchmark sites representative of the study area. Additionally, there was established an index of vineyard suitability from each selected benchmark sites.
It was performed a Spearman correlation analysis, and ETA tests that measured the existing relation between the specified index and the numerical and nominal input variables respectively. Also, in order to select independent variables, there was analyzed the correlations between input variables.
Results show that the first and second control sections of soil have higher correlation with the index than the third one, so further analyses were made with these soil sections. Then, it was observed that most of the variables have a significant correlation with this index. Finally, taking into account the independence between input variables and in order to represent the physical, chemical and biological behaviour of vineyards ecosystems, the following variables were selected as soil quality indicators: relief (altitude, slope); parent material; soil depth; concerning first soil section (carbonate content, cation exchange capacity, organic carbon); and regarding second soil section (bulk density, field capacity, texture).
This research work is integrated in a global project of vineyard soil suitability of Andalusia, where more pilot areas as Montilla-Moriles, Málaga Zona Norte, Ronda and Condado-Aljarafe composed the whole study zone. Integrated modelling will be the following phase of this research study.

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Rendzin biological activity of different natural zones of the Nothewest Caucasus

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Rendzins - on Northern Caucasus stretches through significant areas. Conditions in which thisoils generated, strongly differ. In the Western Black Sea Coast renzins meet alongside with brown soils zone, and in mountains of Adygea with grey and brown wood soils zone. The purpose of the present work was research of biological activity of Northwest Caucasus rendzins. Researches spent in two regions with significant distribution of outputs carbonate breeds. In conditions of dry subtropics research have been lead in area of Novorossisk - Abrau, carbonate soils of the damp moderate mountain woods studied in area of plateau Lagonaki - Guzeripl Republics Adygeas. For rendzin region it is likely the strong variation of quantitative characteristics of capacity humus horizon, the maintenance humus and its stocks is characteristic. Research of biochemical properties of soils, generated on carbonate and noncarbonate breeds of Northwest Caucasus, lead in 2006, has shown their essential distinction from each other. As a result of calculation of an integrated parameter of a biological condition of soils (under the maintenance humus, activity of three enzymes) to become obvious the fact of influence of carbonate breeds on biochemical soil properties. Zone soils of different areas of the Western Caucasus - brown and brown wood - possess approximately equal biological activity which, in turn, on 30-40 % is less, than for introzone soils. Researches have shown in subtropical soils, containing carbonates, quantity does not define biogennost and biological activity soils, does not render neither stimulating, nor oppressing influence. In humidity conditions of mountains of Adygea carbonatnost of soils breeds serves as the factor causing significant distinctions with zone soils, raising rn environments, efficiency and biological activity of soils. Researches are supported by the grant of the Russian Federal Property Fund 06-05-64722 and the grant of the President of Russian Federation 1091.2006.4.

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Indicators and indices integrated in Agenda 21 for the assessment of desertification processes in Mediterranean environments

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Desertification causes the loss of environmental quality in Mediterranean environments. The aim of this work is to analyze environment quality with a minimum set of indicators in representative zones of the Mediterranean region affected by desertification processes, within the framework of a research project funded by the Fundación Biodiversidad. The analysis was focussed on three municipalities, representatives of the three types of environments with different land use patterns and problems identified in the European Mediterranean region.

These are the coastal area (e.g. municipality of El Puig), the inland area (e.g. municipality of Vallanca) and the middle area (municipality of Olocau). The indicator-based approach included a minimum set of 12 indicators based mainly on soil properties and water availability. Application of a Pressure-State-Response framework of indicators has allowed the identification of the main pressures affecting the municipalities of the study area and the understanding of how these pressures are affecting environmental quality, here referred to as the degree of naturalness and the capacity of natural resources to function as a source of materials, sink and support for human activities. The results show that the environmental quality is very low in the coastal zone (El Puig) due to urban-industrial expansion, which grown by 360 % since 1956 to 1998, whereas in the inland area (Vallanca) is very high because there are less human pressure and larger forest ecosystems regeneration, which has incremented by 270 % since 1956. In the middle zone, the quality index changes according to predominant uses. For instance, in Olocau the environmental quality is moderate as forest ecosystems have increased in the last decades but urban uses have growth considerably (580% since 1956). This sets a basis for decision-makers to implement, evaluate, and monitor environmental policies to combat desertification in the framework of the Agenda 21 Local.

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Magnetic fingerprint for the source area of an alluvial Vertisol in southern Mali

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We investigated samples from an alluvial Vertisol developed in a flat lying flood plain in the savannah woodland of southern Mali. The soil is characterized by a water regime governed by regularly occurring wet and dry seasons. The soil was subdivided into four horizons Ap, A2, A3, and Ag which differed in the content and speciation of the redox sensitive elements Mn and Fe. The redox-cline is indicated by the minimum concentration of Mn in the A3 horizon. Dithionite-extractable Fe (Fe_d), which is a measure for the content of crystalline ferric oxides, is about two times higher in the Ap and A2 than in the lower horizons. The oxalate-extraction (Fe_o), indicating poorly crystallized ferric oxides, exhibits a maximum in the Ag and a minimum in the A3 horizon. The ratio of Fe_o/Fe_d increases within the profile and reaches a value of 0.96 in the Ag horizon. Such a value in the gleyic horizon suggests that almost all ferric oxides are present in a poorly crystallized form. Lithogenic hemo-ilmenite particles are distributed in the profile. Transmission electron microscopy revealed that the hemo-ilmenite has solid solution properties, which is indicative of volcanic origin. The magnetic characteristics, i.e. magnetization and blocking behavior, of the hemo-ilmenite were identical throughout the profile. Such homogeneity provides clear evidence that these particles were formed under the same geological conditions, and, therefore, they were derived from the same source. Based on the magnetic information, a Permian dolerite outcropping in the catchment area of the Bafini river in western Burkina Faso in a distance of about 50 km from the sampling location can be deduced as source area.
The finding that weathering resistant hemo-ilmenite particles can carry information of their origin opens the door to use this mineral phase as proxy for landscape development.

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How to manage and analyse a large biodiversity data set: the case of the regional “RMQS BioDiv” experience

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“RMQS BioDiv” is a pilot program which values biological components of Armorican soils (Brittany region, France). Several biological groups, such as all macro-invertebrates, earthworms, acari, collembola, nematodes, microflora, and also some activity index are studied. This program is linked to the national French Soil Quality Measurement Network (classical RMQS) and both generate a large data set according to an important grid sampling scheme (1 site each 16 km). In this context, a data analysis strategy must be developed in order to highlight the indicative value of structural and functional soil biodiversity and its relationship with environmental variables.
To reach this aim, an analytical methodology for data treatment was constructed following a hierarchical scheme composed of successive steps. In a first step, the data set of each biological group was analysed independently by the means of descriptive and exploratory statistics. In a second step, global analyses were conducted on the whole soil biological dataset. These analyses included correlations between taxa, descriptors of biological diversity, community pattern descriptions and multivariate analyses. In a third step, environmental factors, which could influence soil biota variability (distribution/heterogeneity), were integrated into the analysis. Potential explicative variables within pedological characteristics, physical and chemical properties, land use and management practices were assessed to explain the community structures. For that, land-scape, environmental and agronomical typologies of the sampled sites were first performed. Then, the relationships between soil biological components and potential explicative variables were investigated by using multivariate and multitable approaches. Furthermore, the spatial variability analysis was ensured by the grid sampling scheme, thus informed whether soil biodiversity displayed spatial patterns at the regional scale and how these patterns were related to the site characteristics.
Finally, the relevance of this analytical approach and the results will be discussed with respect to ENVASSO recommendations (data analysis, results representation …).

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Assessment of soil friability by the volume-dependence method in selected Hamadan soils

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Soil friability (F) is defined as the tendency of a mass of unconfined intact soil to crumble under applied tensile stresses. The F might be considered as an index of soil physical quality and/or soil structure. It is also a key quantitative parameter to evaluate tillage and management systems and tillage timeliness. No information on F of soils in western Iran (i.e. Hamadan Province) was available. Hence, this work was carried out to measure F, to assess the effects of intrinsic soil properties on F, and to predict F by easily-measurable properties on selected (23) Hamadan soils with a wide range of texture, organic matter and carbonate contents. Enough intact soil clods/aggregates were collected from the arable layer of the soils at a suitable soil water content in summer 2007. The aggregates were gently sieved to separate 4-8, 8-10, 10-15, 15-25, 25-30, and 30-38 mm fractions. The aggregates were equilibrated on a pressure plate apparatus to a soil matric suction of 200 kPa. Then, the tensile strength of 20 to 30 aggregates was determined by the indirect Brazilian test. Finally, the F was calculated by the volume-dependence method, in which, the logarithm of tensile strength was plotted versus the logarithm of aggregate volume and the F is considered equal to the slope of the linear relation. The positive effect of organic matter and clay contents on F was considerable but the effect of carbonate content was in the second order. The multiple linear regression analysis showed that the derived pedotransfer function could be recommended to predict soil friability (F) with acceptable accuracy and might be included in timeliness programs of soil tillage practices.

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Soil Degradation as a Catastrophic Event

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The environmental conditions, threatening human life or his living conditions and work is accepted as a catastrophic event. Soil degradation is a catastrophic event as it has many off-site inappropriate consequences for human life and health. Their size, location and time are possible to predict only with some probability. The paper treats the soil degradation process in terms of *system failure*.
Soil degradation is a process of cumulative damages, reducing the quality and ability of soil to perform satisfactorily its *main functions*: (1) as a medium for life and habitat for people, animals, plants and soil organisms; (2) as a filtering, partitioning and storage system of water; (3) as a buffer against contamination of groundwater and food chain; and (4) as a natural storage of cultural history.
The reduced ability of soil to perform its functions is described by a set of non-negative *performance characteristics* $\mathbf{v}=(v_1,v_2,\ldots,v_n)$, (*soil qualities*), which are the final (output) soil characteristics. Soil qualities $\{v_i\}$, (normalized in the interval $0\le v_i\le 1$) are complex attributes that cannot directly be measured, but each of them can be represented quantitatively as a function $v_i=\varphi_i(\mathbf{u})$ of measurable or estimated *soil quality indicators* $\mathbf{u}=(u_1,u_2,\ldots,u_p)$.
Soil quality indicators describe the process of soil degradation $u_i=u_i(t,\boldsymbol{\alpha})=u_i(t,\boldsymbol{\alpha}(\tau)\ |t_o\le\tau\le t)$, $i=1\div p$ as a function of time t and external land load *"inputs"* $\boldsymbol{\alpha}(\tau)=(\alpha_1(\tau),\ldots,\alpha_k(\tau))$, $\tau\in[t_o,t]$, which represent permanent or cyclic controlled or uncontrolled impact on soil resources.
Soil quality index is defined as a function $Q_s=\varphi(Q_1,Q_2,\ldots,Q_m)$ of non-negative components Q_i , $i=1\div m$, representing the ability of soil to perform all *main functions* satisfactorily, and index $Q_i(\mathbf{v})=Q_i(v_{i1},\ldots,v_{ni})$, represents only a specific soil function.
Suppose the set of all possible values of soil qualities $\{v_i\}$ is partitioned into two subsets: Ω1- the set of functioning soil and Ω0 -the set of failed (degraded) soil. Then the probability $F(t)=P(\xi\le t)=P\{\mathbf{v}(\tau)\notin\Omega 1\,|\,\tau\in[t_o,t]\}$, defines the *risk* for the soil system to fail in the time interval $[t_o,t]$ with respect to the specified soil function. The probability $R(t)=1-F(t)$ defines the *reliability* of the soil system to perform its functions satisfactorily in that time interval.
This approach is illustrated with some examples.

P376
Application of fractal theory to describe soil aggregate stability for different land uses

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Soil structural stability is an important and critical factor for germination and growth of plants and also for transport of water and contaminates in agricultural fields. The present study investigated the ability of fractal dimension to quantify soil aggregate stability in different land use systems. Furthermore, the non-linear fractal dimension *Dnl* was contrasted with linear fractal dimension D_l and the mean weight diameter (MWD) of aggregates. Soil samples were collected from three sites with four adjacent land-use types: forest area F, cultivated lands adjacent to forest CAF, pasture P, and cultivated lands adjacent to pasture CAP. Results indicated that values of D_{nl} were more accurate than D_l. Coefficient of variations (CVs) between D_l and D_{nl} were also contrasted and the low value of CV indicates the higher precision of the method. The lowest CVs belonged to D_{nl}, showing that D_{nl} is more accurate than D_l and *MWD* methods. Maximum and minimum values of D_{nl} and D_l were related to cultivate pasture (CAP) and pasture (P) respectively. There were significant difference between D_{nl} of forests (F) and cultivated forest (CAF) and cultivated pasture (CAP) also between pasture (P) and cultivated forest (CAF) and cultivated pasture (CAP) while there was no significant difference between forests (F) and pasture (P). The mean-weight diameter *MWD* of soil aggregates was significantly greater in the forest and pasture soils than in the cultivated forest and cultivated pasture respectively. There were significant differences between forest and pasture for the measured *MWD*. Both fractal dimensions had negative correlation with *MWD* and macroaggregates (>0.25 mm).

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Evaluation of Sorghum Response to Different Sources and Rates of Phosphorus Fertilizers

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Pot experiment was carried out to study the effect of different sources of phosphatic fertilizers applied at different rates, on the bioavailability of N, P and K and some heavy metals absorbed by Sorghum plant (*Sorghum Sudanese L.)* cultivated in clay loam soil.
The obtained results indicated that phosphatic fertilizers were positively affected the weight of sorghum dry matter; the response was depending on the source of P-fertilizer and rates of application. Concerning the type of phosphatic fertilizer applied, data indicate that the higher weight for dry matter content was found when (DAP) was applied at either lower or higher rates of application, meanwhile the lower one was observed when (SSP) fertilizer was applied regardless the time of plant sampling gathered.
The analytical analysis of the soil samples after each cut show that, increasing rates of P-fertilization led to increase the availability of N, P and K as macronutrients and Cd and Pb as heavy metals in the extraction solutions.
Data representing the uptake of N, P, K and Cd or Pb metals by sorghum as affected by different rates of application and sources applied of P-fertilizers showed positive responses compared to control. Values being higher for Cd and Pb in the highest rate of (SSP) fertilizers compared to TSP and DAP fertilizers.
Keywords: Di-ammonium phosphate (DAP), Single super phosphate (SSP), Triple super phosphate (TSP), Heavy metals (Cd, Pb) and Sorghum.

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Impact of Nitrogen Fertilization on Iron Uptak by Maize Growing in Calcareous Soil

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Pot experiment was conducted to evaluate the effectiveness of nitrogenous fertilization in combination with nitrification inhibitor with or without iron application for maize crop in calcareous soil. Results revealed that, at different growth stages the combination of ammonium sulfate with nitrapyrin (N-serve) gave the highest dry weight as compared with other treatments and had prominent effect on nitrogen uptake, iron and chlorophyll content. Application of potassium nitrate or ammonium sulfate resulted in an increase in NO_3 accumulation. However, ammonium sulfate+ N-serve dramatically decrease the accumulation of NO_3 in maize leaves. Results also indicated that, NO_3 concentration was higher at 60 DAS over 30 DAS (day after sowing) except when N-serve < ammonium sulfate < potassium nitrate. It was observed that iron contents seemed to be affected by nitrogen source. Using N-serve with ammonium sulfate reported higher values of ferrous, total and available iron in soil. At latter stages of maize growth, the iron content increased due to application of ammonium sulfate as compared to potassium nitrate addition. Iron application generally increase N uptake, NO_3 content, chlorophyll and ferrous iron over a period of maize growth. The increment of nitrogen and iron uptake was associated with predominant increase in chlorophyll content of maize leaves correcting the chlorosis symptoms appearing on maize in calcareous soil.

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Kinetics of Some Micronutrients Desorption by DTPA from Calcareous Soils

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Kinetics of native Zn, Cu, Mn and Fe desorption by DTPA (diethylene triamine penta acetic-acid) from 12 calcareous soils were studied in a laboratory experiment. Samples of soils were equilibrated with DTPA solution for 15 to 11520 minutes. Seven kinetics models were evaluated to describe the kinetics data. The zero-, first-, second- and third order equations in all time domains, did not describe micronutrients releases properly from soils. Comparisons of coefficients of determination (r^2), standard errors of estimates (SE) of different models, and the close value between the measured and predicted micronutrients desorbed, indicated that the best model for describing Zn release in all soils was the two-constant rate equation. For Cu desorption the results showed that two- constant and simple Elovich rate equation were the best- fitted equations among seven kinetic models. The copper desorption pattern based on the parabolic-diffusion model predicted higher rates during the first 9h followed by a slower release rate, which suggest that two different release mechanisms may be involved. The best model for Mn desorption in all soils were two-constant and parabolic - diffusion equations. Pattern of Fe release in studied soils was different between soils and in this respect two soil groups were distinguished. At the first group Fe release rate was very rapid initially but declined fast with time. For the second group release rate was rapid initially but gradually declined with time. Two - constant - rate equations were the best equation which described Fe desorption. Simple Elovich and parabolic diffusion models could also satisfactory describe Fe desorption.

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Effect of phosphorus rates and methods of zinc application on maize yield and its components

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ABSTRACT
A field experiment was carried out at Demo, El Fayoum Governorate during two successive seasons 2004 and 2005 to study the effect of different levels of phosphorus (0, 15, '30 and 45 P_2O_5 /fed.) and methods of zinc application (soil application and foliar spray), and their combination on growth characters, mineral content and yield and its components of maize plant *zea mays* L, C.v. Single hybrid 10).

The most Important results could be summarized as follows:

1. Plant height, dry weight, ear weight, 100-grain weight, yield and yield components were increased significantly by increasing rate of phosphorus up to 45 kg P_2O_5/fed.
2. Zinc application by both methods has its positive effect on improving increasing maize yield and its components.
3. The interaction between phosphorus rates and methods of zinc application had a significant effect on grain yield/fed and yield components in both seasons.
4. in general, the highest yield and yield components were obtained when the plants received 45 kg P_2O_5/fed. combined with zinc application as foliar spray.

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Influence of saline water irrigation and compost plant residues on yield and nutrient uptake by fodder beet grown on a sandy soil

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Abstrac
Consequent to population growth and high living standards in several arid and semi-arid regions, competition for freshwater among different water-use sectors is expected to increase vis-à-vis its decreased allocation to irrigation. Non-conventional water resources, such as saline and/or sodic drainage and groundwater represent complementary supply to narrow the gap between freshwater availability and demand. A pot experiment was conducted to investigate the response of fodder beet to salinity and to determine the interactive effects of salinity and compost of plant residues on yield and soil salinity. Irrigation water treatments included: a tap water (EC, 210 ppm), saline water irrigation (EC, 4000, 6000 and 8000 ppm). Compost was also applied at 0, 5 and 10 ton/acre.
Results revealed that application of compost to the soil resulted in reduced soil electrical conductivity and SAR. Also, data indicated a sharp decrease in the concentration of Ca^{+2}, Mg^{+2}, Na^+ and Cl^- while the concentration of K^+, HCO_3^- and SO_4^{-2} in soil solution were increased by increasing compost application.
Data revealed that leaves and roots weights slightly decreased with increasing saline water up to 4000 ppm. Moreover, significant increments were noticed when fodder beet plants were subjected to the high a level of salinization (6000 and 8000 ppm).The maximum growth reduction in leaves and root yields occurred due salinity at 8000 ppm (42.3 and 39.2 %, respectively, reduction compared with tap water in 10 ton compost/acre). Root growth was less affected than leaves yields. Compost application caused growth enhancement at all salinity levels.
Salinity diminished N, P and K content of plants to some extent in our study. Under salt-stressed condition, the uptake of N, P

and K by plants was generally affected . Increasing compost levels increased N, P and K content of plants.

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Effects of zinc and irrigation intervals on yield and component yield of sunflower

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In order to find out the effect of different levels of zinc sulfate and irrigation and the mutual effect of them on morphological characters and also on yield and yield components in sunflower. Plot in a completely randomized blocks including three replications different levels of irrigation namely 10,20 & 30 days as first factor and zinc sulfate levels of 0,20, &40 kg per hectare the second factor. Irrigation was in main plot and zinc sulfate in subplots. Statistical analysis was preformed by analysis of variance and Dunkan method. The results showed that by increasing the interval of irrigation decreases the yield and on the most of under research components had bad effects; zinc sulfate deficiency has effect on most of characters there was no significant difference between 20 and 40 kg zinc sulfate per hectare. The interaction between irrigation and zinc sulfate consumption indicates that between 10 & 20 days irrigation yield is differed significantly. Other measured characters also got better in the presence of zinc. Even the application of zinc at 20 days irrigation interval resulted the yield equal to 10 days interval. In 30 days irrigation period zinc sulfate has no effect on yield and some other characters;but caused the number of seeds per flower and increase of vegetative growth of sunflower.The height yield was detected in 10 days irrigation interval and 40 kg of zinc sulfate application per hectare as 3258 kg per hectare. In irrigation interval of 20 days and use of 40 kg zinc sulfate caused the yield from 2433 kg (no zinc sulfate) to increase 2881 kg per hectare.

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Study of density and activity of native VA mycorrhizal related with soil phosphorus in some farmlands of Marand

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Injudicios use of phosphorus fertilizers lead to excessive concentration of phosphorus in soil with harzardeous,effect on nutrient balance of plants and soil health.One of soil biological characteristics that impressed by phosphorus fertilizers is VA mycorrhiza.In this experiment we studied the effect of soil phosphorus with four levels:P1,P2,P3,P4 (0-5.9,5.9-6.9,6.9-8, P >8)respectively, on density of native VA mycorrhizal and Percent of root length colonization (RLC) on sunflower,cucumber and tomato. A CR design was used with factor of phosphorus levels .Statistical analysis indicated that phosphorus had significant effect on VA mycorrhizal density and percent of RLC on sunflower, cucumber and tomato ($P < 0.01$). A positive correlation was observed between density of native VA mycorrhizal and percent of RLC on sunflower,cucumber and tomato ($P < 0.01$).Also soil phosphorus negatively correlated with native VA mycorrhizal density and percent of RLC on sunflower,cucumber and tomato.

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Effects of nitrogen, phosphorus and boron on some growing Charactristcs of polianthus tuberose L.

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This research was conducted to study the effect of nitrogen, phosphorus, and boron on length of inflorescence, length of cut flower, number of florets, weight and number of bulblets of polianthus tuberosa . a factorial RB design was used with factors: 1) nitrogen in three level of 0, 20, 40 g (NH 4)2SO4 / m ; 2)phosphorus in two level of 0,20 g (NH4)3PO4 /m ;3) and two level of boron, 0 and 90 ppm of acid boric solution(H2BO3). Statical analysis were done using MSTATC program.the results indicated that the main effect of nitrogen had significant effect on the length of flower, length of inflorescence and number of florets($p<0.05$), the main effect of boron was significant on the length of inflorescence ($p<0.01$)and the main effect of phosphorus was significant on the length of inflorescence, number of florets ($p<0.01$) and length of cut flower ($p<0.05$).

P385
Textile industry wastes, a real threat to agricultural environment in Egypt

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The problems associated with the discharge of textile dyes into the environment are of growing public concern. This study was conducted to identify the magnitude of the problem in relation to environment pollution. A questionnaire was submitted to several textile plants in the major industrial sites in Egypt. The questionnaire intended to seek information regarding textile wastewater disposal, effluent volumes discharged, dyes used, and percent of dyes loss into the effluent discharge.
Soils close to the textile plants were analyzed to assess the potential for soil degradation. Soil biological activity using dehydrogenase enzyme activity, total microbial counts as effected by three textile dyes used (Dis-azo brown, Acid red, and Reactive) and their mixture were evaluated. The effect of these dyes on beneficial soil microorganisms; *Rhizobium*, *Azotobacter*, yeast, and fungi, was appraised. The main findings were as follows:
The effluent wastewater COD was generally high reaching up to 3918 mg/l. On the other hand, the BOD which involves measuring the dissolved oxygen used by microorganism to biodegrade organic compounds was generally low and did not exceed 350 mg/l. Such low BOD values relative to COD can be attributed to the dyes toxic effect on microbial activity.
The pH of the tested wastewaters ranged from 3.8 to as high as 11.9. The salinity measurement as EC ranged from 0.4 to 19.6/ dS/m. The textile plants had a detrimental effect on the quality of adjacent soils expressed by chemo-physical properties such as pH and EC of the soil as well as the biological activity of the soil.
The dyes showed devastating effect on beneficial soil microorganisms such as *Rhizobium, Azotobacter* and yeast. On contrary fungi showed a strong resistance to the dye toxicity. This strengthens the ideas of studying the fungal strains to identify the potential fungal candidates for dyes removal and biodegradation.

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Optimum Rate of Top Dressing of Nitrogen Fertilizer on Red Pepper by Ground-Based Remote Sensing

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Pot experiments using sand culture were conducted in 2004 and 2005 to estimate the recommendation model for top dressing rate of N fertilizer on red pepper using ground-based remote sensing under greenhouse conditions. Six nitrogen levels were imposed from 40% to 140% of N in Hoagland's nutrient solution for sand culture. Also field experiments were conducted for ten fields of red pepper in 2005 and 2006, respectively to estimate the N fertilizer efficiency on red pepper recommended by remote sensing test. Canopy reflectance measurements were made with hand held spectral sensors including GreenSeeker™, Crop Circle™ passive and ACS-210 active sensor, and spectroradiometers as well as Field Scout™ and Minolta SPAD-502 chlorophyll meter. The reflectance indexes of aNDVI obtained from Crop Circle™ ACS-210 was the best tool for assessing biomass and nitrogen uptake by red pepper at every growth stages in pot experiment. The same index measured at about 70th day after planting (DAP) was also closely correlated with dry weight, yield, and nitrogen uptake of red pepper at the harvesting stage. From the above results, the recommendation model for top dressing rate of N fertilizer on red pepper was developed by the sufficiency index of the same index at near the 70th DAP. The sufficiency index measured at 58th and 60th DAP in 2005 and 2006, respectively were ranged from 0.71 to 0.98 and from 0.85 to 1.01 for ten fields. The yield of red pepper grown on the remote sensing test plot was similar to that of soil test plot while application rate of N fertilizer has lowered. Consequently ground-based remote sensing providing a non-destructive real-time assessment of plant N status should be a useful tool for in-season red pepper N management providing both spatial and temporal information.

P387

Effect of FeSO4/Ca(OH)2 addition on phosphate exchangeability and iron forms in an acid soil submitted to different redox conditions

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The application of Fe-rich amendment has been proposed to decrease P losses from soils. Anoxic conditions, however, are known to increase Fe and P solubility in soils. Our aim was to evaluate the effects of continuous oxic or anoxic conditions and of alternating anoxic/oxic conditions on P exchangeability and Fe forms during a 8 week incubation in a soil that had received FeSO4/Ca(OH)2. Phosphate exchangeability was assessed with the isotope exchange kinetics. The forms of Fe were analysed by chemical extractions and Mössbauer spectroscopy. Adding a FeSO4/Ca(OH)2 amendment to the soil incubated under oxic conditions resulted in a strong decrease in P exchangeability and in an increase in oxalate extractable Fe. Mössbauer analyses suggested that the addition of FeSO4/Ca(OH)2 resulted in the precipitation of a Fe phase tentatively identified as a mixture of goethite and ferrihydrite (D1oxide) with a strong sorbing capacity for P. Submitting the soil, amended or not with FeSO4/Ca(OH)2 to continuous anoxic conditions increased P exchangeability and oxalate extractable Fe. Mössbauer analyses suggest that these conditions triggered a partial dissolution of the D1oxide phase and the precipitation of a phase tentatively identified as a ferrihydrite (S3) which kept P in a rapidly exchangeable form. Alternating anoxic and oxic periods induced cycles of dissolution and precipitation of iron oxides and of P release and sorption. The consequences of this work for the development of strategies to limit P losses are discussed.

P388

Effects of Zn and Fe on yield and yield components of sunflower

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A field experiment was conducted to evaluate the effect of Zn and Fe fertilizer on yield of two sunflower varieties. This study was conducted in a split plot arrangement with 4 replication in 2005. Main plot consisted of two sunflower varieties (R1: Zaria, P2: High sun 25). Sun plots consisted of two levels of zinc and iron (Z1=20, Z2=40, F1=10, F2=20Kg/ha). In this experiment 1000 seed weight, stem diameter, plant height, harvest index, kernel ratio, day from planting to first flowering, 50 % ,100 % flowering, physiological maturity, oil and protein percentage were determined. Results showed that seed yield was not significantly affected by varieties whereas it was significantly affected by fertilizer (40 Kg/ha zinc) had highest seed yield (5667.7Kg/ha), also plant day matter production was significantly affected by fertizer and varieties, at the same treatment (40Kg/ha zn) had highest dry matter(13716.5Kg/ha). Maximum leaf area index belonged to the (40Kg/ha Zn). Head diameter, number of seed, 1000-seed weight, stem diameter, were significantly affected by fertilizer, whereas day from planting to flowering 50%, 100% flowering, physiological maturity, protein percentage were significantly affected by varieties.

P389

GIS Evaluation of nitrates concentration in groundwater. A case study in Central Italy

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A study to evaluate the agricultural systems sustainability in Piana del Fucino (Abruzzo, Central Italy) was performed in collaboration with the Regional Agency for Agricultural Extension Services (ARSSA). This area is characterised by highly profitable intensive agriculture, mainly irrigated horticultural and short rotation crops. The Piana has a shallow and controlled groundwater table, and channels draining the water during winter. The area is "highly sensitive" since several factors, e.g. the geomorphological structure, the soil origin (from reclamation) and the artificial drainage, contribute to its fragility. All the anthropic interventions concur to water pollution and pose a threat of nutrient losses, especially in periods with high water surpluses. Therefore, nitrates contamination is one of the main risks for groundwater in this area.
The monitoring has been performed through chemical analyses on water samples collected from piezometers set up in the area. Point data may be inadequate to define and delimit vulnerable areas, so geostatistics represent a tool for the estimation of nitrates contents as an alternative to a detailed survey. Analytical data have been processed with a non-parametric geostatistical approach, the Indicator Kriging. This method has provided a model of spatial uncertainty, representing the probability that the threshold of 50 mg l-1 is exceeded, and results have been transferred into a GIS. The monthly maps show that from January to April the probability to exceed the threshold is high, due among other to the reduced nitrate uptake of crops at the starting stage of growth in this period.
Nevertheless, in some areas the probability is always high either for an excess of nitrogen fertilisation or a particular hydropedological situation, to be further investigated.

The methodology can provide an effective operative tool to support decision makers for the identification and the designation of nitrates vulnerable zones.

P390
Olive mills solid waste soil application in olive crops: Effect on herbicide fate

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The aim of this work was to study the effect of the application of a solid waste from olive oil production (alperujo) on sorption, movement and persistence of the herbicides diuron and terbuthylazine, widely used in olive crops. The application of alperujo, fresh or composted, to the land has been shown to be an extremely effective contribution to increasing crop yields and to maintaining or improving soil fertility. An experimental olive grove located in Southern Spain was divided in three plots: 1.- Plot without organic amendment (blank), 2.- Plot treated with fresh alperujo during 3 years at a rate of 17920 kg of alperujo ha^{-1} and 3.- Plot treated with composted alperujo. Diuron and terbuthylazinew were applied to plots at a rate of 2 kg ha^{-1}a.i. After 7, 14, 21, 28, 49, 70, and 117 days of herbicide application, triplicates from each plot were sampled at 3 depths (0-10, 10-20 and 20-30 cm), air-dried, remains of olive leaves, grass roots, and stones removed and sieved through a 5 mm mesh sieve. Herbicides were extracted with methanol 1:2 weight:volume ratio, the extracts were evaporated to dryness, resuspended in 2 mL of methanol, filtered and anylized by HPLC. Results from laboratory studies indicated higher herbicide sorption and persistence upon amendment with both fresh and composted alperujo when compared to unamended soil. Field studies also revealed higher amounts of diuron and terbuthylazine at each sampling depth in plots treated with fresh and composted alperujo. The increase in soil organic matter content upon amendment with alperujo is responsible for the increased sorption and the higher persistence of herbicides in the soil.

P391
Thermal properties of some Bulgarian soils

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The study of the thermal properties of soils is discussed on the basis of the Usowicz statistical-physical model of the thermal conductivity of soils and of de Vries formula concerning the volumetric heat capacity of soil. Statistical-physical model of soil thermal conductivity developed in Usowicz (1992) was applied in the current study. Results for main thermal properties of the soil: thermal conductivity, volumetric heat capacity and thermal diffusivity were presented. For this purpose mechanical composition, some physical and chemical properties were determined in laboratories of the Institute of Soil Science "N.Poushkarov". The dependence of soil thermal properties versus volumetric water content at different values of bulk density was investigated.
Keywords: thermal conductivity, volumetric heat capacity and thermal diffusivity.

P392
Loads and fate of fertilizer derived uranium in agricultural soils

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Rock phosphates used for fertilizer production are mainly of sedimentary origin. These are generally characterized by higher uranium contents than igneous rock phosphates. Depending on their geographical origins, concentrations up to more than 200 mg kg^{-1} U may occur. In the fertilizer production process, U is enriched in the final product. Based on literature data as well as our own laboratory analyses, typical U concentrations in P fertilizers of various origins are estimated to range from 2-325, 50-362, and 2.9-188 mg kg^{-1} U for superphosphates, triple superphosphates, and NP fertilizers, respectively, while in soft/ground rock phosphates, PK and NPK fertilizers, ranges from 43-205, 82-99, and 0.5-66 mg kg^{-1} U, respectively, are found. In contrast to that, mean U concentrations in farmyard manures and sewage sludges do not exceed 4 mg kg^{-1} U. U balances calculated for different fertilizing regimes and scenarios show U loads (gross inputs) from 5.4-11.9 g/ha*a (grassland) and from 2.8-16.4 g/ha*a (arable farmland). Long term field trials at various experimental sites in Germany (Schuby, Thyrow, Müncheberg and Braunschweig) suggest that the use of mineral fertilizers over a long period of time may indeed induce an increase in soil U concentration if the fertilizer bound U load exceeds the offtake by harvest products. This is usually the case, since U uptake by crop plants is generally rather low. In a pot experiment with a substrate of low U background concentration (<1 mg/kg U) typical for German soils, and P fertilization at a rate conforming to the rules of good agricultural practice, uranium transfer was only demonstrated for plant roots, while no transfer into the shoots was found. Hence, the major risk associated with U accumulation in agricultural soils is assumed to be connected to leaching of this rather mobile element into ground and surface waters.

P393
Profile distribution of enzyme activities in relation to some physico-chemical parameters of intensively used soils of the Wielkopolska Lake District (Poland)

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During the last decades many research efforts have been devoted to soil enzymes activities at the surface soil layers. Very little is known however about their activity towards the deeper horizons of the profile what is of great ecological meaning. That is why the aim of this work was to investigate 14 typical brown soil profiles for the distribution of activities of enzymes of the C, N and P-cycle: β-glucosidase, nitroreductase, urease, phosphatase as well as dehydrogenase activity. Moreover, the following physical and chemical properties of soil from the surface down to 150 cm were studied: organic carbon (TOC), total nitrogen (TN), available phosphorus (P_{E-R}), Ca^{2+} , Mg^{2+} , $CaCO_3$, pH (1 : 2.5 H_2O and 1 M KCl) and fractional composition. Simple linear regression analysis was used for evaluation of the relationship between all the measured parameters.
The distribution of enzymatic activity in the profile indicated that the investigated soils had the most active top 30-cm layer, where there was the most appreciable organic matter content. The enzyme activities in some profiles under study decreased systematically with soil depth while in some other profiles there was no clear changes in the profile distribution of the enzymatic activity. In general, the content of TOC, TN and P_{E-R} declined with depth in all the profiles studied, while there was no clear direction in the profile distribution of other parameters
The profile investigation of physico-chemical and biochemical parameters should be the subject of further research. This kind of studies give much information on subsurface processes and are needed to assess the contribution of subsoil geochemistry to the cycling of the elements, as well as to explain potential transformations in surface-applied chemicals and their metabolites as they move down to ground water.

P394

Dehydrogenase and cellulase activities in the arable-humic horizon of an acidic soil

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The objective of the investigations carried out on a 50ha field under winter wheat located near Budniki (Warmia, north Poland) was to assess dehydrogenase and cellulase activites and their changeability in the arable-humic horizon changing a great deal in its reaction (pH/KCl 3.77 - 6.7). This horizon varied also in the organic carbon and clay fraction content (8.5-31.7 g/kg and 8-39 %, respectively). 50 soil samples were collected from the 0 - 20 cm layer in the dispersed points system with Magellan GPS receiver. Soil dehydrogenases activity was assayed as described by Casida et al., while cellulolytic activity according to Deng and Tabatabai. Dehydrogenase activity assessed in the analysed arable-humic horizon ranged 0.767 - 1.502 (mean 1.065) μM TPF g^{-1} DM $\cdot$ $24h^{-1}$, while cellulases activity ranged 0.799 - 1.940 (mean 1.092) M glucose x g^{-1} DM $\cdot$ h^{-1} x 10^{-3}. Statistical analysis showed that despite similar basic digital data noted for both enzymes activities (means - above, and standard deviations - 0.151 and 0.183, respectively) as well as changeability coefficients (14.18 and 17.39, respectively) they revealed various distribution, which in case of the first enzyme type was close to symmetrical one (skewness 0.355) but rather flat (kurtosis 0.696), and in case of cellulases it was more agglomerated (kurtosis 10.24) with the skewness (2.444) towards a higher activity. However it was find that a high variability of soil acidity (CV=152) didn't have any significant effect of the activities in the studied horizon. It was shown as low correlation coefficients (-0.15 and -0.01, respectively) indicating a high tolerability of dehydrogenases and cellulases to changing pH.

P395

The effect of different fertilization systems on content of some micro and macro nutrients in soil and seed of oilseed rape (*Brassica napus* L.)

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This experiment was conducted at randomized complete block design with four replicates under rainfed condition, at 2004-2005 and 2005-2006 growth season. Treatments conclude 0, 50,100, 150 kg N ha^{-1} urea (F_0 To F_{150}), 100 kg N ha^{-1} as urea + 50 kg N ha^{-1} as manure ($M_{50}F_{100}$), 50 kg N ha^{-1} as urea + 100 kg N ha^{-1} as manure ($M_{100}F_{50}$), 150 kg N ha^{-1} as manure (M_{150}). In organic and integrated fertilization systems, content of nitrogen in seed and available nitrogen in soil was lower than chemical fertilization system. In spite of significant deference between fertilization systems in respect of available P and Zn in soil, concentration of P, Zn and Fe in seed were similar at organic, integrated and inorganic fertilization systems (F_{150}). It seems that excess availability of P at M_{150} and $F_{50}M_{100}$ has reduced translocation of Zn from roots to shoots.

P396

Comparison of effect of azola and azola compost on nitrogen mineralization of paddy soil

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Most of paddy fields have covered by Azolla filiculoides in Guilan province. Effects of this plant, can consider from different aspects including: environmental pollution, plant nitrogen nutrition and difficulty land ready for rice seedling. Influence on nitrogen mineralization is another effect of Azolla. This effect is more important than others, because Azolla filiculoides has coexistence with Anabaena azollae, which can fixate nitrogen of atmosphere. Determining amount of nitrogen mineralization, in these conditions, can be important because it influence on pollution of waters, nitrate cycles and rice inorganic nutrition. Azolla can transform readily to compost, because it is rich of nitrogen. In these conditions, circumstance of nitrate and ammonium production is notable.
In this study, nitrogen mineralization was compared between soil of paddy field and soil paddy field mixed with Azolla and Azolla compost. Rate of nitrogen mineralization was determined by spilt plot with four repetitions. Main factors were included soil of paddy field and soil of paddy field mixed with azolla and azolla compost. Subfactor was time of mineralization in six weeks.
Samples were put in plastic bags in spring (MAY) and these bags were put in field. Sampling was carried out every week, and concentration of total nitrogen, nitrate and ammonium were measured each interval. The result was revealed that, rate of mineralization of total nitrogen and nitrate in 3 treatments was significantly different ($p < 0.01$). Treatments of time mineralization also were significantly different ($p < 0.05$). Amount of ammonium was statistically different, but sum of nitrate and ammonium was significantly different.

P397

Remote sensing data for small rivers basins soil and vegetation mantle assessment

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Stability of various ranks natural territorial complexes, including river drainage basins, greatly depends on their territorial arrangement. Rational land tenure structure is characterized by the optimal ratio of various lands among which intensively utilized, converted, protected and virgin natural territories are found.
In the current research land tenure structure and some parameters characterizing ecosystems productive potential (phytomass reserve, biological productivity, soil and vegetation mantle condition) on the basis of some small rivers basins, being the tributaries of the Klyazma river and characterized by various soil mantle structure have been assessed applying automated methods of remote sensing data processing.
For image digital processing Erdas Imagine program has been applied. Object classification has been executed with ISODATA (cluster) method and further identification of the specified classes with spectral curves analysis and spectral brightness transformation using linear and fractional combinations (vegetation indices). It allowed distinguishing various land tenure objects and assessing vegetation and soil mantle condition using images.
To assess vegetation condition and productive potential vegetation index (NDVI) of standardized difference, calculated according to the obtained remote sensing data, has been used. Soil mantle condition has been assessed using clusters spectral curves related to the open arable soils. The maps of river basins tenure land structure have been compiled and further used for calculating area occupied by various lands, productivity indices and phytomass reserve of river basins ecosystems.

P398

Use of NIRS technology with a fibre-optic probe for the determination of total carbon, total nitrogen, pH and yields in soils after 16 years of applying different tillage and residue management systems

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Total carbon, total nitrogen and pH of the soil are the main parameters measured in conventional soil analyses; the yields of the soil are also evaluated, this parameter being correlated with soil quality. Classical analytical methods are tedious and time-consuming, and involve sample destruction and the use many chemical reagents. In contrast, near infrared reflectance spectroscopy (NIRS) is rapid, non-destructive, multi parametric and environmentally friendly.
NIRS technology with a fibre-optic probe was applied for the determination of total carbon, total nitrogen, pH, and yields in soil samples. The soils were from the Valles Altos of Mexico, and for 16 years they had been subjected to the application of different tillage and residue management regimes. Briefly, the soils were cultivated with maize and wheat subjected to zero tillage and conventional tillage; with rotation or monoculture, and with residues and without residues.
The regression method employed was modified partial least squares (MPLS). The calibrations, with the multiple correlation coefficients (RSQ) and corrected standard error of prediction (SEP(C)), of 0.978 and 0.05% for total carbon; 0.854 and 0.01% for total nitrogen; 0.948 and 0.08 for pH, and 0.938 and 142 kg ha^{-1} for maize yield, allowed the determination of these parameters. The ratio performance deviation (RPD) (>2.5 excellent) values obtained were 6.8, 2.8, 4.6 and 4.2 for total carbon, total nitrogen, pH and maize yield, respectively, indicating that the NIRS equations obtained were applicable to unknown samples in the 0.51-2.36% range for total carbon; 0.03-0.18% for total nitrogen; 5.21-7.28 for pH, and 887-4411 kg ha^{-1} for the maize yield. Taking into account the results, it may be concluded that the performance obtained with the NIRS method is comparable to those obtained using classical analytical methods. Indeed, this method can provide rapid, non-destructive measurements with little sample treatment or preparation.

P399

The effect of zinc and boron interaction on the concentration and uptale of phosphrus and potassium in corn grain

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For the purpose of studying the effect of Zn and B on the concentration and uptale of P and K in corn grain, a field experiment was conducted in 2004 at Iran. Experiment was carried out in factorial from, completely randomized block design with five levels of Zn (0, 15, 30, and 45 kg/ha Zn and Zn solution spray) and four levels of B (0, 4 and 8 kg/ha B and B solution spray), in three replications. The effect of Zn and B on P and K concentration in the grain was insignificant. Application of Zn, only to the soil, increased P uptake in the grain. Application of Zn and B at all levels, increased K uptake by the grain. The least K uptake by the grain at 33.02 and 34.86 kg/ha were seen at no Zn and B levels, respectively. Boron application at low Zn levels had no effect on P and K concentration in the grain, but at high Zn level, increased P and K concentration in the grain. Boron use had no effect on K uptake by the grain at any level of the Zn, but at high Zn levels, it increased P uptake by the grain. Thus, high level of Zn in the soil helped with increase in P and K concentration as well as P uptake by the grain after B application. Application of 15 kg/ha Zn at B spraying level, increased P concentration in the grain but at the same B level, application of 45 kg/ha Zn lowered K concentration in the grain. Application of Zn to the soil at 8 kg/ha level and B spraying, increased P uptake by the grain.
Keywords: Interaction, Zinc, Boron, Phosphorus, Potassium, Corn grain

P400

Search of ecological ways preservation and increasing of soil fertility

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Prolong farm land utilization without scientifically-based system of agricultural causes its degradation and loss of fertility. To explore the recovery of soils fertility we carried out long-term experiment on influence of plant cove of different origin grassy coenosis over some chernozemic south carbonate soil indices. Research variants were: 1) agro-steppe - 16 old model of steppe coenosis, made by the method of combine grass sod replanting and undersowing of dominance of natural steppe coenosis (*Poa angustifolia, Koeleria cristata, Cynodon dactilon, Festuca repeliana*). Floral composition is represented by 93 species; 2) 15-old sod field naturally restored, numbering 50 species with the preference of *Poa angustifolia, P. pratensis, Koeleria cristata*; 3) monospecific 8-age seeding lawn (*Poa angustifolia*); 4) a ploughed field served as a control plot. The sod cover under agrosteppe led to soil structure recovery, being a characteristic feature of this kind soil natural analogy with maximum root spreading up 80 cm. It is marked almost 3 multiple increase of nitrate nitrogen content in this layer in comparison with 2 and 3 test-variants; calculus potassium and humus accumulation up to 60 cm depth. Old soil field favored clotted structure formation in comparison with clody-lumpy one on the ploughland with maximum root placement in 50 cm layer. It should be observed the tendency to soil acidulation by grass root secretion. Under monospecies sowing it was fixed the considerable soil structure improvement due to agronomically-valued aggregates 1.5-2.0 times in comparison with arable land, the increase of constitution ratio in 20 cm layer, the decrease of clod quantity. Thus, any variant both artificial and natural ground cover causes the structure improvement and soil humus content, nutrient availability elements accumulation. Such methods of ground covers can be used in ecological viticulture and creation of scientific basis for organical winemaking legislation in Ukraine.

P401

Grouping of common soil varieties by cluster analysis on the basis of data for main soils' properties and their thermal characteristics

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The investigation was carried out for 13 soil varieties in meteorological stations (MS) of the National Institute of Meteorology and Hydrology (NIMH) of Bulgarian Academy of Sciences (BAS). Soil samples from the layer 0.05-0.10 m were taken in the vicinity of the soil thermometers positioned on the grassed ground of the meteorological stations and mechanical composition, and , soil organic matter (humus), mineral forms of Nitrogen, amount of , were determined in laboratories of Poushkarov Institute of Soil Science. Bulk density, particle density, porosity and air filled pores of soil samples were also determined. Soil thermal properties: thermal diffusivity and

volumetric heat capacity were calculated. The effect of thermal properties on soils differentiation in groups was evaluated by means of cluster analysis. This influence was investigated as two combinations were done separately with thermal diffusivity and volumetric heat capacity respectively. It was concluded a similarity in forming clusters i.e. thermal properties included in analysis- thermal diffusivity and volumetric heat capacity- didn't affect the differentiation of the investigated soil varieties in different groups and the change in average linkage was insignificantly.
Keywords: cluster analysis, volumetric heat capacity, thermal diffusivity.

P402
Sequential Extraction of Different Forms of Zinc in Several Soils of Guilan Province

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Zinc (ZN) is an essential plant nutrient . Knowledge abut distribution of Zn between its different chemical forms is useful in understanding the chemistry of this element in soil and also in development of soil properties and effect of corn crop on zinc forms in soil .
Twenty surface (0 - 30 cm) soil samples of Guilan province were collected and fractionation of zinc in different chemical forms was performed by a procedure, namely, those of singh et al. (1988). A pot culture experiment with corn plant also in randomized complete design with 3 replication was carried out. The plant top dry weight, zn concentration and zn uptake were used as the plant responses.
Based on the results of this experiment, zinc in soils of the study area has been distributed in the forms of Exchangeable, carbonate, organically bound , manganese oxides , amorphous and crystalline sesquioxides bound residual that the residual form is the most dominant form .
Stepwise regressions showed that soil PH, organic matter and clay percent except extractable zn with DTPA have no significant correlation with exchangeable, carbonate, organically bound, manganese oxides and crystalline sesquioxides bound forms of zn . So generally, those zinc forms are source of usable zinc in these soils.
After a corn growth period (56 days) the amount of all soil zinc forms except amorphous sesquioxides bound form changed. changes in organically bound and Mn oxides bound forms of zn showed a significant correlation with the plant responses , so these forms might be considered the available zinc forms for plants .

P403
Leaching of some heavy metals into drainage water in Croatia

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This study was aimed: at determining the concentration and total leaching of heavy metals (Pb, Zn and Cd) in drainage water and their contents in soil (until 0.30 m) at four different variants of pipe drainage spacing (15 m, 20 m, 25 m and 30 m) and at determining the yield of crop maize for each variants. The study was conduced on reclamation field, during five years. The crop maize was grown and the same agricultural practices were applied in all pipe drainage variants in each trial year. Drainage discharge was measured continually by means of automatic limnimeters. Sampling of drainage water were done three times each month during the discharge period and sampling of soil were done each month. Heavy metals were determined by AAS. The total annual quantity leached of heavy metals were estimated on the basis of average yearly concentration and yearly quantity of drainage discharge. Data were statistically processed by means of the ANOVA.
Based on the results, it can be confirmed that the concentrations of heavy metals in drainage water and in soil at all variants and in all years were below from limited values. The results of concentrations and their leaching depended on variant to variant and from year year to year. The highest concentrations (and leaching) of all heavy metals in drainage water and at all variants were recorded soon after appled of fertilizer and after higer precipitation (t.i. drainage discharge). There were no statistically significant differences between the tested variants and heavy metals in drainage water and in soil in a particular year. As a rule, the highest yields were achieved in the drainpipe spacing variant of 15 m and the lowest in variant of 30 m. The yields are fluctuated from 88 $dt.ha^{-1}$ (15 m) ap to 43.48 $dt.ha^{-1}$ (30 m).

P404
The selenium content in soil and red clover (*Trifolium pratense* L.) affected by organic fertilisation

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In trace amounts, selenium is an essential micronutrient and has important benefits for animals and humans. The selenium content in plants and animals is strongly correlated with its concentration in soils and depends on soil factors such as redox-behavior, pH or microbiological activity. The selenium concentration in agricultural crops is very low in many areas throughout the world and also in large areas of Middle and Northern Europe. Increasing the selenium content in crops may be done either by supplying organic amendments of high level selenium (sewage sludges, manure) or by adding selenate containing mineral fertilizers. The aim of this study was to determine influence of organic fertilization on the selenium content in soil and red clover plants. Soil samples were taken from the long-term experiment established at the Experimental Station of the IUNG Pulawy. The soil was affected by organic fertilisation in a form of manure (0,20,40,60,80 $t \cdot ha^{-1}$). Total selenium content in soil and plants was determined fluorometrically. The application of manure resulted in the highest amounts of organic carbon in soil. Total selenium content in soil from control plots was in the range of 0.090-0.115 $mg \cdot kg^{-1}$ and increased with the increasing doses of manure. We observed the increasing of total selenium content about 40% in soil manured with the highest dose in comparison with total selenium content in soil from the control plots. Total selenium content in the soil samples was statistically highly correlated with organic carbon content. The selenium content in red clover from control plots ranged from 0.086 to 0.128 $mg \cdot kg^{-1}$. We observed the highest selenium concentrations in red clover gathered from plots manured at the doses of 40 and 60 $t \cdot ha^{-1}$. The application of manure at the dose of 80 $t \cdot ha^{-1}$ resulted the decrease of selenium content in red clover about 17%.

P405
Use of phosphorus applied with animal manure to organically and conventionally managed soils

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Finiteness of P resources on the one hand and eutrophication of water bodies due to over-fertilization on the other hand ask for proper recycling of P contained in animal manure. We studied the use efficiency by ryegrass of P applied with animal manure to soils that were for 22 years under organic or conventional cropping systems (bio-dynamic (BIODYN); bio-organic (BIOORG); conventional with organic and mineral fertilizers (CONFYM); conventional with exclusively mineral fertilizers (CONMIN); non-fertilized control (NOFERT)). Soils are characterized by different available and total P contents and microbial activity. Soil available P was labeled with ^{33}P and soils amended with animal manure or water soluble di-ammonium-phosphate or zero P. Shoot material from four cuts of *Lolium multiflorum* was analysed for dry matter (DM) production, P content and specific activity to calculate proportions of plant P derived from residual (Pdrf) or fresh fertilizer (Pdff) and recovery of fertilizer P in ryegrass (RecP). With no fresh P DM production was lowest on NOFERT (5.9 g kg^{-1} soil) and highest on CONFYM soil (11.7 g kg^{-1} soil). The order of DM production agreed with soil available P contents. Relative and absolute Pdrf took the order BIODYN < BIOORG < CONMIN < CONFYM. Without fresh P application RecP of residual fertilizers ranged from 9 (BIODYN) to 15% (CONFYM). For fresh fertilizers RecP ranged from 37 (CONFYM) to 43% (BIOORG) for mineral P and from 24% (CONFYM) to 35% (NOFERT) for animal manure. RecP and Pdff were mainly affected by soil available P contents, with lesser use of fertilizer at higher available P. Differences in microbial activity among soils were of subordinate importance in the use of fresh and residual P fertilizers, but microbial P immobilization limited residual P use on all soils when they were amended with fresh animal manure.

P406
Development of a sewage sludge ash based phosphate fertilizer (PHOSKRAFT): characterization of ashes and potential for phosphorus-fertilization

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Phosphorus (P) recycling from sewage sludge (SS) is crucial because P resources are finite. Direct application of SS in agriculture has been forbidden in Switzerland for sanitary concerns, resulting in high quantities of P rich sewage sludge ashes (SSA, residues from SS combustion). As SSA have high heavy metal contents, fertilizer production is only feasible after removal of heavy metals. ASH DEC Umwelt AG developed a thermo-chemical treatment to remove heavy metals from SSA, combining $CaCl_2$-addition and high-temperature incineration. Swiss SSA have been collected and submitted to the thermo-chemical treatment. Chemical characteristics and P-related fertilizer properties of treated and untreated SSA have been analyzed.
Total P-content of untreated and treated SSA ranged between 38 and 86 g kg^{-1} and decreased with increasing proportion of SS from industrial origin. Due to different P-precipitants during waste water treatment, the ashes could be grouped into aluminum, iron and calcium-rich SSA. X-ray powder diffraction showed P-bearing phases whitlockite and hydroxylapatite in untreated, and chlorapatite in thermo-chemically treated SSA. Phosphorus-solubility in water was below 3% of total P and increased slightly due to the thermo-chemical treatment. Phosphorus-solubility in citric acid improved from average 52 for untreated to 69% of total P for treated SSA. Growth trials with ryegrass under greenhouse conditions showed an enhanced performance - compared to unfertilized control - for untreated SSA. (Trials with treated SSA are in progress). However, dry matter production of plants fertilized with untreated SSA was 30 and P-uptake 70% lower than for plants fertilized with water soluble P. For the development of a SSA-based fertilizer, the P-fertilization effect has to be better understood by a) identifying and quantifying all mineral phases in untreated and treated SSA and by b) investigating the availability of P to different soils and plants using isotope tracer techniques (^{32}P, ^{33}P).

P407
Synthetic siderite is effective to prevent iron deficiency

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Iron deficiency (Fe chlorosis) is a serious problem in many calcareous soils of the Mediterranean area. Iron chelates are effective to correct and prevent Fe chlorosis but they are easily leached from the soil; this creates the need for frequent applications and can cause contamination of ground water. The purpose of this research was to test the effectiveness of synthetic siderite (ferrous carbonate) to prevent Fe chlorosis. To this purpose, a pot experiment was performed in which iron chlorosis sensitive chickpea (*Cicer arietinum* L.) cultivar was grown under controlled conditions on an Fe chlorosis-inducing calcareous soil (low in available Fe and high in active lime). The treatments were: control (no Fe added), periodic addition of Fe chelate (FeEDDHA), and a single addition of siderite (mixed with soil at a rate of 0.5 g Fe kg^{-1}). The chlorophyll concentration per unit leaf area (estimated by the SPAD units) in plants fertilized with siderite was significantly higher than that in control plants (without Fe) and not significantly different from that in plants treated with Fe chelate. Moreover, in contrast to Fe chelate, the initial application of siderite was found to be effective to prevent Fe chlorosis in a second cheakpea crop.

P408
Screening tests of epiBS

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The effectiveness of 24-epibrassinolide (**epiBS)** and its interaction with gibberellin (A_3), as well as the influence of the concentration of basic nutritional elements and some trace elements on exogenous phytohormones was tested in our laboratory. **EpiBS**, *synthesized by the Chemical Faculty, MSU (NEST-M),* gibberellin (Sigma), sulphate and chelate forms of zinc were used in these experiments. The nutritional elements were varied in Knop medium. It has been shown that **epiBS** exhibits both an additive effect and a synergistic effect depending on studied factors. It has also been discovered the effects found in our experiments vary depending upon the concentration of **epiBS**.
The aim of preliminary experiments was to find sensible, reproducible biological tests to determine effective concentrations of **epiBS**. Concentrations from 10^{-5} to 10^{-15} M were studied. Diverse biological tests were used. It should be noted that in addition to using specific tests which have previously been reported (the test of activity of the second internode of haricot, the test on epicotyls of *Phaseolus aureus* the possibility of using other tests and characteristics was also evaluated. The following characteristics were used: the intensification of epicotyls growth (tests: *Raphanus sativus*, *Phaseolus aureus*, *Phaseolus vulgaris*) and the lengthening of hypocotyls (tests: *Raphanus sativus*, *Phaseolus aureus*), morphological changes of internodes (tests: *Phaseolus vulgaris*, *Raphanus sativus*), hypocotyl and epicotyl curves (*Phaseolus vulgaris*, *Phaseolus aureus*, *Raphanus sativus*), and rhizogenesis (grafts of *Phaseolus vulgaris*, *Phaseolus aureus* and *Raphanus sativus*).
The influence of various concentrations of **epiBS** on the germinating capacity of different plant species was studied. The germination of seeds in solutions containing **epiBS** at concentrations of 10^{-8}-10^{-15} M showed a positive effect on the growth of germs.

P409

The agronomic value of composed sludge. 1- Effect of compost combined with N, Pand K applicationon yield, nutrient and heavy metal concentrations of wheat in newly reclaimed soil

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Two field trials were carried out in sandy calcareous desert soil during 2005/2006 and 2006/2007 seasonas. The experiments investigated the effect of compost at 0 and $10m^3$ fa^{-1} when combined with N (at 0, 45, 60 and 75 kg N fd^{-1}), P (at 0, 15.5, 22.75 and 31 kg P_2O_5 fd^{-1}), and K (at 0, 24, 48 and 72 kg kg K_2O fd^{-1}) on wheat yield and nutrient and heavy metal content of grain.
The results showed that grain and straw yields were significantly increased due to compost application and with the inorganic N fertilizer up to 60 kg fd^{-1} in both seasons. Phosphorus and potassium fertilizer applications significantly increased grain yields, and the increase due to K application was approximately 20% greater than the untreated control treatment. Significant interactions on grain yields were apparent between compost and N fertilizer in both seasons, as well as straw yield . On contrast, no significant interactions between compost and P or K were detected .The chemical analysis of the vegetative plants revealed that there were some immediate benefits from the compost where significant increases in N and Fe concentrations were detected. Mn and Cu concentrations were significantly increased due to the interaction between compost and N at 75 kg N fd^{-1} The chemical composition of wheat grains revealed some evidence of beneficial increases in N, P and K and the micro-elements (Fe, Mn, Zn and Cu) due to compost application, although only the increase in Mn was significant. The concentrations of heavy metals (Ni, Cd, Pb and Cr) were slightly increased by compost application but not reach the level of significance.
It could be concluded from this study that application of compost may increase wheat yields and improve the nutritional status of the plants on such sandy calcareous desert soils.
fd^{-1} $_{=4200m^2}$

P410

Distribution of Forms of Copper and their Relationship with Soil Properties in Agricultural Soils of Central Greece

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The purpose of this study was to determine soil fractions of Copper in an agricultural region of Central Greece. The total concentration of copper was determined by the Aqua Regia procedure. Copper concentration was also determined after division into five fractions, as follows: (a) exchangeable and specifically adsorbed, after extracting with the use of acetic acid, (b) bounded to Fe/Mn hydroxides, using a reducing agent, (c) bounded to soil organic matter, using an oxidizing agent, (d) bound to mineral structures-residual, using Aqua Regia and (e) available to plants, by using DTPA extracting solution.
80 soil samples from Almyros area (Central Greece) were collected from two depths (0-30 and 30-60cm). The clay content of the soil samples ranged from 29.5 to 56.8% and seemed increasing with the depth. The soils were neutral to alkaline, in reaction with pH ranging from 6.1 to 8.3. The increasing of $CaCO_3$ content followed the increasing of clay content. In general the higher content of Copper was observed in surface (0-30cm) horizon.
Data were statistically analyzed, particularly using regression and correlation analysis. The exchangeable, organic bounded and extractable with DTPA Copper fractions increased with the increasing of organic matter content. The available to plants fraction (extracted with the DTPA solution) was significant negatively correlated with soil pH. The total Copper concentration correlated significantly with both organically bounded and available Copper fractions. The possibility of constructing a model predicting the total amount of Copper based upon the organically bounded and extracted with DTPA Copper concentration was, also, discussed.

P411

Study on the Effects of Macro and Micro Nutrients on Yield and Quality of Sesame (Sesamum indicum L.)

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The experiment was conducted in Iran during the 2006 using a completely randomized block design with 12 treatments and 4 replications. The treatments included: T1= NP; T2=NPK1; T3=NPK2; T4=NPK2; T5=NPK1Fe; T6=NPK1FeZn; T7=NPK1FeZnMn; T8=NPK1FeZnMnCu; T9= NPK1FeZnMnCuB; T10= NPK1FeZnMnCuBMg; T11= PK1FeZnMnCuBMgS; T12=foliar applications of a complete formula of micronutrients+NPK1FeZnMnCuBMgS. Nitrogen, P, Fe, Zn, Cu, Mn, B, Mg and S was supplied in the form of urea, triple superphosphate, iron sulfate, zinc sulfate, copper sulfate, manganese sulfate, boric acid, magnesium sulfate and sulfur powder respectively. Potassium based on soil tests was supplied as potassium sulfate (K1 for T2), and at 50% over the soil test as potassium sulfate (K2 for T3), and as potassium chloride (K2 for T4). Measurements showed considerable yield increases with respect to the control (only a yield of 1300 kg/ha) for all the treatments except for T3 and T4. The greatest yield of 1795 kg/ha a 38% increases over the control was obtained from T8. Similarly every treatment (except T4) caused an increase in the oil content of the seeds compared to the control. The application of micronutrients such as iron, zinc, manganese, copper, boron, and foliar applications of micronutrients and the use of sulfur and magnesium resulted in increases in the leaf and seed concentrations of the nutrients. As a conclusion potassium sulfate supplied at rates based on soil tests (K1) increased the seed as well as the oil yields. However, the use of potassium at higher rates (ie K2) resulted in yield decreases. The use of potassium chloride at K2 rates resulted in lower seed oil contents as compared with the control, the seed yield also showed significant differences with the control. Sulfur powder, oxidized in soil to make other nutrients available to the plant, resulted in increases of seed yields and oil yields.

P412

Aftereffect duration of residual amounts of phosphorus fertilizer

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Prevailing in Belarus Luvisol soils are characterized by low fertility status owing to natural reasons. Therefore mineral fertilizer application represents one of the main factors for the improvement of soil fertility status as well as soil productive ability. Mineral fertilizer system for Luvisol soils is developed taking into account the compensation of nutrients yield removal as well as the increase of soil phosphorus and potassium reserve. In this connection the duration of residual nutrient amounts action is of great scientific and practical importance.
Our investigations were performed in long-term field experiment on typical for Belarus Luvisol loamy sand soil underlies by moraine on depth of 0.5 m. Selected experiment treatments were fertilized by calculated doses of mineral fertilizer during 10 years. These selected treatments were used for cropping without fertilization during following 12 years.
The initial content of mobile phosphorus in Luvisol loamy sand soil was equal to 106 mg kg-1. Due to residual amounts of P-

fertilizer, introduced in a form of triple super phosphate, mobile phosphorus content in soil was increased up to 157 mg kg-1. After the stopping of mineral fertilizer (NPK) application mobile phosphorus content in soil returned to initial parameter over the period of 9 years. It was found that the productivity of agricultural crops over indicated period was reduced by factor 2.
At the experiment treatments where the accumulation of phosphorus was observed as a result of application of P-fertilizer (soluble in citric acid or hardly soluble calcium phosphates), mobile phosphorus content was reduced more slowly, by 28-57 mg kg-1 over the period of 12 year aftereffect, however the initial content of mobile phosphorus was not achieved. The agricultural crop yields values remained at the same level as at previous treatment.

P413
Towards a sustainable agriculture in Cuba

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Throughout the 1970s and 1980s, agricultural production in Cuba was characterized by high use of external inputs: fertilizers, pesticides, mechanization and fuel. As a consequence, millions of hectares of soil are degraded and compacted. Soil compaction, decline of organic matter and decrease of pH value of soils affects certain sensitive crops, especially vegetable. Due to the economic downturn affecting Cuba and the continuous decreasing support from socialist countries in Europe since 1990, the use of chemical fertilizers and other inputs has sharply decreased to 20-25% of the consumption observed in the 1980s. On the one hand, this decline negatively affected agricultural productivity and on the other, it provided Cuban scientists with a unique opportunity to play a protagonist role in the search for more effective and efficient ways of using traditional agricultural inputs (zeolites and Cuban rock phosphate) as well as other national alternative sources such as organic manures, vermicompost, green manures, and a wide variety of organic and biofertilizers. The combination of lower levels of inputs and other alternative sources together with the introduction of new farming practices and/or farming systems, allow today Cuban farmers to obtain higher average yields than those obtained during the 1990s. The analysis of organic production in Cuba was also considered. In the framework of the organic production, the successful movement of Urban Agriculture is also considered. The paper concludes that under Cuban conditions in particular, sustainable agriculture is possible only by incorporating an Integrated Crop Nutrition Management approach. This approach is based on a) the diversification of the agricultural production in a determined area allowing crop rotation, and b) the management of all nutrient sources (including chemical fertilizers) and water in order to optimize the efficiency of nutrients supply to the different crops. The paper also shows an example of this approach.

P414
Geochemical atlas of the Republic of Croatia

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Regional geochemical mapping is being carried out as part of the national project "The basic geochemical map of the Republic of Croatia". The current investigations, were based on the analyses of content and areal distribution of chemical elements in the topsoil (0-25 cm). The sampling of the entire area of the Republic of Croatia was conducted in a regular grid of 5x5 km (1 sample per 25 km^2) with 2778 samples collected throughout the country. Regarding detection limits, accuracy and precision, 25 elements (Al, Ca, Fe, K, Mg, Na, P, Ti, As, Ba, Cd, Co, Cr, Cu, La, Mn, Ni, Pb, Sc, Sr, Th, V, Y, Zn, Zr) were presented on single-element geochemical maps. The maps were produced using ESRI® ArcGIS™ 9.2 software, Geostatistical Analyst extension. Data was classified into 8 classes according to the values of the 5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th} , 90^{th} and 98^{th} percentile of the probability distribution of each element including their minimum and maximum values. The method of deterministic spatial interpolator Inverse Distance Weighting (IDW) was used to generate the filled contours of the single-element maps.

P415
Using pedological information in establishing conservation measures concerning soil fertility and environmental protection in south-western Romania

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The present topic concerns an area of 3,251,477 ha of which 2,112,990 are agricultural lands, located in south-western Romania and representing 348 cadastral territories within the counties of Bihor, Arad, Timis, and Caras-Severin (which, in their turn, represent two major historical provinces - Banat and Crisana.
The physical and geographical conditions specific to the four counties in south-western Romania resulted in soils with various features, from sandy ones to extremely loamy ones, from alkaline ones to very acid ones, from humus and other fertilising elements poor ones to balanced ones.
In the conditions of an apparently good natural environment, the general state of soil quality within the research area is however unsatisfactory since most soils are affected by the existence of one or several limiting factors.
Since humus and other nutrients content, as well as other defining features of soil fertility (texture, structure, pH, base saturation degree) are directly linked to the nature of pedo-genetic processes, and the research area is to be noted for its broad diversity of soil types, such as shown by the synthesis of pedological studies, we think it is useful to present the share of these soils from the agricultural area, as follows: 29.60% - Luvisoils, 24.48%, Chermozems, 13,95 Fluvisols et Arenosols, 10,53% Cambisols, 7,75% Vertisols, 4,07% Solonetzs, 4,04 Gleysols, 3,69% Leptosols et Regosols, 0,33% Cambic et Haplic Podzols, et 0,05% Histisols.
Supply of nutrients is also negatively influenced by a series of processes of degradation of the soils, generated by the practice of some improper agricultural systems, common in the area, such as the moderately excessive acidification (33.28%), moderately excessive salefaction (7.54%), secondary and moderately strong primary compaction (71.98%), strong and excessive phreatic and surface moisture excess (35.73%), etc.

P416
Content of phosphorus in soil under corn grown in monoculture

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38 % of Polish soils contain a low content of phosphorus which depends e.g. on fertilization and soil pH. With that in mind research has been taken up which aimed at defining pH_{KCl} and the content of available forms of phosphorus in soil under corn in monoculture and the evaluation whether and to what extent the method of nitrogen application as well as foliar application of microelements determine the parameters researched. The research was carried out based on a field experiment set up on the soil of slightly acid reaction and an average content of available forms of phosphorus. It was carried out over 2004-2006 on a farm located in Chelminsko-Dobrzynski Lakeland. Nitrogen fertilization was applied in two variants: 150 kg N/ha at a single dose or 150 kg N/ha at the divided dose: 100 kg N/ha

into soil + 50 kg N/ha in three foliar sprays. Foliar fertilization with microelements was provided in the form of ADOB Zn, ADOB Cu and BASFOLIAR 36 EXTRA. After three years of corn growing there were observed significant changes neither in the value of exchangeable acidity nor any changes in the class classification of richness of phosphorus. Contents of phosphorus ranged from 43.23 to 60.74 mg/kg. The content of phosphorus in soil was significantly determined by the nitrogen application method, the microelements fertilization applied and their interaction. The use of nitrogen at a single dose resulted in a significant decrease in the average content of phosphorus in soil by 7.5% as compared with the initial value. After the application of microelements there was observed on average the highest content of the ions researched after the use of ADOB Zn, while the lowest content - after the use of ADOB Cu, and respectively higher: by 10.17% and 4.3 % as compared with the control.

P417

Fertilization with nitrogen and sulphur as a factor determining sulphur richness in soil in different types of soil

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The aim of the research was to evaluate the total sulfur content (St) and sulfate sulfur (VI)- S-SO4 in 4 soils, at the layers of 0-40 cm and 40-80 cm as affected by selected anthropogenic factors. It was defined whether and to what extent the application of nitrogen at the dose of 100 and 200 kg N/ha and sulfur at the dose of 25 kg S/ha maintains the richness of soil in sulfur, and at the same time ensures the right development of the plant. The research was carried out over 1996-2004 at the Experimental Station of the University. They were conducted in cases filled with four different soils (Haplic Phaeozems, Orthic Luvisols, Orthic Podzols, Mollic Gleysols) according to their profiles and the plant tested was *Bromus inermis Leyss*. After nine years of research average contents of St in the heavy soils layers researched did not decrease as compared with the initial content. A similar tendency was also observed for light soils. In both cases the tendency did not result in any changes in the classification of soil defined by the content of St. Contents of St and S-SO4 in the 0-40 cm layer in soils were significantly determined by the soil type, the nitrogen fertilization applied and all the possible interactions. The highest increase in S-SO4 was found at the layer of 40-80 cm and it was 46% higher as compared with the treatments without sulfur application, which is confirmed by the fact that sulfate ions (VI) undergo sorption processes to a very limited extent and thus penetrate easily deep the soil profile. Based on the present research one can state that despite the sulfur uptake with the yield the application of 25 kg S/ha/year balances its loss in soil.

P418

Effect of organic matter and copper on chemical forms of copper and copper concentration in corn in two calcareous soils

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Copper is an essential microelements for plants and animals. Soil organic matter content and copper are low in most cultivated soils in Iran. Sequence extraction has been used as suitable method for identification of chemical form of heavy metals and their potential plant availability. However, in calcareous soils of Iran, the capacity of soil components for heavy metals retention and the change in chemical form have received little attention. The greenhouse experiment was conducted to study effects of organic matter and on chemical forms of copper and copper concentration of corn. Treatments consisted of two organic wastes (Esfahan's municipal compost, and cow) in two levels (0, 2 on dry weight basis) and two levels of copper (0, 5 mg kg soil) in the form of $CuSO_4.H_2O$ in two calcareous soils in their physicochemical properties, Typic Calcixerepts (S1) and Calcic Haploxeralfs (S2). The experiment was designed with tree replications in the frame completely randomized factor designed. One sequence extraction scheme was used to fraction Cu in to exchangeable (Ex), carbonate-bound (Car), Mn-oxid-bound (MnOx), amorphous Fe-oxid-bound (AFeOx) and residual (Res) forms. Organic matter and copper and their interaction had a positive and significant effect on the copper concentration of corn and increase Cu concentration in tissue of plant. Application of organic matter and copper increased (Cu-Car) and decreased residual Cu form in (S1) and Increase (Cu-Res) in (S2) application of copper increase (Cu-MnOx) and decrease (Cu-Res) in (S2). Significant liner regression models between copper fraction and Cu concentration in corn Cu-OM and Cu-Car (R^2=0.59-0.37) respectively. In two calcareous soils and important part of Cu to be retained by $CaCO_3$ and when organic matter content of these soils, less Cu was retained by $CaCO_3$.

P419

Rock phosphate availability to oats plants in two inoculated with bacteria soils

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The use of natural phosphates as an alternative source for phosphorus fertilizer in biological agriculture is a way to reduce chemical inputs in soils and to protect the environment. Additional processing of phosphate raw materials (decreasing particle size, partially acidulating, reacting with synthetic or natural organic acids) has been proposed to improve their agronomic effectiveness. Another mean to enhance rock phosphate availability to crops is to induce microbial solubilization in soil by microorganisms inoculation. Different effects on plant growth and nutrition have been reported in experiments with combined direct application of rock phosphates and phosphate solubilizing microorganisms into soil which was probably due to specificity of microbial strains used (viability in soil and activities) and soil characteristics (pH level, phosphorus sorption capacity, water regime, organic matter content etc).
The present work aimed to study the effect of bacterial inoculation of soil on rock phosphate availability to oats plants under different soil conditions. A pelic vertisol (characterized with close to neutral reaction, high humus content and high microbial activity) and a cinnamonic podzol soil (slightly acid reaction, low humus content and low microbial activity) were used to set a pot experiment. Each pot was amended with ammonium nitrate (100 mg N/kg) and superphosphate (100 mg P/kg) or Tunisian rock phosphate (in rates 100, 200 or 300 mg P/kg). Bacterial inoculation in the rhizosphere was done after plant emergence. *Azotobacter vinelandii* and *Pseudomonas fluorescens* species isolated from local soils were used in the experiment. At maturity, grain yield, shoot dry weight and nitrogen, phosphorus and potassium contents in tissues were determined. Data analysis showed that oats grew better in the pelic vertisol yielding higher grain and shoot biomass. Rock phosphate availability to plants was higher in the soil inoculated with *Az. vinelandii*.

P420

Nutrient balance in organic rice farming area in Korea

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Nutrient balance in agricultural area can be used for identifying nutrient use problems and it can also serve as an indicator of the quality of an agricultural practice. The objectives of this study were 1) to estimate the nutrient balance (nutrient input - nutrient output) of the organic rice farming, and 2) to suggest a solution to improve the nutrient balance. The study was conducted at the organic rice farming area (9 ha) in Wanju-gun in Korea during the paddy cultivation period in 2007. To estimate the nutrient status in organic rice farming area, we estimated the nutrient balance between the input quantity and the output quantity of the major nutrients including nitrogen, phosphorus and potassium. Sources of nutrient input included cattle manure, green manure, and organic fertilizer, and nutrient output consisted of farm products. Annual environmental loads of nitrogen, phosphorus, and potassium were estimated at 44 kg ha^{-1}, 60 kg ha^{-1}, and 120 kg ha^{-1}, respectively. Cattle manure had the largest portion among the input items and it had high nutrient concentration; hence, the amount of nutrient input depended on cattle manure input. It is therefore necessary to control cattle manure input to improve the nutrient balance of organic rice farming.

P421
Soil physicochemical properties of reclaimed land in southwestern coast in Korea

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Korea has 387.7 thousand ha of reclaimed land mostly located in the southwestern coast, and 28% of which is used as paddy. The objectives of this study were 1) to survey the soil physicochemical properties of reclaimed land in southwestern coast in Korea, and 2) to provide preliminary data for agricultural cultivation in the reclaimed land. The set of survey was performed at the reclaimed land in southwestern coast in Korea - Hwaong A, Hwaong B, Iwon, Saemangeum and Yeongsangang for one year (in 2007). Silt content was 2~70% and clay content was 3~24%. The contents of silt and clay of five soil series followed the order Poseung > Gwanhwal > Munpo > Yeompo > Hasa. As it was nearer sea, sand content was higher. Soil pH was 7.57~8.75. EC variation was large in the surveyed location and Iwon had the highest EC (14.27dS/m). Total nitrogen (TN) was 0.16~0.53 g/kg and organic matter (OM) was 4.47~10.81g/kg. The contents of TN and OM were lower than general farmland soil. New reclaimed land soils had much higher concentration of exchangeable Mg^{2+}, K^+, and Na^+ than common paddy soils, but exchangeable Ca^{2+} was low. Soils along the sea shore had more exchangeable Mg^{2+}, K^+, and Na^+ than soils along river banks. As the soil matured, exchangeable K^+ and Na^+ decreased.

P422
Quantifying Bioactive P Pools in Fertilized and Manure-amended Soils by Purified Phytic-Acid High Affinity *Aspergillus* Phosphohydrolases

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In areas of intensive animal agriculture, repeated land application of manure resulted in elevated soil concentrations of inorganic and organic phosphorus (P). *myo*-Inositol hexaphosphate and lower phosphomonoesters are the most abundant organic P compounds. Such P-enriched soils are potential pollution sources, increasing risks of impairment to water quality of freshwater systems. Extracellular phosphohydrolases have been used to characterize organic P because they hydrolyze and release phosphate from P-containing organic compounds. As current enzymatic methods have been hampered by low recovery of soil P, we develop a mild *in situ* enzymatic method to quantify bioactive P in environmental samples such as manure, soil, water, and sediments. Induction and culture of five *Aspergillus* strains were conducted to develop a source of high-affinity phosphohydrolases. Differences existed in strains' adaptability to fermentation medium as there was a wide range of phytate-degrading activity. Phosphohydrolases from *A. ficuum* had highest activity when the strain was cultured on a primarily chemical medium, exhibiting phytic acid-degrading potential equivalent to that of commercial preparations. Purified phosphohydrolases effectively quantified bioactive P pools in samples of fertilized and manure-amended soil planted to soybean [*Glycine max* (L.) Merr.]. Within-season changes in inorganic P pools and P uptake showed that the simple equilibration of soil with a dilute solution of polycarboxylate ligand performed equally well or exceeds the extraction efficiency of a strong acid Mehlich 3 extractant. Organic P species were similarly solubilized and dephosphorylated, yielding an additional enzyme-labile soil P fraction. Therefore, extracellular phosphohydrolases are effective sensors for environmental organic P and have an important role in assessing P internal dynamics in soils, nutrient bioavailability, and the effects of crop management in mitigating risks of P emissions.

P423
Distribution of polycyclic aromatic hydrocarbons in urban, suburban and arable areas of the Vojvodina Province, Serbia

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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous products of the combustion of carbon-based materials, important environmentally because many of them cause mutations and certain types of cancer. PAHs can strongly adsorb to soil organic matter and are likely to be retained for a long time. Consequently, soil is one of the main reservoirs for PAHs in the environment.
Soil samples from 12 sampling sites including urban, suburban and arable areas in Vojvodina, the northern Serbian province, were analyzed for 16 US EPA priority PAHs. In addition, two samples of surficial coastal sediments were taken: one from the banks of irrigation canal connected with the Danube river nearby an oil refinery, and the other from the Begecka Jama National Park, an oxbow lake along the left bank of the Danube River, being an area without direct anthropogenic emissions. After air drying and sieving of the samples, PAHs were Soxhlet extracted. The obtained extracts were cleaned up by column chromatography on silica gel and analyzed by gas chromatograph equipped with flame ionization detector. Soil characteristics such as loss on ignition, humus content, total nitrogen content, calcium carbonate content, pH and humidity were characterized in order to examine the possible correlation with PAH contents.
There was high spatial variability in the total PAH concentrations in the analyzed samples. Profile of PAHs identified in most samples revealed their pyrogenic origin. The low molecular mass PAHs, which are petroleum-related PAHs, were significantly higher in the area directly influenced by the oil refinery.According to the obtained results, soil pollution extent was estimated in comparison to other investigations and soil quality standards. The total carcinogenic potency for each sampling site was calculated taking into account benzo(a)pyrene equivalent factors and the found PAH concentrations, and compared with the reference value based on the target concentrations for unpolluted soils.

P424

Interaction effect of organic, inorganic and biofertilizers on the growth and yield of wheat plants in newly reclaimed soil

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Two field experiments were carried out at private farm, at fayioum Governorate. This work aimed to study the interaction effect of biofertilizer inoculation (without inoculation and inoculation with Rhizobium,), organic fertilizer (0, 20 and 40 m^3/fad) and inorganic fertilizer (0 ,1/2 recommended ,recommended dose) on growth and yield of wheat plants grown in newly reclaimed soil. Increasing the input of either organic or inorganic fertilization greatly increased various growth parameters (i.e. leaves and tillers number, dry weight of leaves, stem and spikes) as well as yield components (leaves and tillers number , weight of straw and spikes, grain yield , weight of 100 grains and protein contents of the grains). Inoculation of biofertilizers, significantly increased most growth and yield parameters. The highest dry matter accumulation in shoot system and spikes and the highest yield and yield components recorded by wheat plants fertilized with 20 m^3/fad, recommended inorganic and inoculated with Rhizobium.

P425

Effects of low-molecular-weight organic acids on desorption Kinetics of Copper from soils

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It is generally accepted that metal concentrations in soil solution and bioavailability are primarily controlled by sorption-desorption reactions at the surfaces of soil fractions. Compared with the numerous studies on desorption of metals by soils, there are relatively few that examine desorption kinetics. The objectives of this study is to examinite different models developed previously to evaluate the effect of Low-molecular-weight organic acids (LMWOAs) to desorption kinetics of copper (Cu) from ten different natural soils of Westhern Iran.
Citric and oxalic acids were chosen as representatives of LMWOAs commonly present in soils. The obtained results reveled that, Cu was less readily desorbed from soils (except soil no. 9) with Citric acids than desorbed by oxalic acids, which was consistent with the order of stability of Cu-LMWOAs complexes. Desorption of Cu by LMWOAs showed different trend in response to LMWOAs due to their different complexing abilities. The results also indicate that LMWOAs commonly present in the root exudates play a vital role in the bioavailability of Cu in soils and, hence, may influence its uptake by the plants.
The kinetic of Cu release was found to be described well by zero-order, first-order, power function and parabolic diffusion equations and for less conformity by the simple Elovich equation.
Keywords: Kinetics, Desorption; Copper; Low-molecular-weight organic acids

P426

Microbial transformation of diphenylarsinic acid in Japanese agricultural soils

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1. Introduction
Diphenylarsinic acid (DPAA) and methylphenylarsinic acid (MPAA) was detected from paddy rice on Kamisu-town, Ibaraki Prefecture, Japan in 2004. It is necessary to evaluate the risk to the human of these organo-arsenicals through the soil, water, and farm product. However, there was little research on the biogeochemical change in DPAA in the agricultural soils and farm products. Then, we carried out the incubation experiment to clarify the microbial transformation of DPAA amended soils.
2. Materials and methods
Two types of unpolluted soils were collected from fields in Japan (Eutric Fluvisol and Haplic Andosol). For flooded conditions, each soil was put into a 50 mL glass vessel, and ultra-pure water was added up to about 2 cm depth. After two week's preincubation, DPAA solution was applied to the flooding water (5 mg As kg^{-1} oven-dry soil). For further study, glucose (0.1%) was amended a part of soil sample. All vessels were incubated at 25°C in a dark incubation chamber for up to 24 weeks. To serve the reference of nonbiological activities, soil samples were autoclaved two times at 120°C /20 min. Arsenic was extracted from these soils with 1 M NaOH with 50 % methanol, and inorganic and organo-arsenicals were determined by HPLC-ICP-MS.
3. Results and discussion
In Fluvisol, DPAA in the flooded condition can change into methyldiphenylarsine oxide (MDPAO) by microbial methylation. A part of DPAA can also change into phenylarsonic acid (PAA) which is subsequently changed through MPAA to dimethylphenylarsine oxide (DMPAO) by microbial transformation. In Andosol, MDPAO and PAA were also determined, but its concentration was not as high as in Fluvisol. Furthermore, MPAA and DMPAO could not be detected in Andosol. In sterilized soils, both Fluvisol and Andosol, DPAA was almost stable during the 24 week's incubation, except with small amount of PAA.

P427

Intercropping has a high potential to reduce environmental impacts of agriculture

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Agricultural intensification, plant breeding, mechanisation, and fertiliser and pesticide use over the last 50 years have contributed to the disappearance of intercrops from many European farming systems. Cereal-legume intercropping offers potential benefits in low-input cropping systems, where nutrient inputs, in particular nitrogen (N), are limited. It can increase the input of leguminous symbiotic nitrogen fixation (SNF) to the cropping system and reduce negative impacts on the environment. The main objectives of the present experiment were to: 1) determine N uptake of the intercrop treatments compared with their associated monocrops; 2) explore the effects of intercropping on post-harvest N dynamics and the risk of gaseous and leaching N-losses. A drained-plot experiment was established on the Bush Estate in South-East Scotland (55° 51'N, 3° 12'W), consisting of 12 hydrologically-isolated plots. The treatments were a spring barley (*Hordeum vulgare* cv. *Westminster)* monoculture and intercrops of barley/ white clover (*Trifolium repens* cv. *Alice*) and barley/ pea (*Pisum sativum* cv. *Zero4* or cv. *Nitouche*). No fertilisers, herbicides or pesticides were used. N inputs, N losses (gaseous and leaching), plant N recovery and soil available N were measured over a whole growing season. Pea cv. *Zero4* showed N_2O loss that were comparable to the barley monocrop, while loss from Pea cv. *Nitouche* and clover intercrops were significantly higher. Nitrate leaching from the intercrop containing pea cv. *Nitouche* was lower than from other intercrop treatments. This study demonstrates that nutrient losses from arable farming systems can be reduced by intercropping but the choice of appropriate crop mixtures is critically important. It can be concluded that there are ways to reduce losses and there is a need to choose suitable cultivars for intercropping purposes with care taking into account the effects upon the growth of the main crop and the environmental factors.

P428

Soil Sustainability Indicators under Rice-Winter Cover Crops Cropping Systems in No-tillage Paddy Field

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The objectives of this study were to find out rice productivity, soil fertility and soil microbial populations in no-till rice-winter cover crops cropping systems in the Ihyeon series, which is characterized fine silty over coarse silty, mixed, mesic family of Dystric Fluventic Eutrudepts (Alluvial soils). The effects of rice straw, hairy vetch, rape, rye, Chinese milk vetch on soil fertility and microbial biomass C were measured in no-till and conventional tillage systems. Conventional tillage system includes chemical fertilizers and pesticides. Soil porosity before rice seedling transplanting was significantly increased with winter cover crops. With Chinese milk vetch, dry weight of weeds between maximum tillering stage and ripening period of rice were highly significantly decreased. Soil microbial biomass C reached the lowest after submerging the soil and rapidly increased and reached peak at the effective tillering stage of rice. The no-till rice-winter cover crops cropping systems were considered an effective sustainable farming practice for weed management and soil microbe in temperature humid conditions, due to its improvement of soil physical quality, weeds dry weight, and microbial biomass C content.

P429

Kinetics of Zinc Desorption from Calcareous Soils

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The rate of Zn desorption from soil surfaces into soil solution is a dynamic factor that regulates its continuous supply to growing plants. To ascertain the pattern of Zn desorption and soil characteristics affect it, the kinetic of Zn desorption by oxalic acid and HCl 0.01 M from 10 different soils of Western Iran were studied in a laboratory experiment over a periods of 1008 h. Five kinetic models were evaluated to describe of Zn desorbed by oxalic acid and HCl. Zinc release rate was rapid initially but gradually decline with time. Total Zn released after 1008 h by oxalic acid and HCl solution ranged from 0.853 to 27.424 and 1.172 to 19.022 mgkg-1 respectively. The quantity of Zn released by oxalic acid was higer than HCl in soil samples (except soils no. 5 and 9 with rare difference). It is postulated that the greater effectiveness of oxalate compared whit HCl was related to the ability of oxalate to form bridging complexes between the Zn and the soils surface. It results showed that oxalic acid play a effective role in desorption of Zn, and enhanced the desorption of Zn from solid phase to soil solution. Cumulative Zn desorbed by two solution were described by zero-order, first-order, parabolic diffusion and two constant rate equations.
Keywords: Zinc, Kinetic, Desorption, Oxalic acid, HCl

P430

Contributing areas to P-losses from grassland - hydrological risk areas

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Long-term and excessive application of manure on grasslands has led to high P accumulation in many Swiss agricultural soils. The high soil P status and continuing P applications pose a risk to surface waters, because in many regions diffuse P losses from agriculture are the main cause for eutrophication. Various studies indicate that P losses occur in particular areas within a catchment only. The localisation of such critical source areas might be essential to implement efficient and cost-effective mitigation options. The aim of our project, which is part of the COST Action 869 on “Mitigation options for nutrient reduction in surface water and groundwater”, is to improve an existing model to predict and delineate critical source areas (CSA) for P-losses from agricultural land on the catchment scale. Not only P-availability but also P-transport needs to be considered when delineating such CSA. Thus, reliable predictions of hydrological risk areas are important for the identification of CSA. Two different approaches to delineate hydrological risk areas will be investigated and compared here. The first model focuses on the hydrological soil type response and was calibrated using runoff data from 4 different catchments. The second approach identifies dominant runoff processes and contributing areas based on soil maps only. Spatially distributed soil moisture measurements and surface runoff measurements are performed to test model predictions. The test areas are small watersheds discharging into lake Baldegg, a lake in central Switzerland with serious eutrophication problems due to P inputs from agriculture.

P431

Evaluation of iron and manganese speciation in poor forest soils using the sequential extraction method

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The research was carried out in a pine-covered area of the Wielkopolski National Park (Poland), for the years in which the area was exposed to acid rain. The soils under study are sands and loamy sands with pH ranging from 3.3 to 4.4. The performed research on iron and manganese speciation was conducted using a slightly modified version of the Tessier's procedure. The soil profile under study displayed a lithogenically dichotomous structure which was also reflected in the content of individual fractions. The content of iron and manganese was analyzed in the following fractions: exchangeable, acid extractable, reducible, oxidizable and residual. Basic differences in the course of the concentration changeability in the profile as well as a considerable variability were determined in the percentage proportion of the examined elements for individual fractions.
In the case of iron, the highest concentrations were recorded in the residual fraction (8340 mg/kg), which constituted 48% of the total content. Similarly high values occurred in the oxidizable fraction associated with organic matter (6880 mg/kg). The reducible fraction exhibited a lower iron content (max. 2340 mg/kg). Iron determined in the exchangeable and acid exchangeable fractions occurred in much smaller quantities and its quantities decreased with depth. The highest manganese concentration was determined in the reducible fraction (174 mg/kg). Mn showed a strong association with the profile lithology in the oxidizable fraction where in the transition from the sandy to loamy layer the concentration of manganese increased three times (up to 61 mg/kg). However, despite differences in the percentage proportion of Fe and Mn in individual fractions, the majority of the easily available form of both elements can be found at the depth where they are easy to be reached by plants and has similar concentrations: Fe - 34-70 mg/kg and Mn - 16-73 mg/kg.

P432

Clay mineralogy and soil potassium status in some Alfisols of Golestan Province, Iran

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The different K pools and clay minerals were investigated in some selected Alfisols of Golesten province in xeric and udic moisture regimes. Samples from different horizons of four representative pedons were selected and analyzed for clay mineralogy and K fraction. X-ray diffraction patterns revealed that clay minerals in the soils studied were different in type and also their abundances. Illite, kaolinite and smectite were the most important clay minerals in the studied pedons. More leaching conditions and lower pH were mainly responsible for the presence and formation of vermiculite and HIV (hydroxy interlayer vermiculite) in profiles of udic moisture regime. The results of K fractionation showed that soils of the most humid regions (Typic Hapludalfs) showed the highest exchangeable and nonexchangeable K due to high content clay, organic carbon, vermiculite and HIV. Calcic Haploxeralfs of the xeric moisture regime had the highest mineral K instead. This was mainly related to the dominance of illite and smectite in the clay fraction of this soil.

P433

Fertility status and hazardous and harmful residues in the soils of Srem

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To check soil fertility and contents of hazardous and harmul residues in the soil of Srem region (part of the Vojvodina Province), 250 soil samples were collected. Locations for soil sampling were determined by means of a 4 x 4 km grid superimposed over a soil map of the Vojvodina Province R 1: 50,000. In that way, each sample represented 1600 ha of land. GPS coordinates were given for each sample site. The samples were analyzed for: main chemical properties, contents of heavy metals, organochlorine pesticides and their degradation products. Minimum, maximum and mean values were calculated for all properties.The obtained results were compared against those gathered in 1992.

About 70% of the samples had the humus content between 2 and 4%; the average content was 3.01%. Compared against the previous round of studies, humus reduction was registered in most soil types except in alluvial and alluvial-deluvial soils and in forests. Total nitrogen varied in unison with humus content.

The contents of available P_2O_5 and K_2O were intermediate, 22.70 mg 100^{-1}g and 21.88 mg 100^{-1}g soil, respectively. Considering the mean values of available phosphorus and potassium for the entire territory of Srem region, a decreasing trend can be seen as compared with the previous round of studies.

Contents of heavy metals Ni, Cr and Pb were above the MAC in some soil samples, although their high concentrations are probably due to geochemical reasons. The obtained results show a low presence of pesticide residues in the soils of Srem region, indicating that the soils are not polluted with pesticides.

P434

Ammonium acetate and ammonium chloride comparative soil K extraction potential

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Objectives of this work were to compare the soil K extraction potential of two methods, the classic ammonium acetate 1N pH 7 (AA), and the 0,2N ammonium chloride (AC). Horn Plantain (*Musa* AAB, subgroup plantain, cv. Horn) plants were used as control. Individual plants of 400 g were sowed in 10 L pots containing soil of the top 20 cm of a low K, sandy loam, moderately acid soil. Each experimental unit was one individual plant per pot and its corresponding soil. Doses of 0, 50, 100 and 200 g of potassium nitrate per pot were used. Accumulated dry matter was determined 11 weeks after sowing. A randomized block with four treatments and four repetitions was used as experimental design. Extractable levels of K determined by each method were correlated with dry matter, their coefficients of determination were calculated and the normality of their standard residues was verified.

Results demonstrated that the K extraction with AC showed a R^2 = 66.9 % and AA a R^2 = 44.2 %, both with normality of their standard residues. So, the AC resulted best fitted to determine extractable K in this soil.

P435

Evolution of soil acidity in the preluvosoil from North-Western part of Romania in long term fertilizers field experiments

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In Romania was elaborated since 1968 a stationary long term experiments with fertilizers and lime in all the Agricultural Research Stations belonging to the National Research Institute from Fundulea.

The experiments were set up using a unitary scheme in order to monitor the evolution of the soil's fertility and the influence of the fertilizers and the lime rates and combinations on the level and the quality of the different crop's yield.

The preluvosoil in the North-Western part of Romania is a medium soil, and it has a weak acid reaction in the ploughing horizon.

The paper presents the results regarding the influence of fertilizers and lime rates and combinations on pH values of brown luvic soil from North-Western Romania.

The results have drawn the following conclusions:

Long term experiments are important tools for examining soil fertility.

The soil reaction evolution depends by the fertilizers' type and by the rates' level applied.

In the case of the preluvosoil in North-Western Romania, when systematic nitrogen fertilizers like ammonium nitrate are applied, a decrease of the pH values from 6.3 to 4.9 as a function of rates level is registered

Phosphorus fertilizers applied influence not to strong preluvosoil reaction but it can be observed a slow decreasing of pH values because of depletion of bases due to yields spores obtained

The manure applied alone or associated with NP fertilizers, favorable influenced soil reaction, pH values increasing with 0.3-0.4 units if the manure rates applied are 40 to/ha respectively 60 to/ha

To avoid the decrease of the pH values due to chemical fertilizers applied in preluvosoil conditions is necessary lime application for acidity neutralization. Lime application once at six years in the rate of 9 to/ha maintain pH values between 6.4-7.0, which ensure optimal growing and developing condition for plants

P436

Pedological factor's role in reconstruction measures establishing in Arad County, Romania soils

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Vegetation growing conditions (with hard impact on terrain production), together with environmental factors soil characteristics, represent a majour component with multiple manifestations due not only to its own proprieties but also to its depositing capacities for other environment factors influence. As agroecosystems element, the soil may favour productivity through a range of defined specific properties, such as: quantity, quality, equilibrium of nutritive elements, thermic and hydric regime, mineralogic composition, etc. These factors cognition present a considerable practical and theoretical importance. Approached issues refer to a 775.409 ha area of which 511.620 ha of agricultural terrains. The paper presents data referring to soil quality status in our considered area, as basic elements in ecological, technical and economical that define present level of soil fertility and their protection, conservation and reconstruction measures. Althrough at first sight yield potential seems to be rather good, a thorough check reveals a range of limitation and restrictive factors of which we enumerate: soil supply level in nitrogen: weak-34.92%, middle-58.04%; soil supply level in phosphorus: weak-49.42%, middle-23.32%; soil supply level in potasium: weak-11.47%, middle-34.16%; soil pH level: very acid-3.2%, moderate acid-30.3%, low acid-38.4%, neutral-6.6%, low alkaline-19.3%, moderate -very alkaline-2.2%. To meet crops requests we must neutralize soil restrictive factors applying adequate measures: periodical liming on acid soils, gypsum amendament sprading over alkaline soils, ameliorative crop rotation introduction, organo-mineral fertilization.

P437

Thermodynamic parameters of zinc sorption in some calcareous soils

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To evaluate the sorption mechanism of zinc (Zn) in some soils, an experiment was conducted on ten soils of Hamadan province in the west of Iran. To study the sorption of Zn, 0.5 g soil samples were equilibrated at 25±1 and 45±1°C with 25 ml of 0.01M $CaCl_2$ containing 0 to 30 mgL^{-1} Zn as $ZnSO_4$. After equilibration time, suspension was centrifuged, filtered and concentration of Zn in clear extract solution was determined and then Zn sorbed was calculated. The thermodynamic parameters viz. K^o, ΔG^o, $\Delta H^o$and ΔS^owere determined by using sorption data and concentration of Cu in equilibrium solution at two different temperature. The results indicated that values of K^o increased with rise in temperature from 25 to 45 °C in all the soils. The ΔG^o values at 25 °C and 45°C were negative and ranged from -7.00 to -16.64 and -14.59 to -41.93 kJ mol^{-1} respectively. The values of ΔH^o for Zn sorption were positive and ranged from 357.47 to 74.02 kJ mol^{-1}. The values of ΔS^o for Zn were positive and ranged from 1255.97 to 281.79 J mol^{-1} K^{-1}**.** These results showed that Zn sorption process is a spontaneous and endothermic reaction. These results also showed that calcareous soils can be sorbed high amounts of Zn and thermodynamic parameters were useful in describing Zn sorption.

P438

Effect of cover crops as green manure on nutrient balance and potato yield in organic crop rotation

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One of the major challenges in organic cropping systems is optimasing the soil nutrient cycling. This includes recycling and utilization of nitrogen (N) sources, such as N in residues of N-fixing crops, green manure cover crops or catch crops. Prediction of N and C supply and recycling in organic systems is essential in order to design appropriate crop rotations. The objectives of the research were in organic potato rotations to (i) identify effective winter and spring cover crop species as green manure for supplying soil nutrients, especially nitrogen and carbon and to (ii) determine effects on potato yield and quality. Before potato (*Solanum tuberosum* L.) planting in crop rotation with rye (*Secale cereale* L), both crops with a big interest for organic producers, the next cover crops (autumn and spring genotypes) were tested: 1) single leguminous (peas (*Pisum sativum L.*) or vetch (*Vicia sativa L.*); 2) single cereals (rye or oats (*Avena sativa*) and 3) legume-cereal crops mixture. Biomass yields and C and N contents varied by species, crop stages of incorporated biomass and years. N mineralization and efficiency depend also on soil and climatic factors and require an understanding of N-cycling in crop rotation. As a result, rye +vetch or peas +oat mixture had grater biomass yield than leguminous monoculture cover crops and added to soil more N and C in all years. The incorporated biomass supplied N to succeeding potato (about 43-65% of the removal), increased both potato yield and quality (decreased the small fraction) compare to variant without cover crops. It is possible by mixing leguminous and cereals the C:N ratio to be reduced for improving biomass mineralization and for positive influence on potato yield and quality, and for better ecological effect.

P439

Risk assessment for nitrogen contamination of groundwater under Haplic Chernozems

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The aim of this study is to link the impact of typical land use management practices on regional scale with climatic and geological conditions provoking nitrogen contamination of groundwater under Haplic Chernozems in North Bulgaria.
A 4-years monitoring of the residual soil nitrogen and nitrate content in groundwater was carried out on a well defined small watershed of the Yantra River. The distribution of nitrogen below the one-meter soil depth was determined using the samples of geological materials from six deep (10-17 m) drillings in the vadose zone. The nitrogen data of geological samples along the vadoze zone were statistically analyzed for determining periodicity of the peaks and for correlation between the separate drills. Long-term records of climate data were used for calculating appropriate leaching indices and for time-series and cross-correlation analyses with nitrate content in groundwater.The deep drilling showed that independently of land use NO_3-N was detected in all samples from the soil surface to the groundwater table and varied from 0.2 to 33.0 $mg.kg^{-1}$. The area of the big dairy farm is a point source of contamination. Peaks values are established in all drillings and in some cases they are found even at the end of the aeration zone. They have periodicity different from the thickness of geological profiles which suggests explanation with internal nitrogen transformation or with the water percolation regime. The later is sustained by the link between variability of climate and nitrate content in groundwater. The average for the studied period nitrate content in groundwater varied from 19 to 62 $mg.l^{-1}$ in different wells with maximum up to 83 $mg.l^{-1}$.

P440

CEC and K critical level determined by ammonium acetate and ammonium chloride

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Determination of cation exchange capacity (CEC) using ammonium acetate 1N pH 7 method (AA), and 0,2N ammonium chloride method (AC) as well as the soil K critical level were

objectives of this work. Plantain (*Musa* AAB, subgroup plantain, cv. Horn) plants of 400 g were sowed as a control crop in 10 L pots containing soil of the top 20 cm of a low K, sandy loam, moderately acid soil. Doses of 0, 50, 100 and 200 g of KNO_3 per pot were used as K differential treatments. Accumulated dry matter was determined 11 weeks after sowing. Cations of the exchange complex extracted by AA and by AC were determined and the CEC was calculated by sum of extracted cations. A randomized block with four treatments and four repetitions was used as experimental design. The K critical level related to each method under test was determined according the Cate-Nelson graphic method.
CEC results were 23.06 $cmol^+ kg^{-1}$ by AA and 14.32 $cmol^+ kg^{-1}$ by AC. These differences were mainly related to the fact that AA extracted more Ca (19.52 $cmol^+ kg^{-1}$) than the extracted by AC (11.34 $cmol^+ kg^{-1}$ Ca). The literature reports that AC introduces bias in CEC measurements. The critical level according the Cate-Nelson graphic technique determined by AA was 1.4 $cmol^+ kg^{-1}$ and the one determined by AC was 1.59 $cmol^+ kg^{-1}$, these results were consequence of a higher dispersion of the AA data. Due to the distortion produced in CEC by the AA, it is suggested that the AC is best fitted to get a better measure of the real and effective CEC of a soil.

P441
Evaluation of chosen characteristics of luvic chernozem topsoil in south part of the Hornomoravsky uval

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Pedological survey proceeded during September 2007 at six chosen localities. Except for soil profiles description, whose found out the luvic horizon appears at a depth of 28-48 centimeters and is thick from 12 to 40cm, there were taken away the samples of topsoil as well as of the subsoil. These soil samples were analysed regarding the physical, chemical and biological characteristics consequently.
The analyses established the medium grain class at the surveyed chernozem samples. There were stated physical condition disturbances (raised specific gravity and decreased minimal air capacity) in 50% of surveyed cases. Concerning the chemical properties there is necessary to point out especially the low quality of humus at all localities (measured by means of the HA/FA rate) as well as the low calcium saturation of the adsorption complex (at all localities likewise). Further there shall be refered to the potassium satiation of the adsorption complex in half of the surveyed samples. Regarding the biological aspect there is deficient amount of physiologically exploitable nitrogen as well as of the highly exploitable organic matter. The physiological C/N rate is favourable whereas.
The luvic chernozems in south part of Hornomoravsky uval are moderately to distinctively damaged, which was prooved by the factor of complex incidence.

P442
Effect of organic materials on rice development and soil properties in an acid saline paddy soil

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A pot experiment was designed to determine whether the addition of organic materials could improve soil pH and rice growth in an acid saline sandy soil of Thailand. Three treatments where the same quantity of N was added (150 $kgN ha^{-1}$) were studied: Sesbania (6 $t ha^{-1}$), urea (326 $kg ha^{-1}$) and rice straw (9 $t ha^{-1}$) + NH_4NO_3. The treated soil samples were first incubated in aerobic conditions for two weeks, and NH_4^+ and NO_3^- were determined. Rice seedlings were then transplanted and grown under submerged conditions for 4 weeks. The height of rice, and Eh, pH, and DOC in the soil solution were measured weekly. Rice dry weight and N content were determined at the end of the experiment. In submerged conditions soil reduction and pH neutralization were fast, with no effect of the treatments. NO_3^- and NH_4^+ contents after incubation showed that urea was entirely converted to NH_4^+, Sesbania N and rice straw N were not mineralized, and nitrification was inhibited. Rice growth was enhanced by the addition of Sesbania and urea. The addition of rice straw+NH_4NO_3 gave the same biomass as the control, probably because of a high DOC responsible for poor root growth. Plant N was the same in the urea as in the Sesbania treatment at the end of the experiment. This proves that Sesbania N was eventually mineralized and taken up by the plant. Finally, plant growth and N content were the same in the urea as in the Sesbania treatment for the same quantity of added N. Applying Sesbania seems thus an interesting option to decrease N leaching. However, organic material addition can lead to high DOC that may be detrimental for root growth.

P443
Soil nitrate content evolution with leguminous cover crops in organic farming

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The nitrate contaminations caused by the excessive and inadequate use of chemical fertilizers in conventional agriculture and the scarce alternatives to improve the soils fertility in organic farming systems, have promoted others forms of fertilisations compatible with the environment. One of the most used is the implantation of leguminous cover crops in rotation with herbaceous crops and also growing in the rows between the trees in orchards. The objective of this work was to evaluate under field conditions the fertilizer capacity of three leguminous cover crops: common vetch (Vicia sativa L), bitter vetch (Vicia erwilia L) and lupin (Lupinus albus L.) in organic farming systems, studying the soil ion nitrate content at three different depth (0-5, 5-10 and 10-20 cm) during cover crops growing season, and subsequently when the cover crops were mowed and left on the soil to decomposing. The evolution of soil nitrate was similar in all species, with greater values at beginning of growing and after flowering than during vegetative growing. Also, the soil nitrate content incremented in relation to the soil depth. The greatest values in soil nitrate contents when the cover crops were alive corresponded to common vetch, whereas bitter vetch provided the higher values when the cover crops were mowed and left on the soil. The behaviour of the different species and their relation to the soil nitrate content will be discussed in detail.

P444
Soil weathering stage of volcanic ash soils directly impacts the silicon status of banana (*Musa* spp.)

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Plant species absorb silicon, which is taken up by roots as monosilicic acid in soil solution. The Si concentration in soil solution is governed by silicate dissolution and formation.
Here, we assess the silicon status of banana plants cultivated on soils developed on similar volcanic ash, but differing in weathering stage and mineralogical constitution. We combine two approaches: a field topsoil-foliar survey involving 600 mature banana plants and an experimental study of Si soil-to-plant transfer in greenhouse conditions involving banana plantlets.

The reserve of primary minerals mainly consisted of glassy and crystalline ferromagnesian and plagioclase minerals. With increasing weathering, the content of primary minerals decreased, whereas clay content increased and secondary minerals were increasingly dominant: gibbsite, Fe oxide, allophane, halloysite and kaolinite. From the field study, the average leaf Si concentration ranged from 2.7 to 3.9 g kg^{-1} for bananas cropped in the most weathered soils rich in secondary oxides, and from 7.7 to 9.6 g kg^{-1} in the least weathered soils. The leaf Si concentration was positively correlated with soil $CaCl_2$-extractable Si content, soil Si content and total reserve in weatherable minerals. The experimental greenhouse study showed that the reserve of weatherable primary minerals directly governed the soil-to-plant transfer of Si and the stock of soil biogenic Si (BSi). The largest contents of BSi in plant (6.9-7 g kg^{-1}) and soil (50-58 g kg^{-1}) occurred in the least weathered soils. The lowest contents of BSi in plant (2.8-4.3 g kg^{-1}) and soil (8-31 g kg^{-1}) occurred in the most weathered desilicated soils.
Our data thus imply that soil weathering stage directly impacted the soil-to-plant transfer of silicon, and thereby the stock of biogenic Si in a soil-plant system involving a Si-accumulating plant.

P445
Contributions to the knowledge of soil pollution with fluorine

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Soil pollution, as well as the pollution of the entire environment, has evolved strictly connected with the socio-economic development. Besides the advantages it offers, the building of the factory of aluminium from Slatina (nowadays S.C. ALROM S.A.), where researches have been done, has determined the considerable decrease of the environmental quality, by releasing fluorine in the atmosphere.
Fluorine accumulation in the soil occurs depending on the dominant direction of air streams, as well as on the distance from the emission source. Thus, it has been noticed that fluorine accumulations are bigger (70 - 120 ppm) until the distance of 250 - 300 m., they decrease until 40 ppm at the distance of 500 m. and they decrease under 20 ppm at more than 1000 m. far away from the source. Analysing fluorine distribution on the soil profile, we can see that it is accumulated in a bigger quantity in the arable horizon (0 - 30 cm.); after that, it decreases very much, reaching 80 - 100 cm. in little quantities.

P446
Assessment of organic micro-pollutant speciation in composts using 14C-labelled molecules

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In areas where the spreading of animal organic residues has been phased out, the application of urban compost on cultivated soils helps restore soil organic matter (OM) content. Organic micro-pollutants are potentially present in these composts, and their concentrations are regulated in various countries. Nevertheless, the measurements of micro-pollutant concentrations in compost are carried out on chemicals extracted using aqueous and organic solvents. These methods do not take into account the fraction of non-extractable residues bound to OM. After the spreading of compost on agricultural soils, these bound residues could be released into the soil and transferred to soil sensitive pools for the contamination of the food chain (water lixiviation, adsorption by plants).
The aim of this study was to determine the micro-pollutant speciation during composting and in finished compost by applying 14C-labelled model chemicals to the waste mixture at the beginning of the composting process. Two labelled organic pollutants (fluoranthene and linear alkylbenzene sulfonate) were chosen as model substances as they provide markedly contrasted physico-chemical properties and were expected to interact with OM in a different way. Each of these chemicals was applied on two OM mixtures green waste and wastewater sludge that were composted. A mass balance of the organic pollutant speciation, including mineralization, volatilization, transformation in metabolites, sorption and formation of bound residues, was established at different stages of composting. The experiments in progress aim at pointing out the role of the nature of the composted OM such as biodegradability, as well as chemical and biochemical compositions on the kinetics of OM transformation in relation with the different microbial populations developed and on the interaction between transformed OM and organic micro-pollutants. These results help improve micro-pollutant measurement techniques and, in turn, to better understand the fate of micro-pollutants in agrosystems.

P447
Changes of some chemical parameters of cambisol influenced by twenty years use in wine growing

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The investigations have been conducted in plantation of the largest vineyard in a complex in Montenegro. The soil type is cambisol. The investigated soil has very high content of skeleton (75%) as well as of total carbonates (55%). The contents of humus, available phosphorus, potassium, boron, manganese and iron are low, but of zinc at medium level.
After twenty years of intensive soil exploitation in wine growing (autochthonous Montenegrin grape varieties Vranac), considerable changes in chemical properties have been established. Significant decrease in the content of total carbonates and increase of humus and available forms of macro- and microelements has been found. The investigated nutrients and humus are in positive significant and high-significant correlation. Available K is in high-significant direct proportionality with P, Fe, Zn and B. The decrease of total carbonates has intensified the higher solubility of microelements, in higher degree Zn and Fe, compared to Mn and B.

P448
Leaching of nitrates and base cations under Fluvisols in different crops growing and nitrogen rates

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Leaching of nitrates is primarily associated with conditions that allow nitrogen accumulation in the soil profile. The aim of this study is to evaluate nitrate nitrogen and base cations leaching under rooting zone of Fluvisols in South Bulgaria. Data was obtained during two field experiments: with cereals (barley, wheat, maize) and with vegetables (pepper, beans, carrots, aubergine) grown with application of different N rates and water supply for the period 1999-2005.
The experimental design with cereals included two N fertilizer treatments and one control. The experiment with vegetables included three different N treatments: optimal, 50 % below and 50 % above the optimal N rates. Chemical elements leaching through the soil profile was monitored by modified Ebermayer lysimeters type cut into the soil at 100 cm from the soil surface.
The average amount of water drained out of the rooting zone from all N treatments was between 5-13 % from the incoming water. No statistically significant differences between the leached volumes within the different treatments were found.

An enhanced migration of NO_3-N and Ca^{2+} in dependence with the applied fertilizer rates was observed in all grown crops, but the correspondence between the applied N rates and amounts leached was better in cereals compared with the vegetables. The highest N leaching was obtained under maize (8 - 33 kg.ha^{-1}) and in the experiment with vegetables N losses were the highest under pepper (9-17 kg.ha^{-1}). Good correlation was found between the N rates and Ca^{2+} losses under cereals, while this relationship is not so well expressed under vegetables. Leaching of K^+ and Na^+ was not significantly affected by fertilizer rates. Nitrate nitrogen concentration of the lysimetric water under the maximum N treatments exceeded the maximum permissible concentration levels for drinking water and could turn into a source of groundwater enrichment by nitrates.

P449

Soil amendment with activated charcoal can reduce aromatic arsenicals uptake by rice from soil contaminated by diphenylarsinic acid

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Introduction
In 2004, diphenylarsinic acid (DPAA) was detected in groundwater used for irrigation in Kamisu-town. DPAA and methylphenylarsinic acid (MPAA) were also detected in harvested paddy rice. There is little research on the plant uptake of aromatic arsenicals from soil. So we investigated the uptake of aromatic arsenicals in agricultural soils by rice. One approach to address the problem would be to increase the capacity of affected soils to bind aromatic arsenicals in order to prevent their uptake by the crops. In this study, we wanted to test the potential use of activated charcoal (AC) for this purpose.
Materials and Methods
Soil contaminated with aromatic arsenicals and unpolluted soil were taken from paddy fields in the Kizaki area of Kamisu-town. MPAA, dimethylphenylarsine oxide (DMPAO) or methyldiphenylarsine oxide (MDPAO) was added to the unpolluted soil at a level equivalent to 0.7, 0.6 or 0.6 mg As kg^{-1} soil, respectively.
In the first experiment, rice were grown in soil under flooded from transplanting until maturity. In the second experiment, rice were grown for 3 weeks in contaminated soil into which AC had been mixed at concentrations of 2g kg^{-1} and in untreated controls.
Results and discussion
MPAA was detected in brown rice (0.7mg kg^{-1}) and straw (0.4mg kg^{-1}) grown in MPAA-amended soil. Large quantity of DMPAO (4.5mg kg^{-1}) was detected in straw. DMPAO (7.1mg kg^{-1}) was detected in straw grown in DMPAO-amended soil but was detected in brown rice slightly. MDPAO (2.6mg kg^{-1}) was detected in straw grown in MDPAO-amended soil but was not detected in brown rice.
Aromatic arsenicals concentrations in the rice straw grown in untreated controls were 2.8mg kg^{-1} and did not detected in the rice straw grown in the treatments with AC. So AC appeared to be suited for the reduction of aromatic arsenicals in rice.

P450

Scaling-up nutrient balances from plot to village level under small-holder settlement schemes in sub-humid Zimbabwe

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Nutrient balances are useful tools as indicator of ecosystem quality and for optimizing nutrient use. However, the scale of assessment generally affects the conclusion obtained. A study carried out during the season 2006-7 in north-east Zimbabwe, in three representative villages from contrasting settlement periods (60s, 80s and early 2000), aimed at assessing, from plot to village level, agro-ecosystem quality using partial and full nutrient balances. Nine farmers were randomly selected inside each village (27 farmers in total) and nutrients flows maps were carried out in each of the farmers' plots. During this activity, main nutrient resources among the different land uses into their farms (e.g. fertilizers, crop yields, crop residues, etc.) and their homestead were identified, as well as those fluxes coming from / going to pastures and woodlands. After resource flows were identified and cross-checked on the ground, inputs and crops were sampled. Field sampling (soils 0-20 cm and crop at harvest time) focused on maize fields; however, data taken from literature was used for calculating nutrients flows for the other system components and for complementing information of unmeasured fluxes (i.e. N fixation, leaching) for full nutrient balances. N and P were selected as these nutrients being the main constraints for agricultural productivity in Southern-Africa. Calculated balances at plot level show how farmers in the new resettled area are nowadays mining their soils in more extent than communal farmers due to a strong dependency of inherent soil nutrient stocks (i.e. less nutrients inputs). We also discuss how scaling-up nutrient balances (from plot to village level) reveal a panorama even more alarming. This work shows nutrient balances as a useful indicator of agro-ecosystem degradation.

P451

Application of microelements in plant growing of Belarus

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The important condition in obtaining of high and steady yield of agricultural crops is the supply of them by all necessary macro- and microelements that allows to adjust processes of enrichment of production by the certain elements necessary for normal ability to live of the person and an animal. Necessity of microfertilizers use for plant growing of Belarus is caused by the insufficient contents in soils mobile forms of some microellements. The average mobile copper contents in arable soils of the republic makes 1,89 mg/kg, a boron - 0,60, zinc - 3,32 mg/kg, and a share of soils of the first and second groups of supply by these microelements, where is necessary the application of microfertilizers, is being varied on areas within the limits of 77,6-91,2 %. It is even more distinction on areas, economies and separate fields.
Microfertilizers need under the basic agricultural crops of the republic is very high. Undoubtedly, it is necessary the differentiated system of application of each kind of microfertilizers. Now microfertilizers under agricultural crops are used on 30-40 % from need. Optimization of system of a microelement crops nutrition has allowed to estimate action and interaction of separate elements in multifactorial field experiences, to establish agrochemical and economical the most effective dozes of microfertilizers under the basic agricultural crops, cultivated on sod-podsolic sandy and loamy soils. Results of our long-term researches have shown, that at application of a boron, copper, zinc, manganese, iodine and cobalt in the form of not root top dressing in optimum dozes are reached about the same parameters of efficiency of agricultural crops, as at their application into soil. Thus not root top dressing of plants by microellements provided the greatest economic benefit and ecological safety.

P452

An easy incubation method for measuring nitrogen mineralization from soils and organic residues

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Nitrogen (N) mineralization dynamics in soils is not yet fully understood. Moreover, application of organic residues to soils, apart from being a means of improving soil organic matter, can act as a source of nutrients, namely N. A quick and easy to perform waterlogged incubation experiment was developed, to investigate mineralization of nitrogen compounds in several different soils, with and without application of different organic residues (poultry manure and municipal solid waste compost). Soils tested, differed in texture, organic matter content as well as in pH. A mild solubilizing agent (H_2O) was used to extract easily mineralizable N. After, the extraction suspensions were further incubated at 37ºC for 10 days and sampled over this period. N mineralization curve was well adjusted to polynomial equations and was better fitted for sandy soils. Initial N content of soils was also correlated to N mineralization. This simple incubation procedure was efficient, on the simulation of the release of the easily mineralizable organic N, both from soil and residues.

P453

Enhancement of earthworm biomass and maize production.

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Searching alternatives of soil protection and enhancement of soil fertility in tropics, we installed an experience in order to observe the relationship between soil organic matter, soil macroinvertebrates and maize production. Different kind of mulches (leaves and stems of *Mucuna pruriens var. utilis*, maize fallow, cow manure, mixture of *Mucuna pruriens var utilis* with maize fallow, maize fallow with cow manure) were installed in a 12 years maize culture area at Palenque Chiapas, Mexico. Six treatments with four replicas each one were developed during 10 months. Soil macrofauna and soil properties were measured at the beginning, during and at the end of the experiment. Maize crop was also installed during the experiment. The highest biomass of fruit crops (162.9±53 g) was found in plots with *M. pruriens var. utilis* and Maize fallow (MU+M), 4-fold higher than control. Treatment with the highest crop biomass was also the treatment with the highest biomass of macroinvertabrates (64.7±4.1 gm^2), also 4-fold higher than control. Nevertheless soil organic matter was not significantly different between treatments.

P454

Phytoremediation of soils contaminated by liquid beef cattle manure

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In Russia the practice of liquid manure (LM) application near farms led to contamination and degradation of 2,4 million ha of plowed soils. In this case the main soil pollutants are plant nutrients (ammonium, nitrates, phosphates, potassium) and heavy metals (HM). Not many plants can withstand this type of contamination, because of high soil salinity and soil structure degradation. The goal of this study was to estimate the phytoremediation effect of Amaranthus *cruentus,* Raphanus *sativus,* Sinapis *alba* on soils with LM contamination. The investigation was carried out in long-term field experiment on soddy-podzolic soil. Annually LM. in doses equal to 300 and 900 kg of total N per ha were applied on experimental plots, with these doses 310-940 kg/ha of total phosphorus and 635-2400 kg/ha of total potassium were added to soil. The dose of LM equal to N900 suppressed the growth of R.*sativus,* S.*alba*, while the yield of A.*cruentus* still showed the positive dynamics. The highest phytoextraction efficiency was noted for A.*cruentus*, though nitrogen and phosphorus concentration in biomass was higher in S.*alba*, but total biomass of A.*cruentus,* was 1,5-2,5 times higher, than R.*sativus,* S.*alba.* A.*cruentus* was the leader in potassium concentration in tissues and total uptake of potassium from soil. S. *alba* was the absolute leader in Pb and Cd accumulation. Zn concentration in tissues of all plants is similar. Maximum uptake of HM from soil was observed for A.*cruentus.* The analyses of soil samples from different depths showed, that under A.*cruentus* vertical migration of nitrates and HM was inessential. The comparison of 3 investigated plants showed, that the phytoremediation effect of A.*cruentus* on soils with LM contamination was most effective. Thus, A.*cruentus* could be used to remedy the LM contaminated soddy-podzolic soils reducing the environmental risk of subsoil waters contamination.

P455

Doses and Ammonium acetate and ammonium chloride comparative soil Ca extraction potential

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Objectives of this work were determined a doses of calcium and compare the soil Ca extraction potential of two methods, the classic ammonium acetate 1N pH 7 (AA), and the 0,2N ammonium chloride (AC). Horn Plantain (*Musa* AAB, subgroup plantain, cv. Horn) plants were used as control. Rhizomes plants of the 400 g were sowed in 10 L pots containing soil of the top 20 cm of a low Ca, sandy loam, moderately acid soil. Each experimental unit was one individual plant per pot and its corresponding soil. Doses of 0, 0.96, 1.92, 3.84 and 7.68 g of calcium nitrate per pot were used. Accumulated dry matter was determined 11 weeks after sowing. A randomized block with five treatments and five repetitions was used as experimental design. Doses and levels of extractable Ca determined by each method were correlated with dry matter, their coefficients of determination were calculated and the normality of their standard residues was verified.
Results demonstrated that the dose applied and dry accumulated showed a regression model $y = 23.2 + 15.93x - 2.72x^2$; $R^2= 75.1\%$; however the Ca extraction with AC and AA were not correlated with dry matter, leading to the conclusion that the best dose of 1.92 g of calcium nitrate.

P456

Comparison of colorimetric and ICP determination of phosphorus extracted by the Melich-3 procedure in plots with organic and mineral fertilization

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The Mehlich 3 reagent is a multi-element extractant, thus an effective means for evaluating the status of a quantity of soil nutrients simultaneously, including P. For P determination after solution extraction, inductively coupled plasma spectrometry (ICP) has been increased utilized, instead of the common colorimetric procedure. However, there are concerns about differences between ICP and colorimetric procedures. The objective of this work was to compare ICP and colorimetric P determinations in Mehlich-3 extractants. We evaluated soil samples from plots where manure and mineral fertilizers had been applied. Four different depths per plot were sampled at 32 plots given a total of 128 individual samples. The soil loam textured, rich-in-organic-matter and P levels were in excess of crop needs. The range in colorimetric-P was from 10 to 431 mg kg^{-1} and ICP-P was from 11 to 690. The highest values of extracted P corresponded to the 0-5 cm depth. Mean values of colorimetric-P and ICP-P were 172 and 208 mg kg^{-1}, respectively. Therefore, for the whole data set, the colorimetric P was 82.5 % of the P determined by ICP. Moreover, when only the set of 61 soil samples with colorimetric-P values lower than 150 mg kg^{-1} was considered, a linear fit with R^2= 0.89, a intercept of 0.046 and a slope of 1.068 was found. In this case the colorimetric P was 87.7 % of the ICP-P. Consequently, the differences between the two methods were proportionally larger when the extractable P concentration in the soil was high (> 150 mg kg^{-1} colorimetric-P). The ability of ICP to measure organic P species most likely plays a role in differences between these P determination methods.

P457

The role of plant growth regulators in cadmium toxicity for plants

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Brassinosteroids are capable in small quantities (10^{-12} - 10^{-7} M) to optimize physiology -biochemical processes in plants in such stressful conditions, as a drought, superfluous humidity of soil, high and low temperature, environmental contamination by pesticides and radionuclides.
It is known, that cadmium causes numerous and various changes of a metabolism of plants. Similar changes come to light at studying influence on plants various stressors.
It allowed us to consider the application of plant growth regulators as one of possible method to decrease the negative effect of heavy metals (Cd) on growth, development and productivity of plants.
The aim of this study was to investigate the role of antistress and protective properties of phytohormones (24-epibrassinolide and 24-epibrassinolide with gibberellin) under Cd treated soil in condition with various levels of soil fertility: control (N) and optimal (NPK).
Barley was cultured in soddy-podzolic soil in greenhouse pot experiments.
Cd in a doze of 10 mg/kg reduced the crop of barley, collected in grain and influenced the taking of N, P and K. The effect of regulators of plant growth was showed in decrease in taking of toxic element in grain of barley (on 10-30 %). Especially it was showed on an optimal level of mineral nutrition in case of joint action of 24-epibrassinolide and gibberellin.

P458

The small-scale pattern of nitrate concentration in seepage water below the main rooting zone in an N saturated homogeneous mature spruce forest is regulated by net N mineralization in the organic layer

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Soil net nitrogen (N) mineralization and nitrification as well as gross nitrification rates were studied in the organic layer of an N saturated spruce forest soil within a 30 m x 18 m plot located at the Höglwald (Bavaria) in order to explain the small-scale variation in nitrate (NO_3) concentration in seepage water below the main rooting zone (40 cm depth). The study was performed for (i) 20 randomly selected sampling spots, and (ii) for 20 sampling spots selected based on previous measurements of NO_3^- concentration in seepage water (N=121 suction cups) in order to cover the whole NO_3^- concentration range. Nitrate concentration in seepage water showed a well pronounced small-scale spatial pattern which did not change over time. We found that these small-scaled variations in seepage water NO_3^- concentration were related to similar small-scaled variations in key processes of microbial N turnover rates in the organic layer. Within this study net N mineralization in the organic layer could explain 50 - 60% of the corresponding small-scale variation of nitrate concentrations in seepage water below the main rooting zone using a multiple linear regression model with stepwise procedure. The main controls of N turnover in the organic layer were organic matter dry mass and water content. We conclude that the small-scale pattern of net N mineralization in the organic layer plays a decisive role in the regulation of nitrate losses via seepage water in the investigated N saturated spruce forest ecosystem.

P459

Influence of mineral and organic fertilizer inputs on soil nutrient fluxes in eucalypt ecosystems

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In Brazil, Eucalyptus plantations have been introduced on more than three million hectares and obtain high yields (40 to 50 m3 ha-1 year-1). Their demand in water has been widely discussed but the influence of silviculture practises on surface water chemistry has been less studied. An experimental design was installed in Southern Brazil to assess the effects of N inputs on N cycling in Eucalyptus grandis ecosystems installed on deep Ferralsols. A control treatment without N application was compared with ammonium sulphate application (120 kg N ha-1) and biosolid inputs (350 kg N ha-1). Nutrient budgets in soils were quantified over one year before clear felling and two years after replanting and fertilization treatments establishment. Soil characteristics and stocks were identified by using total analysis and determination of soil mineralogy, extractions of adsorbed cation and anion (effective CEC and AEC), and specifically adsorbed anions (nitrate, sulphate, phosphate). A water balance model (MIN3P) was calibrated thanks to a water drainage experiment and TDR monitoring of soil solution all over the experiment period. Soil solution fluxes were calculated at depths of 15 cm, 50 cm 150 cm, 300 cm using water fluxes from the water drainage model and nutrient concentrations measured from ceramic cups and lysimeters sampling devices, and input-output budgets were calculated. It was shown that nutrients issued from the fertilizers and organic matter mineralization were rapidly drained with water flux. Anions such as sulphate and phosphate were rapidly and specifically adsorbed on soil matrix and did not reach a depth of 3 m. Nitrate fluxes, correlated to aluminium fluxes were only weakly retained, but the fast root development of eucalyptus and its high water demand prevent these fluxes to reach a depth of 3 m two years after planting and losses of nutrients through deep drainage were very low.

P460

Effect of nitrogen, phosphorus and potassium fertilization on the growth and development of pedunculate oak seedlings (*Quercus robur* L.)

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Problems occurring in the regeneration of oak stands have highlighted the issue of nursery production. This research attempts to answer the requirements of pedunculate oak seedlings for certain nutrients, at the same time satisfying the quality of planting material. The experiment was established using the randomized block method with 32 treatments and 4 repetitions. The paper presents nitrogen, phosphorus, potassium, calcium and magnesium concentrations in the leaves, the results of chemical soil analyses, the results of seedling measurements and concentrations of photosynthetic pigments. Fertilization with nitrogen, phosphorus and potassium did not affect their level in the soil. The applied fertilizers affected the chemical leaf content, primarily in the form of increased concentrations of applied nutrients (N, P, K) in the leaves of pedunculate oak seedlings. Statistically significant differences were found in potassium concentrations in seedling leaves between the control and fertilization with different potassium dosages. Significant differences in heights, height increments, stem biomass and leaf biomass between nitrogen treatments indicate strong correlation between nitrogen fertilization and the variables mentioned above. The applied nitrogen, phosphorus and potassium fertilization did not affect the root collar diameter, the increment of the root collar diameter, the mass of 100 leaves and the concentration of photosynthetic pigments. According to research results, fertilization with 100 kg/ha nitrogen and phosphorus and 150 kg/ha potassium is recommended to produce pedunculate oak seedlings of satisfactory quality.

P461

Mineral and organic contribution to nutrient pool in black anthropogenic soils from the African Great Lakes Region

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In the African Great Lakes Region, low crop yields due to widespread soil infertility involve difficulties to cope with demographic pressure. Improving the productivity and sustainability of the dominant banana-based cropping systems requires a better understanding of nutrient pools.
Four sites differing in parent rock (granite, shale and other pelitic rocks) were selected from Rwanda and Burundi. In two or three homesteads per site, soils were sampled as a function of distance to farmer's house.
Two major types of soil properties discriminated the soils: (i) contents of organic matter and major plant nutrients (Ca, Mg, P), both linked to past and current soil management practices, (ii) nature of parent rock, linked to the abundance of iron and the occurrence of muscovite as residual mineral. All soils were deeply and strongly weathered. Typical anthropogenic soils similar to the Amazonian Dark Earths occurred under ancient banana cropping where frequent supply of manure, ash and kitchen residues was done. Close to the house, the thickness of man-made dark Ah horizons could exceed 160 cm. Accumulation of organic matter promoted root exploration, thereby enhancing uptake of water and nutrients, and banana plant biomass. Yet, the soil gradient was strong in some sites and smooth to absent in ancient banana cropping areas. Gradients were revealed by contrasted stocks of a.o. carbon (19-12; 29-15 kg m^{-3}), and total content of Ca, Mg and K (420-370; 570-440; 370-280 mol_c m^{-3}). The organic contribution to the nutrient stock of Ca, K and Mg ranged between 33 and 12%, and was highest around farmer's house in contrasted sites, but also in ancient banana cropping areas whatever the distance to the house.
High population pressure and soil infertility require sound management practices, based on better insight into soil formation and soil management processes.

P462

Proportion ammonia / nitrate in nursery plants Hartón Plantain (*Musa* AAB subgroup Plantain cv. Hartón).

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Objectives of this work were determined to doses of ammonia / nitrate. Horn Plantain (Musa AAB, plantain subgroup, cv. Horn) plants were used as control. Rhizomes plants of 400 g were sowed in pots of 10 L containing soil of the top 20 cm of a low Ca, sandy loam, moderately acid soil. Each experimental unit was one individual plant per pot and its corresponding soil. Doses of 5.66 / 0, 2.81/0.96, 1.41/1.92, 0.70/3.84 and 0/7.68 g of ammonium sulfate / calcium nitrate were used per pot. A randomized block with five treatments and five repetitions was used as experimental design. SPAD reading with Minolta clofilometer was determined 11 weeks after sowing, in leaf 1, 2, 3, 4 and 5, the right side and left side of each leaf in the middle portion. Doses were correlated with readings SPAD, their coefficients of determination were calculated and the normality of their standard residues was verified.
Results demonstrated that there were no differences between right and left side of the leaf 3, 4 and 5 and were not associated with the doses. The doses applied and SPAD readings showed the best model for the leaf 2, left side $Y = 74.4 + 10.77x - 2.37x^2$; $R^2 = 87.5\%$, and right side $Y = 77.1 + 9{,}1x - 2x^2$; $R^2 = 86.5\%$ leading to the conclusion that the best dose were 2.81/0.96 g of ammonium sulfate / calcium nitrate per pot.

P463

Comparative Effect of Two Different Types of Phosphate on Cadmium Phytoextractability in the Field Soil Affected by Mine Activity

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In situ immobilization of cationic heavy metals in contaminated soils using phosphates leads to formation of products which are highly insoluble and thermodynamically stable over a broad soil condition. To evaluate the effect of phosphate materials on reducing soil Cd extractability and plant Cd uptake in field soil, two different properties of phosphate materials, fused and super phosphate (FSP, acidic phosphate fertilizer) and K_2HPO_4 (alkaline phosphorus chemicals), were selected and applied at the rate of 0, 33.5 (recommendation level), 100.5, and 167.5 kg P ha^{-1} before radish (*Raphanus sativa* L.) seedling in Cd contaminated soil. Different from general information, NH_4OAc extractable Cd concentration in soil and Cd concentration in radish significantly increased with increasing FSP application, but in contrast decreased with K_2HPO_4. The significant decrease of soil pH and negative charge by FSP application led to increase of bioavailable Cd fraction in soil and radish Cd uptake. However, K_2HPO_4 increased the soil pH and negative charge, and then decreased bioavailable Cd fractions. Phosphate induced soil pH and negative charge showed significant negative relationship with Cd concentration in radish plant, implying that the two parameters played an important role to control Cd uptake by radish. Different with our expectation, the precipitation of Cd species assumed to be a minor factor on reducing Cd phytoavailability in this phosphate fertilized soils. Conclusively, alkaline phosphate fertilizer such as K_2HPO_4, not acidic fertilizer, is recommendable to reduce Cd phytoavailability in Cd contaminated field soil.

P464

Nitrogen and carbon release from organic residues by extraction with KCl: effect of temperature and acidification

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Nitrogen availability in organic residues differs according to their composition, which makes difficult to estimate the application rate required to supply a desired amount of plant-available N. Methods using hot KCl have a great acceptance in recent years, given the relative success achieved with soils. This method is also promising for anticipating the potentially available N in organic wastes. The aim of the present study is to evaluate the acidification of the hot KCl extraction in the release of ammonium-N (N_{am}), organic N (N_{org}) and organic C (C_{org}) from five different organic residues: cattle manure, potato crop residue, solid fraction of dairy slurry, pig slurry and on-farm compost. Organic residues were heated with KCl 2*M* (1:20) at 100°C for 4 hours in a digestion block without or with acidification with HCl to 0.05 *M* and 0.10 *M*.
Acidification led to a significant increase of the extracted C and N amounts in heated treatments, but almost no differences were detected for the cold extractions. The amount of C_{org} increased for the five materials (36 to 87 g C kg^{-1}), but some differences were observed for N_{am} and N_{org} among materials. Both N forms increased with hot acidification, except for slurry. For the latter residue, N_{am} increased significantly at expenses of N_{org}, since the sum of N_{am} + N_{org} remained constant. Therefore, protein-like compounds in the pig slurry seem not to be further hydrolysed with mild acidification. Except for the compost, the acidification of the KCl solution leads to an increase of the C/N_{org} ratio in the extract, which is especially notorious for the slurry (28 to 93). Consequently, a better understanding of the different N and C pools behaviour during KCl acid extraction may lead to an improvement of this chemical test to assess N turnover in soils.

P465
Micronutrient levels in natural stands of European oaks in northwest of Iberian Peninsula: a comparative study

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A total of 52 natural forests of sessile oak (*Quercus petraea* Liebl.) and 40 of rebollo oak (*Quercus pyrenaica* Willd.) were inventoried in northwest of Iberian Peninsula, and micronutrient levels were assessed by analysis of several edaphic parameters. The substrates under *Q. petraea* forests are siliceous, mainly slates, and the soils (mainly Umbric Regosols) are loamy, whereas under *Q. pyrenaica*, schist and quartzite predominating with sandy-loam texture, and also, the soils are basically Umbric Regosol-type. For sessile oak, the copper content was very low compared with soils under some deciduous tree species, and the soils of rebollo oak were a high concentration of the iron micronutrient. The application of ANOVA'S to the edaphic parameters resulted in significant differences between the two species.

P466
Comparison between the chemical properties and the macronutrient content of natural stands of *Quercus petraea Liebl.* and *Q. pyrenaica Willd.* soils in Galicia, NW Spain

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Fifty-two soils of sessile oak (*Quercus petraea* Liebl.), and forty of rebollo oak (*Quercus pyrenaica* Willd.), distributed throughout the Autonomous Community of Galicia, northwest of Spain, were sampled, and 8 edaphic parameters (4 were related to chemical-nutritive properties -pH, OM, N and C/N ratio-, and 4 with to soil fertility -P, K, Ca, Mg-) were estimated in each. The substrate of all stands is siliceous and the soils are basically Umbric Regosol-type. Organic matter and nitrogen contents were highest in the soils under sessile oak, and the C/N ratio was significantly higher in rebollo oak than in sessile oak, as were the concentrations of all macronutrients. The application of ANOVA'S to the soil parameters resulted in significant differences between the two species studied.

P467
Effect of fertilization treatments and water regime on Fodder beet productivity

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In order to asses the effect of water saving in addition to organic and biofertilization treatments, a field trial was conducted at Tamiya, El Fayoum Governorate, Egypt .in the period (2004 - 2006) on fodder beet plant using three irrigation intervals 14, 21 and 28 days in addition to three fertilization treatments (60kg N /fed as control, 20kg N /fed+ biofertilizer application and40kg N /fed + biofertilizer application). Results showed that extension of irrigation to 21 and 28 days reduced the foliage fresh weight / plant although foliage dry weight and root diameter were not significantly affected by irrigation augmentation, but the root length /plant (cm) was seriously affected and showed a clear reduction reaching 23.9(cm). Among different N fertilizer doses in addition to biofertilization. It was proved that the ideal effective dose was for application of 40kg N /fed + biofertilizer where it led to a significant increase in fodder beet root length, diameter, fresh and weight and foliage fresh and dry weight, root and foliage yields ton / fed under extension of irrigation interval to 28 days. Also, N, P and K percentages increased at 21days irrigation interval and the uptake at 14days their percentages increased in shoots and roots when applying 40kg N /fed + biofertilizer at 14 days of irrigation interval followed by 21 and 28 days.

S04 Soil Compaction

P468
Oxygen Diffusion Rate in Vertisol

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Experimental data from research under field conditions on the oxygen diffusion rate in vertisol near the city of Sofia are examined, in relation with soil moisture and the volume of the aeration pores in the 0-50cm. soil layer.
The possibility of optimizing the conditions for oxygen supply to the roots through controlled soil moisture in the ploughed 0-30cm. layer is established. The minimum volume of the aeration porosity above which conditions for normal supply of oxygen to the roots is determined.
It is found that the limiting factor for the creation of favorable physical conditions for soil fertility in vertisol is the slow diffusion of oxygen in the under-ploughed layer. The change in the soil moisture content in this layer does not improve the conditions for aeration. Melioration is necessary for stable improvement of soil structure and increase of the aeration porosity in the under-ploughed layer.

P469

Effect of agricultural activity on soil deformation on Estonian grasslands

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The load bearing capacity of the different soils have been investigated decades. However, the main attention is paid to the cultivated land and much less on grasslands. In the same time grasslands are located on the areas (wet soils), where conventional cultivation is impossible. The increasing need of high quality fodder for animals (for cattle), especially of silage, press to use grasslands more intensive and to use more efficient and heavier machinery. All that management increases the negative pressure on soils. In Estonia the effect of soil compaction on grasslands is slightly investigated, more attention has been paid on crops. In the grassland studies in the rest of the world, the main attention is paid on the grazing and trampling effect of cattle on pasture soil properties. In 2007 the preliminary study was conducted on one intensively used second year lucerne (*Medicago sativa* L.) field in Estonia. After third cut of lucerne for silage the soil properties (moisture content, penetration resistance, bulk density, porosity (pF), texture, shear strength, precompression) were measured from the tracks (compacted) pick-up machinery (total full load 20 tons) and between the tracks (un-compacted). Soil of Experimental area was sandy loam Cambisol (calcaric). Measurement of penetration resistance revealed 0.5-1.0 MPa increase in tracks compared to un-passed soil in top 10 cm of soil. The wheel track was 2-3 cm deep. In the same 10 cm soil layer decreased soil porosity, increased plants unavailable water content and bulk density in wheel tracks. Beside the topsoil compaction, the hardpan has been formed during the years in the soil in 20-30 cm depth on the field edges. The results of the study indicated that soil compaction problem exist next to cultivated fields also on grasslands.

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The effects of conservation tillage on soil physical and biological properties in maize monoculture

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In our long-term soil tillage experiment, the effects of conservation tillage systems on soil compaction were examined in maize monoculture during ten years.
The research work was carried out at the experimental site of Pyhra Agricultural Secondary School in Lower Austria. The weather is determined by continental and maritime climate influenced by the closeness of the Alps as well. The soil is Endogleyic Fluvic Cambisol (Dystric, Siltic), with a base rock of fine-graded silt deposited during floods. The soil has good structure and favourable water regime, however it can be susceptible to compaction.
In the experiment three soil tillage systems were compared, namely direct drilling, ridge tillage and conventional tillage with ploughing in maize (*Zea mays*) monoculture. To evaluate soil compaction soil physical-, hydro-physical, biological properties and crop yield were used. Soil physical state was determined by soil structure (morphological and agronomical), bulk density, penetration resistance. Moisture content and soil water retention curve (pF) were analysed for hydro-physical conditions. Earthworm activity characterized by earthworm abundance, earthworm biomass and number of earthworm channels were measured to estimate soil biological stage.
The results of bulk density and penetration resistant measurements show that the soil is more compacted in undisturbed direct drilling than in disturbed tillage treatments. Even though slight soil compaction has been detected in direct drilling the crop yields were not different considerable because soil moisture and plant available water content were almost the same in the tillage treatments. In case of direct drilling earthworm activity was much more favourable in contrast with tilled treatments.
Consequently, physical evaluation itself is not suitable for the examination of the effect of soil tillage systems on soil compaction. Within the experimental period, the effect of annual precipitation had an important role regarding the effect of tillage systems on soil properties.

P471

Mechanical models for the dynamic of the cone penetrometer

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The dynamics of penetrometer must be very well known in aim to realize the precise estimation of the stress state in the soil, stress which is in relation with the soil density and soil moisture, but what relation? Which is the relation between the soil compaction definition and the cone penetrometer data? In this paper, first, we try to clarify this problem. The main parameters involved in this problem are the soil bulk density and the soil moisture. Using these characteristics is possible to estimate the compaction degree. But, what exactly measure the penetrometer? of course, the resistance of the soil at the penetration cone. These resistances have many mechanical components: a resistance which is given by the exceeding of the yield limit of the soil, a resistance which is given by the soil density, a viscous component and a friction component. In these visions the penetration phenomena contain characteristics of the solid - solid interaction and solid - fluid interaction. The process is located at the frontier between the solid body mechanics and the fluid mechanics. There are many soil compaction definitions, which include many mechanical terms: bulk density, compression, stress.
A first dynamic model of penetration is given in the paper by simulate de movement of a material point in a resistant media, which contains all the resistance component specify ahead. In the paper will be analyzed the contribution of the resistance of the each resistance component at the total resistance force.
Another dynamic model of penetrometer is possible to be obtained by using the model of the movement of a rigid body in a high viscous fluid, which will be able to be seen in the full paper.

P472

Assessing effect of plant residuals on reduction and prevention of soil compaction in afforested parks

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Existing evidences show that soil compaction of afforested parks happens due to the user movements in these areas and tends to some problems relating to this action. This research was carried out in the Chitgar park (west of Tehran),planted by broad leaves and conifers trees. The research was conducted based on 24 plots in size of 1 by 1 meters (1 square meter) using randomize split plots research method. Three main treatments together with three submain treatments including adding to and mixing plant residuals with soil as well assowing and compacting soils using small size rolling-pin were respectively applied so that both of main and submain treatments replicated three times . Soil samples were obtained of each plot and amount of soil density and soil moisture contact as indicators for the rate of soil

compaction were measured. Results of variance analysis and F-Test as well as mean comparison of the examed parameters indicate that the effect of leave residuals of conifer trees in lowering soil compaction rate is much more than broad leaves trees. Accordingly, adding and mixing plant residuals to soil through sowing of planted areas in afforested parks can be suggested to decrease rate of soil compaction and to pervent its negative effectes in survival and growth of plants. But, there is great need to carry out further researchs on optimum amount of needed plant residuals to be mixed with soil to effectinely control soil compaction in afforested areas as parks.

P473

Influence of different nutrients on rheological parameters with special regard to potassium

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Recent works were able to proof the applicability of rheometers in soil science. Rheological measurements can therefore be useful to research structural changes on the microscale level.
Homogenized samples are installed between two parallel plates; of which the lower one is immobile whereas the upper plate is oscillating. The resistance of the sample towards the oscillation can be quantified by the parameters storage and loss modulus e. g. Hereby, the energy stored during a deformation process is represented by the storage modulus whereas the loss modulus shows the amount of energy which is irreversibly lost and will not be available for recovery. Ratio and development of loss and storage modulus during increasing deformation enable quantification of a so called deformation limit and flow point. The first term indicates the value which will cause irreversible deformation if exceeded, the latter the deformation value which causes flow.
Deformation limit and flow point are influenced by several factors. First of all, a higher bulk density as well as a higher soil water pressure will shift deformation limit and flow point to higher deformation values. Additionally, different nutrients change the rheological parameters. With a special remark on potassium, the influence of several nutrient concentrations is examined. Some salts are said to decrease, some are said to increase soil stability. First surveys made clear that with higher potassium content the deformation limits increases; the soil is stabilised. But still little is known about the influences and interactions of potassium and other nutrients on rheological parameters in detail.

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The effect of compaction and reduced tillage on the macro- and microscale gas transport in a loess soil

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Intensification of mechanical agriculture has increased the risk for soil compaction and deformation of arable soils. Simultaneously, reduced tillage practices have become popular due to energy saving, environmental concerns, and a strengthened and better functioning structured soil pore system. Soil aeration is affected by both compaction and reduced tillage through changes in soil structure and in the distribution of easily decomposable organic matter. We investigated whether a single wheeling by a 35 Mg sugar-beet harvester in a Stagnic Luvisol derived from loess near Göttingen, Germany, influenced the air-filled porosity, the gas transport properties (air permeability, gaseous macro- and microdiffusivities, ODR), and the microprofiles of oxygen partial pressure in the topsoil and subsoil samples, and whether the effects were different between long-term (12 years) reduced tillage by a cultivator to 8-10 cm depth and mouldboard ploughing to 30 cm depth. For this purpose, structurally undisturbed soil samples were taken were taken at 12 cm (topsoil), 35 cm (plough pan) and 60 cm (subsoil) depths after harvest the beets, and the measurements were carried out in the laboratory after equilibration to different matric potentials. Poor structure in the topsoil resulted in slow macro- and microscale gas transport at moisture contents near field capacity. The macrodiffusivities in the topsoil under conventional tillage were slower compared with those under conservation treatment, and soil compaction reduced the diffusivities by about half at the soil depths studied. The microprofiles of oxygen partial pressures in the compacted topsoil showed a sharp decline with depth, whereas those in the reduced tilled soil where higher. This shows that even one pass with heavy machinery near field capacity impairs soil structure deep into the profile, and supports the view that reduced tillage improves soil structure and aeration compared with ploughing, especially in the topsoil.

P475

Soil compaction in vineyards of Slovakia

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We studied the influence of agricultural practices on soil chemical properties, structure and compaction in vineyards. There is a little information about long time human influence on the soil properties in row and interrow of soil profiles in vineyards. The soil samples were taken from two known wine areas of Slovakia, in south-western, locality Dulovce and in eastern, Tokaj region (locality Vinicky). In Dulovce was observed a high soil compaction in row of vine in layer 0.3-0.8 m where values of bulk density (BD) overpassed the critical value for loamy-sandy soil (1.7±0.07t.m-3) and porosity (P=35.2±2,74%). Soil vulnerability was high in layer 0.3-0.8 m and the values packing density (PD) were in range 1.67-1.81 t.m-3. The highest values of total (CT=0.80%), labile (CL= 2215 mg.kg-1) and hot water soluble organic carbon (Chws=239 mg.kg-1) were in top layer 0-0.3 m and with depth decreased. In interrow of vine the soil vulnerability was high in layer 0-0.6 m, the value BD=1.74 t.m-3 and PD=1.79 t.m-3 what was as a result of used agricultural practice. The highest content CT was in interrow of vine in layer 0-0.2 m, in Dulovce (1.04%) and so in Vinicky (1.30%) but organic carbon contents in both vineyards were low. Soil compaction in Vinicky (<0.01=29.4%) in comparison to Dulovce (<0.01=13.4%) was lower although difference in soil texture was high. The high compaction was in row in layer 0.2-0.6 m (BD=1.61 t.m-3) locality Vinicky and in interrow in layer 0.2-0.4 m (BD=1.61 t.m-3). Coefficient of vulnerability (Kv) was higher in Dulovce (2.43) as in Vinicky (1.92) where was higher abundance of silt and clay fraction. We acknowledged some differences of soil compaction in interrow therefore it`s necessary to solve the question of decreased of negative impact of the agricultural practice on the soil profile parameters.

P476

Defining soil compaction stages by the 'Packungsdichte' method

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Soil compaction is a human-induced physical soil failure connected to cultivation. It unfavourably effects crop production and degrades soils. The EU included compaction as a dangerous threath on our soil cover in the proposal of the soil framework directive [COM(2006)232] to reduce the spread of harmful tendencies that are present nowadays. Present paper demonstrates a simple, but easy-to-use field method developed earlier in Germany. Our approach was to test the so called '*Packungsdichte*' or packing density method and to define the

macromorphological characteristics of each compaction state. For this aim we have chosen sampling sites where soils were created and effected artificially and sites where compaction appeared due to usual cultivation processes.
In Hungary, bulk density measurement of relevant horizons and layers or penetrometer have been in common use in order to define soil compactness. Beside these methods there are field techniques that handle soil compactness investigation more complex and probably easier. One of these is the so called '*Packungsdichte*' or packing density field method.
The PD method works with a scale of five classes according to the DIN 19682-10 German standard. To test and adjust the PD method for Hungarian conditions sampling sites in Hungary have been designated on plough-land territories near Nagygombos and Hatvan-Jószefmajor. At the Nagygombos site soils categorised into PD5 (most compacted state of soil) have been found at a depth of 20-25 cm-s. In this stage of compaction it is typical that roots could not break through the compacted layer, and so root deformations, parallel with the surface appeared, beside the sharp-edged polyhedral structure.
Our approach aims to partly substitute other methodologies as they can not be utilised in all circumstances. The field usage of penetrometer is weather dependend, while bulk density measurements require laboratory background.

P477
How do conventional and conservation tillage practices with organic manure application affect the seasonal variation of topsoil hydraulic conductivity?

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There is limited information about the effects of associating tillage practices and organic manure fertilisation on soil hydraulic properties, especially over time. Long-term field experiments were conducted to study the influence of conventional tillage (CT), reduced tillage (RT) and no-tillage (NT) with mineral or organic fertilization on the dynamics of soil hydraulic properties under wheat crop cultivation. Measurements were made in November, March, May and July 2007 on a loamy soil in Brittany, France. Bulk density, soil hydraulic conductivity (K) and derived hydraulic parameters (mean size of hydraulically active pores and percentage of active pores per unit area) were measured in situ for three water potentials (-0.6, -0.2 and -0.05 kPa) at 2 cm and 12 cm soil depths.
The results indicated that tillage practices had a major impact on soil hydraulic properties, creating unconsolidated soil and increasing K values at -0.2 and -0.05 kPa suctions. Manure application had almost no effect on bulk density and K. From November to July, K showed a decrease under CT and RT at the 2 cm soil depth and an increase under RT at the 12 cm soil depth. Regression analysis revealed a dynamic and negative correlation between K and bulk density when tillage treatments were considered. Soil hydraulic behaviour agreed reasonably well with mean active pore-size distribution and effective porosity percentage. We conclude that processes such as fragmentation or compaction had a major impact on intra-annual soil hydraulic properties under tillage practices and manure application at varying soil depths.

P478
Soil mechanical and soil hydraulic parameters on a recently established agricultural recultivation site in Eastern Germany

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The largest lignite mining area of Germany is located in Lusatia, Eastern Germany. In this region lignite mining leads to disturbances on a landscape level. Recultivation efforts attempt to regenerate mining areas for land use options.
Our study is concerned with the agricultural recultivation of lignite mining areas in this region. The sandy to loamy substrate (~65% sand, ~30% silt and ~5% clay) that is used for recultivation stems from depths of several meters and is therefore free of soil organic matter. However, some lignite fragments are present. The substrate itself is unstructured. During the excavation, deposition and management process the substrate is subject to strong mechanical stresses. This practice leads to more or less serious soil compaction causing decreased yields of agricultural crops. In this context we investigate the effect of different organic soil additives in combination with different recultivation crop rotations on the development of soil structure for improved agricultural land use. Our experimental site has recently been heaped up and levelled off. On each of the 24 experimental sub areas undisturbed soil samples have been taken to characterise the experimental substrates according to their mechanical (precompression stress, shear resistance, cyclic loading behaviour) and hydraulic parameters (water retention characteristics, saturated hydraulic conductivity) and to determine the scattering of these parameters on a site that should be recultivated as homogenously as possible. We present first results of our ongoing experimental study

P479
Patterns of soil structure in spruce stands in south-western Germany - natural and anthropogenic causes

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The impact of machine use on soil structure during forest operations is well investigated. Concerning the natural heterogeneity of soil structure in forest soils the following questions arise: Do spatial patterns exist and if so, is it possible to differentiate between natural loss of soil structuring and compaction under wheel-tracks? Under certain preconditions such as a sensitive soil structure, a shallow, wide-spread rooting, e.g. in consequence of waterlogged horizons within the main rooting zone, wind-induced root movement can be an important origin of soil structure disturbance. Our two investigation sites at the prealpine mountains in south-western Germany conform to these conditions. The heights of the spruce stands exceed 35 m so it's ensured that the wind energy is transferred to the soil.
An intense sampling of soil structure parameters with common methods is very intricate, so the CO_2-concentration in the soil air was used as an indicator for compaction (enrichment of CO_2 in compacted soils because of limited exhaust to the atmosphere). The soil CO_2-concentration was measured in a 50x50 cm grid in 10 and 20 cm depth using a mobile gas chromatograph.At both sites we found heightened CO_2-concentrations around living trees and stumps, especially in a depth of 20 cm. To ensure, that the elevated concentrations are not caused by higher CO_2-production, we collected soil air samples for the three situations "tree", "stump" and "interspace" down to 90 cm depth using a diffusive sampling technique. By adapting spline functions to the CO_2-profiles we modelled the CO_2-production for the different horizons. The results strengthen the hypothesis that under the investigated preconditions wind-induced root movement leads to a distinct pattern of soil structure disturbance. The results of this study can e.g. be used as "reference states" in order to differentiate between natural and anthropogenic soil disturbances caused by ancient skidding.

P480

Influence of mountain pasture landuse on soil structure and its related physical parameters

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Abstract
Mountain pasture is a very common landuse in alpine countries like Austria.
From the soil physical point of view bovine pasture may become a problem. The aim of this work was to investigate the influence of high soil compaction through animal pasturing on soil structure and their related physical functions.
At the Wurzeralm, Upper Austria, 1371 m asl and the Tauplizalm, Styria, 1640 m asl, strong
cow pastured soil areas were investigated and compared with adjacent non pastured reference areas. Two types of soil with medium and high clay content were investigated.
The results showed that when animals pasture for longer time on the same soil surface and under humid conditions, an extremely high compaction occurs, expecially with high clay contents where the irreversible amount of compaction (plastic) is much higher than the reversible one (elastic). This leads to a change of soil structure with consequently damage of its function in the water-air soil regime.
It could be shown that in the high compacted soil compartments, more than 80% of coarse pores (> 50 µm) were destroyed, the soil therefore impermeable, and a loss of 70% of available field capacity occurred.
In the theoretical physics, the lowest possible porosity at hexagonal arrangement of spherical particles of equal dimension is 26 vol. % with 12 particle-particle contact points (Hartge and Horn, 1991). This never occurs in soils, even not in best sorted sediments, because soil particles are never exact spheres. The soil in question showed a decrease of porosity to 36 vol.%, which can be considered very close to the lowest possible limit of cultivated soils.

P481

Effects of different compaction impacts and varying subsequent soil management practices on soil microbiological parameters

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In a field trial on a deep cambisol (20% clay, 26% silt, 1.4% org. C) in Zurich-Reckenholz, Switzerland, compaction treatments with differing subsequent mechanical soil loosening were installed to investigate the importance of soil management practices on the extent of structural regeneration. The aim is to study the functional relationships between soil structure, soil environment and the amount, composition and activity of soil organisms.
For this purpose three main treatments were installed: 1) one single compaction at the start of the experiment and 2) annually repeated compaction, both followed by natural regeneration without mechanical loosening, and 3) one single compaction at the start of the experiment followed by annual plough tillage.
Each of these treatments was carried out under actual weather conditions and under irrigation in order to amplify the effects of compaction for unambiguous identification. Maize, wheat, barley and ley were used for crop rotation.
Disturbed soil samples were taken early in each spring before and during the field trial for the estimation of soil microbial parameters.
Absolute differences between treatments at a given sampling occasion were difficult to detect because of differences existing already at the beginning of the experiment, but the evolution of soil microbial biomass differed between treatments: Whereas biomass in the non-compacted control as well as in the treatments with mechanical loosening after compaction increased, it decreased or stayed constant in the compacted treatments without mechanical loosening.
Denitrification potential was estimated in disturbed samples taken in autumn 2007. Highest denitrification potential was found in samples of irrigated treatments, independently of compaction and regeneration course.
Soil respiration measured in structured soil samples, taken in autumn 2007, showed only small treatment effects. At water potentials of -30 and -1000 hPa, CO_2-production was lowest in the treatments which were irrigated and yearly compacted, highest in the control treatment.

P482

The strength of plant roots and their impact to soil shear strength in disturbed and undisturbed grassland soils

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Plant roots can increase soil shear strength by forming a binding soil-root matrix and thus anchoring the topsoil layer. The binding network is depending on the characteristics of the root system, e.g. plant species, number and type of roots, and the tensile strength of single roots. Sampling took place on continuous grassland topsoil (seeding in 2004, 75% grass, 19% legumes and 6% chicory species) with different experimental setup regarding fertilization and compaction status. Roots were sampled to assess the tensile strength using a modified surface shear device. Undisturbed soil-root samples were taken to quantify the mechanical shear resistance in the consolidated drained box shear test. Hereinafter the samples were homogenized and measured without roots and with roots re-implemented to quantify the reinforcement effect of roots to soil shear strength. There was no statistical significant effect (P=95%) of fertilisation and compaction on soil shear strength. Fertilisation had a statistical significant effect on root tensile strength. Tensile strength decreased with increasing root diameter following a power law curve. The presence of roots in undisturbed, as well as in disturbed soil-root samples increased soil shear strength. In particular cohesion was increased, while the friction angle remained substantially unchanged.

P483

Monitoring root growth alteration caused by heavy forest machinery

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Mechanized wood harvesting was introduced into forestry practice mainly due to economical reasons. In Europe and Slovenia the share of harvesters and forwarders is increasing. Their adverse impacts on soil physical properties and root growth will require operational limitations based on relevant indicators. In the study initiated in autumn 2007 we compare long-term root growth disturbance after mechanized harvesting in wheel rot and undisturbed soil profiles using minirhizotrons and RhizoTronMF® (Regent) Software Program. In addition cone penetrometer is used to calculate soil penetration resistance and soil moisture conditions are measured with a TDR probe. Rhizotron scans are taken monthly in four directions to the depth of 60 cm. Methodological considerations regarding field measurements and image processing as well as preliminary results of six month root growth are reported in the paper and presentation.
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P484

Mechanical behaviour of a clay soil under different buffer zone management practices in Finland

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Soil structure has an influence on the infiltration of water and solutes in vegetated buffer zones (BZs). Effects of management practices (1) natural grassy vegetation with no harvesting, 2) annually harvesting and 3) grazing) on compression behaviour of a clay soil (Vertic Cambisol) were studied in laboratory using a confined compression test at the matric potential value of -6 kPa. Soil initial bulk density and air permeability before the compression test were also determined. Undisturbed soil cores (240 cm^3) were sampled from the surface soil (0-3 cm) of each BZ, and from the middle of horizons of a soil pit, excavated to the depth of 200 cm.
Bulk density increased with depth down to 45-90 cm and then decreased again, while the average vertical displacement, i.e. a strain, decreased from the top to the bottom. At 0-3 cm, much lower values of air permeability (2.7-5.1×10^{-5} m s^{-1}) were found for the grazed sites compared to the BZ under natural vegetation (15-22×10^{-5} m s^{-1}). This indicates reduction in the connectivity of the pore network and a consequent decrease in the hydraulic conductivity. Data from the confined compression test showed that the 14-year old grazed BZ which had a low bulk density (0.97 g cm^{-3}) tended to be easily compressed but owing to the organic matter accumulated onto the soil surface, it was able to recover more elastically subsequent to the stress removal compared to the 3-year old grazed BZ of the higher initial bulk density (1.17 g cm^{-3}). Thus, we emphasize the importance of preserving surface soil and soil structure without disturbances under vegetation and recommend grazing only after organic cover has developed on the soil surface of BZ.

P485

The efect of aggregate for minibeds forming on physical and mechanical propertys on soil

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Effect of presowing soil preparation and minibeds forming on changes in its physical and mechanical property were investigated. The investigation was carried out during the summer 2006. Tractor engine nominal power was 139 kW. Working width aggregate was 3 m and working depth on cultivated soil was 12 cm. At the same time aggregate was forming 4 minibeds. The height of minibeds was 18 cm and width was 24 cm. This is enough for two row carrots sowing.
The work aimed at practical measuring physical and mechanical properties such as penetrometric resistance of soil (chernozem type), volumetric bulk density, porosity, k-Darcy, soil moisture and aggregate composition of soil in minibed, which helps to clarify the facts assisting in development of conditions of carrot root growing. The assessment of aggregate composition was performed by calculating the structure coefficient (k).
Soil moisture before minibed forming at depth 0 - 20 cm was in range of 13.83 to 15.82%. Penetrometric resistance value in minibed soil are basically equal in range of 0.03 to 0,312 MPa, volumetric bulk density was in range of 1.19 to 1.24 g.cm^{-3}, porosity was in range of 52.02 to 53.54 vol%, k-Darcy was in range of 11.67 to 7.85 cm^{-1}. Structure coefficient before minibed forming was 1.21 and after preparation was in range of 2.83 to 1.55.

P486

In situ characterization of the structural heterogeneity of a compacted tilled soil by electrical and mechanical methods

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Due to the continuing increase of the machine loads in Europe, soil compaction has become a problem of major concern causing a large broad of consequences (reductions in crop yields, water runoff, erosion and greenhouse gas emissions). Compaction affects soil structure i.e. the arrangement of soil particles in space. Since structure rapidly changes in space and time under the effects of climate, biology, and anthropic actions like traffic and tillage, methods to characterize its *in situ* state are required. In this perspective, we have tested several methods: electrical resistivity measurements and electrical impedance measurements coupled with mechanical measurements.
In a first experiment, the electrical resistivity has been used to describe a complex 3D structure in the field at the decimetric resolution. The studied zone - a 2.4 m × 2.4 m field plot - consists in a compacted band, created by a heavy tractor and then fragmented by ploughing. The structure has been described by visual morphological profiles and was composed by dense aggregates, loose material and large voids. This structure has been compared to electrical resistivity measurements thanks to Wenner arrays and square arrays. The analysis of apparent resistivity data has shown that we can localise zones with large voids, and zones with compacted aggregates. The inversion of the apparent resistivity data by using Res3DInv software has evidenced the position and orientation of the compacted aggregates.
In a second experiment, a tractor wheel tooled-up with a tyre sensor has been used to measure simultaneously the tyre deformation and the electrical impedance. Results have been compared with penetrometer profiles. The association of continuous acquisition of these two set of electrical and mechanical measurements allowed us finally to discuss about the changes of soil structure occurring during the field operation.

P487

Tillage and crop rotation influence over soil physical properties

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Spatial and temporal variability in soil properties can be critical in the evaluation of the effects of tillage management practice on soil and crop parameters.
The paper presents the result of researches regarding tillage technologies over soil physical properties for maize-soya-wheat crop rotation.
The researches covered a three year period within a experimental lot using mouldboard plough, rotary harrow and cizel plow.
For the mentioned period, measuring the bulk density, compaction level and soil resistance, positive effects regarding soil conservation are encountered when using crop rotation and tillage technologies without furrow inverting. On the basis of obtained results, recommendations are made regarding the tillage machinery use for Romanian farms.

P488
Impact of soil tillage practices on the spatial organisation of earthworm biostructures

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Earthworm biostructures are widely accepted for their distinctiveness in term of soil structure, organic matter availability or biological activities. However, while the determinism of earthworm activities has been investigated since a long time, only few studies have reported data on the spatial distribution of earthworm biostructures according to agricultural practices.
Therefore, many soil profiles corresponding to conventional tillage (CT) and no-tillage treatment (NT) were thinly sketched according to the typology of soil morphologic features (physicogenic and biogenic facies). Then, GIS tool were used (i) to quantify the areas of biostructures according to the depth, (ii) to qualify the size and the shape of the facies (iii) and to detect their preferential orientation.
This study showed that the area of biogenic facies clearly differed between 0 and 25cm, with the significant highest value for NT treatment (25 to 35%) vs 10% for CT treatment. On the other hand, the percent of biogenic facies that decreased gradually below 25cm did not differ significantly between the agricultural treatments.
Facies of bioturbation was composed by a major part of cast aggregates assembling (B3), dominated by welded casts (B3i), while the facies B1 (burrows) never exceeded 1% of the soil profile.
The size of B3 facies could reach 80cm², but most of them (80%) were ranged between 4 and 20cm². In addition, the shape of the facies B3 appeared frequently circular, even if a contortioned shape characterized often the welded casts assembling (B3i). In No-Tillage treatment, the impact on earthworm activities of past ploughing was noticed by the oblique orientation for many facies B3i between 10 and 25cm.
Our study showed that earthworm activities under the constraint of soil agricultural practices are an important process of soil structure.

S18 Urban and Anthropogenic Soils

P489
Phytoremediation of lead in contaminated urban residential soils of Portland, Maine, U.S.A.

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Lead contamination in urban residential soils is a widespread problem, and lead poisoning is an important environmental health problem affecting children world-wide. Many soils in the greater Portland, Maine, U.S.A. area are contaminated with high concentrations of lead, largely because of the prevalence of lead in pre-1978 residential paint and past industrial activities. Plants grown in lead contaminated soil may accumulate lead from translocation into plant tissues, and this phytoremediation process may be exploited for soil remediation. The purpose of this research was to test the ability of phytoextraction to reduce soil lead concentrations using Spinacia oleracea (spinach) grown in thirteen urban residential gardens contaminated with lead. The spinach was planted in May and harvested in July. Soil samples were collected from the garden areas before planting and after harvesting, and analyzed for total and plant available lead, pH, organic carbon, and particle size. Plant roots and shoots were analyzed for total lead. Spinach accumulated greater than 340 ug Pb/g dry weight in roots, and 105 ug Pb/g dry weight in shoots, and decreased total soil lead concentrations by 11%, and plant available lead concentrations by 21%. Strong correlations were found between total and plant available lead and between total and plant available lead and lead concentrations in shoots and roots. Correlations were also found between total and plant available lead and pH. The high metal accumulation suggests that spinach may be used to clean up toxic metal contaminated sites. This method of phytoextraction should be researched further and tested on sites for more than one crop rotation in order to examine the long term possibilities of using phytoremediation to reduce heavy metal contamination and improve the quality of the soil.

P490
Mobility and REE fractionation pattern in natural and mining soils in relation to parent material

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Rare earth elements (REE) may be mobilized in supergenic environment by numerous alteration processes. In particular secondary dispersion is of great importance during weathering as indicator of long-term variation of soil redox conditions. The purpose of this study is to investigate the REE distribution pattern in soils developed in a restricted abandoned mining area located close to Muravera (SE Sardinia, central Italy) and to compare the REE behaviour of these soils with those of a nearby un-mineralized area developed on the same parent materials. The results evidence a similar REE distribution pattern among the three main soil parent materials, namely porfiroids, metarenaries and calcarenites. Soils from porfiroids and calcarenites show an evident enrichment of REE, while in soils developed from metarenaries there is a small evidence that Light REE (LREE) has been leached from the system while a slight increase in all horizons has been observed for the Heavy REE (HREE). In all samples a close ratios of ΣLREE/ΣHREE characterizes both mineralized and un-mineralized soils. Other geochemical parameters as Ce/La, La/Sm and Yb/Sm ratios, give evidences of a scarce REE fractionation. The REE normalized data of each soil profile, calculated as regards to the correspondent parent material, show a clear differentiated pattern that can be considered typical and as a distinguishing mark of each parent material.
This work evidences that REE, being not significantly influenced by pedological processes and being resistant to fractionation in supracrustal environment, can be used as 'parent material fingerprint' and can be considered as a valid tool to identify the original material from they are derived, overall in areas with intense rock alteration and strong anthropic influence.

P491
Heavy metal pollution assessment in a Romanian mining area

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The Baia Mare region is since centuries the Romanian main center for mining and metallurgy of Cu, Pb, Zn, Au and Ag. The region became of international concern after the cyanide spill accident in January 2000 that affected the ecosystem of Tisa and Danube rivers. The high levels of anthropogenic soil pollution have recently become a major issue due to the fact that

even after the large industrial plants have reduced their activities and some of them were closed, the area is still highly polluted.
The objective of this study was to evaluate the Cu, Pb and Zn contents in surface soils from the industrial side of Baia Mare town. Determinations were carried out by inductively coupled plasma atomic emission spectrometry (ICP-AES) after aqua regia digestion according to ISO 11466:1995.
The results showed that the contents of all metals were high, exceeding the alert values for sensitive soils (residential and agricultural use) for the majority of the samples. In case of Pb and Zn the 1st quartile is higher and in case of Cu is around the corresponding alert level for sensitive soil. For all samples the 3rd quartile was much higher than the intervention level for all metals. The average metal content exceeded the intervention level for sensitive use according to Romanian legislation, 1.5 times in case of Cu, 3 times in case of Zn and 18 times in case of Pb.

P492

Influence of compost application and mycorrhization on urban soil characteristics and growth of bigroot geranium (*Geranium macrorrhizum* L.)

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The goal of this experiment was to examine the effect of compost of urban waste (consisting of decomposed grass clippings, leaves, and wood chips) and mycorrhization on chemical and physical characteristics of urban soil, and growth of bigroot geranium (*Coreopsis verticillata* L.) - perennial used as ground cover. Bigroot geranium was inoculated with mycorrhizal fungi using commercial inoculum Endorize - TA AMF inoculum (Biorize Sarl, France) consisted of a mixture of *Glomus* species. The plants were then planted in mineral urban soil, unamended and amended with compost at 8 dm^3 m^{-2}. The initial increase of pH, total soluble salts, N-NO_3, N-NH_4, P, K, Mg, Ca, and Cl caused by addition of compost was not maintained till the end of growing season. After 5 months of cultivation of bigroot geranium in the amended plots only total soluble salts, N-NO_3, and P values were slightly higher than in unamended ones. Mycorrhization decreased total soluble salts in compost amened plots, and N-NO_3, and P content in both, unamended and amended plots. The effect of compost and mycorrhization on soil physical properties was negligible. The highest fresh weight and height reached the plants inoculated with Endorize - TA AMF inoculum and grown in compost amended plots. Mycorrhization increased also these parameters in plants grown in unamended plots.

P493

Levels of Lead and in Roadside Soil Samples of an Agricultural Area of Central Greece

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Lead in gasoline has been remarkably reduced during the current decade, mostly in urban areas of Greece. On the other hand in agricultural areas the automobiles used for the commercial transportation of the agricultural products or even for cultivation practices, continue to use gasoline with lead, probably due to the old fashion machines.
The purpose of the present investigation was to determine the levels of Lead concentration in soil samples of an agricultural area of central Greece, which also is close to the highway, connecting Athens to Thessaloniki.
From 2000 to 2005, 50 surface (0-30cm) soil samples were collected each year. The soil samples were collected from agricultural areas which are close (<50m) to the specific highway. Twenty soil samples (every year), from areas with the same agricultural uses, but away (>1000m) from the highway, were also collected, in order to be the background samples for the present research. In order to investigate the possible seasonal variation of Lead concentration, the soil sampling was taken place every October and March, of the same sapling points.
Lead concentrations lied in the range from 2.2 to 48ppm on March and from 2.8 to 69ppm on October. The enrichment factor of Lead was calculated and it was obvious that there was an increasing trend for every year of the study. The seasonal variation was also of interest, as higher factors were observed in autumn than in spring of each year.

P494

The Use of Enrichment Factor for the evaluation of Zinc Pollution in Agricultural and Industrial Soils of Central Greece

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The purpose of this study was to determine soil enrichment factor of Zinc in an agricultural region of Central Greece. The equation used to calculate was as follows: EF $=(S_{Zn}/S_{ref})/(C_{Zn}/C_{ref})$, in which S_{Zn} is content of Zinc and S_{ref} is content of the reference element in soil, B_{Zn} is content of Zinc and B_{ref} is content of the reference element in the earth's crust. The enrichment factor was determined in accordance with calcium as a reference element.
During the years 2000-2005, fifty soil samples (each year), from depths (0-30 and 30-60cm) were collected. The area studied was an intensively cultivated area of central Greece (Almyros Region), which also includes a factory about metal processes. In order to find out a possible seasonal variation of the EF, the soil sampling was conducted two times a year, in March and October, from the same sampling points. The soil samples were analysed for the determination of soil pH, electrical conductivity, soil texture, organic matter content, $CaCO_3$ content, available Zn (with DTPA method) and total Zn content (with Aqua Regia method). Correlation analysis was used in order to determine the relationships among the calculated EF and soil physicochemical parameters.
Higher values of EF (2-5) were observed in alkaline soils, with high CaCO3 content. In acid soils the EF was in all cases lower than 1, indicating that the possibility of Zn leaching is lower in soils, particularly with pH values lower than 5.

P495

Constructozems of golf courses as new soil differences

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Gold course creation is a complicated and multistage process of layer-by-layer removal of soil horizon and parent rocks with their future laying according to golf architect's vision and standards of game. It is stipulated by peculiarities of game zones' construction and by necessity to rise them in case of high water and flooding. The result of this laborious work is the creation a new slightly undulating relief of golf game zones such as *tee* and *green* - the start and finishing game points, and also *fairway* - the basic game zone.
Thus, about 70% of golf course territory is so-called fairway constructozems, which are layered formations of different thickness, from 1m to 3m depending on game zone relief, with scalped alluvial-layered soil. The upper fairway horizon of 20cm consists of humus horizon of A native soil.
The horizon in particular is the basis for creation and growth of the basic mass of game grass surface. Game zones tee and green, taking 2% of the golf territory, are of more compound structure, it is connected with their function and heightened load according to the game peculiarities.

The given objects can be classified as laminated constructozems, consisting of highly drainage materials. Intergame zones, so-called *roughs*, represent native alluvial-layered soil, scalped in same degrees, but lost not more than 10-20cm of their thickness. Thus, the golf course, created in the Don-river floodplain, represents a complex of different urbanozems, urbosoils and alluvial-layered soil, which continue to function naturally, in spite of their significant transformation by a human-being.

P496
Soil PAHs contaminats analysis using fluorescence spectroscopy

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Suplacu de Barcau - Romania is an area historically polluted with oil products due to high concentration of rafineries, petroleum transport societies, undergroud pipes and so on. The sources of pollution are not only primary sources (extraction processes) but also secondary (storage sites).
In order to establish the optimum method for bioremediation and the species of microorganisms from autochtonous mycroflora adapted to the site's conditions it is necessary to evaluate the vertical (in depth) and horizontal (aproximately 500 m around the source of pollution) distribution of petroleum products and correlate them with pollutants migration in the field and chemical and physical properties of the soil.
The evaluation was performed by fluorescence spectroscopy correlated with real time detection of gases at soil surface.

P497
Heavy metal content in soil near sedimentation ponds, North-Western Romania

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Heavy metals are ubiquitous in the environment. They originated from natural or anthropogenical sources, and their concentrations are highly increased through mining and smelter activities. Under anthropogenic influences, both essential micronutrients, such as Cu and Zn, or toxic elements such as Pb and Cd from the environment might accumulate to a toxic concentration level, causing ecological damages.
The contents of Pb, Cu, Cd, Zn in soil from two rural areas (Tautii Magheraus and Recea) situated in the vicinity of sedimentation ponds, in North-Western Romania were investigated. The concentrations of heavy metals were determined by inductively coupled plasma atomic emission spectrometry after aqua regia digestion. The obtained results show that the mean concentrations of lead exceed the alert level for sensitive soils in both areas, the mean concentration of zinc is higher than the alert level in Tautii Magheraus area. The Cd contents were below the alert level in both areas. Generally, the concentrations of Cu were below the alert level in both areas, few samples exceed it.
This results show that the studied area is seriously contaminated due to mineral extraction and processing activities and represent a potential health risk.

P498
Development of improved urban soil evaluation methods

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In Germany, planning activities like settlements, roads, industrial areas etc. result in approx. 120 ha sealed soils per day. Politicians came beware of the problems concerning loss of soils and soil functions by sealed soils. Therefore they aim to stop these developments and propagate a maximum sealing rate of 30 ha per day until 2020.
To realise this aim, it is necessary to develop and practise methods which make information available for urban land use planning. Sites which are in focus and vacant for planning activities within the municipalities are e.g. brownfield sites. To characterize brownfields properly, information about the environmental status are necessary. The required information should be exposed by suitable tools reproducible.
The LBEG and the University of Applied Sciences Osnabrück adopts in close cooperation with the German working group 'urban soils' (AKS) methods provided by the MeMaS (MethodManagementSystem) of the Lower Saxony Soil Information System NIBIS® to handle urban soils too. MeMaS is a well established and often used system for the evaluation of soils in Lower Saxony and other German states. Main aspects within the project REFINA (Research for reducing land consumption and sustainable land use management/ Forschung für die Reduzierung der Flächeninanspruchnahme und ein nachhaltiges Flächenmanagement) are the development respectively the adaption of soil evaluation methods which will be able to generate required information for anthropogenic soils and urban land-use planning. Details of the methods will be presented.

P499
Classification of soils in Szeged based on anthropogenic diagnostic properties

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Due to the intensive anthropogenic activities (e.g. infilling, mixing) following the 1879 Great Flood, the soils of Szeged suffered a significant modification both regarding their physical and chemical properties. Soil samples were taken at 25 sites from horizons of soil profiles located in the downtown and surroundings of Szeged in order to examine diagnostic properties (artefacts, mechanical soil type, quality of organic matter, humus matter, carbonate content, pH (H_2O, KCl), total nitrogen content etc.) and to categorize the profiles according to WRB (2006).
All soil parameters mentioned but the total salt content are excellent markers of human influence. This can be seen either in the change of their recorded concentration values or the modification of their vertical distribution along the profiles. An elevated amount of artefacts, fluctuating humus and nitrogen levels, poor quality of the humic materials, higher and fluctuating carbonate content, concomitant variance in the pH, and the modified mechanical properties all refer to soils affected and transformed by human activities.
In accordance with human influence the studied profiles can be divided into 3 classes: Profiles made up of original genetic soil type in peripherals and the orchard profiles with some modifications were placed into category of soils slightly and moderately influenced by human activities. These profiles were classified into Phaeozem, Fluvisol, Gleyosol, Arenosol, Solonetz natural soil groups. Mixed profiles (embedding both considerable amount of infill material and buried soil horizons) on outskirts fell into the category of strongly modified soils. The profiles completely altered by a very intensive human influence were placed into Technosols.

P500
Microbial properties of sandy mine soils afforested with different tree species

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Microbial communities are of crucial importance for proper functioning of reclaimed soils. The objective was to compare microbial properties of mine soils afforested with different tree species. Samples of O horizon and uppermost 5 cm of the mineral soil were taken in a reclaimed sand quarry under thirty years old pine, larch, birch, alder, mixed birch-alder and mixed pine-alder stands. The samples were measured for basal respiration (RESP) and microbial biomass (C_{mic}). Community level physiological profiles (CLPPs) were studied using BIOLOG plates. The lowest C_{mic} and RESP in both studied layers were determined under the larch stand (O horizon: 4733 mg kg^{-1} and 33.0 mM CO_2 kg^{-1} $24h^{-1}$, respectively; mineral soil: 101.44 mg kg^{-1} and 0.57 mM CO_2 kg^{-1} $24h^{-1}$, respectively). The highest C_{mic} and RESP in the O horizon were measured under the mixed birch-alder stand (9965 mg g^{-1} and 77.3 mM CO_2 kg^{-1} $24h^{-1}$, respectively) and in the mineral soil under the birch stand (213.7 mg kg^{-1} and 1.18 mM CO_2 kg^{-1} $24h^{-1}$).
Analysis of BIOLOG data indicated significant differences in CLPPs under particular forest stands in the O horizon. The microbial communities under the larch stand were the least active and diverse (the lowest Shannon diversity index). The highest activity and functional diversity of microbial communities was found under the birch-alder stand. The microbial communities under the mixed birch-alder and pine-alder stands were more active and more diverse than those under the birch and the pine stands. In the mineral soil, differences in CLPPs between the stands were less significant.
The results indicated a significant effect of tree species on C_{mic} and RESP in both considered soil layers. However, the functional diversity of microbial communities was significantly affected by the tree species only in the O horizon.

P501
Impact of the urbanization on soil conditions

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The basic aim of the study has been to determine influence of the city on soil conditions and properties. The work took in the Densic Podzols and Dystric Arenosols grown with the forest. Study was carried out in the six agglomerations in Europe and Asia, it is Utrecht (Holland), Göteborg (Sweden), Bialystok (Poland), St Petersburg, Perm and Irkuck (Russia). Samples of soils were collected from urban and suburban part of each agglomeration, distant apart from 45 to about 100 km between city and suburban region. The soil properties being evaluated were: mineral and grain composition, bulk density, field water capacity, organic carbon, different form of nitrogen, exchangeable cations, heavy metals content, exchangeable aluminum, exchangeable acidity, iron, aluminum and carbon associated in humus complexes with sesquioxide, amorphic iron and aluminum, free iron and aluminium. On the basis of obtained data, the evaluation and comparison between two different land use habitats was made. Differences in ecological functioning of the soils in natural and anthropogenic environment were found.

P502
Evaluation of metals mobility and phytoavailability from mine tailing technosoils (Massif Central - France)

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Anthropic activities generate large unexploitable areas over the world (e.g. more than 180 000 sites in France) because of organic and/or metallic pollutions. Decontamination solutions are more restricted and expensive. Thus, the use of biomass energy crop (e.g. *Miscanthus x giganteus*) represents a new possibility to revalorize this type of contaminated sites. This plant belongs to non food biomass (biocombustible, bio fuel and paper industry) and could potentially grow on such contaminated sites. In order to understand and estimate the adaptability of *Miscanthus x giganteus*, two former mine sites with different physico-chemical properties and a polymetallic contamination were chosen.
Both studied sites are situated in Massif Central (France) and present a polymetallic contamination (As, Pb, Zn …) with lead and arsenic levels higher than 0.1% and around 1,000 ppm for zinc. Since the end of mining extraction, no anthropogenic activity has been done inducing development of technosoils. Vegetation is essentially composed by graminae, horsetails and birches. Physico-chemical characterization (pH, CEC, Carbon content…) and mineralogy (XRD and SEM-EDX) of soil samples were realized. Metallic elements bioavailability has been estimated by chemical methods (DTPA, $CaCl_2$, BCR, and rhizo-A) and compared to a biological test (rhizospheric mobilisation by ryegrass).
All of these results will be discussed to evaluate technosoils behavior towards (i) metals and metalloids mobility, (ii) solid phases role in the metal release and (iii) the agronomic parameters to determine the adaptation capacity of *Miscanthus x giganteus.*

P503
Testing of engineered nanoparticles colloidal stability for mobility prognosis

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Large scale production and proposed applications of titanium dioxide nanoparticles causes their widespread emission into the environment, affecting not only surface waters but also soil and groundwater.
Distribution of industrial nanoparticles between environmental compartments (soil, water, air) and mobility in the environment strongly depends on the colloidal stability of the nanoparticles itself. Mobility in the unsaturated and saturated soil zone depends on the tendency to undergo attachment to the immobile soil matrix, air-water interface and the aggregation and subsequent straining filtration. These reactions are controlled by the surrounding conditions as i.e. pH, dissolved organic matter, sodium and calcium concentrations. This study investigates colloidal stability of titanium dioxide nanoparticles under natural environmental conditions. Stability of TiO2 particles was investigated in a multidimensional matrix of batch experiments under controlled water chemical conditions representing the natural milieu in soil pore waters.
The master parameters controlling the colloidal stability of the selected titanium dioxide and hence the mobility are low pH, high concentration of dissolved organic matter, low calcium and low sulfate concentrations. Since the experimental set covers a wide range of conditions, it enables the direct estimation of nanoparticle mobility for a variety of local conditions. Results from our study provide information and serve as tool for the predictions of fate and behaviour of engineered nanoparticles in porous medium.

P504
Heavy metals in urban soils of Belgrade, Serbia

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It is well known that over the past few decades' content of heavy metals in urban soils is continuously increasing as a consequence of industrialization. However, the content of microelements in soils primarily depends on the underlying rock type and its mineralogical composition. Beside this and the following paedogenetic processes, the anthropogenic factors

also have influence on soil composition. The aim of this research was to determine the concentrations and main source of heavy metals in soils of Belgrade, Serbia. For this purpose 202 surface and subsurface soil samples from 42 locations were analyzed.
Using the National Law Regulation of Serbia (23/94) for soil heavy metal content, the following can be concluded:
1. Concentrations of nickel in Belgrade soils are high at 7 out of 10 examined locations in both surface and subsurface samples. The main natural sources of nickel are fragments of peridotites and serpentinites, which are the oldest geological units in the investigated area. This indicates that the cause of high nickel concentration does have a geological origin.
2. Location Ada Ciganlija (river island at Save and Danube confluence) is specific with high nickel, lead, copper and zinc concentrations, which can be explained with the variability of alluvial deposits. It is possible that the soil brought for transforming Ada Ciganlija isle into a tourist attraction, has already been contaminated by heavy metals.
3. Frequent appearance of the same elements in positive correlations: nickel-copper, nickel-chromium, nickel-arsenic, nickel-lead, copper-zinc, copper-lead, zinc-lead, on different locations, is an additional evidence of geological and not solely anthropogenic origin of these elements in soil.
This investigation could be a starting point for further research of heavy metal content in Belgrade soils. Special attention should be given to Ada Ciganlija location which is frequently visited by Belgrade citizens and tourists during the summer months.

P505
Source identification of polycyclic aromatic hydrocarbons (PAHs) in river bank soils

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Elevated concentrations of PAHs were found in bank sediments of Mosel river, a tributary of Rhine river. These compounds, including alkylated substitutes have gained serious attention due to their considerable environmental persistence and toxic potential. The source of these contaminants at Mosel river is unclear.
The origin of the PAHs in the studied river bank soils was interpreted by a combination of analyses on a large number of PAH target compounds (45 PAHs including alkylated PAHs), PAH distribution patterns, specific PAH ratios, distribution patterns of n-alkanes and principal component analysis (PCA) of the examined samples and of reference materials such as coals.
An analytical method has been developed enabling the quantification of 45 PAHs in soils and sediments including the 16 EPA-PAH and alkylated PAHs including C_1-C_4 naphthalenes, C_1-C_4 fluorenes, C_1-C_4 phenanthrenes/anthracenes, C_1-C_4 fluoranthenes/pyrenes (semiquantitative) and C_1-C_4 benz(a)anthracenes/chrysenes (semiquantitative). In addition, the efficiency of the tested approaches was assessed.
The results showed that highest concentrations of PAHs occured in the presence of coal and coal-derived particles, which represent the petrogenic input. At three sampling points a mixture of petrogenic and pyrogenic sources were found and at two sampling points pyrogenic sources dominated. This study showed that in complex mixtures the analysis of parent PAHs is valuable for the identification of pyrogenic sources, while the analysis of n-alkanes is essential to obtain detailed information about the petrogenic source.
Hence, source identification of complex PAH mixtures requires more than one identification method to identify PAH source(s).

P506
The distribution and migration of cadmium and lead in hortic antrosoils conditioned with polymeric materials

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The studies regarding the distribution and migration of heavy metals in hortic antrosols are important for prevention and elimination of agriculture products contamination with heavy metals. Our studies have been realized on hortic antrosoil samples from Copou glasshouse (Ia[[Unable to Display Character: ş]]i, Romania) and have been analyzed two metals with high toxicity: cadmium and lead. The total contents of Cd and Pb and their fractions differential bonded by hortic antrosols components have been determined by atomic absorption spectrometry, after selective sequential extraction in combinative solid phase extraction - aqueous biphasic systems. These data have been supplemented by the results obtained through UV-VIS absorption, IR, Raman spectrometry, thermal analysis and electronic microscopy. On the basis of these have been estimated the values of distribution coefficients, specific migration mechanisms in conditions of hortic antrosols conditioned with polymeric materials and the relative affinities of Cd and Pb towards to antrosols components.
In hortic antrosols, the distribution and migration of heavy metals have a particular character, because these soils present frequent modifications of lithology and of chemical-mineralogical characteristics. Ours studies have been show that in hortic antrosols, Cd and Pb have a general accumulation tendency (preferentially by bonding on organic matter and organic-minerals compounds). But, the distribution of these metals is abnormal most of cases, and their association way with the components of hortic antrosols conditioned with polymeric materials has a particular character. A specific phenomenon of hortic antrosols is the cadmium and lead complexation exclusively with the functional groups of organic macromolecules. This phenomenon has two important consequences: (i) the strong fixation of heavy metals and (ii) their presence determined major modifications in the structure and conformation of organic macromolecules.
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P507
Spatial variation of surface soil pollution in Qingdao, China

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Qingdao, venue of the 2008 Olympic Games' sailing competitions, is located about 550 km southeast of Beijing. About 2.5 million inhabitants are living in the inner zone of Qingdao, whereas the whole district of Qingdao comprises 7 million inhabitants. Today, Qingdao is a famous destination for Chinese tourists because of the ideal sunbathing conditions along the beautiful beaches during summer. However, the environment of Qingdao is affected by numerous industrial complexes, one of the largest Chinese harbours, growing traffic volume and intensive construction activities. Owing to the fact that only limited information was available to assess the urban wide environmental conditions in Qingdao, we carried out a reconnaissance soil geochemical survey since the chemical composition of urban soils reflects impacts of urban land uses and anthropogenic pollution. In total, soil layers between 0 to 5 cm and 5 to 10 cm were sampled at 69 locations grid like distributed and covering an area of about 18 km². This area reached from the industrial areas in the north towards the sandy beaches in south and from the harbour in the west towards the foothills of the Laoshan Mountains in the east. Within this area, the historical and modern business districts are located as well as various residential districts causing different chemical fingerprints within the soils. Soil samples were analysed for a large number of trace elements including elements indicating geogenic sources, such as Rb, Y, Zr, and Ce, as well as elements indicating anthropogenic sources, such as Cu, Zn, Sn and Pb. Furthermore, clay content, organic carbon and pH were determined to assess the mobility of harmful elements. The spatial data was evaluated by geostatistical and multivariate statistical methods and GIS based methods allowed to delineate urban wide varying levels of soil pollution with regard to the respective land use units.

P508
Acidity parameters variation along a permanent preservation area in a rural-urban stream with different degradation kinds and levels in Santa Maria, RS

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This study had as objective to evaluate the soil acidity parameters (pH, total acidity and aluminum saturation (%)) along a permanent preservation area, comparing this aspect in different depths and distances from the stream border, in 5 points sampled along the course, which have different uses and environmental impacts. Through a auger use, soil samples were collected in 10, 20 and 30 meters from the stream border, in right and left side, in five different sampling plots, beginning in the source. The samples were collected due to the subdivided method, until 50 cm, with 10 cm intervals. The pH was mainly acid in all the sampled places. Only in some points, where there was a eroded material accumulation (crop) and in places filled with ruble, the pH was higher. The highest pH variations happened in the two first soil layers, showing the effect caused by the rural and urban activities done in the area. The soil total acidity has a reverse behavior compared to pH, showing marked variations in the deepest layers and a high value in places with old trash accumulation. The most part of the Al saturation ranged in the limit considered as injurious for plants, in some cases, the saturation values reached more than 50% from the effective CEC. This can cause big problems for root development in future degraded area rehabilitation projects that may contemplate vegetal species planting. In general level, the studied area shows environmental impacts distributed along the different layers, depending on the variable, in function of the current impacts and some old degradation factors.

P509
Evaluation and Improving of Urban Soils Fertility State

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Soils from built-up urban areas have been generated as effects of physical impacts of civil or industrial engineering, streets and green areas fitting out, on natural soils. As way of consequence, major physics, chemical and biological transformation were taken placed. Moreover, the pollutant emissions and imissions emanated from industrial and household environment have been contributed to contamination and pollution of anthropic soils generated in urban areas.
Having in mind that the urban soils from farther of center and peripheral areas are often horticulture used in purpose to produce some vegetal origin food for the own consumer or even for commercialization, a good knowledge of the fertility state of these kind of soil is necessary. With this purpose in view, we proposing an urban soil fertility index, that including a series of physics, chemical and biological soil properties. Also, the paper present experimental dates collected from plants cultivated on urban soils material origin in green house These results emphasize the acidifying role of proton, both on phosphorus mobilization in bases saturated urban soils, and on macro element absorption process. Acidifying process has been, also, a significant effect on other physical and chemical soil properties. The acidifying level that improving the soil fertility properties and those from whom negative properties of inorganic chemical elements, like toxicity, appear, were established.
According to the fertility level obtained by this fertility index calculation, we could make concrete proposal on the one hand for agro-technique, agro-chemical measures and on the other hand for combating the pollution potential or removing the effects of pollution phenomenon. The aim of all these measures is obtaining the superior quantities and qualities vegetal origin foods, free of any contaminants and/or pollutants.

S24 Soils and GMOs

P510
Fate of Cry1Ab-protein from Bt-maize (MON810) during silage and subsequent co-digestion in a biogas plant, and consequences for agricultural use of the remaining biogas manure

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Biogas has been developed to a successful renewable-energy technology. In the past years, the production of energy by biogas plants increased in Germany, caused by governmental aims to double the part of the renewable electricity production up to 2010, following the orders of the Kyoto Protocol. The Renewable Energy Sources Act (EEG) encourage farmers to produce energy from organic wastes and energy crops. However, economic biogas production depends on high biogas yields. In Germany, maize is the leading co-ferment for biogas production in agriculture followed by corn and grass.
In the past decades, the cultivation of genetically modified maize (Bt-maize) increased worldwide. We suggest, that in future Bt-maize will be cultured as an energy crop in Germany also. Thus, the aim of the present study is to investigate the fate of the Cry1Ab-protein from various Bt-maize varieties (MON810) during the ensiling process and the subsequent co-digestion in a laboratory-based biogas plant, relative to non-Bt-maize. Supplementary to various Bt-maize varieties a synthetic Cry1Ab protein is involved into the study. Investigations will be carried out under mesophilic and thermophilic digestion conditions.
The detection, quantification and fragmentation of the Cry1Ab protein in maize silage samples and the remaining biogas manure is performed by DAS-ELISA and western-blotting procedures.
Additionally, our investigation covers the potential use of biogas manure derived from Bt-maize as an organic fertilizer in agriculture.

P511

Mineralizable and total soil C and total N in surface soil were not affected by 7 years of continuously planted Bt corn

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Genetically engineered corn (*Zea mays* L.) containing the gene from soil bacterium Bt (*Bacillus thuringiensis*) constitutes a large portion of all corn planted in the USA. In a number of studies Bt plant residues have been reported to have higher lignin content and to decompose slower than that of the non-Bt plants, possibly due to presence of Cry endotoxin. We hypothesize that after multiple years of continuous Bt corn the combined result of alleged higher lignin contents and of Cry endotoxin presence will be reflected in soil characteristics, specifically in soil carbon (C) and nitrogen (N) levels. We collected soil samples at 0-7.5 cm depth in 2006 from continuous Bt and non-Bt corn treatments in an RCB designed experiment with 4 replications located at Kellogg Biological Station in southwest Michigan, established in 1999. We found that neither total soil C and N nor soil C mineralized during 35-day incubation were significantly different between Bt and non-Bt corn treatments ($p<0.05$). Total soil C was equal to 7.3 g/kg and 7.4 g/kg, in Bt and non-Bt corn, respectively, and total N was 0.67 g/kg in both treatments. *Post-hoc* power analysis indicated that given the number of samples collected in this study and the observed level of variability, the minimal differences between the Bt and non-Bt treatments that could be detected as statistically significant at $\alpha=0.05$ with power of 0.80 were equal to 1.0 g/kg, 0.14 g/kg and 0.125 g/kg for total C, total N, and soil C mineralized during 35-day incubation, respectively.

S10 Advances in Soil Monitoring

P512

Uncertainties in pesticide monitoring using suction cups: Evidences from numerical simulations

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Porous cups provide a simple and direct method for solute monitoring in the vadose zone and are widely used e.g. in pesticide leaching studies. A serious limitation, however, resides in the fact that the suction cups act like a small point sink and therefore, soil heterogeneity plays an important role in the amount of extracted water and solute concentration. On the other hand, nearly all experiments for the characterization of the suction cup influence were performed under steady-state flow conditions. Over the last years various authors investigated the reactive solute transport in heterogeneous media under transient conditions, whereby large differences occurred between transient and steady-state flow.
In the present work, numerical simulations were performed to evaluate the impact of soil heterogeneity on reactive solute extraction with suction cups for a better understanding of observed field data. For the simulations of the soil water and solute fluxes the HYDRUS-2D software package was used. Soil heterogeneity was generated using a random field generator based on the Miller-Miller-similar-medium approach. To mimic natural conditions transient flow was imposed and results were compared with results from steady-state experiments. The results indicate that the mean pore water velocity, dispersivity, peak concentration, and mass recovery depends on the location of the suction cup in the heterogeneous flow field and the type of boundary conditions, as well as the physicochemical properties of the applied substance.

P513

Long-Term Monitoring of Soil Physical and Biological Properties

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Soil physical and biological properties are determining factors for the state of soil quality, their evolution has been recognised as a decisive factor for sustainable soil use. Long-term monitoring of soil physical and biological properties over space and time helps to detect changes in soil quality early and predict their further development. Therefore, monitoring physical and biological soil properties is required by law in Switzerland. While monitoring of chemical soil parameters started already in 1984 within the Swiss Soil Monitoring Network (NABO), hardly any experience in monitoring physical and biological soil parameters existed. Therefore, we conducted a field study 2001-2006 to verify the performance of various methods to determine physical soil parameters at two arable sites and biological soil parameters at three arable and three grassland sites. The main objective was to identify suitable physical and biological parameters for long-term monitoring. Soil physical parameters selected were bulk density, total pore volume, pore size distribution, air permeability, precompression stress, penetration resistance and structural soil state. Soil biological parameters chosen were microbial biomass, soil respiration and N-mineralization in the aerobic incubation test. The selected soil parameters were measured annually. The performance of these soil parameters was evaluated with regard to the following aspects: (1) sampling design scheme, (2) sampling technique of the field soil, (3) sample preparation, (4) sample storage, and finally (5) sample conditioning and analysis. Preliminary results after 3 experimental years demonstrated that precision and bias of the methods can be determined reasonably well. The poster will summarise the main results achieved concerning precision and bias of the selected physical and biological soil parameters during the first phase (2001-2003) of this six-year field study.

P514

Application of laser diffraction method for determination of grain size distribution of soils on example of brown soil

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The laser diffraction method is one of the modern methods for determination of grain size distribution. The measurement of particle sizes is carried out on the basis of analysis of angular dispersion of laser light on particles. Dispersed light reaches detectors registering the power of the signal and transmitting data to a computer which, on the basis of an appropriate model (Fraunhofer theory or Mie theory), determines the distribution of particle sizes in the studied sample.
Taking into account the essence of phenomena which are the basis of sedimentation methods (being at present the most frequently applied in soil science) and the method of laser diffraction it is difficult to expect the same results of particle distribution using both methods. At the same time it is impossible to state unambiguously which method gives the real value of

grain size distribution. However, it is possible to indicate advantages of laser diffraction method as compared to the sedimentation method, i.e. it requires a smaller soil sample and, most important, this method is many times faster (time of measurement of the range of several minutes) and precise (better repeatability and reproducibility). Taking into account these factors, the requirement emerges to recalculate the results of grain size distribution between the sedimentation methods and the method of laser diffraction.
This paper presents a comparison of grain size distributions obtained with the use of the areometric and the laser diffraction methods. The study was performed for 8 samples of mineral soils collected from the arable layer of brown soils. These soils contained from 0.654 to 2.280% of C_{org}. For particular fractions (sand, silt, clay) equations were elaborated which enabled to recalculate/compare the results. The linear equations were obtained with coefficients R^2 equal to 0.77 for silt fraction, 0.89 for clay fraction and 0.86 for sand fraction.

P515
Selection of optical parameters in grain size distribution measurement of brown soil by laser diffraction method

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The laser diffraction is the method for determination of soil texture which enables to obtain repeatable result. To obtain information about the distribution, it is required to choose a model according to which a computer recalculates the signal from detectors registering the dispersion of light into information about the distribution (the Fraunhofer and the Mie theory). When choosing the Mie theory one should give the values of refraction and absorption coefficients for a given sample. Invalid selection of these coefficients can be one of the sources of uncertainty of measurement, therefore in this paper a trial was undertaken to evaluate the impact of selection of optical parameters of the sample on the result of measurement. The analyses of grain size distribution by areometric method and laser diffraction method were performed for eight soil samples taken from arable layers of brown soils. The results were calculated applying the Fraunhofer and the Mie theory with combination of various values of the refraction coefficient (values from 1.43 to 3.22) and the absorption coefficient (values from 0 to 1). To choose optimal optical parameters, the results of the distribution obtained by laser diffraction method were compared with the results obtained by aerometric method. The result of three main soil fractions was treated as a point in a three-dimensional space. In this space, a measure of the distance between points was defined, which enabled to evaluate for which model or for what optical parameters the results of measurement by areometric method and by laser diffraction method were the closest to each other. The results with the use of both methods were the closest to each other when applying the Mie theory with the coefficient of light refraction equal to 1.43 and the coefficient of absorption equal to 0.

P516
Background concentrations of trace elements in the groundwater recharge of northern Germany

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An important aspect of soil protection in Germany as regulated in the Federal Soil Protection and Contaminated Sites Ordinance (BBodSchV) is the prevention of the accumulation of inorganic trace elements in soils as well as their leaching into the groundwater. Representative background concentrations of trace elements and heavy metals in soils and groundwater recharge are needed to derive and update evaluation criteria like trigger values for the soil-groundwater path for natural, ubiquitous polluted environmental conditions. Because data of uniformly sampled and analysed water samples from the transition zone between the unsaturated and the saturated zone are not available on a nationwide level, a project was initiated to develop uniform methods to sample this water and to provide a database with background values of inorganic trace elements. To select representative sampling sites the already existing network of long-term soil observation sites (BDF) in Germany is taken as a basis. Up till now more than 50 field sites in northern Germany were sampled to determine the background concentration of selected inorganic trace elements (Sb, As, Pb, Cd, Cr, Co, Cu, Mo, Ni, Se, Zn, Sn) in the groundwater recharge. Evaluations concerning the variability of the background concentrations in space and time give valuable information for the development of a sampling strategy and the quality of the data. A first data base for sandy and silty soils in northern Germany shows that the background concentrations of trace elements of these sites are predominantly clearly below the trigger values of the BBodSchV.

P517
The soil quality monitoring network for French soils (RMQS): state of progress and first results

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A soil quality monitoring network is currently being implemented in France. This network of 2200 sites is based on a 16 km x 16 km systematic grid covering the whole French territory, with a ten-year sampling frequency. Ninety percent of the 2200 sites of this network have already been settled up and the first sampling campaign will be completed by the end of 2008. The RMQS has been designed to be representative of the main soils and land-uses of the French territory. Soil occupation corresponds mainly to arable lands and forests, but orchards, vineyards, urban parks or natural vegetation are also represented. The RMQS includes the 545 forest sites of the French ICP-Forest level 1 network, re-sampled during the BIOSOIL campaign which ended by July 2007. Preliminary data processing shows that this network can be used for the determination of pedo-geochemical background values at regional scale. The RMQS also provides good assessments of gradients of diffuse contamination by trace elements, especially around big cities and industrialized areas. Further data analysis and interpretations will require a lot of scientific efforts, but the quality of the collected data appears very promising.

P518
Long-term soil monitoring in the federal state of Schleswig-Holstein (Northern Germany)

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In order to assess changes of soil properties in Schleswig-Holstein there are 38 long-term soil monitoring sites, which were mostly established in 1989/90 as recommended by the German Federal and State Panel for Soil Protection (LABO).
The investigation, which operates with a long-term data set in different temporal resolution, focuses on the detection and the assessment of the impact of environmental changes and different land management on soil properties.
At the monitoring sites comprehensive physical, chemical and biological soil analyses, such as contents of heavy metals, nutrient and organic pollutants as well as chemo-physical standard parameters, cultivation data, vegetation, zoological and lichen investigations are carried out in intervals varying between five and ten years.

Additionally water and matter flows are observed to get information about short-termed changes of the actual water and matter balance. This includes the collection and chemical analysis of leachate such as pH, nitrogen potassium and phosphate compounds and the atmospheric deposition material (DOC, nitrogen and phosphate compounds, ions, heavy metals), measured in intervals varying between two and four weeks at four sites.
The paper mainly focuses on short-term changes on soil properties with data in high temporal resolution. In correlation with general chemical and physical parameters it points out measurements of atmospheric deposition and leachate of three sites of different land management and landscape units. A focal point is the demonstration of the data information potential and the interpretation of the effects of different land management on the matter flow of these sites.

P519
Development of laboratory analytical procedures to determine thermal properties in soils

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Typically, three parameters are measured to characterize the thermal properties of any porous media: specific heat capacity, thermal conductivity and thermal diffusivity. Thermal properties are strongly influenced by physical properties as bulk density, water content, and particle-size distribution. Therefore, these factors have to be taken into account to perform measurements at laboratory and field scale. Recently, Decagon Devices Inc. has developed the KD2-Pro-meter logger and the SH-1 thermal sensor, to measure the thermal properties employing the dual needle heat pulse method (DNHP). In order to obtain reliable data, field and laboratory procedures to determine thermal properties with the KD2-Pro need to be normalized, according to existing standards and manufacturer's indications, because soil scientists, engineers and other users are demanding these kind of data for different applications. The present work describes the first steps towards the development of a laboratory procedure to obtain reliable, accurate and rapid thermal properties data in soils. Disturbed samples from a silty loam soil were taken from the Llobregat delta plain (NE of Spain). To characteriza the soil physical properties were determined. Air dried soil samples were repacked inside four small soil columns. Four different water contents (hygroscopic water content, saturation and two intermediate moisture contents) were established, and controlled by frequency domain reflectometry probes. Preliminary results showed that the four levels of water content gave enough information about the relation between thermal properties and volumetric water content. The observed variability on the samples showed that, for this specific soil the number of replicas was enough. Furthermore, a major number of soil types and procedure tests will be need to improve the analytical confidence of this laboratory test.

P520
The French soil sample archiving, memory of our soils

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A soil quality monitoring network (RMQS) is currently implemented in France. This network of 2200 sites is based on a systematic grid covering the whole territory, with a ten-year sampling frequency. It aims at assessing current soil status, measuring the evolution of physico-chemical properties in soils and estimating soil degradation intensity attributable to anthropogenic pressures.
On each site, composite samples from two soil layers (0-30 and 30-50 cm), bulk density samples related to each layer and horizon samples from a soil pit are collected in compliance with a guideline. The whole samples are sent to the National Soil Sample Store, at INRA InfoSol, where they are prepared prior to analyses and archived for the long-term.

The organisation has been set up as to insure a high degree of integrity and conformity of samples and data. Each step of the process from sampling to storage is controlled by quality insurance rules, which ascertain reliability and enable to trace the different work operations.
Constituting a soil sample archive aims at :
- preventing analytical drift with time to offer the possibility to re-analyse samples with new analytical methods or in case of an improvement of the detection limit,
- "going back" in time to be able to perform new analytical determinations in the future, on stored samples,
- constituting a bank of soil samples, characterised by wide-ranging soil properties, soil types and land-uses, representative of France, available to researchers, on demand.

This network, with associated soil samples and database, is already involved in several national research programs for soil quality assessment of chemical properties (trace elements and persistent organic pollutants), biological component (biogeography of microbial communities and pathogens by using molecular tools), or to evaluate large scale non-destructive methods to assess soil properties (NIRS, MIRS, DGT).

P521
Seasonal alterations of soil properties and nutrients concentrations in a small Mediterranean river catchment

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The goal of the present work was to estimate the amount of nutrients lost into the river for different soil types within a hydrological cycle due to natural leaching processes.
The study area is a catchment of a typical Mediterranean temporary river which is located in the northern Peloponnese, Greece.
Ten different types of soils have been identified by using some basic criteria (regarding land use, forestry, slope and geology) and soil profile samples have been obtained at two different seasons:
• autumn, when there is an increase of nutrient concentrations in soils because of elevated temperature and humid conditions leading to organic matter and litter decomposition and,
• late-spring, when due to heavy autumn-winter rainfalls, a leaching effect leads to a decrease of soil nutrient concentrations along all different depths of the soil profiles.

Approximately 150 samples were acquired (5 to 9 samples from each profile for both seasons). The concentrations of nutrients (N-NO3, N-NO2, P-PO4, and total C-N-S) as well as basic properties of the soils (water content, bulk density, stone content, pH, CaCO3, soil color) were analyzed in the lab.
Comparison of the same sites between the two seasons revealed a considerable variation of nutrients' concentrations and displayed temporal, as well as spatial (in between soil types) differences.
An estimate of nutrient load variations was made, by extrapolating the site-based soil data across the respective sub-catchments. This was feasible due to the choice of the sampling method (known volume of the samples by using a metal ring to obtain the samples). Statistical assumptions concerning the homogeneity and continuity of the soils were made through GIS

analysis, in order to establish a base-line for the extrapolation method.

P522

Frequency dependent dielectric loss as the indicator of bulk soil electrical conductivity

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Common standard of soil moisture measurement is the reflectometric method (TDR - Time Domain Reflectometry), which allows simultaneous measurements of electrical conductivity (EC) of soil basing on attenuation of reflected signal from the TDR probe. In order to calculate soil salinity it is necessary to measure also soil temperature, which is easy to accomplish. However the reflectometric method is still too expensive. Another method, which ensures comparable accuracy of measurement and economy of use is the frequency domain method (FDR - Frequency Domain Reflectometry) working in frequencies above 100 MHz. This method enables to measure the real and imaginary parts of dielectric permittivity at the same time, where the imaginary part describes dielectric loss caused by flowing electric current. It is important to investigate the correlation between the imaginary part of the dielectric permittivity measured by FDR and electrical conductivity measured at low frequencies in order to make the FDR method more universal and comparable with the TDR method, which is the objective of the work.
The measurements were conducted by three probes of 1, 2, 3 cm length, at frequencies 375 MHz, 190 MHz and 125 MHz, accordingly, which were connected to a vector network analyzer. The dielectric loss caused by relaxation effect of water particles was neglected. Reference measurements of EC were done at the frequency of 100 kHz with one of tested probe of 3cm length. The results shows strong correlation for both methods and the obtained discrepancy can explained by the influence of water relaxation effect.

P523

Assessment of metals' phytoavailability from various soils: conventional extraction procedures versus DGT technique

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Risk assessment of metals in soils is mostly based on the determination of phytoavailability through standardized extraction procedures using EDTA, DTPA or $CaCl_2$ as extractants. Although these methods are recognized to be reliable under specific conditions, none of them can be considered as "universal". Extraction procedures focus on metals fractions according to their reactivity when reaching equilibrium between the soil and the extraction solution. However, metal-plant interactions in the rhizosphere are dynamic since plant locally acts as a sink for metals. The diffusive gradient in thin film technique (DGT) has been recently proposed as an alternative method for metals' phytoavailability assessment. However polymetallic contaminations were rarely studied by this method. DGT is a sampler that locally lowers metals concentrations in soil solution and, therefore, collect metals according to their desorption kinetics.
This study aims to compare the assessment of metal phytoavailability to ryegrass (*Lolium perenne* L.) by conventional extraction procedure and the DGT technique toward polymetallic contamination. The comparison has been conducted using various types of soils (2 technosols, 2 cambisols developed from ultramafic rock and 1 andosol) displaying different properties such as pH_{H2O} (from 3.2 to 6.5), organic matter content (0.06-10.5 g/100g), CEC (2-15 cmol/kg), mineralogy and metallic bearing phases (oxides, oxy-hydroxides and/or clay minerals) and metallic element content (for technosols: Zn up to 800ppm, Pb and As > 1%; Ni (150-500ppm) and Cr (100-2700ppm) for cambisol and andosol. For each soil, metals accumulated by ryegrass (phytoavailable metals), extracted with EDTA or $CaCl_2$ and sampled by the DGT technique were determined. Results will be presented in order to highlight possible correlations between phytoavailable metals and fractions determined by extraction procedures or DGT technique. Then, the reliability of extractions procedures and DGT technique for the determination of phytoavailable metals in soils will be discussed, with emphasis on soil properties influences.

P524

DONECOSOL: A software tool to manage biodiversity's data

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In order to monitor soil biodiversity (species and function), a pilot program named « RMQS Biodiv » was carried out at a regional scale (Brittany, France).
This program completed the French Soil Quality Measurement Network ("classical" RMQS) which monitored soil abiotic parameters measurements (chemistry, physic) and agricultural management practices using a regular sampling grid (16 X 16 km) covering the whole country.
The link between these two programs allowed the study of biological parameters (7 groups of soil organisms and some biological activity index) in regards to soil and agricultural characteristics, leading to the definition of biological indicators.
Since enormous data sets were generated, it became evident that an efficient tool of storage and management was required.
Thus, DONECOSOL database was created in 2007 by the Ecobio team of the University of Rennes (France). Its conceptual creation and evolution were the result of permanent discussions within a working group, in order to meet requirements for both the RMQS Biodiv program data and further studies. Moreover, it was designed to be compatible with the "classical" RMQS database in order to link the biodiversity's parameters with potential explicative parameters (e.g. mesological parameters, land use or management).
DONECOSOL has been developed by using a relational database management system. A user-friendly front end was designed to optimise and facilitate consultation, and will be soon accessible from the web.
The main related functions of DONECOSOL are:
(1) storing, handling and managing the data obtained from field samples,
(2) inventorying species of the sampled soil organisms, to establish and understand their ecology,
(3) analysing and linking taxa together, and also linking taxa to other parameters particularly those related to the environment.
The aim of this presentation is to present DONECOSOL: its structure, its components and its functions.

P525

Procedures and protocol for soil biodiversity monitoring: "RMQS-Biodiv", a French Pilot area experience

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In order to incorporate biological parameters into soil quality monitoring, a French program « RMQS-biodiv » was performed at the regional scale (Brittany, France). This program assessed a range of biological parameters, and was connected to another soil monitoring network developed at the national scale (Soil Quality Measurement Network- RMQS) which monitor agro-pedological parameters. The connexion of both programs allowed the merge of both biotic and abiotic data in a larger dataset, the analysis and the monitoring of soil biodiversity (species and functions) in relation to land use (mainly agricultural practices) and/or pedoclimatic parameters.
The RMQS-Biodiv Program also focussed on the optimization of soil biota sampling procedures with the objective of their necessary standardization at national or European levels. It finally assessed emerging criteria with respect to their relevance vs their cost effectiveness before promoting them towards practical field actors.
Thus, this programme required an important research network to measure a large range of biological parameters: macrofauna (earthworms, total macrofauna), mesofauna (acarina and collembola), microorganisms (nematodes, microbial biomass, bacterial and fungal diversity), and also functional biological parameters (soil respiration, humus index).The pilot area covered more than 27 000 km² and the sampling scheme followed a systematic approach based on a 16 X 16 km squared grid. 115 sites were sampled in 2006 and 2007. The sampling methods adapted to the present study context were designed to meet, as far as possible, the ISO standards.
This paper will expose the logistics required to perform this type of program. Moreover, the protocols and procedures will be discussed with respect to the ISO standards and to the propositions and recommendations made by the ENVASSO project (Environmental Assessment of Soil for Monitoring).

P526

Seasonal behavior of soil solutions in a Mediterranean forest

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Mediterranean forest ecosystems are permanently affected by strong climatic variability, both seasonal and interannual; they are then effectively adapted to climate stress and continuously reacting to it. Analysis of the processes underpinning such adaptation can provide invaluable data on forest ecosystems response to climate change.
Soil solution monitoring is an established tool for the study of forest soil processes; as the dynamic phase of the system, soil solution allows to follow exchanges between soil, plants, biota and atmosphere, continuous monitoring giving insight into the time component.
Within a national Forest Service program of ecosystem monitoring, CONECOFOR, itself part in the ICP Co-operative Programme on Air Pollution on Forests, soil solution monitoring was established within a plot lying at 690 m asl, at 42°49'50" N and 11°54'10" E. The site is an old Quercus cerris coppice, growing on a Luvisol with strong texture contrast; its productivity was always limited by summer drought. Sampling started in 2000, soil solution being withdrawn from below the humus layer, the E horizon, and two depths within the Bt horizon.
Results allowed to trace the cycling of nutrients through biomass, forest floor and mineral soil, a cycle whose nature is now understood as basic to the way forest soils stock carbon. Nitrogen cycle processes evidenced unusual aspects: solution NH4+ concentrations are often important, and generally uncorrelated with NO3- ones. This suggests complex, and partially independent, controls on nitrogen cycle, rather than dominance of nitrification. Salt deposition loading of solutions entering the soil varies greatly following seasonal cycles, especially influencing soil solution pH. Seasonal factors appear, overall, to have such a strong influence that well diversified seasonal "modes" of ecosystems functioning can be hypothesized a

P527

Distribution of radionuclides in agricultural soil samples of southeast Belgrade, Serbia

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Distribution of natural gamma-emiting radionuclides 238U and 40K were determined in the soil profiles from the peach-trees field on experimental farm Radmilovac, southeast Belgrade. Internal soil morfolgy has been changed in 1992. when soil rigosol type with deep Ap-horizon (0-80cm) has been formed by special treatment of parent soil, chernozem type. Gamma-spectrometry method is applied in measurement of radionuclide activities in soil samples by using hyperpure coaxial gamma-ray detector, Canberra type.
Investigation results has been shown that the natural activity contents obtained in the experiment are within the range of normal backround activity according to UNSCEAR 2000 and that radionuclide activity decreased in the plant root zone.

P528

Influence of *in-situ* storage conditions on the composition of soil solutions from Norway spruce and Douglas fir forest floors

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Soil solution study provides useful insight on current soil processes. However, artefacts can be induced by its *in-situ* storage during the period between solution reception in the lysimetric device and the effective sampling. This work aimed at assessing the impact of three *in-situ* storage devices on the composition of soil solution.
We studied solutions from forest floors under Norway spruce and Douglas fir stands, planted in 1976 on a Cambisol at the experimental site of Breuil (Morvan, France). The solutions were collected by low tension (pF 1.3) fibreglass wick lysimeters and transferred every 3 hours to separate containers in tree *in-situ* storage devices: a covered pit, an insulated box refrigerated with ice (0.1°C) and a freezer (-10°C). Effective sampling was done monthly during one year.
In both forest stands, the solutions stored at -10°C presented the lowest Si concentrations and the largest concentration of low-molecular weight organic acids (LMWOA). However, we observed no statistical effect of storage conditions on pH and concentrations of inorganic nitrogen, cations and DOC.
Our data show that no significant ammonification or nitrification occurred in these soil solutions during storage in a pit. We suggest that organisms active in the nitrogen cycle in these forest floors should not reach the storage bottles.

Instead, the degradation of LMWOA was active in the bottles stored in the pit or at 0.1°C. As the global concentrations of DOC were not affected by storage, we suggest that the larger concentration of LMWOA in frozen samples were balanced by the precipitation of large molecular weight molecules as a result of freezing. This hypothesis is supported by the smaller specific absorbance at 280 nm in frozen samples.
Storage in a pit should thus affect the concentration of LMWOA but not that of inorganic nitrogen.

P529
Development of a Decision Support System (DSS) for generating reliable hazard quantifications of mudslides

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During the last decades heavy precipitation with successive disastrous slides have accumulated in the Alps. Mainly shallow landslides in quaternary layers, like mudslides, lead locally to serious damage and obsolescence. Although currently different institutions undertake enormous efforts to make external hazards ascertainable through the development of precise simulation-systems, movements like mudslides keep mostely unconsidered due to their small scale and their relatively high expenses in simulation work. Since these movements can lead to enormous losses of livelihood for various alpine business units like agriculture and forestry, a Decision-Support-System (DSS), developed at the University of Federal armed Forces, with the aim of supporting - besides experts like geologists and geotechnical engineers - mainly users without any substantiated background on site for first reliable hazard quantifications. This approach assures them realtime and extremely cost saving results compared to complex simulations.
DSS, evaluating probabilities of mudslides via flowcharts e.g. by the swiss Workgroup of Geology and Natural Hazards of the Federal Agency of Water und Geology serve as a research basis. Practical applications of existing DSS show significant fuzziness concerning range and intensity of the movement. Furthermore a multitude of influences and phenomena, like karstwater-influxes do not find accordant consideration in mapping-records, but most important, published monitoring concepts miss precise analysis sections based on prevailing scientific knowledge.
For considerable specification on DSS it therefore seems essential to integrate and evaluate influencing and detaining factors, which have kept unconsidered in existing models up to now in equal measure to generate a scientific data-refinement. Thereby a main focus will be put on the implementation of soil-mechanical properties of fine-grained terra-fusca soils, which are wide spread in the Bavarian Alps. Furthermore the influence of shrinking cracks will be accommodated, which lead to strong percolation of soils under heavy precipitation - especially under consideration of the increasing loading case “climate-change”.

S17 Land Use and Soil Protection

P530
Influence of soil usage and soil tillage system on soil properties

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The purpose of this paper is to evaluate the soil properties of arable and grassland usage follow then the changes of classic soil tillage systems versus three minimum soil tillage variants in the pedoclimatic conditions from Cluj-Napoca (46º46'N, 26º36'E), Romania.
The soil features are in relatively balance estate with the environment, but, the agricultural working of the fields influences the evolution pattern, soil fertility or soil degradation. The present paper presents the evolution of vertic preluvosoil in its 40 years (1960-2000) use as arable soil (with conventional working system), in comparison with its profile in hay field use, within the same ecologically homogenous terrain. The changes observed on the arable field, compared with those observed in hay field, are: morphological differentiation of soil profile, profound texture differentiation (the texture differentiation index increase from 1.12 to 1.2), structural hydro stability decrease from 69.7-85% to 58.6-63.3% on 0-30 cm depth, decrease of humus reserve from 151 t/ha to 134 t/ha (0-50 cm), increase of soil compaction and increase of pseudo-gleization phenomena in A/Bw horizon.
The researches follow then the changes of arable soil properties by a 5 years application (2001-2005) of 4 working systems of soil (conventional, paraplow, chisel plow and rotary harrow). The appliance of minimum tillage systems determine an increasing of the humus content with 0.8-22.1% and an increasing of the hydro stabile aggregates content with 1.3-13.6%, on 0-30 cm depth towards the classical system. Minimum tillage, with or without straw, resulted in enhanced soil moisture conservation and moisture availability during crop growth. Availability of soil moisture during the crop growth resulted in better plant water status.

P531
Changes in soil chemical properties under modern and traditional farming system at Khagrachari, Chittagong Hill Tracts, Bangladesh

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Land degradation in Chittagong hill tracts have been taking place due to shrinkage of forest cover, policy weakness, population explosion, inappropriate hill farming system. Modern farming system in the Chittagong hill tracts like Sloping Agricultural Land Technology (SALT),is practiced to provide a new strategy for developing lands for economic productivity and bio-diversity conservation through establishment of ecological community rather than traditional shifting cultivation which is no longer sustainable according to the carrying capacity of ecosystem of Chittagong hill tracts. The research study evaluated to find out changing trends of chemical properties between different modern and traditional hill farming site at Khagrachari district of Chittagong hill tracts in Bangladesh. The result of the research showed that Sloping Agricultural Land Technology has significantly higher capacity of production due to the presence of highest percentage of organic carbon, organic matter than shifting cultivated site. The study recommended that in the Chittagong Hill Tracts, shifting cultivation may be changed into a relatively stable semi-permanent farming system through participatory integrated farming systems development to establish stable production environment.
Key words: Sustainable hill farming system, Modern and traditional farming system, chemical properties

P532
Evaluation of the meliorative effect of waste products in soils damaged by coal mining

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The study is directed towards determining the character and degree of the multi-year changes of important agronomic physical properties during field experiments in geological spoils

destroyed by coal mining activity in the Maritsa-East coal basin and meliorated with industrial (ash from power stations) and organic agricultural (from pig farm) waste products.
To achieve this purpose, the criterion “relative change” has been introduced. It signifies the change between the relative values of the studied properties of the meliorated and non-meliorated geological spoil, expressed as a percentage based on the non-meliorated (controlling) variant.
According to the designation of the “relative change” of the respective properties, marked using (+) and (-), a summarized conclusion may be made that the recultivation of the geological spoils with 15% w/w ash separately or in combination with 15% w/w organic waste has a positive, favourable effect.
The degree of improvement at this stage is difficult to determine because of the wide range of variation of the “relative change” values of the properties throughout the multi-year period of research. The reason is mainly the non-homogeneous content and the properties in the 0-30cm layer of the geological spoil, as well as the uneven spatial distribution of the meliorative substances in this layer.
It is expected that the aforementioned problems would be partly or fully overcome by the appropriate technology which could ensure even distribution of the meliorative substances and would reduce the quantity and area of disposal of waste products (ash and organic waste) from power station.
These actions will help for the simultaneous resolution of two essential problems - resturn of the soils damaged by coal mining back to the arable fund of the country and reduction of the environmental damages caused by pollution from waste products from the coal mining industry and agricultural production in the region.

P533

Heavy metals and selected physicochemical properties of Rendzic Leptosols of the Ponidzie Region (southern Poland)

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The aim of the study was to characterize and compare physicochemical properties of Rendzic Leptosols formed in the Nida Basin, which is a part of the Slasko-Malopolska Upland. The formation of Limestone-Rendzic Leptosols in this region was facilitated by transgression and regression of Cretaceous seas, leading to sedimentation of a several hundred-meter deep series of limestones, chalk rocks and marls. Recurrent short-term return of a shallow sea to the area of the present Nida Basin in Tertiary period left a series of lithotamnic limestones, marls, glauconite sands and gypsum (in the changing sedimentation condition zone). Gypsum accumulation and weathering processes promoted formation of Sulfate-Rendzic Leptosols. This study investigated in detail 5 profiles of Rendzic Leptosols occurring in the Nida Basin.
The soils under study differed in the type of bedrock and land use (arable land, forest crops). Calcium carbonate occurred in the study soils at different quantities and constituted, besides grain size distribution and bedrock, the main factor distinguishing the soils. Based of soil features listed in Soil Trophic Index (ITGL), these soils can be classified as hypertrophic and eutrophic.
It was demonstrated that the study soils belonged to the following subtypes: Cretaceous-Rendzic Leptosols, Tretiary-Rendzic Leptosols, Sulfate-Rendzic Leptosols (Mollic). They are skeletal soils of medium depth. The highest heavy metal contents were observed in surface horizons. Average heavy metal contents were estimated at: (mg/kg^{-1}): Zn 59.9; Cu 24.9; Pb 23.4; Cr 15.4. These values are typical of Rendzic Leptosols and moderate to heavy soils. The soils under study were characterized by high pH values, large content of organic matter, $CaCO_3$, high saturation of sorption complex with basic cations. The soils did not show greater differences in chemical properties.

P534

Land use planning as an instrument of soil conservation in reclamation areas (a case study of Belarusian Polesye)

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The Belarusian Polesye is the unique geographical region with common area 6,2 million hectares. It is located on the south part of Belarus and reaching to 500 km from the west to the east and almost on 200 km from the north to the south. A variety of natural factors and also hydraulic engineering land reclamation, which carried out here, have caused the expressed heterogeneity of a soil cover of this territory. All genetic soil types of Belarus are submitted here. These soils develop on ecologically unstable breeds (water-glacial and ancient fluvial sands, friable sandy loams and peats). In this region prevail derno-podzolic boggy (26,8 %), peat bog soils (26,7 %), derno-podzolic (21 %), turfen boggy and turfen boggy carbonate (11,5 %) soils. To present time it is drained more than 40 % of the agricultural lands of region (1,6 million hectares), including 18,8 % of peat bogs and 44,5 % of the sandy lands. About 26 % of lands are covered with melioration actions.
In many cases land reclamation was accompanied by radical change of a water mode, change of structure and properties of soils, loss of an organic matter of reclaimed peat bogs which capacity under influence of processes of condensation, mineralizations and deflations annually decreases on 1-2 cm per year. The decision of these problems is connected with planning of land tenure.
Use of modern GIS-technologies and methods of remote sensing in a combination to traditional methods of spatial planning have allowed us to carry out a complex estimation of region and to develop offers on soil conservation. The thematic layers describing the basic natural factors influencing on agrarian land use (relief, soils), layers of agricultural sustainability of lands under these factors and combination of layers constructed by means of overlay operations are created.

P535

The role of soil components in association of heavy metals in agricultural soils

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Trace elements are essential for plants, however their excess in soils due to anthropogenic accumulation might be crucial for the quality and quantity of crops.The land application of municipal composts, chemicals for plant protection and mineral fertilisation may be a source of metal contamination. The aim of the investigation was to estimate the role of individual soil components in asssociation of metals and to characterize the mobility of solid phase metals in mineral soils ,agriculturally used. Soils selected for the study represented variation of texture, pH and organic matter contents. Total metal contents were determined after mineralisation of soil in a mixture of hydrofluoric and perchloric acids. Chemical sequential method acc.to Miller et.al was used for the characterization of exchangeable fraction of metals, metals associated with organic matter, with free manganese and iron oxides , occluded in carbonates and bound in residual, aluminosilicate phase.It was observed that soil-metal interactions were affected by soil composition, including mineral and organic components, particularly in colloidal form.
Soil organic matter plays a major role in retention of copper and zinc . Hydrous iron oxides are a good scavenger for zinc and lead. The iron and manganese oxides account for about 10 and 25 percent of total lead in soils, respectively. Organic matter plays also important role in binding lead. In soils rich in calcium carbonate its contribution in association of heavy metals was significant.

The results of the study allowed to estimate metals content in different soil compartments as well to predict the potential mobility of particular fraction due to change of such soil factors as pH or redox potential.

P536
Soil loss in Slovenia due to the permanent land use changes in the last 15 years

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Soil can be degraded in many ways (displacement of soil material, in situ deterioration of quality, total prevention of performing its functions). In Slovenia all types of degradation exists to some extent, but some are of less importance and extent (wind erosion, salinisation), the others of greater (water erosion, pollution).
Since the present days very little attention had been given to the soil loss due to the permanent land use changes and soil sealing. Slovenia with its 20.000 km2 is small, but distinctly hilly country. Very limited flat land on the bottom of the alpine and prealpine valleys and basins is facing enormous confrontation of interests between farming, residency, industry and infrastructure. With this research we tried to establish the amount of fertile soil loss due to the sprawl of the urban way of life in the last 15 years. Changes had been detected with the use of GIS in the 11 top growing urban and suburban areas and 10 rural ones. Two sets of digital orthorectified aerial photos had been used for detection. The first set was form 1991, while the other from 2002-2004. The present state was established through the use of digital data and corrected with extended field research.
In the last 15 years soil loss due to the permanent land use changes is by far the most widespread and problematic type of soil degradation in Slovenia. These are the areas of strategic importance. There we can find Slovene most fertile soils and largest amount drinkable groundwater. But on the other hand these are also the areas with highly polluted soils and air and highest rate of urbanization.

P537
Soil stability affected by different land use

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The object of this work was to quantify the amount of readily-dispersible clay in Polish agricultural soils and to estimate the stability of soil terms of the quantity of readily-dispersible clay (RDC). A smaller content of RDC indicates greater soil stability in water.
Soil samples were collected from different land uses (pasture, forest and arable). This affects the stability in water which is a major problem in soil management around the world. Soil samples were collected of soil from the 0-20 cm layer from sites in Poland. The results show that soils under pasture and forest have smaller contents of RDC than arable soil.
RDC was measured using turbidimetry as will be described. For each of the soils and treatments, 10 sub-samples were measured from each sample.
This research shows the very large effect of organic matter (OM) in reducing clay dispersion. Different crop rotations and fertilization treatments, applied over a period of 20 years to a sandy soil at Grabów in Poland, have produced a range of OM and RDC contents. The results show a negative correlation between the RDC and OM content in soil.
An additional microplot experiment was run with the object of comparing the effects of OM derived from barley and maize, which were grown on sandy soil with an original OM content of 0.35 % in the 0-20 cm layer. After 8 years, the OM contents were 0.55 % in the barley plot and 0.58 % in the maize plot. The contents of RDC were 3.3 and 3.5 NTU/(g L-1), respectively, and were not significantly different. The general conclusion is that organic matter reduces the content of RDC in soil. Organic matter derived from maize and barley have the same effect on RDC.

P538
Development of a GIS-based model for the assessment of regional element balances of agricultural soils

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Limiting the input of toxic trace elements into soils is an important task in achieving sustainability of agricultural land use. While methods have been developed and are continuously improved to assess element balances in European agro-ecosystems at the farm scale, there is a lack of similar models that are applicable to agricultural systems at regional scales. The main challenge in modelling element balances of regional agro-ecosystems is to process site-specific environmental data and non-site specific agricultural statistics. The advantages of combining GIS with environmental models are that a GIS provides an excellent framework to integrate multiple databases including remote sensing data, visualize and extract the needed model input data, and process and display the model results. We developed a regional model that stratifies the agricultural land of a region by farm types and cropping systems and relates metal input fluxes through fertilizers to the P nutrient management of these strata. One of the main features of the regional stochastic model is to identify the area within a region that is at risk for trace metal accumulation in soils. Furthermore, the balance model is capable to account for uncertainty in model parameters. The objective of this poster is to outline further development of this regional balance model towards a GIS-based addressing: (i) its applicability to agricultural systems at regional scales in Switzerland, (ii) its capability to deal with the problem of a complex data acquisition from very diverse information sources, and (iii) its potential to account for dynamic feedbacks between system components.

P539
Building military facilities in earthquake zones on collapse prone loess soils in Afghanistan

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The subsoil in the Hindu Kush consists mainly of alluvial loess from the Marmal Mountains. The water content dependent plasticity (higher water content = higher plasticity) of this soil can result in settlements of up to 10 cm in buildings. The particular problems posed by the nature of the soil in this earthquake zone must be taken into account in all phases of planning and construction.
The Institute for Soil Mechanics and Foundation Engineering of the Bundeswehr University in Munich has carried out a comprehensive drainage and foundation study on behalf of NATO in Afghanistan. The object of the study was the development of calculation and construction procedures to provide foundation and building stability in this type of “soft soil” and to give recommendations for the protection and stabilisation of the ground in view of its high water-dependent lability.
The concept for foundations, drainage and protection against high water levels was resulted from tests made locally over several months. The particular considerations of building in a crisis region, such as local customs including a religiously

determined way of handling water as well as the demands of carrying out studies far removed from the western style infrastructure, strongly influenced the work of the geotechnical engineers. In the light of experience of similar geotechnical conditions e.g. high speed railway construction in Western China, the problems posed by the tendency of loess soils to collapse were considered. The collapse of loess soils often encountered in China is characterised by a sudden reduction in stability due to salt and chalk compounds in particles being dissolved in wet conditions. Our institute determined by means of dynamic triaxial experiments the collapse behaviour of the soil when it is subject to the stresses posed by earthquakes.
Factors, challenges and results will be discussed in this presentation.

P540

Soil cover evolution in the Cortina d'Ampezzo valley (Italy) between geomorphological fragility and sustainable management

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In this paper we present preliminary observations of a geomorphopedological survey carried out in the region of Cortina d'Ampezzo, in the Dolomites scenery (Italy).
The main purpose of the study was to highlight the pedological aspects of the territory by means of a soil survey and subsequent GIS application, in order to give decision makers an useful tool in soil conservation and sustainable land planning.
The territory examined has an extension of approx 250 km2, and is very variable in both morphology, lithology and vegetation.
Aerial photographs allowed identification of different landscape units. For each unit, soil observations were carried out. Totally, 120 soil profiles were excavated, described and analyzed according to the Soil Survey Manual. Entisols, Mollisols, Inceptisols, Spodosols, Histosols are the typical soils of the area investigated. Mollisols are the most represented, and characterize the soilscape of calcareous rocks. Instead, Spodosols from silicate parent material are the least frequent, outcropping only at Falzarego Pass. Entisols and Inceptisols partecipate to the soil cover as intermediary stages. Histosols characterize particular ecological conditions, in small mosses and wetland areas with very fragile equilibrium; therefore, attention must be paid to their conservation.
The results obtained point to a generally fragile territory with little developed soil cover and marked erosional episodes, particularly due to anthropic impact. However, the most significant problems are related to actual and potential landslide hazard to residential and tourist population.
Particular attention has been paid, in the course of the study, to the evaluation of land suitability for forestry and to sustainable tourist land use, being these two items of relevant interest to local population. The suggested land use, indeed, should be commeasured to the potentiality of the territory, keeping into consideration the presence, within the territory itself, of the Regional Park of the Ampezzo Dolomites, with its beautifulness.

P541

Compaction of loamy soils due to tillage and chemicals operations in vineyards and its effect on soil oxygen content in Bozcaada (SW Turkey)

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Viticulture in Mediterranean area demand frequent tractor traffic in vineyards for tillage and for the application of chemicals during annual vineyard cycle, resulting in soil compaction. The aim of this study was to investigate the extent of soil compaction and its effect on soil oxygen level in vineyards in an area in SW Turkey, known for its wine production in Bozcaada (*Tenedos*) Island situated close to the entrance of Dardanelles. These vineyards loamy soils were under intensive traditional tillage practices inter-rows (with a 1.7 x 1.7 m pattern) by hand-driven rotary hoe (RT) for years. Alternative soil tillage practices (with a 1.3 x 3.1 m pattern) consisting of using tractor-driven harrow (ST) or rotary hoe for 5 years, tested against RT. The soil measurements were done for two growing seasons. In tillage vineyards in both ST and RT, larger values of the penetration resistance (1.15-2.88 MPa) were found below the depth of tilling (7-15 cm) than above (<2 MPa) in both equipment track and inter-rows. Soil compaction at the subsoil layer was significantly greater in the equipment track than in the soil around the plants which is usually received hoeing by hand hoe for weed control. Oxygen levels were slightly higher at the 15 cm level than 45 cm in both equipment track and inter-row in either treatment while RT treatment has the highest amount of oxygen comparing to ST treatment through the soil profile. The results show that ST may be more economical due to saving operations time although it increased soil compaction below equipment track than RT which requires more time and labour input for tillage practices, if traditional vineyards plantations of inappropriate mechanization applications adopted to modern mechanized vineyard plantations.
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P542

Maize (*Zea mays* L.) response to tillage systems after winter vetch on a clay loam soil in Western Turkey

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The fertile, but naturally poorly soils due to organic matter in the region of Western Turkey are received 600 mm of rainfall annually. These soils were under intensive conventional tillage practise for years, which contributed to their poor low organic matter, and overall poor structure. The objective of this study was to determine short-term responses of soil temperatures and plant growth characteristics to spring rototiller (or shallow) (ST) and chisel tillage (CT) as called reduced tillage, and conventional tillage with mouldboard plough tillage (MT) each of them using spring maize (*Zea mays* L.) and winter vetch (*Vicia sativa* L.) as winter cover crops in the rainfed conditions. Field experiments were conducted for 2 years following winter cover crops in fall 2005 on a clay loam. Plant growth characteristics and soil temperatures were measured during the two growing seasons. The preparation of seedbed using either ST or MT increased the vegetative biomass growth of the crops than CT out of 50 days after planting. Root biomass was also higher significantly in ST and MT than CT in early crop stages when there was non-significant different between treatments as the growing season progressed. ST recorded higher plant height in 25 and 34 days out of 40, 50, and 64 days while MT and CT recorded similar results each other. ST and CT treatments reduced soil temperatures by 2.22 to 2.25oC during early maize emergence at 0-10 cm layer, respectively. Maize emergence in CT was delayed by 3 days and plant stand was reduced by 25% compared with the MT, the corresponding values 1 day and 6% in the ST which has 13% higher maize yield than the MT averaged over two years. Further yield data indicate that ST systems can perform equally or better compared to MT in this soil type.
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P543
Validation of an assessment tool for heavy metals in soils using site-specific heavy metal balances

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The model ATOMIS (Assessment Tool for Metals in Soils), developed during the first three project phases of the Collaborative Research Centre "Land use options for peripheral regions", estimates site-specifically the long-term development of the heavy metal status in top soils depending on land use and cultivation system using a balance approach. The validity of this simple approach has to be demonstrated considering differently cultivated sites, of which longtime management documentations (soil tillage, fertilization, pesticides, original heavy metal background concentrations, etc.) are available. The used pedotransfer functions enable the derivation of heavy metal concentrations (Cd, Cu, Ni, and Zn) in solid phase and soil solution, which allows the estimation of the metal output (leaching and plant uptake) in the balance approach. Inputs in the balance are input by fertilizer, pesticides and atmospheric deposition. First results show that land use and cultivation system have element-specific influence on the heavy metal status in soils. Long-term manuring of sewage sludge and pig manure caused clearly accumulation of copper and zinc in calculated and measured contents, whereas accumulation of cadmium and nickel can be neglected. The calculated mean error index as quotient of modeled to observed values was < 1 for Cd and Ni i.e. the model underestimates the element accumulation. Regarding Cu and Zn the mean error index was near 1, though it can vary highly between sites.
The heavy metal contents in soils and fertilizers, the spatially different site characteristics and the model parameters may vary greatly. Therefore the uncertainty of input variables and model parameters is determined for all sensitive factors. After that, the uncertainty of model results will be assessed in a global uncertainty analysis (Monte-Carlo-Study). The results will demonstrate the quality of predicted versus observed data and therefore will help to confirm the chosen balance approach or to improve it.

P544
Numerical analysis of water and soil properties and environmental potentials of touristy Ormieh lake basin and shorelines for land planning (North West of Iran)

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The Ormieh lake basin area is 52700 km^2 with 102 islands, familiar national park, with 186 species of birds, and animals and fertilizer agricultural soils. Due to economic, tourism, agricultural activities has a special role in the northwest of Iran. Where this lake is the biggest cachemet in the western Asia, and due to Rio conference published Declaration in 1994, the Ormieh lake ecosystem and national park of them as known as one of the protect area among the 9 protected area. Also the National park of Ormieh lake, among the 14 national park in the world utilized from spatial limitations. The water of lake are very salty (240 gr in winter and 260gr in summer) and fluctuation of lake water level threaded 500km^2 of banks or shorelines soils. Water level rising in intensive rainfall years caused damage for ports instruments in shoreline and agricultures lands. This tectonically Ormieh lake, surrounded by agricultural plains and consists of 10.5 % of basin area and has 34000 million m^3 water resource. The average depths of lake is 6 m and in the about 5.2 % of basin area (in marginal and mountainous area), soil erosion rate is very high. The result of drainage morphometric showed low density (49.8 m/km$^{2)}$, basin form factor and coefficient such as Gravelius 1.49 indicated little along form but basin has high adoption with Rotundity and triangle ratio. The ratio of salt in soils is from %1 an Ec 8 mmhose to %3 and Ec more than 40 in around lake expanded in vast area. To control Stalinization preceding and rehabilitation of marginal soils due to environmental potential, some techniques suggested for land using of shorelines and basin.

P545
Schatkamer Aarde, a tool for improving integration of soil in spatial planning

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Geoheritage NL is a network of non-governmental organisations, its focus being on strengthening the role of earth sciences in spatial planning. SIKB is a network, encompassing the private and public sector, to enhance soil management. It works out procedures (NEN and ISO norms) for handling polluted soil as well as criteria to certify companies. Recently SIKB broadened its scope towards archaeology, implementing the Treaty of Valetta.
Soil pollution issues have dominated Dutch soil policy for the last decades. In recent years the government broadened its perspective of soils and gives now more attention to the eights threats recognized by the EU Soil Strategy, as well as to sustainable management of soil in general. Soil as a heritage and as carrier of cultural landscapes are acknowledged as issues, but no legislation exists. Government policy is directed towards improving awareness of these soil issues in relationship with sustainable spatial planning.
Geoheritage NL and SIKB jointly produced a handy guide for local government and spatial planners. It describes the steps needed to integrate soil in local spatial planning procedures and policy, and gives practical check lists and useful tools such as the *soil functions* of the EU Soil Directive and the *DPSIR approach*. The tool can be translated for application in other EU countries.
The content of the planning guide, its success and follow up will be explained in more detail during the congress.

P546
Low input agricultural systems: Intercropping's role in resource use efficiency

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Intercropping, the cultivation of two or more crops in the same space at the same time, can increase yields by improving the utilisation of available resources, and offers an opportunity to provide an input of symbiotically fixed nitrogen (N) in low-input agricultural systems. The overall aim of this study was to develop a better understanding of the role of intercrops in contributing to improved N use efficiency in low-input arable systems. Intercropping experiments were established in April 2006 at two sites in eastern Scotland (Aberdeen and Edinburgh). The treatments were a spring barley (*Hordeum vulgare* cv. *Westminster)* monoculture and intercrops of barley/ white clover (*Trifolium repens* cv. *Alice*) and barley/ pea (*Pisum sativum* cv. *Zero4* or cv. *Nitouche*). No fertilisers, herbicides or pesticides were used. Above ground biomass (barley, clover, peas and weeds), grain yields and land equivalent ratio (LER) were measured at key points during the growing season. There was a consistent affect of treatments at the two sites. The total grain yields of barley/clover were significantly greater than barley/pea and barley monocrop at both sites. In the first year of the experiment, the Land Equivalent Ratios (LER) for the barley/clover (1.83 and 1.12 for Edinburgh and Aberdeen site, respectively) were significantly greater than the barley/pea intercrops (1.6 and 1.4 for cv. *Zero4* and for cv. *Nitouche*, respectively for Edinburgh and 1.45 for cv.*Nitouche* for Aberdeen). This study has demonstrated that intercrops can allow efficient resource (nutrients and land area) use. Other work has also demonstrated that nutrient losses in intercrops can be reduced, however it is important to choose appropriate combinations of cereals and legumes in order to optimise potential benefits.

P547

The challenge of sustaining soils: An integrated perspective

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At an interdisciplinary workshop held in Vienna in 2007, participants discussed the complexity of challenges for sustainable use of soils. Participants concluded that well informed, effective public policy requires integrated knowledge of soils, water, air, and biota. The role of soils as mediators in global water and element fluxes and the linkages between site specific and global processes need to be understood. While humanity strives to maintain biodiversity, provide for human needs and deal with global climate change, threats to soil resources are not recognized enough. Human-soil interactions must be a center of concern to meet the challenge of providing future generations with productive soils.
Given the non-linear character of environmental change over time, we argue for the necessity of a long-term, integrated socio-ecological perspective and offer cornerstones for such a perspective. Human use of one soil function can endanger other soil functions. We present an integrated framework, in which driving forces and pressures on soils such as human energy and biomass needs, or infrastructure and raw material demand are linked to impacts on soil resources in developed and developing countries. Our rapidly increasing needs for food and energy place growing and conflicting demands on soil. Overall, human impacts on soils are complex and site specific. Development issues, food security, nature conservation, our dependence on fossil fuels, social inequality, and armed conflict, all have a bearing on soils. We present soils as part of the global biogeochemical cycles, and - based on examples from Africa - discuss options for site-specific, sustainable use. While much of the parts of the interlinked web of demands and impacts on soils have been elucidated, an empirically grounded general picture has not been attempted. This paper presents such a general picture, but takes the site-specific, locally diverse character of soils into account when doing so.

P548

Case study on arsenic enrichment in agricultural soil and food chain in an arsenic affected area in Inner Mongolia, China

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Subject of this case study were the consequences of irrigation by arsenic contaminated water in the Hetao Plain, part of the Inner Mongolia Autonomous Region in China. Therefore, the arsenic distribution within the water-soil-plant-system was examined in a representative farming village in order to assess arsenic within the food chain. Especially the horizontal and vertical distribution of As in field soil was a matter of particular interest as well as the abundance of arsenic in crops.
Two fields (a sunflower and a corn field) were sampled in July 2007, each irrigated twice a month since three years by groundwater which is characterized by high salinity and alkaline pH. On both study sites, two soil pits of 1 m3 were excavated and a grid for topsoil sampling installed. Additionally, water and plants were sampled.
Various analysis were carried out by means of ED-XRF, µ-SyXRF, XRD, FIAS and HR-ICP-MS to determine the elemental and mineralogical compositions. Total arsenic concentration in the groundwater used for irrigation of the corn was about 150 µg/L and 240 µg/l As. Both concentrations clearly exceeded the Chinese drinking water standard of 10µg As/l. Vertical distribution of As in soil indicated a slight enrichment in topsoil and a possible relation to grain size. In contrast, the spatial distribution in topsoil (11.0 to 22.0 mg As/kg) varies strongly and seems to be reflecting the surface micro-relieve. Although the concentration in soil is not that serious, Arsenic could have been detected in plant parts too, ranging from below the detection limit of 0.33 up to 1000µg/kg. The results allude to the necessity of further monitoring of the use of As contaminated groundwater for irrigation purposes in Inner Mongolia.

P549

Qualitative and quantitative soil protection in the Czech republic in connection with proposed Soil Framework Directive

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The main soil degradation factors were defined on EU level in the document Thematic Strategy for Soil Protection. Of these, erosion, contamination and sealing are the most important ones in conditions of the Czech Republic. Special methodical tools were developed to combat these degradation factors. A methodology to count a risk of soil erosion on agricultural and forest soil was developed, based on detail information on the level of grid parcel. In soil pollution, several databases were analyzed in order to provide data for identification of contaminated sites, as it is proposed by the Soil Framework Directive. To characterize negative impacts of soil sealing, this process was analyzed on a pilot area in Central Bohemia in period 1966 - 2005. Rate and different qualitative classes of sealed soils were assessed in different conditions. Also a methodology to assess possible variants of sealing was developed.

P550

Reducing agri-environmental problems through conservation agriculture

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An overview of the main agri-environmental problems in Europe and of EU regulations related to agri-environment is given. Conservation agriculture refers to several practices which permit the management of soil for agrarian uses, altering its composition, structure and natural biodiversity as little as possible and defending it from erosion and degradation. Conservation agriculture includes direct drilling/no-tillage, reduced tillage/ minimum tillage, non -or surface- incorporation of crop residues and establishment of cover crops in both annual and perennial crops. Generally, with conservation agriculture the soil is protected from rainfall erosion and water runoff; the soil aggregates, organic matter and fertility level naturally increase, and soil deformation under heavy wheel load is reduced. Furthermore, less contamination of the surface water occurs, the emissions of CO_2 to the atmosphere are reduced and the biodiversity consistently increases. Conservation agriculture is a sustainable solution to the most important agri-environmental problems in Europe and it is increasingly adapted in European policies and initiatives. In the past few years pressure has been put on farmers to carry out environment-friendly practices. At present, over 30 million hectares are cultivated with conservation agriculture techniques in Europe (ECAF, 2006). Those most followed are minimum tillage with a vegetation cover, over 27 million, and direct drilling, reaching 3 million hectares. Cover crops in perennial trees contribute to this total figure with nearly 1 million hectares, basically olive and other fruit trees.

P551
Land evaluation from the natural resources and cadastral classification viewpoint

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Heterogeneous land use needs and limited extent of land as natural resource, request careful land management and spatial planning. Agriculture as food producer depend most among all space users on different natural conditions (soil quality, climatic conditions, relief), therefore it is very important to make detailed inventory and evaluation of land properties. Defined quality of individual land parcel is very important for rational resource protection and sustainable spatial planning. Presented method of land evaluation is understandable also to spatial planners and gives them opportunity to avoid the best quality land when they define some new locations for construction of buildings or infrastructure etc. On the other hand quality evaluation of land is useful for agriculture as well. Based on proposed quality classification some most appropriate production directions can be proposed for agricultural production areas also. In modern agricultural production beside soil quality, also other factors (accessibility, plot size, distance to pollution sources, transport infrastructure, water availability etc.) influence the decision where the agricultural production and of what kind will take place.
For evaluation of soil conditions (production potential of agricultural land) some methods has been revived. The procedure of adaptation is described for a most often used methodology in Central Europe based on soil and land properties, which results as land productivity index.
Based on the mentioned index the production capacity of land is determined upon natural and economic condition for agricultural and forestry production. In land cadastre system at least basic data about natural conditions as soil fertility, climatic influence, inclination, water conditions and economic ones as accessibility of land, distance from economic centres and possibility of use mechanization for cultivation has to be defined to assure common basic criteria.

P552
Historical view on land-use changes in the Dragonja river valley

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An understanding of driving forces behind modern landscapes requires knowledge of its structure, function and the landscape changes. Especially social factors can be considered as the essential driving forces behind land-use changes in the cultural landscape.
The Dragonja river valley is situated at the most south-western part of Slovenia and it consisit of roughly 17.000 ha, the catchment itself is of course much bigger. The Dragonja valley is area is geologically composed of Eocene flysch with some parts of limestone (SW part) and conglomerates. Soil is carbonate rendzina, some ridges consists of brown eutric soil. The Dragonja valley bottom is covered with alluvium. The Dragonja river catchment consists of long flat ridges hardly higher than 400 m a. s. l. The area is rather steep and usually covered with forests on northern expositions, meanwhile on southern expositions, vineyards and olive trees prevail nowadays. The settlements are situated above the deep valleys of the Dragonja river and its tributaries, on the bottom part of the hill slopes.
Due to Mediterranean climate, which is very appropriate for agriculture, the area use to be important for vegetable production before the 1st World War. Pressure for new housing area (i.e. for land use changing) is strongly present today.
An assessment of landscape changes has been carried out in the Dragonja river valley using national land-use maps for data on present land use, followed by a comparison with land-use data from the 19th century Franciscan land register of the same region.
The results show striking difference between major groups of land-use and major shift from agricultural matrix in the early 19th century to forest matrix in the beginning of the 20th century. Urban pressure and nature conservation (i.e. Natura 2000 site) are recognised as the most influential driving forces of the near future.

P553
The influence of the climate conditions from Oradea, Romania on the biodegradation of oil on a polluted soil

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The paper presents the results of the researches carried out at the Agricultural Research Station Oradea, Bihor county, between 1993 and 2002, regarding agricultural yield from a luvosoil polluted under control with oil brought from the exploitation site at Suplacu de Barc[[Unable to Display Character: ă]]u, Bihor county.
The experimental device was made out of micro parcels of 1 m², set up in a randomized manner, in a Latin square, polluted with a concentration of: 0, 1, 3, 5 and 10 % (0, 3, 9, 15, and 30 l/m²), oil in the ploughed layer, in 4 repetitions.
The experience was than cultivated with in the first three years with millet, a plant which is considered to be resistant to pollution, and than until 2002 with spring wheat.
The analysis of the yield losses from the parcels polluted with oil in various concentrations, have shown that the concentration decreases in time, becoming insignificant after 7 years in the concentration of 1 %, 8 years in the concentration of 3 % - 5 %, and 9 years for 10 %. This shows the biodegradation of the oil without any sort of agropedomeliorative measures.
By analyzing the correlations between the millet yield in the first 3 years of research and the climate factors (rainfall and air temperature) registered in the vegetation period, very significant square, polynomial correlations were established for each oil concentration. The fact that correlation report increases from 0,936499, for the parcels polluted with 1 % oil, to 0,988837 for the parcels polluted 10 % oil points out the influence of the increase of the pollutive agent.

P554

The effects of types and amounts of organic matter on soil aggregate stability

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This study was carried out to determine the effects of types and amounts of OM on stability aggregate indices and soil properties. Indices were including MWD, and GMD with two wet and dry sieving method, aggregates percent over 0.84 and below 0.42 mm, Bulk Density (BD), soil infiltration, water stable aggregate over 0.5 and 0.25 mm, and cone index (CI). The experiment was conducted with split plot design, 3 replications and two factors for 3 years, in Zarghan. The main plot was OM sources including sheep manure; cow manure; rice hull; chopper straw; wheat straw; root refuse of licorice, and control. Sub plot was its amounts with three values of 5, 15, and 25ton.ha^{-1}. Results showed that application of sheep manure increased the MWD. GMD and index>0.84 increased with sheep manure and cow manure application. MWD, GMD and the index>0.84 had an increasing trend from the beginning of sowing stage to the end of the season, but the index<0.42 decreased. Moreover, MWD, GMD and index>0.84 showed the least amount in the treatments in which sheep manure was used. The sources of OM increased the soil aggregate stability. Maximum value of MWD obtained from the highest amount of OM. Different sources of OM didn't have significant effect on the soil aggregate stability in wet sieving series. Soil aggregate stability with rice hull, wheat straw, chopper straw, and root refuse of licorice was higher than control. The maximum values of GMD, WSA>0.5, and WSA>0.25 were acquired from 25 ton.ha^{-1} OM. In the cow manure, wheat straw, sheep manure, and rice hull treatments, WSA>0.5 index were higher than that of control. Application of OM increased OC, P, K, Mn, and Fe in the soil and decreased pH. Using different sources of OM increased the soil infiltration and decreased BD.

P555

Effectiveness of soil conservation measures on soil degradation - A survey in selected case studies in the EU

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Soil as a major part of ecosystems achieves significant ecological and socio-economic functions. However, many agricultural practices lead to soil degradation. To maintain soil functions and prevent them from soil degradation suitable soil conservation measures and adapted farming practices are required. Within an EU research project on "Soil conservation measures and policy: the case studies" a comparative survey of soil threats, soil conservation measures and farming practices in eight EU case studies was performed. The survey was mainly based on expert knowledge and already available data. Case study areas were selected in such a way that a variety of geophysical conditions, farming systems and soil threats were represented. The classification of major soil threats was based on the EU strategy for soil protection and included soil erosion by water, soil erosion by wind, decline in organic matter, carbon balance, diffuse contamination, soil compaction, salinisation, decline in soil biodiversity, floods and landslides and acidification. Farming systems were analysed and soil degrading practices identified. Soil conservation measures applied in the case study areas were evaluated and compared in terms of their economic and environmental impacts through cost-efficiency and effectiveness analyses.
The study gives a comparative overview on various soil conservation measures and farming practices and their impact on soil conservation. A link to respective soil conservation policies is provided.

P556

Effect of herbicide on the chlorophyll content and growth of herbaceous and broadleaf Weeds

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In Taiwan, the application of herbicides was the most used method in weeds control. However, they are not environmental friendly materials and may result in many environmental problems. To protect the soil environment, different types of herbicide were used to investigate their appropriate applying rates in controlling the growth of herbaceous and broadleaf weeds. Seed bank of the study site was in the levels of 44-756 plants m^{-2}. In the beginning of experiment, all weeds were clipped to keep them in the same height and determine their shoot height and chlorophyll content weekly. Selecting and non-selecting herbicides were applied at fifth week in the applying rates of 0- (CK), 0.5-, 1.0-, and 2.0-fold of regular applying rate. Experimental result shows that all of the herbicides had significant effect on decreasing the chlorophyll content of herbaceous and broadleaf weeds even in the 0.5-fold of regular applying rate. Their total biomass of shoot was significant decreased relative to CK. We revealed that these herbicides should be applied in the 0.5-fold of regular applying rate or less when further applying in weeds control.

P557

A method for the assessment of soil functions based on the German agricultural land evaluation (Bodenschätzung)

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With the Federal Soil Protection Act (1998) efforts in the communities have been intensified to develop practical methods for large-scale (1 : 5,000) evaluation of soil functions with regard to municipal planning procedures. Thereby the database is one of the main issues, in particular due to the insufficient availability in a large scale as well as high costs and the time necessary to provide high-resolution primary data. A solution for this problem is the use of the soil map at a scale of 1 : 5,000 based on the estimate of the German agricultural land evaluation (starting 1934) available almost throughout North Rhine-Westphalia (NRW). This soil map portrays the geometries of the land evaluation (parcel of land) blended with the topography and gives detailed information about soils of agricultural land down to two metres depth. This information is given by up to 20 representative soil profiles at the edge of the map created by the Geological Survey of NRW using detailed soil descriptions from the field mapping protocols. On this basis an evaluation method was developed to enable decisions concerning the protection of the regulation functions of soils during large-scale municipal planning- and approval-procedures. For this purpose the data from the soil profiles was recorded computer-readable and transferred to the contemporary nomenclature of the current German methodology (Bodenkundliche Kartieranleitung 5). In order to describe and measure the soil regulatory functions (filter-, buffer-, transformer-function and water balance-function) criteria and parameters were subsequently selected. Finally present available methods using these criteria and parameters allow a GIS-based five-stage assessment of the agricultural soils. The applicability and validity of this procedure were tested in an area in the district Dönberg (Wuppertal, NRW).

P558

Temporal impact of soil conservation on crop production and soil fertility in the highlands of NE Thailand

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Despite tremendous efforts in the past, soil erosion still remains a widespread problem in hillside agriculture of Thailand, impacting soil fertility, crop yields and environment. For more than 20 years, sustainable crop production on sloping land has focused on erosion control by using hedgerow barriers. Therefore, the object of this study was to assess temporal change of soil fertility under various soil conservation systems and fertilizer application. A field experiment was carried out on moderate slope ranging from 21-28% in the Loei province of Northeast Thailand. Yields and soil data were assessed in a control and three contour hedgerows systems, +/-fertilizer application, for three successive years (2003-2005). Maize was grown in relay with a legume under minimum-tillage conditions. Results showed that after three years, maize grain yield increased up to 3.8 and 5.5 Mg ha^{-1} in the unfertilized and fertilized control plots, respectively. These values were higher than those of the contour hedgerow systems (2.0-2.7 Mg ha^{-1} and 3.9-4.2 Mg ha^{-1}, +/- fertilizer respectively). For all treatments, control plots without hedgerows included, soil organic matter (SOM), total N, available P and cations (K, Mg, Ca) significantly ($p \leq 0.05$) increased over time. Additionally, soil pH and CEC in all treatments showed a constant positive trend after three successive years. Due to the positive yield response and even slightly increase in SOM, the control without hedgerow in combination with relay cropping of legume under minimum tillage is considered as a viable alternative for soil conservation in tropical mountainous regions.

P559

Biological mechanisms involved in stabilization of sandy soils of the machair

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Crofting is a low-input, low-output agricultural system, with small-scale production of livestock fodder and own seed production, practiced on the machair of the Western Isles of Scotland, and coastal areas of north-western Ireland. The machair, a large part of which is protected nature areas, is mainly calcareous sand typically with an organic carbon content of about 5%. Cultivation has traditionally been by ploughing to 10 cm depth with kelp (a brown seaweed) spread as fertilizer. The 2 year crop-2 year pasture rotation allows the natural vegetation to recover between cultivations.
This system is changing to use part of the kelp substituted by NPK fertilizer, ploughing increased to 20-25 cm depth, using undersowing and merging of fields. The effects of these changes on the machair are not known.
This study reports on processes important in stabilizing machair soil, and what potential effects the changes in cultivation and kelp spreading may have on soil stability. Ongoing work focuses on how kelp affects soil stability by dynamic association with soil microorganisms. We are testing these associations in field and microcosm experiments, looking at the degradation of kelp using isotope analysis and C and N dynamics in relation to changes in soil microbial composition and -activity, and soil aggregation.

P560

Updating land evaluation data using remote sensing and expert knowledge integrated in a GIS

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Updated land evaluation procedure can help estimating to what extent lands will perform over time and for other specific purposes. Such a procedure requires interpretation on climate, soil, vegetation, and alternate land-use surveys. Israel is a country with limited land reserves and its land-uses frequently change and consequently affect soil processes and land quality. Due to these changes there is a crucial need for dynamic and effective tools for land evaluation.
This research studies the change in agricultural land-use in Israel, since the 1950s and develops tools to update old land evaluation maps in two study sites: Ramat Menashe and the Western Galilee. Each of the areas is dominated by different mechanism and phenomena that affect the change in agricultural land value. In the Ramat Menashe region, soil thickness was particularly reduced during this term, while in the Western Galilee region the change in land value occur due to the removal of unfertile nari limestone crust and exposure of the fertile soil layer beneath.
The update method we propose here is a four steps procedure: (1) Aerial photographs that cover the study area during the 1955-2006 period were selected. Each aerial photo was classified into agricultural land uses using two methods: object oriented and per pixel while the more accurate method was selected to map the agricultural land uses in each term. (2) Change detection procedure was applied to each of the areas to determine the direction and magnitude of land use change. (3) SEE5 algorithm was used to find the relation between the change detection data and the update in land value based on spatial disorder (entropy). Those relations were used to determine the rules to update the land evaluation data. (4) Land evaluation data was updated by the rules and update procedure was evaluated using field data.

P561

Soil cover changes under the influence of land use in the hilly area of Eastern Romania

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In the eastern part of Romania, the human activity made its presence felt as destructive influence constantly during the last two millennia, but with an extraordinary intensity in the last two centuries, in a close relation to the development level reached. Thus, the replacement of the natural forest vegetation with crops has had an essential role. Although largely a deciduous forests domain, at the beginning of the last millennium the percentage occupied by forests in the Moldavian Plateau was of about 75%. In 1832 the forests occupied 47.4% in the Tutovei Hills, in 1893 - 21.9%, and in 1970 it reached only 18.8% of the studied territory.
Departing from this reality, in the last two decades (after the communist period), through the large scale use of the traditional up and down-hill cropping system, the accentuated fragmentation of parcels due to the allotment up to 4th degree relatives, the partial drawback to a rudimentary tillage technique, the accentuation of forest clearing, the poor management or even destruction of the soil erosion control measures, the region begun to witness an alert land and implicitly soil degradation rate.
In these conditions, the main characteristics of the soils from his region came to be highly modified through the acceleration of sheet and gully erosion processes, secondary salinization,

regradation, etc., that lead to the partial or total modification of soils' natural characteristics.
Among the characteristic types, Erodosols (eroded subtypes in WRB) occupy about 6% of the surface of Tutovei Hills, and together with the Regosols are typical for the region, occupying more than one third of it. The majority of the studied soil types have evidenced a decrease in fertility, described by a series of unsatisfactory physical and chemical characteristics (humus, mobile P, cationic exchange properties, hydrophysical indices and so on).

P562

Soils, a natural resource between sustainability and commercial efficiency

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Space, respectively soil, represent in Slovenia one of the most important natural resource, due to only about 18% of lowlands. Areas traditionally held as agricultural, are widely changed to suburban and industrial with an admixture of traffic and energy corridors. Soil degradation, including destruction, is unquestionably reflecting on all other parts of the environment, and might reach a great extent- much greater than initial. Even if we neglect food security and self supply, soils are in such a great amount interfering in functioning within all natural ecosystems, that they might be endangered as well.
The modern way of life depends on severe exploitation of natural resources. The growths of incomes are the only measure for success of enterprises and states. Land is a market good and as a rule is usually sold to the highest bidder. If a land use change is incorporated in the transaction from agricultural to urban, the profit can be enormous.
Although, from each generation's point of view, the time they live in is the most important, we must, at least to a certain extent, take care for the following generations. Apart from clean air and water, here belongs the protection of soil's multifunctionality as well. The authors consider the regional level of land use planning as the most important for levelling and balancing the land use between urban needs, food supply and environmental functions.
The soil data records as a digital soil map in scale of 1:25.000 and the collection of attribute data as a part of Soil Information System, could serve in regional planning for different land use and feasibility studies of biotope protection measures as well as for soil and land evaluation. Environmental reports based on this data will be considered important for decision-making about development and possible environmental burdens of specific regions.

P563

Ecological valuation of soils effected by Norilsk Nickel smelter

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The Norilsk polymetallic ore field is located in the Arctic region on the South of the Taymir peninsula. More than 75 years of smelting result in considerable pollution of natural environment.
The main objective of investigation was to evaluate the ecological state of the soils on the different distance from the Norilsk using chemical and biological parameters.
The following conclusions have been made:
The regional climatic conditions and heavy metals repression of cellulose bacteria result in accumulation of considerable amount of undecomposed organic matter within the soil. The surface horizons of the soil recorded high heavy metals contamination. Concentrations of total Cu, Ni and Co exceeded Russian maximum permitted concentration (MPC) level 3-10 times. The concentrations of labile forms of Cu exceeded MPC level more than 60, Ni more than 40 times. The heavy metals fractions analysis revealed that in contaminated soils accumulation of heavy metals was revealed in mobile fractions of amorphous iron. The biological CO2 emission from the contaminated soils was 5-10 times less intensive than on the background. Three zones in accordance with level of environment degradation were defined surrounding Norilsk.

P564

Land classification in Ciuc Depression (Romania) according to the natural limitations and anthropic degradations

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Ciuc Depression, with an area of 68000 ha, is located in the Romanian Eastern Carpathian Mountains, in the upper basin of Olt River.
The aim of this study is to classify the Ciuc Depression land, according to the natural conditions and anthropic induced degradations and to establish the types of agro-pedo-ameliorative works, in order to remove or mitigate the negative effects of these land restrictions.
According to Romanian current methodology and on the basis of natural conditions and anthropic induced degradations, there are six classes of land capability. Each of them contains: the limiting factors arising from the soil and relief conditions, as well as the drainage type.
The limiting factors induced from the soil conditions are: texture, edaphic volume, acidity, compaction and surface erosion, while that arising from the relief conditions are: the slope, gully erosion, the degree of land non-uniformity, the degree of stoniness or rockiness. The limiting factors that arise from the drainage are: surface waterlogging, moisture excess from groundwater, slope seepage and flooding.
In this respect, the lands of Ciuc Depression were grouped in four land capability classes (the first and the six-th are missing), they being mainly lands with high limitation for agriculture (fourth and fifth classes). On the basis of grouping the land in capability classes, a land classification map of Ciuc Depression was drawn.
Taking into account the limiting factors, the main meliorative and land improvement works are: land surface leveling and drainage.

P565

Effects of plant species richness and functional group diversity on soil stability

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Erosion, due to decreased stability of soil structure, is the most common source of soil degradation. It leads to dramatic decrease in crop yields and loss of soil material increasing water pollution. Previous research on soil stability has focused mainly on the relation between soil stability and organic carbon content in soil. However, only few studies have considered the influence of other soil parameters, which can also affect soil stability, e.g. by modifying the amounts and quality of organic matter inputs to soil.
In the DISCOVER program, we investigated the effects of plant species richness and plant functional group identity on soil aggregate stability using an experimental field study (the Jena-Experiment', Germany). Experimental plots varied in plant

species diversity (1, 4 or 16 species), and functional group diversity (1, 2, 3, and 4) and identity (grasses, small herbs, tall herbs or legumes). Aggregate stability was measured according to Le Bissonnais (1996) to distinguish three breakdown mechanisms: slaking, mechanical breakdown and microcraking. Moreover, organic carbon content was determined.
Soil stability increased significantly in mixtures with 4 and 16 plants species compared to monocultures. This process was particularly observed for the fast-wetting test (which emphasizes the slaking) and for the slow-wetting test (which expresses mainly the breakdown of the aggregates by microcracking, although some slaking also takes place).
Plant functional group diversity and identity did not significantly influence the global soil aggregate stability, however the "grass" type was associated to low soil stability for the slow-wetting test.
Our results indicate that the global loss of biodiversity might have important consequences for soil stability. Plant species diversity was shown to be more important than plant functional group diversity. Decreased aggregate stability in monocultures indicates a possible increase in erosion risks using conventional agricultural monocultures.

P566
Climate impact on soil: causes, effects

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The polluting factors, which reduce sometimes drastically the quality of the environment, appeared about five centuries ago, once with the application in the industrial production of some procedures for that no organic control was foreseen.
The cumulated knowledge has proved that for eliminating the damaging effects of these factors, efforts must be done in order to achieve the aimed results. Many came to the conclusion that the most viable method of reducing the pollution is not to pollute the environment.
The paper presents researches results regarding prevention possibilities of agricultural soils degradation. For the Romanian specific conditions, proposals are made regarding conservative technologies.

P567
Conservation tillage for vegetable growing

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The paper presents part of the results obtained in a study concerning the effects of different technological agricultural systems on a reddish Preluvosol, located at Vidra, south of Romania. The experimental layout included two technological soil tillage systems: (1) the conventional-traditional tillage in aleatory traffic: annual autumn moldboard plowing at 25-28 cm depth, several seedbed operations, annual modeling of high layers with a width of 1,5 m between furrows; (2) the conservation tillage in controlled traffic: basic soil loosening without inversion, keeping the molded, 1,9 m wide layers for several production cycles, several seedbed operations, the opening an additional furrow having small dimensions in the middle of the high layer to improve soil water distribution. The observations were carried out at two times: immediately after seedbed preparation and during the vegetation period within two crops (bean-*Phaselus vulgaris L.* and carrot-*Daucus carota*). The main objective of the experiment was to evaluate the physical status of the soil, the microbial biomass and its activity after five years application of the tillage systems, in order to improve and preserve the soil fertility, crop growth and to increase the economical benefits. The results obtained reflected the benefits of the conservation tillage: under the new technology the soil is more loosened and permeable in the cultivated area under the both plants and has a more reduced stratification of the soil profile; the bacteria biomass are increased in the surface soil layer under conservation tillage; the yield increased in average with 5 % for bean and with 10-12 % for carrot while the fuel consumption was reduced.

P568
Evaluation of soil microbial indices along the revegetation chronosequence in grassland soils on the Loess Plateau, Northwest China

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There is a growing interest in soil microbial quality indicators that can be used as early indicators of directional change. The two most popular ways of vegetation rehabilitation are afforestation and natural succession after enclosure to mitigate the soil and water erosion on the Loess plateau. Results showed that the changes of soil nutrients in soil profile tend to be concentrated in surface layer, especially the soil organic matter, total nitrogen and available nitrogen. It was observed that soil organic carbon arrived at 20 $g.kg^{-1}$ after 50 years of revegetation. Soil enzyme activities and soil microbial biomass carbon (SMB C),nitrogen (SMB N) increased along with the rehabilitation years. However after 23 years of revegetation, soil microbial properties remained stable. The changes in soil enzyme activities were directly related to soil organic matter and total nitrogen, increased with the increasing of revegetation time. They were increased fast in the beginning of revegetation, which was about 15-20 years enclosure. After the 23 years following revegetation, the microbial dynamics of the system changed significantly and come to a quasi-equilibrium with the revegetation system. SMB C,N had positive relationship with soil nutrients and soil enzyme activities. SMB N also increased faster before the 23 years enclosed in the 0-20 cm, the increasing rate of SMB N was 20.14%. Soil basal respiration (SBR) had obviously different during the vegetation natural succession, SBR in 23 years site was higher than other sites which showed that the microbial activities was high in this site. We believe that natural vegetation succession of overgrazing grassland have altered the properties of surface soils, including the soil nutrients and soil microbial properties. Our research reinforces the notion that recovery of soils and vegetation in degraded soil will be a slow process.

S02 Soils and Climate Change

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Approach to predict soil fertility alteration due to global warming during the 21st century

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The prediction of long-term changes of soil properties due to climate change is very important and difficult, but a mathematical modeling for a whole century usually not very reliable. A possible approach could be based on the geographic law of soil zonality and the establishment of a quantitative relationship between

Budyko's radiative index of dryness (I_v^{2000}) and modal values of some regional biological and chemical virgin soil properties (φ_v^{2000}) of geomorphologically homogeneous soil groups. Existing long-term climate change forecasts can be used to calculate the climatic index (I_{2100}) for the end of the 21st century. It is assumed that a rather slow climatic change will not break the equilibrium in $\varphi_v^{2000}(I_v^{2000})$ relationships. These relationships can be used to determine a new soil property φ_v^{2100} corresponding to the climatic index I_{2100} in selected sites. It is also possible to establish relationships of an integral soil fertility index (F_v^{2000}) and a climatic index (I_v^{2000}). The difference (φ_v^{2100} - φ_v^{2000}) can be considered as assessment of the agricultural soil fertility alteration (F_a^{2100}) due to global warming: $F_a^{2100} = F_a^{2000} + (\varphi_v^{2100} - \varphi_v^{2000})$. The integral soil fertility index (F) was calculated considering mainly organic matter content, plant-available P and K contents, and pH value. The application of this approach in Mexico permitted to assess how virgin and agricultural soils will develop corresponding to given climate change scenarios, and to assess the vulnerability of maize and wheat yields to global warming. The results of the crop yields calculation showed that changing soil fertility can lead to crop productivity changes of 30% or more. This approach can also be applied to model past changes using paleosols, delivering insights regarding the time-frames and reversibility of soil development, and allows predicting the impact of climate change on soil carbon storage.

P570

SOC dynamics in a long-term water-logged single rice cropping system

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Long-term single rice cropping system in the water-logged paddy field has long been managed in Korea. Soil management practices, that may alter the soil organic carbon (SOC) content in agricultural land, are expected to cause changes in soil quality. Managing SOC is becoming a crucial issue not only for improving soil quality and productivity but also for mitigating global warming through carbon sequestration. The objective of this research was to evaluate soil organic carbon dynamics on a long-term single rice cropping system for Korean paddy field. Research was conducted in the research farm at NIAST-RDA, Suwon, Korea and with analyzing of soil quality monitoring data.We found that SOC contents were increased continually at the long-term compost treatments and were enhanced in carbon storage rate. In conclusion, continuous returning of plant residues is recommended to sequester soil carbon for Korean paddy soils effectively. This results imply that continuous input of compost in a paddy field may contribute not only for increasing SOC in the soils but also for mitigating global warming through reducing carbon dioxide emission into atmosphere.

P571

Causes and extent of fluctuations of the gaseous carbon pool in a deeply aerated soil

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When ecosystem CO2 exchange is analyzed in most cases it is implicitly assumed that surface CO2 efflux represents the instantaneous soil respiration. However, this assumption is violated e.g. by changes of the gaseous Carbon pool that, though negligible in relation to the SOM, can amount to up to several times the daily soil respiration. In this study we want to quantify the portion of stock changes in the CO2 efflux in a pine stand in south-west Germany. The soil was a well aerated Haplic Regosol adjacent to the Rhine river with the ground water table fluctuating around 7 m depth. For 6 months soil-air CO2, water table depth, soil moisture, temperature and soil-profile air pressure was monitored with high time resolution and the gaseous C content of the soil profile was modeled.
The gaseous C content of the soil and the vadose zone ranged between 154 and 174 kg ha-1. Maximum rates of change were between + 165 g ha-1 h.1 C after a heavy rain and - 250 g ha.1 h-1 C during the rise of the ground-water table. Furthermore, soil CO2 decreased when the pressure sensors revealed high-frequency fluctuations of pressure indicating wind action. The typical effect of rain was a short-term lowering of the CO2 stock followed by an increase during the following days. In one fifth of the total time, the stock changes were greater than 9 % in relation to the temperature-modeled soil respiration, in the extreme case it was 36 %. We conclude that stock changes can be an important source of noise for soil respiration data. This can be considered either through a (challenging) comprehensive modeling of the soil carbon exchange, or by disregarding measuring periods with typical background conditions of high stock changes.

P572

Ancient and recent soils of reserve "Arcaim" in steppe area, Russia

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Changes in time of soils derived on different parent materials were studied in preserver "Arcaim" of Zaural plato, Chelyabinsk region, Russia. There is a fortress of Bronze century with age 3700 years. The city diameter makes up 165 m. Bypass ditch and two rings of defensive wooden walls of 7 m height with towers and advanced fortification are well distinguished (Zdanovich, Arkaim…, 1995). There was square with temple complex in the city centre, from it ring and radial streets passed. There were boards for bronze melt and ceramics production in many dwellings. People of unique professions: votaries of temples, potters and metal-workers lived in the city.
Investigation of paleosoils showed, that 6000-4000 years ago climatic conditions were somewhat more humid them modern, soils was ordinary little depth chernozems. The race formation began in relatively favorable conditions and finished in Arkaim epoch in more aridic and continental climate (4000-3600 years ago).
The least profile thickness and humus stock have litozems, that is caused by low weathering rate of stable rocks and relief location. Further in row of increasing profile thickness and humus stock follow chernozems derived on mesozoy kaolin clay, neogene-quaternary mica-montmorillonite salted and nonsaline rocks. Solonetzes and salted soils frequently occur. Upper layer of many soils contains close humus content, but its stock is considerably distinguished. Pasture soil differs from plowing analog by enriching humus and its labile fraction and smaller humusness. For 12-18 years at reserved regime in former arable chernozems the beds of litter and soddy were generated, the total humus content, its labile part and catalase activity increased.
In reserve scientists of many specialities work, the ancient technologies are studied. On its territory museum was creatured, kurgan "Temyr" was reconstructed. Continuous connection of nature and man here is shown, it's important for ecological education and people recreation.

P573

Contribution of the geogenic sources to the methane budget in soil, in hydrocarbon-prone areas

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By hosting complex biotic processes, and by its position at the lithosphere-atmosphere interface, the soil cover plays a major role in the gas exchange between the atmosphere and the solid Earth. Particularly the methane budget, one of the most active greenhouse gases, is strongly influenced by the production/consumption mechanisms occurring in soil. In drylands located in warm or temperate climate regions, the bacterial methane consumption in soil is exceeding the produced amounts, generating a negative flux in the order of -5 to -1 mg m^{-2} day^{-1}. Consequently, dryland soil is considered a net sink for atmospheric methane. Recent studies have shown that on relatively large areas, superimposed on hydrocarbon-bearing basins, there is a positive methane flux, that may produce a measurable impact on the budget of greenhouse gases. Areas of fractures and/or enhanced permeability over natural gas reservoirs may continuously release methane. The seeps that involve significant fluxes, and give directly observable features, such as mud volcanoes, everlasting fires, water bubbling, are classified as macroseepage. The methane quantities released to the atmosphere are in the order of units to hundreds or even thousands of tons km^{-2} y^{-1}. More common is the case of slow, continuous and pervasive flow of methane, units to tens of mg m^{-2} day^{-1}, detectable only by instrumental measurements, called microseepage. Often, the macro manifestations are surrounded by extended areas with relatively intensive microseepage. An extensive program of gas flux measurements was initiated in the Transylvanian depression. Several sites, with or without macroseepage manifestations, were investigated, and the distribution of fluxes was portrayed. The goal of the currently running project is a more precise assessment of the contribution of the natural emissions from hydrocarbon-prone areas to the methane atmospheric budget.
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P574
Open-N: An open source code for modeling nitrous oxide emission from upland and water-logged soils of a spruce forest ecosystem

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Besides water vapour, carbon dioxide (CO2), and methane (CH4), nitrous oxide (N2O) is regarded as one of the most important greenhouse gases. Total global N2O emission from temperate forest soils is estimated to be in the range of 0.1-2.0 Tg N yr-1. However, particularly at larger scales estimates of N2O emission have still a high degree of uncertainty due to the huge temporal, spatial and inter-annual variability of N2O fluxes. Since field measurements are time- consuming and costly, a precise inventory of N2O emission is hampered by a limited number of available field measurements. One potential way to overcome this shortcoming is the use of process- based models. However, although highest N2O emission with up to 10 kg N ha-1 yr-1 were mainly reported for forest soils affected by stagnant water, the current available N2O emission models are restricted to upland soils, except Wetland-DNDC. However, since the user has no access to the source code of Wetland-DNDC, the applicability is limited. Against this background we developed the open-source model open-N. The new model simulates long-term carbon and nitrogen dynamics of organic and mineral spruce forest soils with special emphasis placed on the formation and emission of N2O. State-of-the-art approaches and algorithms to describe the fundamental biogeochemical processes (e.g. mineralization, denitrification, nitrification) and the driving soil environmental factors (e.g. soil moisture and temperature) were combined and numerically solved using the ordinary differential equation (ODE) solver Berkeley Madonna (Version 8.0.1). The model was calibrated by means of the Levenberg-Marquardt algorithm and validated against measured data (200-2004) from various water-logged and upland soils of a spruce forest ecosystem in South-west Germany. In our presentation we will focus on simulation results indicating that open-N is a powerful tool for simulating N2O emission from upland and water-logged forest soils.

P575
Continuous Measurements of Soil CO_2 Profiles under *Miscanthus x giganteus*

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Soil contains the largest active terrestrial carbon pool on Earth, and through soil respiration, contributes an annual flux of CO_2 to the atmosphere that is 10 times greater than that from fossil fuel combustion. Due to the magnitude of this flux, soil respiration, has a potential role either to amplify global warming due to its sensitivity to environmental conditions or to mitigate climate change due to enhanced soil carbon sequestration and reduced CO_2 effluxes .
Miscanthus x giganteus with its great productivity and its perennial habit, reducing the soil tillage, appears to be a favourable crop for soil carbon sequestration. Therefore, the principle aim of this study to gain a full understanding of the effects of the introduction of new perennial energy crops on annual fluxes of CO_2 to the atmosphere.
Numerous methods have been used to sample soil gases at varying depths below the soil surface. In this study, we have developed a method to obtain continuous field measurements of CO_2 in the soil using soil CO_2 diffusion chambering measurement technique.
Determining the CO_2 concentration in the soil profile helps to identify the location of sources and sinks in soils. Accurately sampling soil gases is essential for understanding vertical distribution of soil CO_2, its movement in the soil and estimate the CO_2 fluxes according to their concentration gradients.Moreover, this method allows analysis of ^{13}C abundance from soil respired CO_2 providing useful indication of the dynamics of the carbon cycle

P576
Impact of tropospheric ozone on soil mesofauna in the rhizosphere of field-grown winter wheat

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It is well known that tropospheric ozone levels reduce growth, biomass and yield in many crop species. This negative effect is often associated with reduced partitioning of photosynthates to sink tissues such as roots which would be expected to affect the rhizosphere environment. However, little is known about the impact of ozone on below-ground processes. Furthermore, there is no information available on how soil mesofauna in the rhizosphere of ozone-exposed crops is affected. A 2-year open-top field chamber experiment (2006 and 2007) was conducted to examine the effects of ozone on plant growth and on selected groups of soil mesofauna in field-grown winter wheat. Enchytraeids, collembolans and mites were analysed because they play an important role for the C-turnover in soil food webs and are known to be sensitive to chemical changes in the soil environment. Each year, two ozone treatments were conducted from May through June in four replicate chambers: non-filtered (NF) ambient air as control or NF with additional 50 ppb ozone (NF+). Soil sampling was performed at three dates according to different crop developmental stages. Root biomass decreased during plant development in NF+ with the lowest biomass (-20%) observed at the end of anthesis. Generally, the individual density of all three mesofaunal groups decreased in the rhizosphere of winter wheat in the NF+ treatment. This result was significant for mites in both years and for collembolans and enchytraeids in the second year. Furthermore, significant results were found at anthesis and at grain maturity, (dates 2 and 3), respectively, but not during stem elongation (date 1). In conclusion, elevated tropospheric ozone concentrations seem to deteriorate the nutritional conditions for the analysed mesofaunal groups in the rhizoshere of cereal crops. It can be assumed that such effects will influence the dynamic of decomposition processes and the turnover of nutrients.

P577
Climate changes and its potential impact on soil organic carbon stock of selected Slovak agriculture farms

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Soil organic matter presents a major pool of carbon in the biosphere. At present time as a consequence of climate changes and rapid changes in the land use and the land management is a very important task of prediction of the soil organic carbon (SOC) stock in future. Prediction of SOC stock in future time scale on the basis application of RothC 26.3 model on Slovak agricultural land is a main goal of project: Modeling of estimation and prediction of soil organic carbon stock. In the first step, application of RothC 26.3 model at modeling of SOC stock on three agriculture farms was using for modeling period 1960-2080. On selected farms are different climate and soil conditions and also soil management. Soil data for modelling were received from Digital Database of General Soil Survey of Agriculture Soils of Slovakia. Climate data for period 1960-2000 from the nearest Meteorological stations were obtained. For time period 2000-2080 climate scenario CCCM 2000 was applied. On farm Michalany application of climate scenario CCCM 2000 and CCCM 1997 was used. Existing soil management data were collected from model farms. Identical soil management was applied also for 2000-2080 time period. On farm Selice, modelling data of SOC were compared with measure data. On the basis results obtaining from comparison measured and modelling data it can be concluded that RothC model is suitable for prediction of SOC stock in our climate and soil conditions. Results of application of two different climate scenario show that higher temperature has negative impact on SOC stock and vice versa.

P578
Climate and maize yields in Plovdiv region I. under non irrigated conditions

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Seven years(1999- 2002 and 2005- 2007) field experiment was conducted with maize for grain (bulgarian hybrid Kneja 509 on meadow- cinnamonic soil in ISS"N.Poushkarov" experimental station in Tzalapitza, Plovdiv region.
The climatic years were very different: from very dry 2000(53,2 mm rain during the period V-IX) to very wet 2005(454,5 mm) and 2007(485,5 mm) during the same period and in the same time very irregularity distributed.
Soil water regime was evaluated by gypsum blocks and tenziometers, designed in ISS"N.Poushkarov" twice in the week and Infrared thermometer was used to evaluate plant water status by the difference between canopy temperature(T_c) and the ambient air temperature(T_a). The temperatures were measured at 14 o'clock every day.
The grain maize yield varies from 182kg/da in 2000 to 950 kg/dka in 2005(the coefficient of yield variance Cv= 21%).
The relationships between yield and rain sum, yield and the number of days with maximum temperature > 30^{o}C, yield and number of days with RH< 60%(all during the period V-IX) were obtained with R^2 > 0,7.
The relationship between yield and dT= T_c- T_a was obtained with R^2> 0,8.

P579
Climate and maize yields in Plovdiv region under irrigation

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ABSTRACT
During the same experiment, but under optimal irrigation, the yield varies too, but they were more sustainable(Cv= 15%). Grain maize yield under optimal irrigation varies from 630 kg/da in 2000(when the number of days with the maximum temperature > 30^{o}C were 69 and 5days from them - with the temperature > 40^{o}C and the number of the days with RH < 60 % was 47 and 15 from them with RH < 45 %) to 980 kg/dka in very wet 2005.
The correlation relations were found between yield and the number of days with high air temperature, low air humidity and dT > 0.
The variations in yields, found under optimum irrigation should be considered when designing and operating irrigation systems.

P580
How does tillage affect carbon dioxide emissions from agricultural soils?

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Due to soil and root respiration an agricultural soil is a significant source of atmospheric CO2. However, adapted management practises are supposed to reduce the efflux of CO2 and to enhance carbon sequestration. In order to assess the impact of soil management on CO2 emissions and carbon dynamics of Austrian cropland a research project of three years duration has been started in 2007. As carbon fluxes are influenced by a series of factors, e.g. temperature, moisture, pH value, amount of substrate, soil properties and vegetation activity, five agricultural fields in Lower Austria and Styria have been chosen. These study sites differ in climatic conditions, soil texture, slope and crop rotation. All fields belong to long-term tillage treatment experiments performed by agricultural schools. Three different tillage systems are investigated: Conventional tillage (CT), reduced tillage (RT) and no-tillage (NT). RT and NT use cover crops during the winter period. Each tillage system is replicated three times per site.
Soil CO2 emissions are measured with a portable soil respiration system in intervals of about one week in order to estimate its annual course, but also in relation to management events. For better data interpretation concurrent soil temperature and soil water content are measured and soil samples are taken for chemical and microbiological analyses.
First results of the study indicate that the spatial variation of CO2 fluxes is very high even within one plot. In most cases lower fluxes were observed for NT than for CT and RT. Especially, immediately after tillage the differences were obvious. Compared to CT plots calculated carbon losses from April to November 2007 amounted for NT plots to 65-94%, while for RT plots no general reduction was observed: Referred to CT carbon losses for different RT plots ranged between 84 and 128%.

P581
Environmental changes and the transformation of soils in case of lowland areas, SE Hungary

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The development of the soils is a process, which takes thousand of years. Soils can however alter within a surprisingly short time

due to environmental changes, as it was observed in case of a study site located on the Great Hungarian Plain.
Our sample area can be found in the south-east part of Hungary at an elevation of 85-90m. Until the flood protection works, performed in the second part of the 19th century, the area was inundated by water during most of the year. Among these circumstances mostly meadow soils developed on the territory. In a few decades subsequent to the diversion of water (under the effect of the extremely salt water that getting deeper) soils started to get saline at deeper areas, and typical alkali soils could form. (The most characteristic soils are solonetz and meadow solonetz turning into steppe formation).
The study area, as a typical Hungarian saline ,,puszta" got natural protection at the end of the 1970s (today it is the part of the Körös-Maros National Park), and at that time detailed geographical and pedological surveys are made there.
In the Great Hungarian Plain as a result of the decreasing precipitation from the 1980s, certain parts of the landscape (even the characteristic extreme saline areas) started to change and returned to be a steppe again. Based on our surveys, made between 2005 and 2007, this process can be demonstrated with the change of specific soil data: total salt content significantly decreased, calcium took the role of the previously characteristic sodium ion and humus content decreased. As a result of these factors the vegetation and the appearance of the landscape have significantly changed.

P582
The effects of global changes on the transformation of soils and landscape in the Great Hungarian Plain

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In the past few years a huge amount of data was gathered to prove the consequences of global climate change. Our research activity in the past 30 years has revealed relationships, which are beyond the generally known facts of climatic changes.
During the 20th century the annual mean temperature increased by 0.68°C, and the annual mean precipitation decreased by 60-80 mm in Hungary. A well-known consequence of climate change is groundwater level sinking in connection with the process of aridification. In the case of our research, on the one hand we managed to quantitatively describe some changes, on the other hand we demonstrated that climatic changes have significant indirect effects.
Our important observation is, that long term groundwater-sinking can initiate significant transformations in soils. The lower groundwater table is hardly available for the vegetation, thus results biomass decrease. The changes of the groundwater level can modify the vertical water and salt transfer, leading to the modification of the genetic soil types. Therefore salinization processes can start or even salt-decreasing processes can occur in case of alkali soils. The change of the soil types can infer the altering of the natural vegetation as well.
In Hungary alkali soils are the most sensible to climate change. Alkali soils with their sparse vegetation start to turn steppes and become grassy in approximately 30 years. The salt content and the previously dominant sodium content of soils declined, while the organic matter content increased
The above mentioned processes have two important consequences: the fertility of the soils changes, and some typical landscape features disappear as a result of climate change.

P583
Carbon budget of peat lands of Southwest-Germany

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In Germany most peats have been drained for agriculture and forestry purposes and have to be considered as sources of CO_2 emissions, associated with the mineralization of organic matter after drainage. After re-wetting, CO_2 emissions in peats decrease, while CH_4 fluxes may increase due to anoxic conditions. However, more research is needed to quantify the contribution of climate-relevant trace gas emissions from re-wetted peat lands to the total gas emissions at the regional level. In this study the carbon turnover and net CO_2 ecosystem exchange (NEE) in peat lands in southern Germany is measured. A long-term study is conducted in three representative peat lands (Histosols): a deeply drained, a moderately drained, and a re-wetted peat in the Danube floodplain (*Donauried*). Instantaneous fluxes of CO_2 and CH_4 at the soil-atmosphere boundary are measured on a weekly base using portable closed chambers. Moreover, heterotrophic soil CO_2 efflux is assessed by determination of the litter decomposition rate using litter bags. CO_2 NEE is measured using a portable infrared gas analyzer placed into an opaque chamber. At the mean time, air temperature inside the chamber, groundwater level, peat temperature and redox potential in 5, 10, 20, 40 and 60 cm depth are measured in order to detect environmental correlations and identify the main factors influencing CO_2 and CH_4 emissions. The carbon budget on the three different sites is achieved by calculations considering inputs and outputs through the soil-atmosphere system, in order to determine under which conditions a peat land is acting as source or sink of carbon.

P584
Climate Change - A Challenge for Saxon Soils?

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Perennial soil temperature and moisture measurements at Saxon soil monitoring sites seem to signify impacts of climate change. Decreasing soil moisture and increasing soil temperature of the last several years anyway may not be significant for a long term trend, but still it may be appropriate to have a closer look upon possible future developments.
Because the available performance data do not allow safe conclusions yet the Saxon State Agency of Environment and Geology started a research project on the evaluation of climate data from 1961 to 2005 as well as climate prognosis data as a source for prognostic calculations for the future soil water balance (until 2100). Its aim is to provide a basis for agricultural assimilation strategies as well as for assimilation concepts for forestry and nature conservation. Subject of the site specific modelling are six representative soil types resp. from eight different Saxon climate regions for four kinds of use. This results in 192 site specific settings. First results indicate decreasing natural replenishment on the base of data for increasing evaporation, reduced precipitation and heavy rainfall events.
Further on a new method for the measurement of CO_2 at one soil type in field, grassland and forestry operations is tested. The new method allows on site measurements for different horizons and for a well defined geometric zone.
Eventually in Saxony activities rising public awareness for the role of soils as CO_2 store and reservoir and for the risks of climate change for soils have been started.

P585
Effects of tillage system on soil microbiological activity of agriculturally used soil in Austria

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In order to assess the impact of soil management on soil microbiological activity for five agricultural fields in Lower Austria and Styria soil respiration, substrate-induced respiration, ß-glucosidase activity and dehydrogenase activity were measured. These investigations are part of a research project about the influence of soil tillage on CO2 emissions and carbon dynamics of Austrian cropland. The study sites differ in climatic conditions, soil texture, slope and crop rotation. All fields belong to long-term tillage treatment experiments performed by agricultural schools. Three different tillage systems are investigated: Conventional tillage (CT), Reduced tillage (RT) and No-tillage (NT). RT and NT use cover crops during the winter period. Each tillage system is replicated three times per site.
In spring, summer and autumn 2007, soil samples were taken from each plot at different soil depths (0-10 cm, 10-20 cm, 20-30 cm). Samples were sieved (2 mm) and stored at 4°C in a refrigerator. Analyses were performed within one month after sampling. In addition, soil moisture, pH value and carbon and nitrogen content of the soil samples were measured.
Preliminary results show that the amount of microbiological activity differs between the five sites. For all fields values change during the vegetation period. At three sites significant differences due to tillage system were observed. Microbiological activity is significantly higher in top layer than in deeper layers.

P586
Impact of modified temperature and precipitation regime on soil microorganisms and carbon cycling in arable soils

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Carbon cycling in terrestrial ecosystems provides a feedback mechanism to climate change by releasing or sequestering additional atmospheric CO2. However, the response of terrestrial carbon cycling to the interactive effects of a changing temperature and precipitation regime is still unclear. This project aims to relate soil organic carbon turnover under a modified climate to microbial abundance, activity and diversity. Three different topics will be addressed in a field experiment modifying temperature and precipitation on a arable field. First, we will quantify the seasonal variation of carbon mineralisation under changed climatic conditions by applying respiration, enzyme activity and microbial and fungal biomass measurements. Second, we will clarify the interactive effects of a changed litter quality and decomposition activity on litter decomposition. This will be linked to the fungal community structure by extracting, cloning and sequencing fungal DNA. Third, we will trace the litter carbon flux through the fungal and bacterial community by coupling stable isotope techniques with the extraction of bacterial and fungal biomarkers (PLFAs and ergosterol). The concept of this project, the set-up of the field experiment as well as first results will be presented.

P587
Influence of meteorological factors during vegetation period on the yield and evapotranspiration of irrigated and non irrigated grain corn

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The aim of experiment was to establish the influence of meteorological factors during the vegetation period of grain corn, on the yield and evapotranspiration. The experiment was carry out during 2004 - 2007 period, on Mollic fluvisoils (FAO - UNESCO) in region of Plovdiv (Bulgaria). The data from irrigation (by 75 % of FC) and non irrigated corn have been used. Dependencies between yield and meteorological factors have been established, as well as soil layer water depletion. The value of evapotranspiration and it's formatting nave been calculated (274 - 379 mm without irrigation and 378 - 515 mm by optimum irrigation).

P588
Measurement and analysis of N2O and SF6 diffusion coefficients in soils as a function of the spatial scale

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Soils are important sources for the emission of nitrous oxide (N2O) into the atmosphere. The governing process for gas exchange between soil and atmosphere is diffusion. According to Fick's law, the diffusion coefficient relates the diffusion rate to the gas concentration gradient. Air-filled pore space in soil and the real length of the diffusion path through the pore system (pore effectiveness or tortuosity, respectively) are considered by the soil gas diffusivity Ds, also called apparent diffusion coefficient. Ds in turn is a fundamental parameter for the prediction of N2O emissions from soils.
Different laboratory and field methods to measure Ds were developed through the last decades. A common feature of the existing methods is that the measurement volume in soil (soil core or undisturbed field soil) is in the order of 102 cm3. However, it is not clear if this size is equivalent to the representative elementary volume of Ds, and if this measurement volume correctly characterizes gas diffusion at a scale that is at least governed by intrinsic soil hetero-geneity (profile scale). Therefore, our objective was to extend the scale of this analysis from the soil core to the soil profile scale, and we developed a new field method to measure gas diffusion coefficients at different soil depths in a measurement volume in the order of 104 cm3 (soil profile scale).
In our contribution we will present the new field method, and measurement results for diffu-sion coefficients of N2O and SF6 (inert gas) in sandy field soils. We will show that the field method is suitable to obtain reproducible diffusion coefficients for N2O and SF6, and we will compare the field measured diffusion coefficients with those measured in soil cores taken from the same soil profile using the a standard laboratory method.

P589
An evaluation of the impact of climate change on soil water balance in a catchment in north-eastern germany - a case study

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Future climate changes might decrease soil water availability in spring and summer. This also might cause longer drought periods. Therefore, an estimation of the impacts of such climate changes on soil water availability is essential e.g. for the developing of adaption strategies in the future management of agricultural and forested areas.
For this purpose, a case study was carried out in a catchment located in the northeastern ger-man lowlands. We applied a hydrological model to evaluate the impact of climate change on spatial and temporal dynamics of soil water balance components. For the model application, we used three different meteorological data sets for the period 1951-2100. One of these time series was generated by the Potsdam Institute of Climate Impact Research. The second one, the so called WETTREG-data set, was generated by the Federal Environmental Agency of Germany (UBA), Berlin. A third data set was generated by the Max Planck Institute for Me-teorology, Hamburg in cooperation with the UBA Berlin, the so called REMO-UBA-dataset. Additional data for the model calculations were a landuse cover,

soil map, river net map, digi-tal elevation model and a subbasins map.
The results of this simulation study for the time period 1951-2100 indicated that the future water availability especially on areas with poor sandy soils without groundwater tables showed a strong decrease in spring and also longer drought periods in summer in comparison with the actual conditions. This decrease will cause a stronger limitation for crop production on these areas.

P590
The late Pleistocene paleosols in the centre of the Russian Plain

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In the Late Pleistocene gully deposits of the Russian Plain, the Early (OIS 4) and Middle (OIS 3) Valdai stratum and includes complex loess-soil series. In the Aleksandrovskiy quarry that exposes the system of wide flat-bottomed gullies (balkas), there are two Early and Middle Valdai paleosols above the soil of the Mikulin (Eemian) interglacial stage (OIS 5e). These paleosols are divided by slope deposits and differ from the latter by higher values of the magnetic susceptibility. The lower one is Kukuevskaya meadow soil developed under forest-steppe conditions. The next upwards is the Streletskaya chernozem-meadow soil having the radiocarbon age ≥58700±1900 BP. The next one is the Aleksandrovskaya cryogenic meadow soil formed in a cooler forest-steppe. Aleksandrovskaya paleosol is overlain by gleyed lacustrinelike loams, which contain bones of a wooly rhinoceros and. The ^{14}C age of collagen from the horse's bone is 39710±580 BP, which dates the period of a milder periglacial climate and the existence of a watershed lake. The uppermost layer of the Middle Valdai deposits is represented by the Bryanskaya soil formed at the time of extensive spreading of gramineous-herbaceous steppes; its radiocarbon age is 33140±230 BP. Thus, the Early and Middle Valdai on the Russian Plain is a complex structured period. This is consistent with the concepts of researchers from the Middle and Western Europe and allows us to present the following correlations. The aforementioned paleosols correspond to the interstadials: Kukuevskyi - Kutrussk = Chermensk = Amersfort (105-95 thousands BP), Streletskyi - Kishlyansk = Odderade = Brörup (85-75 thousands years BP), Aleksandrovskaya - Bailov = Moepsfold =Poperinge (55-45 thousands BP), gleyed lacustrine loams that mark periglacial climate warming - Grazhdanskii Prospect = Molodovsk = Hengelo = Podgrad (38-40 thousands BP), Monastyrskyi (33-27 thousands BP) and Bryanskyi (25-24 thousands BP) - Shtilfrid B = Denekamp = Grand Bua.

P591
CO_2 emission rate in Mediterranean ultisols with different degradation degrees

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The rate of CO_2 emission from the soil due to microbial activity has been extensively studied as an indicator of soil quality related to its organic matter content. In this paper, a field and laboratory study is reported, comparing CO_2 emission rates from the soil surface in Mediterranean ultisols in southwestern Spain under different vegetal soil covers and different uses: 1) Soil in an cork oak forest, the climax vegetation of the studied formation, 2) Soil in *Cistus ladaniferus* scrubland with a 100% cover, 3) Soil in a cropping field uncultivated for the past 35 years and with 50% of a shrublike cover dominated by *Cistus crispus*, 4) a cropping field abandoned 12 years ago and covered with 10% shrub analogous to the one in 3), 5) pastureland degraded by overgrazing, and 6) an olive grove continuously cultivated for the past 65 years. A comparative assessment was made of the aerobic activity of each of the soils, at different times of the year, observing the correlation between the extrapolated respiration at 10ºC and 60% of water-filled pore space and the degradation level of the quality of these soils. The evolution of the respiration was explained by laboratory incubation, as well as its differences with the field measurements. Finally, the CO_2 emission from the soil was estimated for each of the uses and vegetal covers studied, per unit of time and surface.

P592
Influence of tillage systems on soil organic matter content - results of long-term research in Baden-Wuerttemberg

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In order to get empirical data about the agronomical and agroecological effects of different tillage systems the Ministry for Nutrition and Rural Areas Baden-Wuerttemberg (SW-Germany) entrusted agricultural research institutions in 1995 to install a net of test plots in different regions across the state. On each of these 14 test plots (size: 0,5-1 ha) three tillage systems were practised:
• conventional tillage
• reduced tillage
• no tillage.
In addition to annually assessed agronomical standard parameters special pedoecological investigations and experiments were realized. With regard to the role of arable soil as source and sink of CO_2 soil samples from 8 test plots (five depths: 0-5, 5-10, 10-20, 20-30, 30-50 cm) were taken and organic matter content was analysed.
The results show that the average content of soil organic matter in 0-50 cm is 134,2 t C ha^{-1} with plow, 139,8 t C ha^{-1} with mulch till, and 141,8 t C ha^{-1} with direct drilling. This indicates an increase of 326 kg ha^{-1} a^{-1} by mulch tillage and 444 kg ha^{-1} a^{-1} by the no tillage regime. Particularly in the depth of 0-5 cm there is a great difference between the tillage systems: plow till has an average organic matter content of 2,58 %, mulch till of 3,35 %, and no till of 3,83 %.
Furthermore additional soil samples were analysed from 5 sites and from 12 fields after conversion to grassland close by to each of the arable fields in SW-Germany. The results of all analysed sites show that the conversion from conventional tillage to reduced tillage induced an averaged CO_2 fixation of 1,26 t CO_2 $ha^{-1}a^{-1}$ in 11 years in the top soil (0-20 cm); direct tillage accumulated 3,26 t CO_2 ha^{-1} a^{-1} and the establishment of grassland 3,6 t CO_2 ha^{-1} a^{-1} in comparison to plow tillage.

P593
DOC dynamics in a boreal riparian soil - Implication of a changing winter climate

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Dissolved Organic Carbon plays an important role in the surface waters in boreal region and is mostly originated from the riparian zone. The quality and quantity of DOC in the riparian soil is determined by a combination of biological, physical and chemical processes. How the DOC characteristics will be affected by a change in climate in northern ecosystems is not presently well understood. However changes in the snowpack accumulation and soil frost timing and distribution are among the predicted future scenarios.

The impacts of soil frost regime on the quality, quantity and bioavailability of DOC has been studied during a field-scale soil frost manipulation experiment in a boreal zone of northern Sweden since the fall of 2002, with at least three more years of manipulation being planned. The investigation has been performed at five soil depths, using three treatments (deep soil frost, no soil frost and control) with three replicates each. Soil temperature and unfrozen water content have continuously been monitored at all depths. Soil water samples were collected 8-15 times / year, more intensively during the spring. In addition, a laboratory study has been performed based on a complete factorial design in order to investigate the contribution of multiple factors (temperature, water content, freezing duration and number of freeze-thaw cycles) on soil respiration and behavior of carbon and nutrients.
A significant difference in DOC concentrations has been observed between the deep soil frost and no soil frost treatments in the superficial soil horizons, with the "deep soil frost" having up to twice the DOC concentration. An indication of soil frost potential to affect the DOC characteristics (measured as changes in spectral slope and SUVA) has also been observed. In addition, bioassay experiments indicate treatment effects and imply that soil frost conserves the high quality characters of DOC.

P594
Soil hidrological response under extreme climate situations

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One of the main climatic characteristics affecting the vulnerability of the Mediterranean region is the high intensity rainfalls which fall after a very dry summer and the high degree of climatic fluctuation in the short and long term, especially in rainfall quantity.
In addition, the rainwater penetration and storage of water in the soil are conditioned by the soil characteristics, in some cases modified by changes in land use and with new management practices.
The aim of this study was to evaluate the impact of the more and more frequent irregular rainfall distribution through the year in a Mediterranean environment, on soil hydrological processes in vineyards, which have been prepared with leveling works to adapt the fields to the mechanisation of almost all labors.
Spatial soil moisture variability at different depths were analysed for several years with different rainfall distribution in two plots which suffered significant soil movements, before vineyard establishment.
Significant differences in soil moisture were observed from year to year, giving rise to critical situations for the development of the crops, particularly in the areas which suffered higher disturbance. In those areas, and after a long dry period, soil moisture contents below 5% are recorded. For the Mediterranean conditions, where an important amount of annual rainfall is concentrated in autumn, usually falling in high intensity rainfall events, very low soil moisture conditions may be recorded just in the seasons, in which water needs are higher. This produces, in many situations, an insufficient water supply to support stable agriculture.

P595
Changes in organic matter and microbial community along a soil climosequence in the Austrian Limestone Alps

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Mountain environments are well-suited for the study of climate impacts on pedogenic processes because of pronounced changes of environmental conditions within short distances along altitudinal gradients. Soil organic matter deserves special attention because of its key role in many important soil processes and its rapid response to environmental changes. The goal of our project was to elucidate changes in soil organic matter and microbial community along an altitudinal climosequence on the Hochschwab massif in Austria. A soil climosequence was studied along an altitudinal gradient ranging from 900 to 1900 m above sea level (asl). The selected sites had similar slopes and aspects. Differences between the sites were therefore mainly caused by the climatic situation and the type of vegetation ranging from the montane (dominated by beech, spruce and larch forest) to the sub-alpine (mountain pine bushes) and alpine (alpine grassland) climate zones. The dominant soil types of the area are shallow Leptosols.
The soil organic carbon stocks showed an increase with increasing altitude from 900 to 1500 m asl followed by a decrease from 1500 to 1900 m asl. At the high-elevation sites, decreased net primary production and/or increased soil erosion may have counteracted the accumulation of soil organic matter, thus leading to lower carbon stocks. The quality of soil organic matter (analyzed with Fourier-transform infrared spectroscopy) also changed along the studied climosequence, e.g. the amide II band (1500 cm-1) showed a significant decrease with increasing elevation. The ergosterol contents indicated altitudinal shifts in microbial community composition, with decreasing contributions of fungi with increasing elevation. The bacterial/fungal biomass ratio calculated using marker phospholipid fatty acids (PLFA) confirmed this trend.

P596
GIS derived susceptibility of forest soils to drought: example from Slovenia

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For large parts of Europe the drop in precipitation levels and higher frequency of drought events are believed to be some of the main effects of forthcoming climate changes. To determine the susceptibility of forests to drought, geographic information systems were used to arrange the forest areas of Slovenia into different categories with regard to their soil properties, climate and geomorphologic characteristics. The amount of water which is infiltrated into the soil and captured, depends on soil depth, soil organic matter content, thickness of humus layer and soil texture. Beside the soil properties, elevation, aspect and slope were also considered. We used the data from the soil map of Slovenia in scale 1:25,000 and arranged pedo-cartographic units into categories on the basis of average soil depth, soil texture and the amount of soil organic matter. Simultaneously the data from a digital elevation model (DEM) was used to delimitate the areas which are more/less exposed to drought. Based on the soil properties and DEM data, the potential susceptibility of forest patches was derived. By using the precipitation data of Slovenia and the estimated amount of water percolating through the root zone the actual susceptibility to drought was obtained. Additionally, several scenarios of precipitation decline were evaluated with regard to their potential effects to forest drought occurrence.

P597
Soil carbon sink and land use change in the Emilia-Romagna Region (Italy)

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Information on soil organic carbon (C_{org}) stocks and their variation (ΔC_{org}) following land-use change is needed to understand the processes linked to anthropogenic CO_2 emissions in the atmosphere and their reduction potential for the mitigation of the greenhouse effect.
The aim of this work was I) to estimate the variation in C_{org} stocks as related to land-use change from crop to forest, on the basis of soil C_{org} measurements available for 24 soils of the Emilia-Romagna Region (RER; "measured" ΔC_{org} values); II) to compare these values with those estimated according to the guidelines of the Intergovernmental Panel on Climate Change (IPCC; "calculated" ΔC_{org} values). Changes in the soil C_{org} reserve were evaluated with reference to the Apennine sector of the RER, where land-use change from cropland to forest mainly occurred in the last 30 years.
We selected 376 soil profiles from 9884 observations on cropland; 201 soil profiles were examined, which were derived from forest soil sampling. The C_{org} content in the top 0.3-m soil profile was significantly higher (P<0.001) in forest soils (96.5 t C ha^{-1}) than in cropland soils (54.8 t C ha^{-1}). We assumed the difference in C_{org} content between forest and cropland soils to be related to land-use change. This difference varied between -1 t C ha^{-1} and +132 t C ha^{-1}. Its mean value (n=24) was +41.7 t C ha^{-1} (SD=37.6 t C ha^{-1}), significantly higher (P<0.01) than the amount estimated according to the IPCC Guidelines, equal to 13.4 t C ha^{-1} (SD=3.9 t C ha^{-1}). The differences noticed in the ΔC_{org} values are dependent on the estimation method ("measured" or "calculated"). Such information is useful to local policymakers for a more accurate application of measures relevant to climate change mitigation.

P598
Adaptation of carbon mineralization to climate change in southern and northern areas of the boreal forest zone

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Much effort has been made to improve understanding of factors controlling the temperature dependence of soil organic matter (SOM) decomposition. The question of how soils formed in different geographical locations and conditions respond to climatic warming is still open. In addition to climate, residence times of soil organic matter are controlled by its decomposability and microbial community. We studied short-term temperature dependence of SOM decomposition near the northern and southern borders of the boreal forest zone. As carbon mineralization rate is driven by microbial activity, we focused on organic carbon fractions available to microbes and the size, composition and functioning of microbial communities in the soil. Soil samples from forest sites located in northern Finland were transplanted to forest sites in southern Finland. Difference in the annual mean temperature between the sites is about 4.5 °C, which is the mean of warming scenarios for Finland during the next 80 years. When the soil samples are transferred, they are disconnected from the surrounding plant root system. The effect of this was studied by transplanting samples also within the sites. The temperature dependence of CO_2 production (Q_{10}) was measured and the microbial community structure was characterized using two methods; composition of phospholipid fatty acids and substrate utilization patterns, before transferring and after two years acclimatization period. Climate, forest site type or root cutting did not affect the Q_{10} value, but microbial community structure and substrate utilization patterns were affected by all these factors. This study shows that despite the differences in soil microbial community the temperature dependency of carbon mineralization is equal in north and south and not affected by rapid temperature increase. However, a similar increase in temperature causes a larger proportional increase in the decomposition rate at a low temperature compared to a high temperature.

P599
A measuring device for the simultaneous direct determination of N_2 and N_2O emission from soil cores

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Losses of gaseous N-compounds (N_2, N_2O, NO) from soil to the atmosphere are a result of microbial activity and reduce N-availability in soils. In view of the importance of N_2O as potent greenhouse gas, they have a major influence on atmospheric chemistry and global warming.
N_2 is an inert gas and the main gaseous component in our atmosphere and it has no effect as a greenhouse gas. Therefore it is interesting to know which factors are responsible for the ratio of N_2O:N_2 emission based on the denitrification process.
Due to the high N_2-background concentration in the atmosphere it is not possible to measure N_2 losses without methodological tricks.
The most frequently applied methods are based on the use of stable Isotope ^{15}N, radioactive isotope ^{13}N, application of gaseous inhibitors to reduce the denitrification enzyme N_2O-reductase (e.g. acetylene) and exchange of the soil atmosphere by an N_2 free atmosphere and direct measurements of N_2 and N_2O emissions.
A relatively new method is the gas-flow soil core technique, in which the soil atmosphere from undisturbed soil samples is exchanged by flushing the soil samples and the measuring system by N_2-free atmosphere. The N_2 is substituted by a mixture of Helium and 20 Vol% O_2.
We built a gas-tight measuring system with two stainless steel incubation vessels, each with six positions for 100cm^3 soil cores. The system is fully computer controlled by self developed software. The incubation vessels are located in a temperature controlled water bath. The emitted gases N_2 and N_2O are analyzed in the vessel headspace by an overpressure method.
For the detection of N_2 we use a pulsed discharge detector and for N_2O a µECD.

P600
Effect of N fertilization and tree girdling on soil greenhouse gas emissions

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Enhanced N concentrations in the atmosphere caused by traffic, industry and the use of fertilizers, lead to elevated N-deposition into forest ecosystems. This additional N-input can increase aboveground plant production but can also cause soil acidification, a loss of biodiversity, a loss of N by leaching, changes in the decomposition of soil organic matter, alterations in microbial activity and consequently changes in greenhouse gas (GHG) emissions from soils. We measured soil-surface CO2, N2O, CH4 and NO fluxes from a 62 year old beech forest soil that receives 13 kg N ha-1 yr-1 by wet deposition. A fertilization experiment was carried out over two years. Wet N input was increased by spraying 50kg N ha-1 yr-1, in monthly doses. Furthermore a girdling experiment was carried out to separate autotrophic from heterotrophic soil respiration. Tree girdling reduces the labile plant carbon input by roots and consequently alters microbial-driven ecosystem functions.
Soil GHG flux measurements were carried out biweekly (by a manual chamber technique) and daily (by automatic chambers). Nitric oxide emissions were measured at each manual sampling occasion by a fully automated system. Our measurements showed that at the fertilized and the girdled plots less CH4 was taken up, while N2O emissions increased. Soil respiration was reduced by fertilization and autotrophic respiration accounted for about 20% of total soil respiration.

P601

Effect of the composition and degree of stabilization of organic amendments on the enhancement of soil organic C

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The combination of suitable soil and waste management practices such as the recycling of organic wastes as soil amendment has the potential to minimise the emission of greenhouse gases (GHG) alongside with the enhancement of the C sink capacity of agricultural soils. The purpose of this work was to study the C dynamics in a soil amended with composts prepared from two-phase olive mill waste (TPOMW) and different agroindustrial by-products used as bulking agents and N-source (olive tree prunnings, sheep manure, horse manure and urea). The effect of the chemical composition and the degree of stabilization of the composting mixtures on the soil C dynamics were studied by monitoring CO_2 fluxes from the amended soils under controlled conditions (two months soil incubation at 25ºC). The total amount of added C that was mineralized in the soil varied between 2 and 14%. Both percentages were registered, respectively, for the more stabilized and the initial composting mixture prepared with urea and horse manure. The use of an easy available N-source (such as urea) in the composting mixtures favoured a fast mineralization of the readily available organic carbon at the beginning of the composting process leading to an end product in which the stabilized organic matter is more resistant to degradation. The low mineralization rate of this stabilized material in the soil could promote the build-up of organic C in the soil.

P602

Rainfall chemical characteristics in native Grass compared to Seasonal Deciduous Forest in Itaara-RS, Brazil

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The pH value is an important indicator of soil chemical characteristics, because it has the capacity to disturb some essential elements arrange, helping or not its release. The electrical conductivity (Ec) is used to measure the salt amount in the soil solution. Some substances in the atmosphere like dust and smoke can cause some variations in pH and Ec in rainfall. In the chemical point of view, the acid rain has a pH lower than 5, 65, that can cause soil acidification. The study had as objective to evaluate the pH and Ec rainfall difference in 2007 in a Seasonal Deciduous Forest compared to open land. The samples were collected every fifteen days from rain gauges of 314,15 cm², being 15 of them randomized allocated in two areas and 4 in the open field area. During the evaluated period, the Ec in the Forest showed highest annual average when compared to the open area with 40, 36 µS/cm and 21, 53 µS/cm respectively. The highest Ec in the forest is related to the high dust particles deposition upon the canopies, and the highest amount of washable ions that become available for the leaves. In pH evaluation, it is possible to observe that the average pH in the Forest was 6, 73, highest than the open area that was pH 6, 0. It evidences that the forest doesn`t show the soil acidification potential, because the canopies interaction takes and adds lots of nutrients that are going to Interact in soil chemical modification.

P603

Seasonal effects on microbiological methane cycling in UK forest soils.

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Methane is a highly potent greenhouse gas and, with atmospheric levels increasing, it is necessary to better understand its cycling. In the UK, forestry is seen as a possible way of sequestering carbon; to validate this it is important to understand whether forest soils act as a source or a sink of methane and whether this varies with environmental changes.
An oak and a Corsican pine stand are being studied over an annual period to investigate effects of seasonality on methanotroph and methanogen community structure in soils. The aim is to gain better understanding of the role of the microbial community in methane cycling within forest soils. Samples were collected every 3 months and DGGE analysis carried out on 16s rRNA genes and functional genes *mxaF* for methane oxidation and *mcrA* for methanogenesis.
Differences between horizons show greater potential for methane oxidation in the organic layer compared with the mineral layer for both sites, with a wide diversity and over 20 species of methanotrophs present in all organic layer samples, with detection in only half of the mineral layer samples. Methanogen species are detected in half of organic layer samples and a quarter of mineral layer samples, with lower detection of the functional gene overall. Much greater diversity and abundance of soil bacterial species is seen in the oak stand, possibly due to heavier textured clay soils in comparison to the light sandy textured soils under the pines. Diversity and overall abundance varied between seasons for both sites. The influence of changes in external environmental factors as well as soil water, temperature and chemistry on methane oxidation and production will be evaluated in these two contracting forest types and forest soils. This study will help to refine the quantification and understanding of methane oxidation and production from UK forest soils.

P604

Recent organic matter accumulation related to nitrogen deposition and climatic factors in four Scottish ombrotrophic peat bogs

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Peat bogs have high long-term rates of organic matter accumulation and store approximately one-third of all soil carbon (390-455 Pg). Hence the rates of accumulation in these ecosystems can influence the global carbon cycle and climate change. It has been suggested that peat accumulation is affected by the input of nitrogen from the atmosphere as well as climatic factors such as temperature and precipitation. Our aim was to study the effects of increased nitrogen deposition during recent years on peat accumulation rate at four Scottish ombrotrophic peat bogs. Correlations between peat accumulation rates and climatic factors were also investigated.
Peat cores were collected between 2001 and 2004 from Flanders Moss, Red Moss of Balerno, Carsegowan Moss and Turclossie Moss in west-central, east-central, south-west and north-east Scotland, respectively. Air-dried peat sections, 1 to 3 cm in thickness, were ^{210}Pb-dated using gamma spectrometry. Organic matter accumulation rates were calculated (in terms of cm y^{-1}) using the constant rate of supply model.

The upper *ca*. 20 cm of peat at each of the sites was estimated to be *ca*. 100 years old. Mean organic matter accumulation rates ranged from *ca*. 0.19 to 0.61 cm y^{-1}. Based on records of the total nitrogen deposition in the UK between 1900 and 2000, in general, trends in increased organic matter accumulation rates were in agreement with increases in nitrogen deposition during recent decades. Local climatic data was available for the Red Moss of Balerno site and preliminary results indicated that organic matter accumulation rates for this site correlated negatively with annual temperature sum and positively with evapotranspiration index.

P605
Impacts of climate changes on rhodic ferrasols and lixisols of Burkina Faso

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The global warming is now unequivocal. The international scientific community proved it by observing the increase of worldwide mean temperatures.
In Burkina Faso, the increase of temperatures is also observed
To determine its impact on soil properties, soil survey was carried out in different climatic areas of Burkina Faso. The methodology for the survey was toposequential survey. For this purpose, 60 pedological pits distributed one 20 toposequences were observations for each climatic area.
The profiles have been described according to FAO manual of soil survey (1994) and classified by using WRB (2006).
Two classes of soil were retained for the determination of the impacts of climate change.
Study showed that the decline of rainfall resulted in to stopping of pedogenetic processes in rhodic ferralsols leading to the compaction of its B horizon and the decline of friability.
Concerning the lixisols, there was a high desiccation leading to the formation of petroplinthic horizon which reduces the soil depth ranged between 20 to 60cm.
The increasing temperatures and the decline of rainfall, affect seriously soil physical, chemical and biological properties.

P606
Modelling impacts on soil organic carbon stocks and crop yields under climate change using EPIC - a case study analysis in Slovakia

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This contribution presents the modelling results assessing the impacts of climate change on SOC in topsoils (0-30 cm) and crop yields at the Ko[[Unable to Display Character: č]]ín farm, Slovakia. Climate change is anticipated by emission scenarios SRES-A2 and SRES-B2. These scenarios were downscaled to daily weather parameters for nearby observatory in Jaslovské Bohunice. The current version of the EPIC model was used to assess studied effects for the period of 2005-2050. These effects were compared with a “zero” weather scenario (OBS), which was modelled stochastically from historical weather data. Twelve profiles of Haplic Luvisols (22.3±3.4 t/ha of SOC in topsoil) were included into study. Three crop management scenarios were constructed from original records of the farm authorities, including winter wheat, maize, sugar beet, rape, barley and alfalfa crops. All management scenarios were modelled for all soils and were hold constant over the simulation period to isolate the effect of climate change.
The EPIC simulations with the two SRES scenarios show a statistically significant decrease in topsoil SOC content for all soils and all crop management systems in comparison with the OBS scenario. The decrease in SOC varies between 1.7 and 6% (3.5% on average for all profiles and management scenarios) in the A2 and between 0 and 6.6% (4.5 % on average) in the B2.
It appears that the modelled climate change scenarios affect crop yields in different ways. The A2 scenario stimulates an increase of maize yields (+17% for corn and +8% for green fodder), sugar beet (+9%) and rape (+14%) compared to the OBS scenario, whereas winter wheat yields (-2.1%) and barley yields (-11%) are affected negatively. Alfalfa yields did not change significantly under A2 scenario. For B2 scenario only a decrease in winter wheat (-2.6%) and alfalfa (-7%) yields was statistically significant when compared to the OBS scenario.

P607
Changes of microbial activity along altitudinal transects in the volcanic mountains of Central Slovakia

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On the basis of climate scenarios for Slovakia, more rapid nutrient cycles are expected especially at higher altitudes above the 6th forest vegetation zone where the production optimum of Slovak forests will be probably shifted upwards.
To characterize the changes in mineralization of organic matter and in carbon storage due to expected warming, we analysed soil samples taken along two transects. One is situated in a primeval beech forest at the altitude of 1060 to 1300 m a.s.l. in the Vtá[[Unable to Display Character: č]]nik Mts.; the second one is located at the altitude of 1000 to 1450 m in the Po[[Unable to Display Character: ľ]]ana Mts. and spans from beech stands at the bottom to spruce stands in its upper part. Soil samples were taken from organic and mineral A-horizons several times. In addition to total carbon and nitrogen, basal respiration and catalase activity were determined in samples from both transects. At Vtá[[Unable to Display Character: č]]nik, also *in situ* measurements of soil respiration were performed.
Although microbial activity varied considerably during the vegetation period, we did not find any altitudinal trends in soil characteristics at any sampling date. However, soil variables are significantly correlated with canopy openness, although the correlation was not consistent among horizons. Open canopy generally increased microbial activity in the A-horizon as well as the respiration *in situ*. On the other hand, the correlations between canopy openness and soil variables were non-significant in the organic horizons. The results indicated that microclimate is probably more important for soil microorganisms than large-scale climatic patterns.

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P608
Approach for an improved assessment of irrigation indirect long-term impacts on soil fertility

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Irrigation requirements are traditionally determined considering only the needs of agricultural plants and the quality of water resources. But irrigation even with a good quality of water can lead to direct and indirect soil degradation. The direct way is rather well known, and affects soils during relatively short periods (several years). In contrast, the indirect way is related to modification of the initial (before irrigation) microclimatic conditions. It is much less studied, realized during relatively long periods (decades), and the prediction of soil quality alteration is rather difficult. Although the mathematical modeling of long-term soil alteration is usually not very reliable, it could be improved using known relationships between regional virgin soil properties and climate. This approach can be based on the geographic law of soil zonality and the establishment of a quantitative relationship between Budyko's radiative index of dryness (I_v) and regional modal values of a virgin soil fertility index (φ_v) inside geomorphologically homogeneous soil groups. The microclimatic index (I_v) is calculated as I_v = Rn/LPr, where (Rn) and (Pr) are mean annual values of net radiation and precipitation, respectively, and (L) is the latent heat of evaporation. It is considered that irrigation with a mean annual amount of water Ir changes the microclimatic index to I_{ir} = Rn/L(Pr+Ir), and will gradually lead to a new soil fertility index (φ_{ir}), which could be better or worse than the initial value (φ_v). Analyzing the curve $\varphi_v(I_v)$, it is possible to identify limits of Ir_s in order to prevent soil degradation. Although these values of Ir_s may not be sufficient to obtain a maximum crop yield, they will conserve or improve soil quality indirectly and allow for a most sustainable use of land and water resources. Some results of this approach and its verification for the case of Mexico are presented.

P609

The physical and mathematical analysis of irrigation water optimization in arid conditions

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In offered work the results of researches of thermal and water modes of various agricultural crops in conditions of Kur-Araz lowland of Republic Azerbaijan are presented. Laws of change of the basic power parameters of system soil-plant-atmosphere and quantitative ratio between them in the form of functional dependences are received.
It is shown that at excess of solar radiation the problems of economy of water and the problems of soil protection from processes of secondary salinization demand the search of new approaches in agricultural production. In this respect the suggested variants of normalization of irrigation water and taking into account the vegetative phases of plants and their energy accumulative properties can be perspective.
On the basis of data about change of radiation, average temperature of air and a surface of soil during the periods of various phenological phases, sizes of energy expenses for total evaporation and its connection with an economic crop of various agricultural crops have been established. The energy accumulated in different part of plant, the rate of irrigation water and the system of application of fertilizers was simultaneously considered.
Possible variants of increase in an economic and biological crop are shown. It is revealed, that almost in all cases, after the certain norm of irrigating water, there is an attenuation of curve dependence between a crop and quantity of the water used for an irrigation. This phenomenon was observed almost in all phenological phases of development of agricultural crops.
On the basis of the received experimental data, models for definition of optimum size of water-need of plants on phenological phases of their development and factor of useful use of energy which are suggested to use at definition of time and norms of irrigation waters separately for each agricultural crop in conditions of arid steppe zones are offered.

P610

Biological activity of water in agriculture problems

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The works of influence of various kind of the information devoted to studying on quality of water and, accordingly, to its influence on the various processes which are taking place in agriculture production, in particular information influence on quantity of grains germination represent theoretical and practical interest.
Results of the researches spend by us have shown, that action of various information fields on water lead to change of its superficial tension.
On depending of size of the energy applied on unit of volume of water, the factor of its superficial tension decreases. It occurs due to increase in intermolecular distances or type of packing of molecules the water leading reduction of forces cohesion. Thus by application of various information fields, we will changed biological activity of water (BAW).
For change of BAW, preliminary processing by its silver was spent, i.e. created various concentration of silver in applied water. Comparing quantity of germination grains, in various variants in unit of time we will defined relative change of (BAW).
It is necessary to note, that if BAW there is more than zero (BAW> 0) process conducts to reduction of factor of a superficial tension of water, in case of BAW <0, factor of a superficial tension of water increases, and if BAW=0, the factor of a superficial tension of water does not change. Experiments were spent on the basis of influence of BAW by various concentration of silver on germination of various grades of wheat.
For change of BAW preliminary processing by its silver was spent, i.e. created various concentration of silver in applied water. Comparing quantity of germination grains, in various variants in unit of time we will defined relative change of BAW.
Results have shown the greatest effect is received at application of active water by differ concentration of silver.

P611

Changes in soil properties due to different soil and water conservation methods in a non-terraced sloping oil palm plantation

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The main objective was to compare the effects of four conservation methods (oil palm frond heap or control, oil palm empty fruit bunches or EFB, EFB mat or Ecomat and silt pitting) on several soil properties over a period of 17 months. The experiment was on a non-terraced sloping land (6 degrees). Treatment applications were done annually for two years. Soil properties measured periodically were: pH, CEC, exchangeable Ca, Mg and K, total N, P, C, bulk density, aggregation, and aggregation stability. Soil water content until 1 m depth was also measured. In all treatments, there were more changes to the soil chemical properties than the soil physical properties. In the first six months, EFB, then Ecomat, gave the highest improvement in almost all the soil chemical properties. After nine months, however, all treatments begun to have comparable soil properties. In the first six months, both EFB and Ecomat were better in conserving water in the 0 - 0.6 m soil depth. EFB concentrated water more in the upper soil layers, whereas Ecomat tended to distribute the water more uniformly throughout the profile. Silt pit plots concentrated water in a shallower depth as compared to Ecomat and EFB. The control plots only conserved water in the upper layers during the wet weather periods. However, as EFB and Ecomat decomposed, they were less effective than the control and silt pit in conserving water. This study showed that EFB, followed by Ecomat, were the best methods to increase soil fertility and conserve water. As EFB and Ecomat fully decomposed after about six months, this study suggested that either higher rates or more frequent application (more than once a year) of EFB and Ecomat are required to sustain their benefits in the soil.

P612

Ecological-hydrological evaluation of Humic Gleysols drained by plastic and ceramic drainage during 20 years

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Humic Gleysols form on the carbonate-free loesslike loam with a low or moderate permeability. The use of these soils is complicated by their intensive overwetting.

We examined the ecological-hydrological conditions typical of soils with natural water regime and Humic Gleysols drained by the non-trench plastic drainage and the ceramic trench drainage during 20 years in the Moscow region.

A typical feature of the wetness regime of undrained soils is the development of a two-stage perched water table in their profile. Its upper stage is confined to the plow layer, and the lower was situated at the depth of 70-75 cm. Between these two horizons there are zones with wetness equal to the “maximal field moisture capacity” (MFMC) - “full moisture capacity”(FMC).

Observations show that drainage in wet, moderate, and dry years has very substantial influence on the wetness regime of Humic Gleysols. Its action in these soils appears in the fact that it completely or almost completely eliminates the presence of free gravity moister at the level of full flooding. In the presence of drainage in Humic Gleysols, not only is the two-stage state of the perched water table eliminated, but the gravity moister at the level of FMC also disappears from the lower horizons.

The results of observations of the wetness regime of soils let us identify definite differences in the action of ceramic trench and plastic non-trench drainage. In wet years plastic drainage causes mere intensive drainage of the soils than ceramic trench drainage.

It has been established that, throughout the entire cycle of investigation, the yield of agricultural crops in undrained soil was always substantially smaller than on drained soil.

P613

Advances in Determining Soil Water Potential Using an Engineered Porous Ceramic and Dielectric Permittivity

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Soil water potential is a key parameter for determining water availability for plant growth, water flow, and soil stability. Although an *in situ* measurement of water potential has been the focus of considerable research over the years, existing solutions still have many draw backs such as necessary routine maintenance, limited longevity, individual calibration requirements, high cost, and small measurement range. The objective of this research was to develop a sensor that could be used in the field to accurately measure soil water potential without the limitations noted above. The sensor, which consists of a dielectric sensor sandwiched between porous ceramic, was tested over a range soil types, electrical conductivties, and temperatures to calibrate and characterize its output. Data show consistent calibration curves between sensor output and actual soil water potential over a variety of soil textures and electrical conductivities. Although temperature showed an effect on sensor output, it was small compared to overall sensor output. Likewise, salt effects were not visible in saturated matrices up to 10 dS/m. Data suggest the sensor will be an effective and robust tool to determine *in situ* soil water potential.

P614

Groundwater quality and threshold values for irrigation in the River Basin of Pinios, Greece

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Groundwater samples were collected from boreholes of the former lake Karla in central Greece. This is a part of the hydrological system of Pinios River which constitutes the catchment area of former lake Karla and occupied its lower depression plain. In 1962 it was drained and land was used by farmers. Taking into account the progressive decline of soil fertility and the disturbance of the hydrological regime, currently another project for the partial restoration of the Lake Karla is under progress. Hydrochemical analyses indicated that increased Na^+ was found in most samples. It was also observed that Ca^{++} was at normal levels but elevated K^+ content was recorded. Ammonium was at normal level and nitrates ranged between 0.26 and 80.97 mg/l. The elevated concentration of nitrates can be attributed to sources related to heavily N fertilisation. Results have shown that increased content in $SO_4^=$ was recorded in one sample and this is of minor importance. Average chloride content was 488.59 mg/l and four samples are unsuitable for irrigation use, while fluorine ranged between traces and 0.54 mg/l. The content of heavy metals (Fe, Cu, Mn, Zn, Cd, Pb and Ni) was low and only manganese was high in 2 samples due to weathering of parent material which is rich in manganese. Electrical Conductivity in four samples was higher than 750 μS/cm, indicating a degree of low suitabily for arable crops. Three values of SAR were greater than 4 and the maximum value was 24.60. It was observed that certain samples cannot be used for irrigation under current conditions, because the irrigated soils in the study area are characterised by low permeability, drainage is not adequate, and only very salt tolerant crops should be adapted. Water quality in the studied district is related to agricultural activities, overexploitation and geological factors.

P615

Dryland maize yields and water use efficiency in response totillage and nutrient management practices in China

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Rainfed crop production in northern China is constrained by low and variable rainfall. This study explored the effects of tillage and nutrient management practices on maize (Zea mays L.) yield and water use efficiency (WUE), at Shouyang Dryland Farming Experimental Station in northern China during 2003-2007. The experiment was set-up using a split-plot design with 3 tillage methods as main treatments: conventional, reduced (till with crop residue incoperated in fall but no-till in spring), and no-till. Sub-treatments were 3 NP fertilizer rates: 105-46, 179-78 and 210-92 kg N and P ha^{-1}.

Maize grain yields were greatly influenced by the amount of growing season rainfall, and by soil water contents at sowing. Mean grain yields over the 5-year period in response to tillage treatments were 5422, 5171 and 5156, under reduced, no-till and conventional tillage, respectively. Mean WUE was 13.7, 13.5 and 12.8 kg ha^{-1} mm^{-1} under no-till, reduced till and conventional tillage, respectively. Mean soil water contents at sowing and at harvest were significantly influenced by tillage treatments. At harvest time, the no-till treatment had ~10-20% more water in the soil than the conventional and reduced tillage treatments. Under conventional tillage, grain yields increased with NP fertilizer application rates. However, under reduced tillage, grain yields were highest with lowest NP fertilizer application rate.
In conclusion, grain yields and WUE were highest under reduced tillage at modest NP fertilizer application rates of 105 kg N and 46 kg P per ha. No-till increased soil water storage by 10-20% and improved WUE compared to conventional tillage.

P616

Characterization of the soil water content profile along a frequency domain reflectometry probe using advanced forward and inverse modelling techniques

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The determination of the unsaturated flow properties in the field with the required spatial and temporal resolution is tedious. Recently, inverse modelling procedures have been introduced to obtain soil hydraulic properties *in situ* by inverting water content time series obtained indirectly using geophysical methods. In particular, Time Domain Reflectometry (TDR) has become a standard method, which is well adapted to estimate soil water content. Based on the reflected electromagnetic pulse from a probe inserted into the soil, the method simultaneously measures the soil dielectric permittivity and electric conductivity. TDR waveforms are commonly analyzed with techniques such that average soil water content along the transmission lines is obtained. Major steps have been made so that it is possible to characterize the soil water content profile along a TDR probe. However, these methods still suffer from limited model adequacy and non-uniqueness of the inverse estimates.
In the following of these works, our study aims to describe the soil water content profile along a frequency domain reflectometry (FDR) probe by advanced forward and inverse modelling of the measured waveform. The model describing the transmission line, made by the cable-probe-soil, is based on an exact solution of the one-dimensional Maxwell's equations for wave propagation in multilayered media. The optimization problem is formulated in the least-squares sense and is carried out using the GMCS-NMS algorithm. We analyse the signal with a large frequency range (0.2 - 3 GHz) to maximize information. The forward model is validated through a series of FDR measurements for reference materials. After having tested the proposed inverse modelling procedure for various numerical scenarios, i.e water content profiles for different probe lengths, we analyse the stability of the soil water content estimates with respect to actual electromagnetic modelling and measurement errors realised in laboratory on undistributed soil samples under various hydraulic conditions.

P617

Model for evaluating maximum nitrate leaching fluxes to free aquifers for prevention grounwater polution at catchment level according with Nitrate Directive

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The requirements for not exceeding nitrate concentrations over 50 ppm in groundwater are converted in Nitrate Directive in limiting the amount of organic nitrogen fertiliser to 170 kg/ha/year. This approach is very general not considering the leaching of soil solution to the groundwater and the balance of nitrates in the groundwater.
A two step approach evaluating the maximum nitrate fluxes below the rooting depth that are not increasing the nitrate concentration in the groundwater is proposed. The first step is the simulation of water and nitrate dynamics in soil-crop system (simulation model ROIMPEL) considering the site specific data and various amounts of organic nitrogen applied according with usual agriculture practices. The output of the simulation is the nitrate leaching fluxes vs. applied organic nitrogen.
The next step was to evaluate the maximum amount of nitrates possible to be removed from the groundwater considering a maximum nitrate concentration of 50 ppm and a flux of water from aquifers to surface water evaluated using the minimum flows recorded on the rivers connected with the aquifer. The average maximum nitrate leaching flux for all the aquifer area is calculated than by dividing the maximum amount of nitrates potential to be removed from the aquifer to the agricultural land area over the aquifer. The maximum leaching flux is related to the amounts of organic fertiliser applied in the field using the output of ROIMPEL model
This procedure was applied for calculating the maximum animal loadings in the designated nitrate vulnerable zones of Romania showing that in areas with low aquifer flows (south Romania) the animal loadings (1.5-2 Animal units/ha) are less than that predicted using the standard 170 kg/ha/year (3.5 Animal units/ha). An opposite case is for areas where groundwater flows are high enough (central and western parts of Romania).

P618

Preferential flow of water and solutes along macropores under tilled and untilled loess soil - A multiple tracing field study

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Leaching of fertilizers and pesticides through soil has been recognized as one of the most serious environmental problems in agriculture. This concern is strengthened by the increased amount of earthworm channels especially under untilled land. Earthworm burrows can function as preferential flow pathways for infiltrating precipitation water and may enhance downward transport of surface-applied agrochemicals. Our study investigates the effects of the tillage systems plough (P), conservation tillage (CT) and no till (NT) on vertical water and solutes movement based on a tracer experiment carried out on 1 x 1 m² plots in the loess region of Saxony, Germany. The experiment involved tracer applications including a dye tracer brilliant blue as well as KBr, NO_3-N and Durano (glyphosate) that were applied on the entire plots and irrigated for 20 minutes with an intensity of 1,9 mm min^{-1}. Afterwards soil samples were collected up to 1 m depth for tracer estimation. Furthermore, the abundance of earthworm channels and soil microbiological parameters such as dehydrogenase activity and soil respiration were examined as sensitive indicators for characterisation of soil management effects. The results showed that the amount of earthworm burrows in the CT and NT plots were about 2,5 times higher than in P and deep reaching. This observation corresponds to the spatial distribution of applicated tracers under CT and NT due to preferential solute transport within the macropores network produced by earthworms. Highest values of enzyme activity and soil respiration were measured along the macropores in the CT and NT plots. It could be concluded that the tillage system affected the abundance of earthworms and consequently the flow patterns of dye and mineral tracers. The high values of soil biological parameters in macropores under CT and NT practices indicate a high metabolic activity and mineralisation potential for agrochemicals transported with soil water.

P619

Infra-red thermometer application for soil and plant water regimes

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Three years(1998- 2002 field experiment was conducted with bean, sunflower and maize for grain on meadow- cinnamonic soil in ISS"N.Poushkarov" experimental station in Tzalapitza, Plovdiv region. The experimental variants were: non irrigate and 5 irrigated with relative irrigation depth 0.3, 0.6, 0.8, 1.0 and 1.3 in 3 replications.
Soil water regime was evaluated by gypsum blocks and tenziometers, designed in ISS"N.Poushkarov" twice in the week. On the base of soil water content(SWC) by balance method was computed soil water stores(WS) in different soil layers and evapotranspiration(ET) during different growth stages. Infrared thermometer(IRT) was used to evaluate plant water status by the difference(dT) between canopy temperature(T_c) and the ambient air temperature(T_a). The temperatures were measured at 14 o`clock every day. Pressure chamber, designed in ISS"N.Poushkarov" was used to measure plant leaf water potential(LWP).
Relationships between LWP and water stores were with R^2>0,7 and the relations "LWP-soil water content (SWC)"- R^2 >0,8. Relations"dT-WS" were with R^2>0,7 and "dT- SWC"- R^2>0,8 and "dT- ET"- R2> 0,7.
On this base can make the conclusion, that the measurement of T_c by IRT can be used to evaluate and control soil and plant water regimes. The method was non destructive, quick, cheap and allows an automation.

P620

Impact of stony soils on soil water retention and hydraulic conductivity - comparison between field measurements and lab experiments

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The appearance of rock fragments in soils can have a great impact on soil hydraulic properties. The Hydrographic Monitoring Network of Unsaturated Zone in Austria aims to estimate soil water movement and ground water recharge rates. As pilot project a stony field site in Styria, Austria, was equipped with soil water content (TDR) and soil water tension sensors (tensiometers and granular matrix sensors) up to 150cm soil depth. Data were recorded hourly. The soil texture is a sandy loam with a fraction of rock fragments of 25% in the 0-30cm soil depth and of 68% in the layer below 30cm.
A field soil water retention curve was determined from these measurements. Observations delivered very low water content values (~12% at saturation to ~7% at matric potential of 200hPa) during investigation period.
In order to check the plausibility of the field data a vertical soil column with free drainage was filled with air dried disturbed soil, repacked with same particle size distribution and bulk density of the in situ soil and was equipped with the sensors of the same type used in the field. Constant irrigation rate was applied and after steady state condition was reached unsaturated hydraulic conductivity and soil water retention curve were determined. Lab experiments showed water contents near saturation of about 22% and at -150hPa of about 12%. These values are about 70% higher than those measured in the field.
Deviation in hydraulic properties derived from lab and field data result in high uncertainty of estimated deep drainage and ground water recharge. Discrepancies can be explained by weakness of TDR technique in stony soils, hysteresis effects or distinct lower boundary at the lab experiment and in the field.

P621

Thermal water exploitation and it's environmental risk in Hungary

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Hungary is in an advantaged state among Europian countries in point of thermal water reservoires. On the 70% of the area of the country can be found thermal water. The utilization of it is very diverse, can be used for balneological purpose, for drinking water (mineral water), for agricultural, industrial or municipal heating and hot water supply. It depends on the temperature of the water when it is arriving to the surface. Approximately 50% of the wells' water of temperature is 30-40 °C, about 25% of the wells yields water of temperature is higher than 60 °C, and 4 % is warmer than 90°C. Currently in Hungary there are 850 active thermal water wells, the most of them are located in the south part of the Great Hungarian Plane. Among the chemical parameters of used thermal water we have to pay attention to the high concentration of salts (especially Na-salts), phenol, ammonia, nitrate, nitrite and heavy metal content, because these can strain soil or ground water. We investigated the environmental effect of thermal water sevage in Szentes. We have studied a horticultural estate, which is warmed by thermal water heat. The question was that the thermal water leaking can cause secondary salt accumulation or salinization perhaps any other contaminations in soil. Pollutants can seek to the groundwater, or the buffering capacity of soil is able to mop up it. Can contamination reach the receptive waterflow? Our poster wish to answer these questions, and would like to give a comprehensive picture of thermal water affected environment.

P622

Constructing a soil hydraulic conductivity map using pedotransfer functions and GIS (application to Horoiata basin, Romania)

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Hydraulic conductivity is a quantitative measure of a saturated soil's ability to transmit water. It can be defined as the ease with which pores of a saturated soil permit water movement. Together with soil's fluid retention characteristics, it determines the behavior of the soil fluid within the soil system, under specified conditions. Hydraulic conductivity determines the ability of the soil fluid to flow through the soil matrix system under a specified hydraulic gradient; the soil fluid retention characteristics determine the ability of the soil system to retain the soil fluid under a specified pressure condition. The hydraulic conductivity depends on the soil grain size, the structure of the soil matrix, the type of soil fluid, and the relative amount of soil fluid present in the soil matrix.
Due to the costs of laboratory or field determinations, nowadays pedotransfer functions are used to estimate and predict the spatial variability of hydraulic conductivity at different scales. Our purpose was to estimate the parameters of hydraulic conductivity, and to model its spatial variability at the scale of a small watershed. The data obtained through these methods may be further used in studies that imply hydraulic conductivity as parameter, for example the evaluation of erosion susceptibility.

P623

P movement to the Missisquoi Bay: Quebec interventions at different scales

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The Missisquoi Bay, northern portion of the Lake Champlain shared by the province of Quebec (Canada) and the Vermont and New York states (USA) has been repeatedly infested with blue-green algae over the last summers, limiting drinking water supply and recreational activities in the region. An agreement between Quebec and Vermont was signed in 2002 to limit P concentration to 25 µg L-1 in waters of the Bay. Quebec interventions were put up to: 1) improve understanding of the dynamics of non-point source P movement in agricultural system constituents, 2) develop diagnostic and water management tools at field and sub watershed scales, 3) evaluate the environmental impact of multiples interventions at the watershed scale. Measurements and model simulations have been carried out for different periods of time on experimental plots, small paired watersheds and on a large watershed. Results obtained from various set up and measurements confirmed that total P in runoff was influenced by: soil type>soil cover>soil type*soil cover>liquid manure. Annual exports of dissolved reactive P and total P at the outlet of the Beaver brook sub watershed (11km2) reached 0.65 and 1.53 kg P ha-1 respectively for the 6 years of measurements and resulted from few events concentrated over a short period (6%) of the year. Implementation of buffer strips and water inlets in the most active sectors of the watershed resulted in a 25% reduction of the total P concentration during the efficiency evaluation period of the Best Management Practices (BMP) used. Stream flow, sediment and P estimated from the SWAT (Soil and Water Assessment Tool) model used at overall watershed scale (630km2) have shown a good fit with measured data and comparison between different combinations of BMPs should allow to reach the established P load in the Quebec-Vermont agreement for the Missisquoi Bay.

P624

Changes of soybean and wheat yields - I.Under non irrigated conditions

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Four years 2004-2007 field experiment with soybean and wheat in rotation were conducted on a meadow-cinnamonic soil in South Bulgaria (experimental field of the ISS “N.Poushkarov” in Tzalapitza, Plovdiv region.
The climatic years were very different : from drought 2007(the high precipitation amount was after July) to very wet 2005 and with very irregularity distributed precipitation.
Gypsum blocks and tenziometrs , designed in ISS “N.Poushkarov” were used to evaluated soil moisture content and infrared thermometer was used to evaluate plant water regime by the difference(dT) between canopy temperature (Tc) and the temperature of the ambient air (Ta) to evaluate plant water stress and to determine the moment when must be irrigated .
The soybean yield varies from212 kg/da in 2007 to 306 kg/da in 2005. The variance coefficient of yield C_v=12% . The wheat yield changes from 301 kg/dka in 2007 to 500 kg/dka in 2006. The variance coefficient of yield C_v=21% .
A relationship between the yield and precipitation amount in the period ,(V-IX) for the soybean and (IV-VI) for the wheat, between yield and the number of days with a temperature>30^{o}C and between the number of days with dT>0 and precipitation amount were received with R^2>0,7.

P625

Changes of soybean and wheat yields - II.Under optimal irrigation

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ISS"N.Pouskarov, Sofia, Bulgaria.

The soybean and wheat yield under optimal irrigation varies too. For soybean it changes from 286 kg/dka in 2007, to 340 kg/dka in 2006. The variance coefficient of yield C_v=6%. In very wet 2005 the yield in optimal irrigated variant was a little below than non irrigated, because 3 days after the irrigation was fallen 140 mm rain.
The wheat yield changes from 438 mm in 2005(the rain for the period IV- VI was 110,5 to 711 kg/dka in 2006. The variance coefficient of yield C_v=21%.
Relationships “yield- rain + total irrigation water” and “Yeld-number of days with dT>0” with R^2>0,8, yield - number days with T>30 ^{o}C were obtained.

P626

Field and laboratory calibration of two TDR sensors

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Accurate soil water content (SWC) measurements are required for investigations of crop water use, irrigation efficiency, hydraulic properties of soils, water balance and movement of substances in soil profile. Although the soil moisture neutron probe has served this need well, it cannot be used unattended. Time domain reflectometry (TDR) methods, which respond to the electrical properties of soils, typically allow data logging and unattended operation. The purposes of this study were: (i) calibrate two TDR sensors (CS616 and TRIME-FM3) for water content under both laboratory and field conditions; (ii) evaluate the performance of TDR probes for soils with different physical properties (texture class, bulk density, organic matter content) and (iii) evaluate the effect of soil temperature on the measured soil water content. In field, TDR waveguides were installed horizontally in 2 depth positions. Soil water content measurements were taken systematically. Comparative SWC measurements were made every week gravimetrically. Four soils were collected and repacked into columns for laboratory calibration. The columns were progressively wetted and then dried over a few months. Linear calibration equations were developed. The laboratory column calibration had higher correlation coefficients (R^2 were varied from 0.78 to 0.96) than field one (R^2=0.46). Temperature correction slightly increased correlation coefficient (R^2=0.49). Use of these TDR sensors are suitable for all investigated soils; however, specific calibration for soil is needed to improve the estimations of soil water content.
This study was funded by the ISTC project 3215.

P627

Nitrate loss from tillage land - linking the unsaturated and saturated zone responses

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Increasing soil fertility through the application of fertilizers is important for maximising agricultural crop yield. However increased fertilizer application can cause environmental problems due to elevated nitrate concentrations in surface and groundwaters. The present study is a part of a broad ongoing project that aims to investigate the effect of over-winter green-cover measures on reducing the nitrate loss to unsaturated and saturated zones under spring barley cultivation with conventional plough method, at Oak-Park Research Centre, Carlow, Ireland. This paper presents the linking of two experimental field sites: first a large-scale field experiment for monitoring nitrate leaching to the unsaturated and saturated zones, and second a statistically designed small-scale plot experiment on nitrate leaching losses to soil. The large-scale field experiment consists of three over-winter green cover treatment plots: mustard cover-crop, natural-regeneration and no-cover (c. 1.5 ha each) equipped with piezometers and ceramic suction-cups. Due to the geological and hydrogeological characteristics of the site, and the need for plots to follow the main groundwater-flow direction, the large-scale experiment could not be randomised. Therefore, the randomised small-scale plot experiment (with 4 plots per treatment, each 12m x 30m in size, and with installed ceramic suction-cups) was used for investigating the effect of over-winter green-cover on nitrate leaching to soil. Both experiments are being carried out over two winter drainage periods and monitoring is on-going. The nitrate-leaching results from the randomised small-scale experiment will be linked with the results from the large-scale saturated and unsaturated zone monitoring experiment. This will allow the statistically analysed temporal differences among treatment effects on nitrate leaching to soil, obtained from small-scale experiment to be compared with the ones from the large-scale experiment on nitrate leaching to the unsaturated and saturated zones.

P628

Agricultural lands irrigation feasibility of Harsova Tableland, Dobrogea area-Romania

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Because of the visible increase in productivity in the irrigated perimeters, especially during drought seasons, a series of large irrigation systems have been developed in Romania, using the Danube river as a water source, especially in Harsova Tableland Dobrogea area, where the average temperature is 11^0, annual average rainfall 350 mm, with reference evapotranspiration Thornthwaite of 700 mm.
Taking this into consideration, I.C.P.A. issued a methodology with a number of 6 classes of irrigation feasibility soils, in order to eliminate the risks associated with irrigation implementation.
Class I - very good lands for irrigation implementation, lacking any kind of degradation risk, till class VI - non - feasible irrigation lands, degraded or with a high degradation risk, with extremely severe limitations for arable use.
The Tableland have lands from class II - good lands for irrigation implementation, with reduced degradation and agricultural use limitations, determined by salinisation, alcalisation, relief, erosion etc. These are lands that can be irrigated, but are in need of implementation of prevention measures. These lands do not raise difficult implementation problems. These lands can be found in the Eastern part of Hirsova Tableland, being occupied by Calcic Kastanozems loam-sandy type, Eutric Fluvisols and class III - moderate irrigation feasibility lands, with moderate degradation and agricultural use limitations, determined by one or more of the factors mentioned above. These terrains can be irrigated, although they present moderate restrictions and they are in need of prevention and improvement works. These lands are located in Northern part of Hirsova tableland, in Ciobanu village and Danubian river bad area with Eutric Arenosols, Gley-eutric Cambisols and Salic Fluvisols.
It can be appreciated that the Harsova tableland are in urgent need of being prepared for irrigation, because are very arid and agricultural production is very powerfully affected by long periods of drought.

P629

Correlations in the soil-water-plant system in the unirrigated and irrigated sugarbeet from Western Romania

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The paper is based on the research results obtained in Oradea, in a long term trial (1976-2007). The number of days with soil water reserve on watering depth (0-75 cm) below easily available water content and below wilting point were quantified; the quantification based on the ten to ten days determination of the soil moisture. Very significant inverse links, statistically assured, were quantified between the values of the number of days with soil water reserve below easily available water content, and sugarbeet yield. The same type of links were quantified between the number of days below the wilting point and the sugarbeet yield. Between the values of these parameters and yield gain obtained using irrigation, a direct link very significant statistically was quantified. The same type of correlation was quantified between sugarbeet water consumption and yield. All these correlations are the arguments of the irrigation opportunity in sugarbeet from Western Romania. The average of the yield in the studied period was of 65.0 t/hectare (variation interval 44.9-87.8 t/hectare) in inrrigated conditions and 40.7 t/hectare (variation interval 18.9-80.9 t/hectare) in unirrigated conditions. The standard deviation was of 6.9 t/hectare and 9.2 t/hectare in unirrigated conditions.

P630

Basic guidelines to interpret soil moisture data obtained with capacitance probes

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The measurement of soil moisture content has been a major technical challenge in recent years. However, despite progress and the incorporation of new technologies, measurement of water content *in situ* remains, today, a subject that is not completely resolved. There is still uncertainty about the accuracy and representativeness of these new technologies. In addition, the development of new soil moisture probes is much faster than the development of methodologies for testing them in a wide range of field conditions. In most cases, a soil specific calibration is done in the laboratory, whereas there are no clear guidelines for conducting equivalent tests in the field. This paper presents basic field guidelines to facilitate the understanding and the interpretation of soil moisture data obtained from capacitive type probes, installed in the field. The guidelines incorporate a decision-making tree to answer the following question: What kind of field tests and information are needed to contrast soil moisture data? Soil specific probe calibrations were conducted in the laboratory following the procedures described in the literature and by the manufacturer. The results showed that the calibrations performed in the laboratory did not provide better information because they are done with disturbed and sieved (<2mm) soil samples, which did not represent the real conditions in the field. However it is worth noting that there are conditions where laboratory calibration is necessary since there are circumstances difficult to control in the field, as is the case of soils affected by salinity. This document also proposes a simplified field methodology to calibrate capacitive soil moisture probes, based on the assessment of some physical properties, such us bulk density and the gravimetric water content at saturation, field capacity and near the plant wilting point.

P631

Chemical species of toxic metals in interstitial water of sediment from the Paldang reservoir in Seoul

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This research was aimed to evaluate chemical species of toxic metals in interstitial water of sediment from the Paldang reservoir, the main water resource for Seoul metropolitan in Korea. The metal species were calculated based on composition of inorganic and organic ligands in the porewater using the Visual MINTEQ program. The pH and EC of the sediment porewater were ranged from 5.15 to 7.78 and 177 to 584 dS/m, respectively. Total organic carbon was ranged from 10.6 to 13.3 mg/L. Copper and Pb concentrations in the porewater were in the ranges of 0.001~0.003 mg/L and 0.012~0.070 mg/L, respectively. But, Cd was not detected in all the porewater samples. Total concentrations of anions were in the orders of $SO_4^{2-} > Cl^- > NO_3^- > PO_4^{3-}$. The major organic acids were oxalate, acetate, tartrate, succinate and citrate. Speciation modeling showed that pH and organic acids strongly influenced composition of metal species revealing that metal-organic ligand complexes were major metal species. The metal-hydroxyl complexes were predominant where pH was 7.78 and free ions were predominant where pH was 5.15.

P632

Thornthwaite and Mather equation modeling to describe the soil moisture evolution in olive groves under two types of soil managements: cover crops and conventional tillage

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Mediterranean regions have a high risk of suffer erosion, not only due to its orography -normally rough-, but also for the climate conditions -with low precipitation and a high frequency of rainy stormy events-. This soil loss is especially intense in regions like Andalusia, surrounded by crops such as olive. This tree grove usually has very low levels of soil cover. Erosion over 80 $tn*ha^{-1}$ have been measured in a year, if the olive is grown in the conventional tillage way.

Cover crops are one of the most efficient methods to reduce run off and erosion in olives. On different studies, the Spanish Conservation Agriculture Association / Living Soils (AEAC/SV), has measured decreases on soil loss until 80% and nearly 70% on run off using conservation agriculture. The main inconvenient of this system is the competition for water and nutrient among olives and cover crops. This situation happens during spring months, when green grasses are evapotranspirating high amounts of water, which cause an important decrease on soil moisture. These losses could produce and important decrease on olive production, as water is the main bounding factor on dry olive groves.

Grass kill period vary with meteorology, zone, ground, cover crop type, etc.. Undoubtedly, the key to success of this system is to make a right control of the cover crop. To reach this objective authors suggest a moisture evolution simple model based on Thornthwaite and Mather equation, which needs low meteorological data, making easier its applicability. The results show the importance of springtime ground water evaporation as the main method of watering, which does not depend as much on the individual system adopted as on the atmospheric conditions themselves.

P633

Parametric estimation of water retention for gypsiferous soils using Pedotransfer functions

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Parametric estimation of soil water retention curve is crucial for modeling water movement and solute transport in the vadose zone. The objective of this study was to derive parametric Pedotransfer functions (PTFs) to predict the van Genuchten water retention parameters for some gypsiferous soils. Consequently, 185 gypsiferous soil samples were collected and their physical properties were measured. The particle size distribution was determined in two steps: (i) with gypsum, by covering the particles with barium sulfate (ii) without gypsum, using the hydrometry method. The easily obtainable variables were grouped as (1) particle size distribution, bulk density and gypsum content and (2) bulk density, gypsum content, geometric mean and geometric standard deviation of the particle diameter. The stepwise multiple linear regression method was used to derive the PTFs. Two types of parametric PTFs were derived, using these variables. The first group of variables predicted the van Genuchten parameters better than the second group. The derived PTFs were compared with the Rosetta database as independent data set. The validity test indicated that to predict the water retention curve of gypsiferous soils the derived PTFs are more accurate than what can be obtained from the Rosetta database. Removal of gypsum from the soil samples has increased the water retention at pressure heads of 0, -100, -330, -1000, -3000, -5000 and -15000 cm ($p<0.01$).

P634

Predicting water retention curve of gypsum soils using point Pedotransfer functions

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The water retention curve is necessary for many studies related to water movement and solute transport. However, its direct measurment is time consuming and costly. The objective of this study was to derive point Pedotransfer functions (PTFs) to predict the retention curve of some gypsiferous soils. Consequently, 185 gypsiferous soil samples were collected and their physical properties were measured. The particle size distribution was determined in two steps: (i) with gypsum, by covering the particles with barium sulfate (ii) without gypsum, using the hydrometry method. The easily obtainable variables were grouped as (1) particle size distribution, bulk density and gypsum content and (2) bulk density, gypsum content, geometric mean and geometric standard deviation of the particle diameter. Stepwise multiple linear regression method was used to derive the PTFs. Two types of point PTFs were derived, using these variables. The obtained results indicated that the first group of variables predicted water retention better than the second group. The gypsum content appeared to be the second dominant parameter for predicting water retention at 0, -330, -1000, -3000, -5000 and -15000 cm. The derived PTFs were compared with the Rosetta database as independent data set. The validity test indicated that to predict the water retention curve of gypsiferous soils, the derived PTFs provide more accurate estimations than the Rosetta database.

P635

Correlation between the crop water stress index and irrigation water requirements for apple in a loamy soil: a case study in southern Romania

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The paper describes the correlation between the crop water stress index CWSI and both the soil moisture content (SMC) and the irrigation water depth (ID) in a medium-textured soil from southern Romania. Soil bulk density has ranged from 1.40 to 1.49 g cm^{-3}. The land slope is from 0 to 2 %, the water table varies between 4 and 6 m depth. The experiment has been carried out at Pitesti-Maracineni, southern Romania, during two growing seasons. The lower base line as a correlation between the crop and air temperature difference versus the vapor pressure deficit for apple under the soil and climate conditions of Pitesti-Maracineni, Romania, has a highly significant regression equation. The CWSI mainly ranged between 0.10 and 0.80. Irrigation applications were usually carried out in this experiment at CWSI values from 0.20 to 0.50. SMC varied with time, usually between field capacity (FC) and wilting point (WP) in the research treatments during the months of maximum interest in irrigation application: July and August. The correlation between CWSI and the soil moisture content as both absolute values and fraction of the available soil moisture storage capacity is inverse and highly significant. However, the coefficient of determination is low due to the multitude of factors involved. The correlation between CWSI of apple trees and ID is represented by a direct and highly significant linear regression equation but with a relatively low value of R^2 (0.414). Soil variability as well as the agronomic factors implied in the experiment could also be responsible for this correlation. The practical recommendation in irrigation scheduling is that the CWSI values of 0.20 to 0.30 are appropriate for application of 500 to 700 m^3 ha^{-1} irrigation depth.

P636

Field calibration of capacitance soil water content sensors in expansive clay soils

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Multi-sensor capacitance probes are widely used for automated continuous soil water content monitoring. These measurements are important for assessing spatial and temporal soil water dynamics under different agronomic practices and for implementing soil water sensor-based irrigations techniques.

Although the use of these sensors is widely extended, the accuracy and precision of the obtained values is often unknown, especially for soils with an extreme hydraulic behaviour or a high degree of heterogeneity.

Most of the existing calibration studies were executed under laboratory conditions or in homogeneous field soils, where soil properties remain constant throughout the monitoring period, an assumption that is violated in expansive clay soils.

Four FDR multi-sensor probes, with sensors at 10, 20, 30, 60, and 90 cm below the soil surface were installed in two adjacent plots subject to different tillage practices at the Tomejil experimental farm (37º 24’ 07’’ N, 5º 35’ 10’’ W) in Carmona, SW Spain, where the soil is classified as a Typic Haploxerert, with clay, silt, and sand contents of 67, 23 and 10 %, respectively. During the 2003-2004 growing season, disturbed soil samples were weekly collected at three depths in each plot to determine gravimetric soil water content. Volumetric soil water content was obtained using previously determined relationships between specific volume and gravimetric soil water content.

Changing soil bulk density throughout the monitoring period had a significant effect on the sensor readings. Using the manufacturer’s calibration, during the wet periods, the hand-sampled water content was underestimated and during the drying period sensed soil moisture content decreased faster than its hand-sampled equivalent.

Using the available data, new sensor calibration equations were derived for expansive clay soil. These equations improved accuracy and precision of the soil water content measurements throughout the wet and dry spells of the monitoring period.

P637

Use of capacitance soil water sensors to evaluate irrigation scheduling and irrigation distribution uniformity in field crops

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Soil water sensors are increasingly used to assist irrigation scheduling in field crops. However, to assure accurate and precise root zone soil water content estimates practical guidelines for adequate sensor installation (depth, orientation) are necessary while decisions on the number and the location of the deployed sensors should be based on measures of the spatial variability of the soil hydraulic properties and the applied water depth.

A field experiment was conducted in a sugar beet field with a heavy clay soil in SW Spain to determine the different sources of sensed soil moisture variability under field conditions. Field soil spatial variability was characterized using a mobile electromagnetic induction device to measure soil apparent electrical conductivity (ECa). Thirty five soil water sensors were installed on a regular grid at a depth of 0.3 m, within an area delimited by 4 sprinkler heads. Soil water retention curves were determined in the laboratory for each sensor location. During 5 irrigation events, distributed throughout the growing season, the total applied water depth was measured at each sensor location using rain gauges. Before and after each event soil water content was measured using a hand-held TDR at each sensor location (0-0.2 m).

Soil moisture-based irrigation distribution uniformity measures were smaller than those based on irrigation depth, due to soil moisture redistribution. However both measures identified successfully the most uniform irrigation events. The irrigation depth pattern within the studied area had the largest impact on the spatial distribution of the soil water content. Taking into account this pattern, the required number of soil water content sensors to estimate the spatial mean soil water content could be reduced significantly.

P638

Dynamics of the moisture regime of a floodplain forest under original and anthropically affected conditions

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Floodplain forests of the Czech Republic rank among little distributed and thus relatively rare forest ecosystems. From the point of view of ecology, it concerns highly productive communities with rich biodiversity. Their living conditions are related to the specific floodplain moisture regime of soils in alluvia of rivers. The moisture regime of soils was studied at the Lednice locality in the Dyje river alluvium for a long time. The original water regime characterized by the annual dynamics of the groundwater level including regular, usually spring floods was disturbed by water-management measures on the Dyje river in 1972. Thus, floods have been eliminated and the dynamics of groundwater level partly reduced. Implementation of revitalization measures aimed at the optimization of disturbed moisture conditions of the floodplain forest were another anthropic intervention.

The results of the measurement of groundwater level and soil moisture are presented, before the water-management measures (1970 and 1971), in a period after these measures (1977 and 1978) and finally, after the accomplished revitalization (2005 and 2006). To stabilize favourable conditions for the floodplain forest ecosystem, an important phenomenon has been preserved: the groundwater level dynamics, and also a fact that its fall to the level of underlying gravel-sands is only of short-term and virtually does not mean moisture stress for main commercial species of the floodplain area. In case of the remarkable and long-term fall of the groundwater level and in case of disturbing of its annual dynamics, the existing complex of forests in the alluvium of the Dyje river can be permanently damaged, what in the event of forecasted climatic changes can be actual.

P639
Reduction in soil evaporation losses due to crop residue on soil surface in three soil texture classes

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The maintenance of crop residue on soil surface forms a barrier to incident solar radiation and, as a consequent, reduce solar energy absorption and modify the energy balance through reducing the energy available for soil evaporation. The daily soil evaporation is reduced as crop canopy grows, however, the literature usually associated soil evaporation with evapotranspiration or even plant transpiration. The objective of this study was to characterize the effect of crop residue on soil evaporation in different soil texture classes. The study was conducted in a set of 12 drainage lysimeters that were filled up 10 years ago with different soil texture classes (clayey, sandy and loamy). Two treatments were applied: without crop residue and 3.0 Mg ha^{-1} of wheat residue on soil surface. The volumetric soil water content was measured, every 15 minutes, using a TDR system (time domain reflectometer) during two soil drying cycles. TDR sensors were installed at 0-10 and 10-30 cm soil depth layers. Soil evaporation was reduced by the presence of crop residue on soil surface, in the three soil texture classes evaluated. The soil texture classes influenced soil evaporation, especially for the treatment without crop residue on soil surface when the soil water content was higher. The presence of crop residue on soil surface directly influenced the water content, in the three soil texture classes, during the two drying cycles. The larger effect of crop residue in reducing soil evaporation was observed for sandy soil compared to clayey soil texture. Considering the upper 30 cm of soil profile depth, the presence of crop residue on soil surface (3.0 Mg ha^{-1}) increased the soil water availability in 15 mm, by reducing the total soil evaporation loss, in comparison with a bare soil surface.

P640
Effect of repeated application of composts on the dynamics of water in soil

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A long- term field experimental, located in Feucherolles (Yvelines, France) has been initiated in 1998 in order to characterise the agronomic value and environmental impacts of urban composts. Three different composts, a biowaste compost (BIO), a municipal solid waste compost (MSW) and a co-compost of green wastes and sewage sludge (GWS), differing in their bio- physicochemical properties have been applied on wheat stubbles every two years from 1998 until now at a rate of 4 tons of organic C /ha.
The 3 compost treatments were compared to farmyard manure applied at the same rate and to control treatment without organic amendment. Wheat and maize were cultivated in rotation. One plot of each treatment is equipped with tensiometers and TDR at 20, 40, 60, 100, 130 and 160cm of depth, and with thermal probes and lysimeters at 40cm of depth.
Water movements were traced by bromide. Cartography of the bromide concentration shows large variability which can be attributed to tillage.
The differences in bromide profiles between treatments will be related to the measured soil hydraulic properties of each plot and will highlight the influence of repeated compost application on soil water dynamics.
Acknowledgment: The field experiment is carried out with the support of Centre de Recherche sur la Propreté, Veolia Environnement R & D.

P641
Soil evaporation losses during maize growth cultivated in different types and amount of crop residue on soil surface

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The presence of crop residues on the soil surface decreases soil temperature and increases soil water content, and affects the water flow in the soil-plant-atmosphere-system. The objective of this research was to evaluate soil evaporation losses from maize sowing to vegetative growth using different amounts and types of crop residue on soil surface. The experiment was conducted in the experimental area of the Agricultural Engineering Department at the Federal University of Santa Maria, RS, Brazil, during the 2007/08 growing season. Treatments consisted of six treatments, factorial (2x3), distributed in a completely randomized design, with three replications. Treatments applied were: Factor A - types of crop residues (black oat and black oat + Vicia sativa L.) and; Factor B - amounts of crop residue (0, 3 and 6 Mg per hectare). The experimental plots were protected against rainfall by an arch rain shelter structure. The experimental plots were covered by shelter just before rainfall. Maize cultivar P 30F53 was sowed on December 11th, 2007, using 45 cm row spacing and seven plants per linear meter. Cycles of soil drying were applied during the maize vegetative growth. A drying cycle was considered completed always when the cumulative reference evapotranspiration (ETo_{PM}) reached a value of 50 mm. Soil water content was measured every 15 minutes, using TDR sensors installed at 0-10 an 10-20 cm soil depth. Soil evaporation losses were higher for the treatment kept without crop residues (22.8 mm) compared to treatments with 3 and 6 Mg ha^{-1} of crop residue of black oat (16.5 to 17.6 mm) and black oat + vicia sativa (16.0 to 19.3 mm), respectively. The presence of crop residue on soil surface reduces soil evaporation losses, and consequently a larger amount of soil water is available for plant growth and development compared to a bare soil.

P642
Modelling the Hydrological Response of Land Use Change in Zanjanrood Basin

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This paper investigates the hydrological effects of specific land use changes in a Zanjanrood basin of Iran. The study reveals how land use changes affect hydrological regimes at the watershed scale. The water balance is simulated with the use of the Soil and Water Assessment Tool (AVSWAT-X.2005). This is a hydrological model that requires, the land uses of the inspected areas, in the form of a digital map. The model's calibration efficiency is verified by comparing the simulated and observed discharge time series at the outlet of the watershed, where long series of hydrometrical data exist. The model is used to simulate the main components of the hydrologic cycle, in order to study the effects of land use changes. Three land use change scenarios are examined, namely (1) expansion of agricultural land, (2) total deforestation(clear cutting) of the Zanjanrood sub-basin and (3) expansion of urban areas in the Zanjanrood sub-basin. The results show that deforestation scenario was the one that resulted in the greatest modification of

total monthly runoff. There is no significant impact on the water yield and river discharge when the deforestation percentage is below 60% or the overgrazing percentage below 50%. The numerical simulations indicate that the hydrological response to progressive land cover change is non-linear and exhibits a threshold effect.

P643
Soil Research in view to introducing irrigations in Baragan Plain

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Climate data have been gradually changing due to progressive atmospheric warming resulting from the combined action of more factors both natural (Earth behaving like a black body) and human (ever growing amounts of various emissions with greenhouse effect in the terrestrial atmosphere), which determines both a reduction in precipitation amount at soil level and an increase in temperature.
Step by step, climate has certainly become a major restraining factor for agricultural crops growth and development, especially in Eastern Romania, where aridity index (P/ETP) has values between 0.50 and 0.65, making climate influence of utmost importance both in alloting and in using water resources in agriculture. Extreme climate aspects (most often manifesting as drought) are amplified by the current status of irrigation systems requiring both new technologies and the extension of tracts that can be irrigated, which is an instrumental measure to enhance physical and chemical features of soil units in Romanian dry-subhumid regions, covered to a large extent by Baragan Plain.
Agricultural potential increase in Baragan focuses especially on irrigation extension, taking into account restraints related to wind erosion, surface erosion, salinization/acidification, soil texture etc., which may result in biodiversity enrichment both in agroecosystems and in ecosystems, provided its known dwindling trend in dry-subhumid areas, and at the same time it calls for the implementation of a sustainable management of soil resources in this area of Romanian Plain.

P644
Preferential flow and slow convective chloride transport through the glossic acidic soil of a beech forest (Fougères, France)

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This study aims to assess the water flow and non-reactive solute transfers occurring in a glossic acidic soil under a beech forest in Brittany (Fougères, France). The objectives were to prove the cohabitation of preferential flows and slow transfers in this soil, and to understand their spatial and temporal variability. For this, we carried out a field tracer experiment and sprinkled chloride enriched solution over two areas of soil (2 x 66m²) in March of 2006. Subsequently, we monitored the composition of the soil solutions collected by zero tension plate lysimeters and ceramic cup lysimeters installed at depths between 0 and 240 cm, over a period of 18 months.
We prove that preferential flows through rapid-mobile porosity and slow transfers by convective flux though slow-mobile porosity coexist in the soils of the experimental plot, and that the time scales brought into play ranged from a few days to a yearly scale. The transfer velocities ranged between 2.38 $mm.day^{-1}$ for the slowest convective flux and 600 $mm.day^{-1}$ for the fastest preferential flows. We also prove that the rapid-mobile porosity represents only a small proportion of the soil volume (means of all depths except 10 cm: about 11%) but the quantity of solute transferred, which by-passes a large part of the rooting zone, may be important (around 17% of the tracer mass applied). Both transfers are also characterised by wide spatial and temporal variability. The wide transfer variability may be explained by the hydrodynamic dispersion related to the heterogeneity of the slow and rapid porosities, combined with the impact of the 2006 growing season, which slowed down the tracer displacement. Lastly, the experiment proves that the zero tension plate lysimeters mainly collect rapid drainage water, as preferential flows, while the ceramic cup lysimeters mainly collect slow-mobile water mixed with rapid drainage water.

S14 Organo-mineral Interactions

P645
Behavior of heavy metals in the model soil system, consisting of mineral, liquid and organic components

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Soil is a very complex stochastic natural system. This justifies the use of model soil systems with a limited number of soil components for study of their interactions. Such approach may be useful for investigation of grounds and construction of soils on other planets also.
Adsorption of lead and cupper in the model ternary soil system, consisting of goethite, solution and oxalate, was studied. The experiments were carried out at pH values ranging from 3 to 5.5 and oxalate/metal (or metals) molar ratios of 0, 1, 2, 4, 8 and 10.
In the absence of oxalate the affinity of Cu for goethite was higher than that one of Pb. The pH_{50} at which 50% of Cu or Pb was adsorbed was 4.7 and 5.1 respectively. At pH 4.5 in the presence of oxalate adsorption of Cu by surface of goethite increased by increasing oxalate/metal molar ratio up to 2 and then slowly decreased. Vice versa, adsorption of Pb on the mineral increased up to an oxalate/Pb molar ratio of 6 and then slightly decreased by further increasing oxalate concentration. The effect of oxalic acid on the adsorption of sum of the elements was similar. Clearly, organic ligands adsorbed on the surfaces of metal oxides decrease their point of zero charge enhancing at certain concentration the adsorption of Cu and Pb or may facilitate the formation of ternary complexes (oxide-oxalate-metal). However, greater amounts of oxalate ligands may inhibit adsorption of the metals by occupying many adsorption sites on the mineral, which are then not available for Cu and Pb or favoring metals desorption relative to ternary complex formation.
The competition of Cu and Pb for adsorption sites at the metals different concentrations and effect of oxalic acid on this process was investigated also.
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P646
Thin layer chromatography study of organomineral complexes using the system of polyphenol/aluminum hydroxide

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Thin layer chromatography (TLC) is a quick method used to separate chemical compounds. This method offers a wide range of uses, some of which are the monitoring of chemical reactions and the qualitative analysis of reaction products. The TLC study was carried out by using different forms of organomineral complexes (OMC) which were synthesized by adsorption in a gas-solid phase at 50 °C in the presence of atmospheric pressure for a period of 60 days in total darkness. For the preparation of the samples, three forms of synthetic aluminum hydroxide (gibbsite, boehmite, pseudoboehmite) and four forms of phenolic compound (pyrocatechol, resorcin, pyrogallol, guaiacol) were used. The analysis was conducted by applying the ascending TLC method which consisted of a thin layer of silica gel and a solvent mixture of 1:9 hexane-methanol. Subsequent analysis of the TLC chromatogramm was carried out by determining the retention factor R_f. The TLC chromatogramm showed specific sequences of separated compounds which confirmed the existence of various reaction products of OMC. On examining the length of the sequences, polarity gradients of separated compounds were clearly identified. Two of the horizontal spot lines of OH-R compounds presented a distinct image which reached the highest R_f values ranging from 0.64 to 0.83. In comparison, the highest R_f values of CH_3O-R-OH compounds ranged from 0.71 to 0.74 and identified just one distinct spot line. The separated compounds were classified as intermediate reaction products that were formed by the organomineral complexation.

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Effects on suspensions dispersed particles & water purification produced by Cardon Dato mucilage, iron chloride, alum, and their combinations

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Pressure to use dispersive soils has increased worldwide, soil conservation against erosion is crucial and water contamination by eroded materials is a relevant problem. Then, research on organic and inorganic conditioners for reducing soils' particles dispersion, improving soils´ properties as structure and permeability, and reducing water sources contamination is necessary. Effects of a Cardon Dato (*Stenocereus griseus* (Haw.) F. Buxb) mucilage (CD), $FeCl_3.6H_2O$ and $AlCl_3.6H_2O$, on flocculating suspensions and arrangement of suspended particles from a Spain kaolin were studied. Suspensions were treated with the following solutions: 50 mg L^{-1} CD; 30 mg L^{-1} CD; 10 mg L^{-1} CD; 3 $cmol^+ kg^{-1}$ Fe^{+3} ; 3 $cmol^+ kg^{-1}$ Al^{+3}; 1.5 $cmol^+ kg^{-1}$ Fe^{+3} + 1.5 $cmol^+ kg^{-1}$ Al^{+3}; 50 mg L^{-1} CD + 1.5 $cmol^+ kg^{-1}$ Fe^{+3}; 50 mg L^{-1} CD + 1.5 $cmol^+ kg^{-1}$ Al^{+3}; 50 mg L^{-1} CD + 1.5 $cmol^+ kg^{-1}$ Fe^{+3} + 1.5 $cmol^+ kg^{-1}$ Al^{+3}; 5 mg L^{-1} CD + 1.5 $cmol^+ kg^{-1}$ Fe^{+3} + 1.5 $cmol^+ kg^{-1}$ Al^{+3}; distilled water; 10 mg L^{-1} of PAM. Concentration of particles in suspension (CPS), an index of solutions turbidity and volume of flocculated particles (VFP), an index of particles' array were determined. CD and the kaolin were characterized.
Composition of CD was: ramnose, arabinose, galactose, galactopiranose, uronic acids, carboxylic, aldoxes and alcoholic groups. Composition of kaolin was: 55% clay and 45% silt and kaolinite its main mineral. 50 mg L^{-1} CD produced the lowest CPS among all treatments and the higher VFP among solo CD treatments, with minimum effects on solutions' pH and electric conductivity. VFP of CD treatments resulted larger than VFP of mineral treatments, effect that could be explained by mucilage's solutions higher swelling capacity which results in a more open, card-house type structure of the particles that CD bonds together.

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Photodegradation of methanol, glutamic acid and glucose on the surface of iron-bearing minerals

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Here we report preliminary results on the photochemical decomposition of glutamic acid, glucose and methanol on the surfaces of haematite and olivine. These early studies were conducted in water and the solutions illuminated for set periods of time with either UV or white light. The analytical techniques used were UV-vis spectroscopy for glucose, glutamic acid and methanol concentration determination, XPS for the adsorption of organics on the mineral surfaces, titration for the determination of iron concentration in the solutions and NMR for the determination of the intermediate reaction products. Various parameters, including temperature, pH, iron concentration and light wavelength, were studied. Control experiments, in the dark but otherwise under the same conditions, were conducted in parallel. Results indicate that the concentration of the organics in solution decreased after exposure to UV or white light for 48 hours. This decrease was not observed in the control experiments. We believe that the presence of haematite and olivine promoted degradation of the three organic substances. The results of this study are connected to research into soil degradation and loss of organic matter since iron-bearing minerals in soil interact with organic matter. Furthermore, the mineralisation of organic matter by photochemical reactions induced by iron-bearing minerals could be one of the reasons why organic matter has not yet been found on the surface of Mars. This is supported by the fact that iron-bearing minerals are abundant on Mars.

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Growth and Nutritional Status of Grapevine Inoculated with Arbuscular mycorrhizal (AM) fungi in Chile

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The effects of root inoculation with mycorrhizal fungi (genus *Glomus*) on growth and leaf mineral concentrations of grapevine (*Vitis vinifera* cv. Cabernet Sauvignon) were studied under the growth conditions of Central Chile. All treatments showed mycorrhizal infection, even the Control treatment where no AM were applied. These results reflect the presence of native mycorrhizas in the soil of the study, with activity in roots of grapevine. Inoculation enhanced the uptake of N and K and vegetative growth but decreased the concentration, but not necessarily the uptake of P. These results obtained in experimental conditions and young plants have a practical importance. The studied inoculant could be applied in the nursery, where moderate amounts of colonization are often naturally achieved and in the vineyard after the transfer of these plants to a low-nutrient environment they could spread and enhance plant growth and production.

P650

Evaluation of the controls on humic acid-mineral interaction

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Sorption on mineral surfaces influences not only the mobility of DOM but also the transport of complexed heavy metals. In a previous work on dissolution of heavy metal from greenhouse soils by humic acid, sorption experiments revealed that humic acid - soil interaction could be one of the reasons of low dissolution. Sorption of humic acid on all soils represented a linear behaviour resembling C-type isotherm; which could be well described by the linear initial mass approach (r^2> 0,99). The distribution coefficients were calculated as 2,24 x 10^{-2}, 1,98 x 10^{-2} and 0,77 x 10^{-2} m^3/kg for Fethiye, Samsun and Izmir soils, respectively, representing a reverse order of their SOM contents. It is well known that soil organic matter hinders while iron and aluminium oxides/hydroxides and clay promote the sorption of dissolved organic matter. The occupation of sorption sites of

Izmir Soil by its high organic matter content resulted in a decrease in positive charge and thus in a charge reversal hindering the sorption of humic acid. Since the extent of sorption also depends on the nature of charge developed by humic acid and mineral surfaces, determining the type of bond involved, the pH of humic acid soil suspensions were evaluated. Considering the equilibrium pH, humic acid adsorptions were proceeding in a pH range of 7 to 8. At this pH range, which is close to the pH_{pzc} of aluminium and iron oxides/hydroxides, aluminium and iron oxides/hydroxides still carry a positive charge; humic acid molecules, on the other site, are negatively charged due to the deprotonation of only carboxylic functional groups ($pK_a \sim 4$). Under these conditions, it can be proposed that sorption of humic acid molecules on mineral surface might have occurred directly and with a lesser extent of cation bridging between the humic acid molecule and mineral surface.

P651
Wetting-drying cycles effects on persistence of a natural mucilage, iron chloride and alum as structuring materials

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Effects of organic and inorganic conditioners on aggregation of suspended particles and alternated wetting-drying cycles influence on persistence of aggregates formed by the conditioners: Cardon Dato mucilage (CD) (Stenocereus griseus (Haw) F. Buxb), iron chloride, aluminum chloride and a commercial poliacrylamide (PAM) were studied. Doses tested were: 50 mg L^{-1} CD; 3 $cmol^+ kg^{-1} Fe^{+3}$; 3 $cmol^+ kg^{-1} Al^{+3}$; 1.5 $cmol^+ kg^{-1} Fe^{+3}$ + 1.5 $cmol^+ kg^{-1} Al^{+3}$; 50 mg L^{-1} CD + 1.5 $cmol^+ kg^{-1} Fe^{+3}$; 50 mg L^{-1} CD + 1.5 $cmol^+ kg^{-1} Al^{+3}$; 50 mg L^{-1} CD + 1.5 $cmol^+ kg^{-1} Fe^{+3}$ + 1.5 $cmol^+ kg^{-1} Al^{+3}$; 10 mg L^{-1} of PAM; and distilled water as control. An oven dried (60-70°C) Spain kaolin powder was used as substrata. Equal amounts of kaolin powder were suspended in each conditioner and submitted to four cycles of drying and wetting. The comparative effect in the aggregation index (AgI) for three different sizes of aggregates (< 6 μm; 6-25 μm & >25 μm), among those 10 treatments was analyzed by a completely randomized model with four repetitions. The effect of each wetting-drying cycle for each treatment was also analyzed by a totally randomized model with four repetitions.
The kaolin was 55% clay and 45% silt and kaolinite its main mineral. The AgI of the 50 mg L^{-1} CD treatment was less persistent than the one of 10 mg L^{-1} of PAM, and the AgI of them both were less persistent than those of all treatments that included Fe and Al. The smaller AgI persistence of these two organic conditioners could be related to their lower bonding strength among aggregated particles, which reduces their effectiveness in avoiding particles dispersion during wetting. The structuring effect of Al and Fe is more long-lasting than the one induced by the organic conditioners.

P652
Soil aggregate stability assessment based on a combination of wet-sieving techniques and turbidimetry

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Water -stable aggregate (WSA) and Water-dispersible clay (WDC), are recognized as the important properties with respect to predicting soil erosion and colloid leaching. In this laboratory study, we evaluated the clay (C), organic matter (OC), and calcium carbonate (CaCo3) contents, influencing the satiability of aggregates and despicability of clay on 33series of soils from west of Iran. We used Pojasok and Kay (1990) method on the aggregates <8mm in diameter, to masseur the WDC and the WSA greater than 0.25 mm diameter. The WSA, measured using this method were compared with those determined by Yoder method (1936) using the same aggregate sizes. The aggregate satiability measured by two methods exhibited the highest correlation to organic -matter content. The WDC were found positively correlated to organic carbon and clay contents. There was a good agreement between two methods

P653
Testing DRIFT for analyzing organic matter composition at intact flow path surfaces

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The Fourier Transform infrared spectroscopy in diffuse reflectance (DRIFT) method allows *in-situ* characterization of the chemical composition of soil organic matter (SOM) for finely ground highly diluted samples with smooth surfaces. However, DRIFT has yet not been applied for analyzing intact flow path surfaces in structured soil such as worm burrows or soil aggregate skins. Main problems are related with the interpretation of effects of surface texture and geometry on signal intensity. The objective was to adopt the DRIFT technique for determining local-scale 'maps' of OM composition at undisturbed crack and aggregate skins.
First, samples with defined (i) relief and (ii) texture using mixtures of quartz with OM of known composition were scanned with DRIFT. The results were used to correct the IR signal intensity of samples with unknown OM composition. Furthermore, spatial distribution of OM composition obtained by DRIFT mapping were compared with those obtained by transflection FTIR-microscopy with respect to the CH- (A) and C=O- (B) group bands (A/B ratios). The signal intensity generally increases with particle size as expected since the diffuse reflection is proportional to particle size. The variations in distances between sample surface and concave mirror caused by the micro-relief modified the intensity of the signal as well as the signal-to-noise ratio along transects. A manual vertical adjustment was found to counteract the relief effect. The results suggest that standard DRIFT instruments require additional calibration for application towards intact surface analyses. Local maps of OM composition, however, may eventually help improving the analysis of transport of sorptive chemicals in structured soil.

P654
Study of the potentially mineralized nitrogen content and nitrogen supply of a brown forest soil by incubation method in East Hungary

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The formation and fate of soluble N-forms and its response to organic matter mineralization is not obvious yet and often inconsistent despite the intensive research. The available nitrogen supply of the soil is very important for the plant nutrition and the environmentally sound N-fertilization also.
The determination of actual N-supply are very important and obligate for sustainable agriculture in Hungary, especially acidic sandy soils, which are very sensitive to environmental effects and inefficient human treatment.
Therefore the aim of this paper is to provide further information about nitrogen mineralization processes and organic-mineral interactions of soil.
To establish the potentially mineralized nitrogen content and available nitrogen supply of soil biological (incubation) method was carried out an acidic brown forest soil of "Nyírlugos" long term field experiment in Hungary.

The incubation was carried out in the laboratory with different treated soils of long term field experiment to investigate the effect of treatments on nitrogen mineralization processes of soil. The incubation period was 16 weeks long.
The pH and the easily soluble mineralized and organic N fractions of soil were measured periodically from leached solution (0.01 M $CaCl_2$). The leaching process is repeated after 2., 3., 5., 7., 9., 12., and 16 weeks. The potentially mineralized N content of soil and the actual rate of N-mineralization were calculated from periodical collected data.
The results of the incubation method can be summarized as follows:

- The kinetic of incubation of 0.01 M $CaCl_2$ soluble organic N similar to mineral N.
- 0.01 M $CaCl_2$ soluble N-fractions are mainly in inorganic forms under incubation period but the content of organic forms significant too.
- The mineralization rate is higher, where the microbiological activity of the soil is expressed and the soil properties are more favoured due to applied treatments.

P655

Capability of wheat (*Triticum aestivum* L.) to uptake potassium from three K-bearing minerals and its effect on mineral transformation

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This study was conducted to investigate the ability of wheat (*Triticum aestivum L.*) to extract and uptake potassium from K-bearing minerals and its effect on mineral alteration in a pot experiment. Three types of mica including a muscovite, a biotite and a phlogopite from the local sources in Iran were selected. They were ground to an appropriate size (0-60 micron). Wheat seeds (*Triticum aestivum* L. cv. Rushan,) were planted in pots filled with a mixture of quartz sand (0.1-0.5 mm) and 3% of the mica minerals of interest. This experiment was conducted in a completely randomized design with three replicates. The treatments consisted of 3 different growing media including biotite+quartz, muscovite+quartz and phlogopite+quartz Mica minerals were assumed to be the sole source of K for plant nutrition. After 4 months, plant shoots and roots were separately cut and their wet and dry mass, shoot and root length, shoot and root diameter, leaf number and leaf flag area were measured. The concentration of K and other nutrients in plant tissues were determined following digestion with standard acid. Also, at the end of experiment, particles from the root zone were separated and analyzed by XRD method. Significant difference ($p<0.05$) was observed in all of the parameters measured among treatments except for the leaf number. Biotite could provide higher quantity of K to wheat (35.5mgK/pot) as compared to both muscovite and phlogopite. There were significant differences between Biotite and the other two mica minerals treatments in shoot biomass. The shoot and root length parameter indicated a similar result. Higher ratio of 1.4nm to 1.0nm peak intensity in XRD pattern in biotite treatment at the end of experiment as compared to that of control clearly showed that vermiculitization of this mineral happened as a result of K uptake by plants.

P656

Difference of arsenic mobilization processes in submerged soils of a jute pond and a rice paddy in West Bengal, India

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Arsenic is playing a crucial role in polluting the environment in West-Bengal due to its high concentration in ground and irrigation water. The role of organic acids with respect to release and fixation of arsenic in soil is still not well understood.
Significant quantities of organic acids are produced in the state of West Bengal (India) and Bangladesh, mainly due to processing of jute in traditional way. Organic acids thus produced, move down with percolating water and react with the minerals on their way to the groundwater table. Strong reducing conditions generated by the decay of organic substances and modification of sorption behaviour of mineral surfaces by organic acids causes mobilization of redox sensitive elements, such as arsenic. Under such condition, arsenate can be reduced into the more mobile arsenite, which subsequently can percolate towards the groundwater table. Within this study, arsenic mobilization processes were investigated in a 9 m deep soil profile of a jute pond and, for comparison, in a 9 m deep soil profile of a rice paddy. Within the jute pond arsenic was mobilized from upper 2.7 meters of the soil profile and subsequently fixed in deeper horizons where reducing conditions were less prevalent. Further downwards, the concentrations reached background conditions. In the soil profile of the rice paddy, arsenic was enriched in the upper three meters, due to irrigation by arsenic contaminated water. In deeper layers, the arsenic concentration decreased towards background conditions. Thus, permanent reducing conditions in combination with water containing low concentrations of arsenic (jute pond) causes mobilization of arsenic within the soil profile, whereas irrigation with arsenic contaminated water (rice paddy) causes arsenic accumulation in most upper soil layers.

P657

A preliminary study of the effectiveness of the sodium pyrophosphate as selective extractant for Al and Fe organically bound in andic soils

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The selective chemical analysis are extremely relevant in soil science, because of their use both as i) indirect analytical methodologies to determine semi-quantitatively some minerals in soils and ii) for soil classification. The acid-ammonium-oxalate (OX) and the sodium-pyrophosphate (PY) extractable Fe, Al and Si are used to infer allophane, imogolite and ferrihydrite content in soils. For Andosols and Podzols classification, the evaluation of the %(AlOX + 0.5FeOX) is required. The ratio AlPY/AlOX is widely used in Andosols classification for separating andic horizons dominated by Al-humus complexes (Aluandic) from those dominated by allophanic materials (Silandic), with the purpose to evidence different weathering processes acting upon the soil. OX is considered a selective dissolution extractant for organically bound Fe and Al, noncrystalline hydrous-oxides of Fe and Al, allophane and amorphous aluminosilicates, while PY should extract only organically bound Al and Fe.
The present work has the aim to investigate the selectivity power of these two extractant in the dissolution of mineral and organic compounds in soils, with a chemical and FT-IR-spectroscopic approach. Chemical analysis, carried out on 198 soils, shown high amounts of AlPY (more than a half of AlOX) for many samples and significant SiPY concentrations. Statistical analysis revealed significant correlations between AlPY and FePY (0,672**) and between AlPY and SiPY (0,76**). Important variations in the FT-IR spectra acquired on selected 8 samples, before and after treatments, are observed. Notably a lower absorption is observed for PY and OX compared with NT (non treated) samples in all andic soils in the region between 3600 and 3200 cm-1, reflecting a decreasing amount of organic compounds and/or of less crystalline minerals both in PY and OX. The results evidence dissolution e/o dispersion processes operated by the PY on mineral soil components, indicating the no-selective power of the sodium pyrophosphate.

S05 Soil Desertification and Salinisation

P658

Effects of different growing medium salinity on germination and seedling growth stages of canola (*Brassica napus* L.)

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Abstract
Plant establishment and survival are dependent on Germination phonologic stage. To investigate the effect of salinity on germination and seedling of Canola (*Brassica napus* L.) in a natural saline soil and to compare the germination process in natural and artificially made saline water (NaCl + $CaCl_2$ solution), an experiment with three phases was conducted in completely randomized design with 12 saline treatment and. Germination in the first two phases was in Petri dishes in an incubator and included a non-saline water treatment (Tap water) and 12 saline water treatments of 3 to 25 dS/m from two sources; natural saline water and NaCl + $CaCl_2$ solution as a charge base. Germination in phase 3 was carried out in a greenhouse inputs containing natural saline soil, which was equilibrated with saline water having the same salinities. The germinated seeds were counted at the desired time intervals and continued until 3 continuous counting were identical. The percent and germination rate were calculated and analyzed. The result indicated that number and rate of germination are decreased with salinity increasing. But this decrease in natural saline water was more than the NaCl + $CaCl_2$ solution. Comparison of seed germination in soil and in incubator showed that the seed could germinate in all salinity treatment in incubator (in spite the decrease in germinated seeds and germination rate), but seed germination in soil was continued up to 11 dS/m. with time, seedling growth decreased with increasing salinity and sometimes was fully stopped. The seed could not germinate and grow in soil salinity more than 7 dS/m. also germination was observed in all saline treatments in the incubator, but seems it can tolerant salinity in germination stage up to 5 dS/m.
Key worlds: canola, germination, salinity, threshold value

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Modeling canola response to salinity under vegetative growth stages

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Sensitivity of plants to salinity varies during growth season. Salt tolerance of various plants has been extensively studied; however, the results have either been qualitative or expressed as average values of root zone salinity for the whole growth period. Thus, developing appropriate models for quantitative characterization of plant response to salinity at different growth stages is essential. Canola which is considered as high economic value plant was selected for this study. Three vegetative stages for canola are recognized: seedling, rosette, and bud. To determine the effect of salinity on canola at vegetative growth stages, a large greenhouse experiment was conducted on a natural saline loamy sand soil, using salinity treatment including one non-saline water (tap water) and 8 natural saline waters of 3 to 17 $dS.m^{-1}$.The plants were irrigated with tap water before the desired stage and salinity treatments were then applied. Various linear (The Maas and Hoffman) and Non-linear (vanGenuchten and Hoffman, Dirksen *et al*. and Homaee *et al*.) models were proposed to predict relative seedling number, and relative transpiration ( ). The Maximum Error (ME), Root Mean Square Error (RMSE), Coefficient of Determination (CD), Modeling Efficiency (EF) and Coefficient of Residual Mass (CRM) statistics were used to compare the models and their efficiency. The results indicated that the Maas and Hoffman model provides reasonable prediction at seedling stage. Analysis of the collected data indicated that the Homaee *et al.* model provides better prediction at rosette and bud growth stages.
Key words: canola, modeling, vegetative stage, salinity, threshold value

P660

Researches regarding the degraded soils through salinisation for their prevention, control and bioremediation

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Large surfaces with salsodisoils (saline and nitric soil-SRTS, 2003; alkaline soil and saline soil-WRB-SR, 2006; solonchak-FAO, 2000) occupied all over the world (323mil. ha), as well as in Romania (614.000-10% from landing crop) and the increasing tendency of the surfaces secondary salinisation determined many researches regarding their amelioration and environmental protection against the phenomena and processes of resources soil degradation.
In this work we are presented the researches results regarding the enhance of degraded soils through salinisation and alkalisation in a middle sector in Prut river meadow from the Eastern of Romania.
There were evaluated the soil resources and ground water quality indicators from the experimental field Osoi-Moreni (middle sector of river Prut meadow - Iasi County) located in a damming and drainage enclosure Sculeni-Tutora-Gorban. There were noticed negative ecological effects of soil chemical degradation showed through salinisation processes and phenomena and some measures were proposed. There had been in view the effects and efficiency of some ameliorative measures.
There are presented the results of some phytoameliorative measures (with perennial plants resistant to salinisation on a drainage and amendment foundation) and with some mineral and foliar fertillisation measures.
Agro-pedo-hidroameliorative measures have a positive influence on the productivity of the natural and cropping phytocenosis.
Mineral fertilisation in complex with the foliar one has a production increasing statistically assured, pointed out from economically and energetically point of view.

P661

Long-Term Soil Degradation and Desertification in Iran

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Iran is a large country with great natural resources and long history of civilization. Soils as a part of the environment underwant a significant change; therefore to day various types of soil degradation can be seen in many parts of the country. The soil degradation is a serious historical and current problem in Iran, the Evidence shows that the beginning of soil degradation took place during the early Persian civilization; since than agricultural activities have caused significant changes in soils.There are several factors which accelerate soil degradation in Iran. This study in addition to the illustration of these factors, discusses how population dynamics and land use changes caused soil degradation in this country. Based on the above, also in order to investigate long-term human-induced soil degradation in Iran with high resolution, it is necessary to reconstruct the initial natural environment with fine stratigraphical analysis of both soil and sediments.These will create an accurate investigation of long-term soil degradation regarding human impact in order to assess how damage can be minimized in the future.

P662

reclamation of saline and sodic soils with out using reclamtor via laboratory physical models

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This experiment was down in saline and sodic soils of Kermanshah which includes lime formation.
Water sample prepared from the nearest well to location.
Soils were sampled from 0-10 , 10-20 , 20-30 , 30-40 and 40-50 cm depths of soil profile and transferred to laboratory .
There, chemical properties were determined. According to Will Kaks diagram, water quality classified in C3-S1.
The mentioned soils with 50cm depth were put in the PVC cylinders which had 10.5cm diameter and 70cm height, with the same arrangement in soils profile.
Paper filters were put between each layer.
Each cylinder had a drain till and a pin to cut the output flow. Soils in cylinders were saturated from down to up then drain tills were cut and left for 24 hours.
Then the pins were opened and gravitational pore volumes exited and were collected. Multiples of This volume became the leaching water treatments.
There were eight different treatments of leaching water with three repeat. Condition of leaching was permanent flooding without hydraulic head .Drainage waters were gathered in 50cc balloons (fix volume) . Times were recoded when these balloons were fulled by drainage water during leaching. Then EC and SAR were measured in them and also in each soil layers after leaching .then the graph of (EC -Time) and (SAR-Time) were drown and equations between them were obtained so we can estimate EC and SAR in drainage water in every moment during leaching and according to Ece= (Ecdw+Eciw)/2 we can obtain ECe in soil in every moment during leaching
.Also the graphs of (EC-deptht) and (SAR -depth) in soil samples before and after leaching were drawn. They show:
- Salinity problem has been solved
-Alkali problem has been decreased with out using reclamator.

P663

Natural risk Management «of sand moves and desertification" In the region of Ziban - Cases in the region of El Hadjeb & Ain beneoui (Biskra - Algeria)

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Risk management is a concept that does not depend only on the natural event causing damage in our case sand moves. Indeed, the risk is a complex concept that is represented by the combination of two distinct components: the event also called natural hazard and the vulnerability of the site. The hazard therefore characterize the physical phenomenon itself, in our case silting and the vulnerability report on socio-economic issues related to the status of the area concerned by the risk (oasis town,
road, railways). In this context the risk management of silting (sand moves) and desertification that we have taken in region of el Hadjeb, which is concederet as a deposit site and sand production in the ZIBAN region. It puts the people of the region and heritages (palmerais, water points, housing, etc.) under risk of silting. In order to understand this risk in a more complete and arrive at the deal. Understanding this phenomenon is essential to delineate the path sands compared to the morphology of the land, every show in the role of mountains in setting and damping of the dynamic wind and its impact on agricultural parcels and human infrastructure. The objective of this work will allow us to the sharing of all information related to the site for a better understanding and / or management of the danger inherent in silting. The methodological approach adopted is split in two: a method based on the appearance geomorphological, where a field work was carried out in order to look for indicators of mobility sands, as well as the prediction of the intensity of the phenomenon in relation to human pressure on a sensitive environments, and a spectral method where the use of remote sensing (aster image 2005) to delimit the wind corridor in the region, by spectral indices.

P664

Desertification Vulnerability in Gorgan Plain, Northern of Iran

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Desertification, land degradation in arid, semi arid and dry sub humid regions, is a global environmental problem, but it is one the most urgent ecological problems in Iran. The objective of the present study was to evaluate and classify of desertification processes in the case study area of the Gorgan plain (Northern Iran). Based on the MEDALUS approach and the characteristics of study area a regional model developed using GIS. Three main indicators of desertification including: soil salinization, wind erosion and land use were considered for evaluation. Each parameter was weighted in relation to its influence on desertification process. In turn the geometric mean of all three quality maps was used to generate a single desertification status map. Results showed that about 85 percent of the total surface is moderately to severely desertified. In addition to the soil salinization indicator was the most important factor affecting desertification process in the study area.

P665

Salts dynamics on a soil cropped with muskmelon under drip irrigation

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The objective of this research was to evaluate salts dynamics in the drip irrigation bulb in muskmelon (Cucumis melo) crop. For that, a field experimental was carried out in an Haplargid in “Las Palmas” farm in Falcon State Venezuela. A randomized block was used as experimental design and evaluated parameters were bulb position in three points: Point 1, near to stem plants; Point two, between stem plant and bulb border; and point three, in the bulb border. Samples were taken at two depths and two repetitions were done by block. Each block was represented by a sowing file of 100 meters, 4 sowing files were evaluated by 48 experimental units. These parameters were evaluated before and after irrigation. Results showed that before irrigation, the salts accumulated between plant’s stem and bulb border and near to the stem of the plants, with values of 2.65 dS/m y 2.37 dS/m respectively and salts accumulate in the first depth with a value of 2.53 dS/m. After irrigation salts moved to the bulb border, showing a value of 3.11 dS/m in relation to a 3.02 dS/m y 2.51 dS/m reported in the position between bulb border and plant stem and the position near to the plant stem respectively. It occurs, because after applying irrigation, salts moved to the bulb border, where a higher wet percentage occurred, 16.81 %, in this point. The higher wetness percentage was found in the depth of 10-20 cm. This behavior is favorable to crop development, because when salts accumulate in the bulb border, physiological damage in the plant is reduced, because salts moved to a most distant point of the plants. However, salts tend to accumulate in the first depth, so the amount of water applied should be reviewed, to reduce or avoid the upward salts movement.

P666
Saline soil-landscape relationships, Centre-West Senegal

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Abstract
The coastal region of Sine Saloum basin (central Senegal) is a low - lying land raising only about 1-2 meters a.s.l. This situation allows seawater to flow as far as 60 km inland through the main channels and into the estuaries of the Saloum River. The intrusion of seawater results, in this particular zone, in the creation of saline soils, which render the land unsuitable for agricultural production.
Soils in this area have been a subject of much research, but these studies have seldom been oriented on the relationships between landscape features and chemical properties of soil.
The objective of this research was to determine the changes in soil salinity according to the landscape position. The impact of tidal inundation and water table fluctuations on genesis and development of such soils was also investigated.
Spatial variability of soil salinity was explored through sixty samples from twelve Profiles along a levee to backswamp toposequence.
It was found that soil distribution pattern follows changes in topographic position. Solonchaks with a clayey texture and important pedogenic iron content dominate in the lower locations (floodplain). Gleysols appear in the middle of the toposequence (low terrace). They show redox features in the central part of the profiles. Arenosols occupy the upper locations (middle terrace) with gleyic features in the bottom of the profile.
Soil pH (ranged from 3.5 to 8.5), EC (from 1 to 10 dS/m)and water soluble cations tend to decrease with elevation of the relief while the CEC (Na^+, K^+, Ca^{++}, Mg^{++}, H^+, Al^{+++}) increases. The use of S.A.R and E.S.P. in our investigation of salinity problems is of less importance for these saline soils with more free than exchangeable sodium, Ca and Mg.
The implications of this research concern all inundated-salt affected areas throughout the world.

P667
Progress in developing a process-based model linked to a geographical information system for soil salinity assessment at basin scale: the GIS-SALTIRSOIL model

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The GIS-SALTIRSOIL model is being developed in the framework of a project for soil salinity state and risk appraisal in Mediterranean agricultural areas. SALTIRSOIL calculates the composition of the soil solution, mainly saturation extract, given an irrigation water composition and amount, crop type, climate features and basic physical and chemical soil data. The lower Palancia river basin, in the limit between València and Castelló provinces in Spain, was selected as study area in order to test the model. This agricultural area is interesting because several factors that cause soil salinization, such as high evapotranspiration to rainfall ratios and high salinity irrigation waters, meet. Five experimental plots have been monitored in this area since late spring 2007. The plots were selected in order to test SALTIRSOIL under the four combinations resulting from the following two factors: irrigation water salinity: low or high, and irrigation technique: drip or basin. Soil sampling in different places within the plots, four depths down to 90 cm and throughout the year has been performed, and saturated soil pastes prepared and analysed, in order to have a representative soil salinity dataset from each plot. Irrigation waters have also been sampled and analysed regularly. Furthermore, soil solution ceramic vacuum extractors have been installed at three depths (30, 60 and 90cm) at the water inlet and outlet in basin irrigated plots and close to selected drip emitters in those drip irrigated. Soil solution from these vacuum extractors has been sampled and analysed every time an irrigation or rainfall event has occurred. In addition to this, a broad soil survey has been performed in the whole basin using a salinity sensor based on frequency-domain reflectometry in order to upscale SALTIRSOIL from the plot to the basin scale, that is to test the GIS-SALTIRSOIL model once is linked.

P668
Assessment of desertification in Gran Canaria (Canary Islands, Spain) from factors and processes

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The island of Gran Canaria, belonging to the Canary Islands, has a surface of approximately 1500 km^2, a maximum altitude of 2000 m and has a high soil and vegetation variability due to its different climates (arid to wet).
Desertification has been assessed based on a Geoscientific Map data base which comprises of 2007 units, in a 1:25000 scale, with information about climate lithology, soils, land capability parameters, erosion (USLE modified) and conservation quality.
Desertification has been assessed in two different methodological approaches based on factors and processes. A first approach has considered the factors involved in degradation, such as climate, soil, vegetation, lithology and physiography, assigning each one of them a qualitative value of favourable (1), unfavourable (2) or very unfavourable(3). The results were classified in four degrees of desertification; low (9%), moderate (24%), high (51) and very high (13%), not considering reservoirs and urban areas.
In a second approach, degradation has been assessed based on processes such as erosion (USLE modified) and salinisation (electric conductivity). Results were classified in five degrees; low (11%), moderate (11%), high (21%), very high (48%), and lithic phase (6%), not considering reservoirs and urban areas. The comparison of the degradation degrees obtained from both methodological approaches allows the conclusion that there is a 9% difference between the degrees low and moderate and it is 5% between the degrees high and very. Therefore, both approaches could be used for the assessment of the degree of desertification, with special importance if the study is to assist the decision making in sensitive areas (high and very high).

P669
A proposal for soil chemical indicators in areas characterised by risk desertification in the mediterranean region

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The processes that affect soil degradation in the Region of Murcia, (SE Spain) are of a physical, chemical and biological

nature. More than 50% of the territory is agricultural, with traditional irrigation systems in some cases, and in other with ultimate computerised technologies. The objective of this work is the collection of characteristic time-variable data and elaboration of new basic data in order to propose different indicators of chemical degradation for the soils of this zone, with possibility of extension to other Regions of the Mediterranean area.
The areas selected for the study correspond to four groups: lands with drip irrigation, lands using flood irrigation, unirrigated lands and areas with natural vegetation.
The reuse of badly depurated water, sometimes including industrial wastes and desalinated water, in semiaridic areas has a harmful effect on the environment and may lead to gradual desertification.
The following indicators have been defined: Indicators of soil quality, climate quality, vegetation quality and management quality, salinisation, alkalinisation, loss of fertility, loss of micronutrients (iron, copper, manganese and zinc) and risk of phytotoxicity: increase of trace lead and cadmium. as well as boron, potassium and phosphorus indicators. These indicators will be applied to the study areas according to the basic data available, Geographical Information System (GIS) methodology being used for monitoring the evolution of the processes.
The combination of all these indicators will provide a new general indicator allowing sensitive environmental areas to be identified.

P670
Reduction of Salt Activity by Green Manure Application in Plastic Film House Soil

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Green manure (GM) is broadly used for reducing salt activity in the intensive farming soil in Korea, but the mechanism is not clear still. We hypothesized that GM amendment decrease active salt concentration in soil by salt adsorption in OM surface and microorganism's salt uptake. Average salt accumulated soil (EC 3.8dS m^{-1}) was collected from the plastic film houses and mixed with four different green manures (rice straw, Chinese milk vetch, maize stalk, and rye grass) for the incubation test. The changes of active salt concentrations and microbial activity were determined during 8 weeks incubation at 30 ^{o}C.
High C/N ratio green manures (maize, rice straw, and rye grass) decreased significantly EC values with increasing application level. In contrast, Chinese milk vetch having low C/N ratio (13.2) decreased slightly EC value up to 3% application (wt/wt), but thereafter increased significantly different with the general information. GM application increased markedly microbial biomass carbon (MBC) concentration during the incubation, and the apparent decrease of soluble nitrate concentration was observed in high C/N ratio of GM application treatments. However, Chinese milk vetch did not show any effect on decreasing soluble ion concentration during the incubation. In conclusion, high C/N ratio GM (maize, rice straw and rye grass) could be more effective organic matter sources to reduce active salt concentration in the intensive farming soil than low C/N ratio GM (Chinese milk vetch).

S29 Time scales of pedogenic processes for predicting soil changes in time

P671
Effects of rye green manure application in soil physical and chemical characteristics in Maragheh dryland condition zone

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In order to study of green manure application effects in soil physical and chemical characteristics in dryland condition, this project carried out with 4 rye green manure treatments along with nitrogen factors included; 0, 26, 103 and 337 kg N.ha^{-1} from urea fertilizer plus check (without green manure) treatment in 3 rotation system (green manure-wheat) in RCBD desigin with 4 blocks at 1999-2007 in Maragheh Dryland Research Station. Results showed that, althrough treatment effects on dryland wheat grain yield was not significant, but maximum grain yield with 2484 kg.ha^{-1} obtained from application of rye green manure along with 26 kg N.ha^{-1}. This grain yield was 442 kg.ha^{-1} (22 percentage) more than check (without green manure) treatment. Application of green manure without nitrogen factors increased soil pH, T.N.V.%, clay% and E.C (dS.m^{-1}), but decreased O.C%, P (av.), Fe (av.), Cu (av.), Mn (av.), Zn (av.), saturation% and sand% in soil. With application of nitrogen factors along with green manure increased saturation%, clay%, E.C (dS.m^{-1}) in soil, but decreased O.C%, P (av.), Cu (av.), Mn (av.), Zn (av.) sand% in soil. Soil moisture decreased 8% in green manure application treatment without nitrogen applicalion in 0-20 cm depth, but with nitrogen application along with rye green manure, soil moisture increased 6% compare to check. It can be concluded that, green manure application is useful in long term along with nitrogen fertilizer application. Green manure application in addition to increasing of soil moisture content, increase dryland wheat grain yield. Green manure application changes soil characteristics for example, increasing of soil T.N.V%. This problem is decreased of availability of some essential nutrient for dryland wheat, therefore in this condition dryland wheat fertilizer requirments must estimate via soil testing.

P672
Effect of Peanut Compost And/or Cobalt Application on Cowpea plants Growth, Yield Parameters And Nutrients statues

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A pot experiment was conducted to study the effect of peanut compost rates (0, 5, 10, 15 and 20 ton/fed.) and two levels of cobalt (0 and 7.5 ppm) on growth, yield and nutrients status of cowpea plants. Plant growth, nodules number, yield parameter, fresh and dry weights as (shoots, roots and grains), macronutrients (N, P and K) and micronutrients (Fe and Mn). Cowpea plants was grown in new reclaimed sandy soil of El-Nobaria farm were recorded.
The obtained results revealed that peanut compost treatments with cobalt (7.5 ppm) significantly increased all the yield parameter and nutrients uptake of cowpea plants as compared with peanut compost treatment without cobalt. The highest value of growth, yield parameter, nodules number and nutrients uptake

were obtained when 7.5 ppm cobalt was used in combination with 15 ton/fed. peanut compost. It could be concluded that the concentration of cobalt (7.5 ppm) with peanut compost had a promotive effect on plant growth, yield parameter, macro and micronutrients uptake by cowpea plants.

P673
Effect of Sewage sludge on Plant Growth in Sandy Soil

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The Agriculture soils in Saudi Arabia are mostly sandy and have low water-holding-capacity. Production of waste effluent is on the increase due to the recent urban development in the country. The objective of this study was to determine optimum level of sewage sludge application for sandy soil conservation in an arid environment. A field experiment was carried out on a sandy soil. Application rates (0, 25, 50, 75, Mg ha^{-1}) of sewage sludge and, two plant types (Prosopis Jliflora and Atriplex halimus) were used. Mean biomass yield of Prosopis Juliflora ranged from 51 to 107 Mg ha^{-1} in different treatments. Mean protein contents in Prosopis Juliflora ranged from 10.41% to 11.37%. Mean biomass yield of Atriplex halimus ranged from 11 to 37 Mg ha^{-1} in various treatments. Mean protein content (%) of Atriplex halimus ranged from 4.11% to 5.47%. Soil salinity increased appreciably with the application of different rates of sewage sludge as compared to the control treatment. Plant mean protein contents were not significantly affected by the different application rates of sewage sludge. These results suggested an application rate of 50 Mg $ha^{-1}$of sewage sludge is appreciable for sandy soil conservation. The research findings also highlighted the usefulness of urban sewage sludge for utilization as organic matter for forage production. Additionally, this practice would minimize the expected environmental impact resulting form land disposal of sewage wastes.

P674
Study of the effects of nitrogen fixation system on biochemical's of Agrobacterium tumefaciens in some Medicago cultivars

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Nitrogen is one of the most important elements in plants. But gas is not usable by most higher plants. For many years nitrogen fixation by micro-organisms has been proved. Many researchers pointed that Agrobacterium tumefaciens has ability to fix nitrogen. To investigate the role of this bacterium in nitrogen fixation; three cultivars of Medicago sativa (Bami; Australian and America cultivars) which were rather inoculated with nif $^{-}$ [[Unsupported Character - Codename]] nod^{+} sinorhizobium or with sinorhizobium contained plasmid (pSRK9) were used and compared with wild type and control. The results showed that those plants which had higher growth; had the lower amount of reduced sugars in their roots. The lowest amount of sugar was recorded in plants which were inoculated with nifK (pSRK9).The results indicated that; there is a correlation between decrease in roots sugars and increase in dissolved protein. Measurement of the total protein of the stem and leaves showed that those plants were inoculated with sinorhizobium contained plasmid (pSRK9) had the most amount of protein in comparison to the other plants. Those plants which were inoculated with sinorhizobium contained plasmid nifK^{-} (pSRK9) converted higher amount of acetylene to ethylene and the rate of ethylene producted were higher significantly. In conclusion, in our study the system which include nif $^{-}$ gene effectively increased growth of the three Medicago sativa cultivars.

P675
Yield and yield components of two dryland wheat cultivars as influenced by crop residue and nitrogen rates

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In most southern provinces of Iran, wheat straw has traditionally been disposed of by burning or removal, that is often criticized for accelerating losses of oil organic and nutrient, increasing C emission and reducing soil microbial activity. Researchers are looking to straw incorporation as a strategy for improving soil organic matter management. However, where residues have been incorporated, farmers often cite concerns for reduced fertility from nutrient immobilization and difficulties in soil cultivation, problems that are attributable to slow rates of residue decay. A 3-years field (2005-2007) study was undertaken at the College of Agriculture, Shiraz University, Shiraz, Iran to evaluate the effect of different crop residue and nitrogen (N) rates on yield and yield components of two dryland wheat (*Triticum aestivum* L.) cultivars (cvs). The experiment was conducted as strip split plot with four replications. Vertical plots consisted of two dryland current wheat cultivars (Azar 2 and Nicknejad), horizontal plots were three crop residues rates (0, 500 and 1000 kg ha^{-1}) and sub-plots were three N rates (0, 35, and 70 kg N ha^{-1}). The results showed that number of fertile spike per plant, grains per spike, grains per plant and 1000-grain weight significantly increased with increased N and residue rates in both cultivars. When the highest crop residues were added, but N rates were not appropriate with crop residue levels, yield components significantly decreased in both cultivars. Increasing crop residue rates increased soil organic carbon. The highest grain yields (1569 and 1177 kg ha^{-1} in Azar 2 and Niknejad, respectively) were obtained from the highest crop residue and N rates. Azar 2 had significantly higher grain yield than Nicknejad, because of its higher fertile spikes per plant, grains per spike, 1000-grain weight and harvest index.

P676
Antimicrobial effects of some egyptian medicinal plant methanol extracts against some soil-borne microorganisms

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The antimicrobial potency of methanol extracts of selected 32 Egyptian medicinal plants was bio-assayed against some soil-borne microorganisms included 3-bacteria and 9-fungi. The extracts tested for its antimicrobial effects using diffusion and dilution agar methods. Results signified that the probed different parts of the tested medicinal plants exerted varied antimicrobial potency, however, at dissimilar intensities. The tested soil-borne phytopathogenic bacteria were affected by *Juniperus phoenicea* and *Cymbopogon proximus* extracts. Whereas, *Citrullus colocynthis*, *Ammi majus* and *Artemisia herba-alba* showed activity towards one or more of ***Erwinia*** species tested by moderate manner. The antimicrobial effects of the investigated medicinal plant extracts against tested soil-borne phytopathogenic fungi showed high active potency toward ***Botrytis cinerea, Fusarium solani, Aspergillus flavus*** and ***Aspergillus niger*** by *C. proximus*, *J. phoenicea*, *Cleome droserifolia* and *Cupressus sempervirens*. On the other hand, ***Alternaria alternata*** and ***Candida albicans*** were inhibited by *C. droserifolia* and *Balanites aegyptiaca* respectively. MICs were determined for the most six medicinal plant extracts that showed highest activities against six soil-borne phytopathogenic microorganisms included 3-bacteria i.e. ***E. carotovora***, ***E. chrysanthemi*** and ***Xanthomonas campestris*** and 3-fungi i.e. ***F. solani***, ***P. digitatum*** and ***Rhizopus sp***. The results showed that, *A. majus* and *C. proximus* were the most active extracts towards ***E. carotovora*** by 6.75 and 4.40 g/L respectively. In addition, the most active extracts towards ***F. solani*** were those of *C. droserifolia*, *C. sempervirens*, *C. proximus* and *J. phoenicea* by 19.60, 14.25, 22.00 and 40.00 g/L respectively.

P677
Stubble Burning, A Serious Threat to Crop Production and Soil Fertility in Iran

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Grain production is reported to total about 2 billion tons a year worldwide which results in the uptake of about 33 million tons nitrogen from soils. It is estimated that along with the production of grains, 4 billion tons of straw is produced and each ton of grain contains about 2.25 kg of nutrients excluding Si, it means burning of stubble will destroy 45 million tons of nutrients in addition to using up the atmospheric oxygen as well as degrading the environment; and if Si were to be included, the figures would be doubled.Therefore, it is essential to discourage stubble burning especially in farms and orchards. In addition to wasting nutrient supplies, other harmful effects of stubble burning include a lowering of microbial population densities, degrading the soil quality, lowering the infiltration capacity, increasing erodability, losing a large supply of carbon into the atmosphere, converting a highly useful material into hard-to-decompose charcoal and ashes, increasing the apparent bulk density and hence lowering the porosity of the soil. Therefore, burning straw, stubble and other plant residues is nothing but destroying valuable supplies of organic matter with a gradual degradation of farmlands as a consequence. In arid and semiarid soils, not only low organic matter is existing, but also the extreme high temperatures contribute to the rate of decomposition. Therefore, stubble burning should be discouraged if we are to protect and improve soil quality. Also, rather whenever necessary, nitrogen fertilizers need to be added to soils that receive plant residues in order to maintain a favorable C/N, moreover, plant residues should be chopped up by mechanical means initially to be conditioned and processed with the help of suitable microbial decomposers. The biologically conditioned and processed materials should then be plowed deeply into the soil so as to slowly develop a fertile land.

P678
Effect of *azospirillum* and *azotobacter* inoculation with farmyard manure and nitrogen application on yield and yield components in a wheat cultivar in fars province

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Azospirillum and *Azotobacter* are two N2-fixing microorganisms which, in symbiosis with the roots of cereals and other gramineae, enhances growth and development of plant. In this research a bread wheat cultivar was treated with *Azospirillum* , *Azotobacter ,* nitrogen and farmyard manure by using split-split plot on the basis of randomized complete block design with three replications at Fars province during 2005-2006. Main plots were consisted of four levels of nitrogen (0, 40, 80 and 160 kg ha^{-1}) , sub plots included farmyard manure and sub-sub plots included three levels *Azospirillum* and *Azotobacter* application (0 , 2, and 4 kg per 100 kg seed). Behavior characteristics categorized as: height , grain and biological yield, yield component and harvest index. The results showed that raising amount of nitrogen had positive effects on all aspects of growing. However, in most cases the value of grain has not increased significantly to show any differences between 80 and 160 kg N ha^{-1} . All characters ,except height and no of spike per square meter, increased with applying farmyard manure. Inoculation of 4 kg *Azospirillum* and *Azotobacter* per 100 kg seeds decreased grain capability. On the other hand, applying 2 kg *Azospirillum* and *Azotobacter* increased biologic yield and no of spike per square meter. As a results of this experiment , it appeared that 80 kg nitrogen with farmyard manure and inoculation of 2 kg of *Azospirillum* and *Azotobacter* per 100 kg seed in such area were the best treatments for more productivity.

P679
Preparation of different growing media for apartment and ornamental plants in the north of Iran

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The production of greenhouse crops involves a number of cultural inputs. Among these, perhaps the most important is the type of growing medium used. The desirable pH, soluble salt, nutrient levels and other chemical and physical properties for greenhouse media vary by the greenhouse or nursery crop and by the management practices used. In Iran many types of organic and inorganic materials are used as growing media. The major types of organic media used in container-crop are peat moss, plant compost, tea waste, litter, manure and etc. Inorganic materials such as Vermiculite, perlite and sand are also added to these media. This investigation was conducted in Guilan province to determine the most suitable composition of growing media for different ornamental plants. The comparison of different growing media showed that pH and texture are two important characteristics that affected the selection of growing media composition. Tea waste, rice husk and sphagnum instead of peat moss are the best compositions in the range of pH less than 5. Litter, decayed bark, a little tea waste and completely decayed manure, and a little rice husk in the range of pH 5-6 and composed of 50% clay and 50% manure, rice husk and tea waste by volume, was used in the range of pH 6-7.5. Composed of 25% litter, 25% tea waste, 25% sand and 25% manure by volume, was used for soils with light texture. In soils with slightly heavy texture 20% clay, 20% sand, 20% manure, 20% tea waste and litter and 20% rice husk by volume was suitable. The composition of clay, sand and manure was the best mediums for the soils with heavy texture. Thus, it is suggested that the suitable composition of growing media to be selected before establishing plants. Factors like transportation, equipment and management should be considered.

S22 Education in Soil Science and Raising Public Awareness

P680
Soil Museum of Azerbaijan as a center of education and public awareness

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The Basic ecological principles following from use of natural resources by mankind and interaction between the person and an environment demand great necessity, understanding and mastering of these principles.
In this point of view scientists should help to the public to realize more deeply the attitude of mankind to biosphere. The state should use media means available at their order, to create new information centers including museums, to acquaint growing generation and adults with natural riches of an environment.
Created programs should consider needs of various layers of the public in view of their education level. These programs should include preparation and distribution of editions and visual aids, and also it is necessary to coordinate school education regarding a since about surrounding ecology systems to out-of-school training of youth. It is necessary to develop the global program of education and the information of the wide public, including principles and value of rational use of an environment.
The State, public and scientific organizations should accelerate creation and protection of national parks, regional study of local lore museums, it is necessary to carry out scientific researches and educational activity with a view of realization of these issues.
In "the Soil Museum" created at the Institute of Soil Science and Agro Chemistry are collected a unique soil genetic fund of Azerbaijan, bench materials, and also scientific-research editions are strong educational and propagandized factors of education of pupils, students, young scientists and wide layers of the public.

P681
Media Catalogue for Introduction of Soil-related Topics in School Teaching

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Soils are one of the classic environmental media, but do not by far receive the high regard and social attention that they deserve.
This is not least reflected in the often inadequate way in which the subject is dealt with in class at schools and vocational colleges.
Recently, however, a positive new trend is becoming apparent. Those responsible for teaching are increasingly endeavoring to include soils more frequently into the natural sciences and environmental classes at school. These efforts, however, often reach their limits rather quickly. Many of those responsible for teaching do not have the necessary basic knowledge required to teach the subject. Furthermore, the teachers are often unaware of the existence of suitable materials that can be used in class.
For this reason, staff in the subject area of General Soil Science in the Faculty of Agri-cultural Sciences and Landscape Architecture at the University of Applied Sciences Osnabrück have been building up and updating a media catalogue since 1998. This media catalogue gives a brief overview of existing materials related to soil science for use in class, as well as how to use them.
Last year, the fourth edition had appeared. In addition to media catalogue it includes material about typical soils of North-Germany and their appearance in the landscape. Here the teachers find pictures of typical soils endued with short and plain explanations, which can be used in class.

P682
Soil Games in Osnabrück

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On the occasion of the World Soil Day on the 5th December the first Soil Games in Osnabrück had taken places on the 5th December 2006. The Soil Games were organised by the "Museum am Schölerberg", which deal which soils since the EXPO 2000. In the museum is a permanent exhibition about soils located.
Twenty-five classes aged from nine to fourteen years resolved different tasks about soil, some more cognitive, some more sportive. For example they had to drive a gouge auger into the soil or to order different leaves by their grade of decomposition. The pupils also had to answer questions about agriculture und the ecosystem of the forest.
By the Soil Games it was possible to arise more public opinion to soils. In the first instance many schools had been adverted to soil, a topic that is normally dealt in an inadequate way in school. This intention had been totally achieved. More classes than possible wanted to take part in the Soil Games. The pupils were very interested and committed; they learn many new things about soils and their importance for humans.
Furthermore a local radio station and newspaper gave an account of the Soil Games, so soils were a topic in different media.
The request and success of the Soil Games shows, that arrangements like this are suitable to arise more public opinion to soils. But to keep the public opinion arose, ongoing endeavors will be necessary.

P683
Bubbling the mud away - A pupils' project on biological sludge removal from a eutrophic pond

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Close collaboration between high schools and universities is a rewarding investment in the researchers of tomorrow. For this reason, we invited two pupils (10th grade) to work on a contribution to "Jugend forscht" (a German science competition for teenagers) at our laboratory. These pupils accompanied a municipal project that aimed on biological sludge removal from a eutrophic pond by continuous aeration. In order to evaluate the success of this campaign, the pupils monitored parameters of water quality for ca. 7 months (weekly sampling; ammonium, nitrate, phosphate, dissolved organic carbon; DOC). An additional lab experiment was set up to study sludge mineralisation under controlled conditions (two 200 L mesocosms; pond water and sediment with and without aeration, respectively). Analysis of pond water samples revealed a clear improvement of water quality over time, most pronounced for DOC (decrease from ca. 15 to 6 mg L^{-1} within 7 months) and phosphate (decrease from ca. 0.4 to 0 mg PO_4^{3-} L^{-1}). The mesocosm study showed no differences between the two treatments, probably because the disturbance of the sludge upon sampling affected biological processes more than the subsequent aeration of one of the treatments. Despite some uncertainties in the results, we concluded that continuous aeration promotes sludge removal, and it is - compared with mechanical dredging - much cheaper and has a lower environmental impact.
The work at our laboratory allowed the pupils to get a first insight in scientific methodology and helped them to understand the processes of surface water eutrophication. Moreover, their enthusiastic and forthright approach to the project also generated interesting contacts between our staff and the municipal authorities, which did not exist before (environment department, waterworks, etc.). These new contacts will be very useful in our day-to-day activities also after the completion of the pupils' research project.

P684

SIMSURVEY - A tool for geostatistical analyses of soil contamination data with R on the web

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Geostatistical approaches are very useful to delineate the spatial extent of a contaminated zone around a point source and to map diffuse soil pollution. Courses in geostatistics are therefore part of the curriculum in soil and environmental sciences at many universities. However, experience shows that geostatistics is a rather difficult subject to teach. Apart from difficulties with the mathematical concepts, the lack of flexible, but at the same time easy-to-use software adds to the problems. Commercially available statistics and GIS software either offers no/very limited geostatistical functionality, or it is very expensive (and often quite demanding to use). The open source statistical software R (http://www.R-project.org), a programming environment for statistical computing and graphics, includes several powerful geostatistical packages. As a script-based programming language, R is difficult to use in introductory courses when the students still lack experience. With SIMSURVEY, we therefore developed a graphical user interface for geostatistical analyses with R. SIMSURVEY is freely available at http://bolmen.ethz.ch/~simsurvey/simsurvey/simProto.html. In SIMSURVEY the user interacts with R, which runs on a web server, by means of a dynamically generated menu in a browser window. After registration and login the user creates a project and a session, uploads his/her data from a web- or ftp-server and starts the (geo-)statistical analysis. SIMSURVEY further includes a virtual soil pollution case study which mimics heavy metal soil pollution around a metal smelter. The user can select sampling points from an areal view or from maps showing land use and geology of the study area. For the chosen points, the attribute values (metal concentrations, geology, etc) are then read from a database. The sampling tool can be used to explore the efficiency of different sampling strategies. In our presentation we shall demonstrate the use of SIMSURVEY.

P685

Soil protection and education - Strategies in Saxony

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Soil protection as a common issue is not as coupled in the public conscience as this is the case for e.g. water or air protection. Rising public awareness for the irreplaceable character of soil and its functions still is indispensible. However, sustainable soil protection, and sustainable soil use have to base on solid knowledge about soils and a “soil-consciousness” as part of the environmental awareness and the “soil-ethics” as life-basis of the earth.
The Saxon State Agency of Environment and Geology has started a campaign to support schools and other educational institutions in the mediation of soil knowledge.
Elements of this campaign are:

- Soil paths (walking routes with attractive soil profiles and educational display boards)
- Teaching material (flyers and booklets)
- Mobile soil exhibition (resin bonded soil profiles and educational display boards, mainly on the topic ‚soil life’)
- Website for kids
- Postcards with soil profiles

Part of the strategy to spread information is the involvement of public institutions like universities and the Saxon Nature Conservation Foundation. Special activities at the ‚Day of the Soil’ as a tool to rise public attention for soil issues are part of the strategy. Soil studies paths are used for soil education very seldom yet. However, their importance as a multi functional education tool is growing.
The two soil paths in Saxony are located in two different landscapes. One (Bienitz) is a catena from a Quarternary end moraine hill with polygenetic soil formation of fossil luvic soil features in combination with different kinds of Cambisols downwards to a floodplain with a Gleysol, northwest of the City of Leipzig. It is well attended at weekends. The other one is in the Cretaceous so called ‚Saxon Switzerland’ scenic tourist area (Gohrisch). A variety of Podzols, Gleysols and Orthic Luvisols give laypersons insight in the matter under their feet.

P686

Forest Soils of Switzerland: how to use the data for practical applications

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The publication series “Forest Soils of Switzerland” comprising three volumes and a total of 95 selected soil profiles, offers an overview of the most important forest soils in Switzerland. The first volume contains all the necessary basic information together with the soils of the Jura region. In the volumes 2 and 3 the soils of the Alps, of Southern Switzerland, the Swiss Plateau and the Prealps are presented. Volume 3 in addition, contains a synopsis of all the soils.
Each soil is documented in a standardized form together with a uniform dataset including soil forming factors, soil morphology, physical and chemical properties, heavy metals, and recommendation for the forest management and soil protection. Because of the comprehensive dataset the 95 soils can serve as reference for the most abundant forest soils.
Examples for applications:
Physical soil protection in forests: Knowledge of the impact of heavy forestry machines on soil compaction and soil function is crucial for our educational concept.
Managing the water regime of mountain forests: Tree species composition and forest structure determine the root distribution that affects the soil water regime particularly in soils with stagnic properties.
Further applications: Forest management and the impact on the quality of drinking water and carbon cycle.

Waldböden der Schweiz. Band 1. Grundlagen und Region Jura: 2004. 768 S.
Waldböden der Schweiz. Band 2. Regionen Alpen und Alpensüdseite: 2005. 920 S.
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Birmensdorf, Eidg. Forschungsanstalt WSL, Bern hep Verlag.
BUWAL, 2005: Nachhaltigkeit und Erfolgskontrolle im Schutzwald.
Wegleitung für Pflegemassnahmen in Wäldern mit Schutzfunktion.
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P687

Do-It-Your-Soil, a virtual course of applied pedology

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Do-It-Your-Soil (DIYS) is a guided self-teaching course in applied soil ecology on the Internet developed in partnership with the Neuchâtel University, the Zurich University and the

Swiss Federal Institute of Technology, Zurich. DIYS is intended for students with a basic training in earth sciences, including initial exposure to soil profiles in the field. It consists of six modules, covering an important part of the applied soil ecology topics, as follows:
1. Soil and water supply: evaluation of methods and importance of vegetation in soil processes.
2. Conservation of organic matter: relationships between organic matter dynamics, ground water and vegetation in natural and drained Histosols.
3. Soil erosion: processes, factors and consequences of soil hydric erosion, use of a forecast model for fighting erosion.
4. Soil aeration and compaction: physical bases of soil aeration and presentation of different problems of surface and ground water stagnation.
5. Soil acidification: relationships between acid precipitations, chemical processes in soil, and their effects on long-term soil acidification.
6. Soil fertility and sustainable management: need of adequate and durable management.
Do-It-Your-Soil relies heavily on interactive animations and simulations. It permits a practical use for solving applied problems regarding sustainable soil management and protection. This course touches on various topics, such as agronomy, biology, biochemistry, ecology, hydrology, environment and forest sciences and environmental engineering.
The use of Do-It-Your-Soil is free. Only a convention settling various legal questions particularly those of copyright and later diffusion of course contents must be signed. As a teacher or a tutor of a higher educational establishment, you can use DIYS in his totality or integrate only a part of it in your teaching.
Do-It-Your-Soil is available in German and in French.
Leading house: Prof. Jean-Michel Gobat, Neuchâtel University, Laboratory Soil & Vegetation, Emile-Argand 11, Mailbox 158, 2009 Neuchâtel, Switzerland; jean-michel.gobat@unine.ch

P688
Soil Analysis Support System for Archaeologists (SASSA)

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Archaeological deposits are essentially sequences of soils or sediments that form the fabric of the site and provide a context for the anthropogenic structures and artefacts. Hence, soil analysis can be a crucial part of interpreting site formation processes and reconstructing human use of the site. Gradually soil investigations are becoming a routine requirement of archaeological interventions. However, the breadth of the soil science and the specialist terminology used can make it difficult for non-specialists to feel comfortable with identifying relevant soils-based archaeological questions and evaluating the various available techniques.
SASSA (Soil Analysis Support System for Archaeologists) is a web-based, mobile, knowledge management and decision making tool. Its aim is to provide archaeologists with the in-field support they require to produce soils based context descriptions and, - in situations where a specialist is not available - answer soils related field questions (e.g. Is this a buried soil?).
The system consists of two parts a Wiki style knowledge base linked to a field tool providing data storage and decision tree style support. The interface is designed to be flexible for use on a PC, laptop, PDA or smartphone. Ultimately the goal is to encourage dialogue between specialists and archaeologists and promote the wider use of soil science techniques.

P689
The Learning Region Concept for Soil and Land

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The University of Natural Resources and Applied Life Sciences in Vienna was carrying out a Socrates Erasmus Intensive-program “Responsible Use of Soil and Land and Regional Development” within the last four years. Now we are going to continue this process for elaborating an academic network within the coming years on a Life Long Learning Programme.
The project aims to establish preconditions to common understanding reasons of uncontrolled soil damages and to develop measures for integrated land utilization and initiate lifelong learning on soil and land use. Therefore we will stimulate the mutual learning process for sustainable land use and also foster the creation of social structures for a constructive encounter between persons with contrasting interests. By this we will transfer operational goals and objectives for soil protection on the basis of the ´EU soil communication´: Towards a thematic strategy for soil protection and Soil Framework Directive.
The results of the process and the training during the lifetime of the project will be summed up and made available for long term target groups. The main target for the project will be to carry out foundation for a permanent knowledge transfer, such as awareness campaigns, in order to initiate a dialog for facilitating international networking and communication in keeping soil and land use multi-functional as a public interest.
The project will offer exchange among participating institutions, capacity building due to on the scientific knowledge and best practices and implementation and dissemination of responsible soil and land use. In co-operation with more than 30 European countries we are elaborating the creation of the framework conditions for measures raising awareness and an enhancement of a dialog between all the partners in an ongoing process to create effective governance towards a ´learning region´ and by learning from each other more and more.

S12 Management of Contaminated Soils (2): concepts and policy developement

P690
Testing the usefulness of using a generic reference level for Cu for risk assessment in Mediterranean agricultural soils

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The Spanish Royal Decree 9/2005 points out that risk assessment must be performed in soils when the concentration of a specific contaminant is over the so-called G*eneric Reference Level* (GRL). The aim of the present study was to test whether the criterion indicated in the legislation is realistic for Mediterranean soils artificially contaminated by Cu under controlled lettuce crops (*Lactuca sativa* L.). Samples were collected from the surface horizons of four agricultural soils (Rojales, Sollana, Nules and Peñíscola) representative of the Mediterranean region which covered a range of soil properties. Soil pH was between 7.8 and 8.5, organic matter was between 1.6 and 9.7% and clay content was between 20 and 41%. Copper was added to soils in the form of $CuCl_2$ to achieve final concentrations of 0 (control), 66, 330, 659, 1648 and 3295 mg kg^{-1}, which represent 0 (control), 1, 5, 10, 25 and 50 times the GRL established for horticultural soils in the Valencian Mediterranean region (GRL 66 mg Cu kg^{-1}). Seven days after the artificial contamination, the OECD test 208 was carried out. The highest dose applied showed a significant inhibition in relation to the soil control and there was found a significant difference among soils for the two highest doses. In three soils, the lettuce root length significantly decreased with increasing Cu doses. However, Nules which is the soil with the highest organic matter content (9.5%) did not show a significant difference among doses, indicating organic matter seems to be the key property controlling Cu toxicity to lettuce in those Mediterranean soils. The results obtained suggest that the usefulness of using criteria based on soil quality standards to recommend risk assessment in soils contaminated by heavy metals can vary depending on the soil properties.

P691
Influence of Salts in Fractionation of Chromium in Agricultural Soils of central Greece

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The purpose of the present study was the examination of the influence of salts in the distribution of Chromium in different soil fractions and also to assess the effect of salts on the mobility of heavy metals. The research has taken place in an intensively cultivated area of central Greece (Almyros region).
Two soils with different clay content and different chromium concentrations were used. The soils were incubated for three months with the NH_4Cl, KCl and KH_2PO_4. Chromium was extracted with the modified BCR sequential extraction method and the soil fractions were the following: (a) exchangeable and specifically adsorbed, after extracting with the use of acetic acid, (b) bounded to Fe/Mn hydroxides, using a reducing agent, (c) bounded to soil organic matter, using an oxidizing agent, (d) bound to mineral structures-residual, using Aqua Regia. It was found that the application of the above mentioned salts could change the distribution of Chromium in the soil fractions. The application of NH_4Cl caused an increased in the exchangeable and specifically adsorbed Chromium fraction by 95% (0.01*p*). The application of KCl leaded to a significant decreasing of Chromium bounded to Fe/Mn hydroxides (47,8%). The supply of KH_2PO_4 caused a significant reduction of exchangeable and specifically adsorbed Chromium, while the Chromium bounded to Fe/Mn hydroxides was increased.
The calculated mobility index indicated that the use of KCl and NH_4Cl increased the mobility, in constant of KH_2PO_4 that caused a decrease in Chromium mobility in the soils studied.

P692
principal component analysis of potentially toxic elements in forest soils of bulgaria

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Detailed research, monitoring and the assessment of the status of forest soils is necessary in order to improve our understanding of the increasing human impact on natural ecosystems. Monitoring the natural variation in the concentration of potentially toxic elements (PTE) is of the utmost importance when assessing soil contamination. Therefore, the present investigation was aimed at identifying the main soil contaminants, and distinguishing between geogenic enrichment and anthropogenic pollution by Cu, Zn and Pb. The principal component analysis (PCA) concentration coefficients (CC) and enrichment factors (EF) were calculated for the purposes of identifying the sources and degree of contamination.
In this study, soils from the *Rila* mountain as well as those from the southern and eastern slopes of the *Stara Planina* mountain, in the industrial region of Elisejna, were sampled and analyzed using common procedures. The selected regions for this field survey are similar in altitude (between 850 and 1250 m above the sea level), parent material (granites, gneisses, schists), tree species (*Scots pine*, *Pinus sylvestris Arn*.) and soil types (*Dystric, Eutric Cambisols*).
The results obtained reveal similarities in the distribution of potentially toxic elements throughout the depth of the unpolluted soils and sub-layers of forest litter. However, there were differences in the soil samples taken from the *Stara planina* region, which is influenced by human activity.
Correlation analysis of the PTE contents showed moderate to strong correlations among Cu, Zn, Pb content, and pH and C content. The correlations are generally stronger in the topsoil layer. PTE negatively correlates with pH and C %. Through the application of the multivariate statistic approach (PCA), it was observed that Cu and Pb accounted for the anthropogenic pollution. It can be concluded that PCA is a useful tool that provides a valuable insight into PTE sources in soils.

P693
Recent EU Developments in the Management of Contaminated Soil - a Legal Perspective

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The EU recognises soil as essentially a non-renewable natural resource of vital importance to the long-term sustainability of the European Community. Approximately 3.5 billion hectares of soil is potentially contaminated in the EU-25 which is estimated to cost approximately €2.4-17.3 billion per annum.
Currently there is no European legislation directly regulating soil protection and remediation. In order to fill this gap, on 22 September 2006, the European Commission tabled a proposal for a framework Directive on soil. In addition, since April 2007, member states of the EU are required to implement the provisions on liability for land contamination contained in the 2004 EU Environmental Liability Directive (“ELD”).
The aim of this paper is to analyse the legal and operational elements of the contaminated soil provisions of the proposed EU Soil Framework Directive. In particular it will consider the procedure required to be followed in identifying contaminated sites, the standard of remediation and the allocation of responsibility for clean up of contaminated sites, including orphan sites. The paper will also examine the land damage provisions of the ELD and briefly consider the relationship between these two Directives.

S15 Soil Information Systems, Regionalisation of Soil Data including Soil Associations

P694
Identification and regionalization of dominant runoff processes - A GIS-based approach

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Rivers react differently to extreme precipitation due to very special catchment characteristics. A widespread method applied nowadays is the identification of areas with defined dominant runoff process (DRP). Digital maps thus derived could help to improve runoff modeling of flood events or might be used to predict potential risk area.
In this study dominant runoff processes have been identified within a micro-scale basin in Germany by means of a field campaign with respect to regionalization. This DRP-map was used as a reference map to validate the results of the three new approaches as follows.
In the first approach a DRP-map was generated based on a digital soil map (1:5000) of the basin. However digital soil maps with the necessary high resolution are often not available. Hence the second approach comprised a simplified GIS-derivation of runoff processes based on the permeability of the substratum, land-use and relief parameters. The third approach was a statistical approach, where the permeability classification of the lithology and the derivates of the DEM are used as variables defining the different DRP areas. A canonical discriminant analysis builds the model for derivation of homogeneous dominant runoff-producing process areas.
The results of the first method are satisfying. The agreement between the simplified GIS-derivation map (MesoDRP) and the reference map was 77%. The classification from the statistical approach leads to a correlation of 73%.
The simplified GIS-derivation and the statistical model were applied to meso-scale basins in the western part of Germany and the Grand Duchy of Luxembourg for upscaling.
Reference data was collected as part of field campaigns and compared with our digital results. Both approaches yielded good results at the micro- as well as the meso-scale.

P695
Soil Information in Germany: The 2008 Position

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In Germany, sixteen state geological surveys and the Federal Institute for Geosciences and Natural Resources (BGR) are co-operating to collect information about the soils of Germany and to organise a network of soil information systems. This network is intended to contain all information relevant to land use and soil protection. It will then be possible to recall and interpret the data according to scientific or regional criteria. Additionally, methods and criteria are being developed for the recognition and assessment of soil contamination.
The soil information system of BGR, FISBo BGR, consists of three main components: The spatial database, containing all small-scale soil maps for nationwide needs, will be used as an extensive data set from which to create thematic maps. The laboratory and soil profile database contains the results of soil analyses, i.e. basic chemical and physical data (soil properties), as well as inorganic and organic contaminants. The method database is intended to document and select standardised methods, e.g. for the derivation of the filtering capacity, groundwater recharge or soil productivity from soil maps and from the relevant basic pedological data. In addition, web soil services like WMS and WFS are in place or even under development.
During the last years, FISBo BGR made good progress at different areas of its structure and contents, mainly regarding soil information needs of science, administration and politics. Moreover, the FISBo BGR experts are increasingly invited to co-ordinate or participate in national or European networks and projects e.g. DynamicData, INSEA, ENVASSO and others.
The presentation gives an overview of the main components and links to internal and external structures.

P696
Lost in the triangular diagrams of soil texture

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There are numerous different triangular diagrams of soil texture in the world. Most of the texture triangles are adapted to the pédological context of their region of origin. Besides, particle-size fractions used also vary amongst countries and even among organisms within a country. We tried to do a stocktaking of the texture diagrams in order to compare them. Almost all the triangles are in agreement on extreme classes (classes where the dominant particle-size fraction is either clay, silt or sand). On the contrary, discrepancies are numerous in the classes of their centre, composed of ternary mixtures. Nevertheless, some particle-size distribution borders seem to reach a general agreement. The harmonization at worldwide level appears, however, very difficult faced to the difficulty to agree on a norm. Some authors succeeded in calculating algorithms of transfer from a triangle to another one, but these functions are far from general among all the triangles. Another method would consists in building transfer functions by parent material and pedogenetic classes using continuous laser particle-size distribution, but it would require considerable efforts. As a result, and waiting to find a solution for harmonization, it is important that one gives full information on the texture triangle reference used in soil databases.

P697
Biomass production potential on saline and sodic soils in Southwest Asia

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Arid and semi-arid ecosystems belong to the ecosystems naturally vulnerable to salinization and sodification. Due to increasing population and the economic development in the region of South-West Asia the requirement of crop and wood production is growing. Ongoing process like the intrusion of sea water, irrigation with poor quality water and the aridification of climate enlarge the extent of naturally salinized soils. The area affected by salinization is increasing in this region each year. So the arable land is turning to wasteland which makes it unsuitable for traditional agriculture.
The BIOSAFOR Project financed by the European Commission is working on improvement of biosaline agroforestry cropping systems for producing biomass on salt affected soils and reclaiming strongly saline or sodic soils.
For locating the potential area for saline agroforestry in India, Pakistan and Bangladesh a database according to the SOTER standard from FAO was established. It contains the most important climatic, terrain, soil and groundwater (irrigation water) characteristics of the problematic sites affected by salinity and sodicity. The characteristics of the common sites have to be matched according to the Land Suitability Classification from FAO with the requirements of the tree species having high salt tolerance and fast growth. The methodology of estimation of the growth performance of the chosen trees will be calibrated with the biomass production data from about 30 case study areas representing different climatic, terrain, soil and groundwater condition and also having different severity of salinization and sodification.
For the regionalisation of the parameters and the estimation of the biomass production potential GIS is used.

P698

Spatial and thematic improvement of the Digital Kreybig Soil Information System for specific functional applications

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There is much more utilizable information originating from soil surveys, than it was processed, published on map series and in reports, and what is provided by simply archiving them digitally. A well-managed spatial soil information system (SSIS) can and should reach higher levels of digital processing. Integration of a SSIS within appropriate spatial data infrastructure and efficient field correlation completed with suitable data collection can significantly increase its reliability.
We present GIS-based methods developed for the spatial and thematic refinement and improvement of the Hungarian, national, 1:25.000 scale SSIS. In two pilot areas we integrated all information collected during the original survey (even if it wasn't formerly published) with appropriate spatial information on topography, landuse and terrain together with soil data originating from recent field sampling. We exploited all available and applicable information fragments on spatial features of both soil mapping units and soil profiles (shape, topology, proximity, spatial correlation). As a result we produced soil maps with the most detailed spatial resolution, which can be produced at this scale based on the original mapping concept. However the thematic information related to soil entities could not have been totally renewed. The fieldwork was determined by the concept of the potential use of the final maps that is their functionality together with a strong economic restriction. As a consequence we designed the data collection in a way that the recent profile related information could be spatially extended to as large part of the mapped area as possible. For the characterization of the spatial reliability of thematic information we introduced a simple indicator function, which is presented together with its thematic soil map. Two functional digital soil maps were compiled for the pilot areas: (i) agricultural suitability of the soils and (ii) sensitivity of soils to physical and chemical degradation.

P699

Designation of low-productivity areas for cultivation of wild growing fungi

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Significant landuse changes are suggested in Hungary as a consequence of entering the EU. In this context one of the potential utilization of low-productivity areas can be the establishment of fungal plantations mainly with valuable edible mycorrhizal fungi. Designation of low-productivity areas requires regionalization of soil functions related to food and other biomass production. This process can be carried out in different scales from national to local level, but always requires map-based pedological and further environmental information with appropriate spatial resolution.
For the regionalization of less productive areas in national scale a functional approach was used which integrates the knowledge on soil degradation processes in nationwide level. Specific soil threats were classified into ranked categories. Supposing (quasi)uniform distribution of vulnerability measure along these classes, we introduced a "standardized" value as a ratio of the class order to the maximum class order expressed in percentage. For the overall spatial characterization of degradation status, spatial information was integrated in a result map by summarizing the degradation specific "standardized" cell values. This map in one hand has been used for the delineation of soil degradation regions. On the other hand appropriate spatial aggregation of index values on geographical and administrative regions is suitable for their quantitative comparison thus they can be ranked and this feature can be used for the identification of less favourable areas. At the more detailed, county level the Digital Kreybig Soil Information System was used as a tool of the regionalization of soil functions related to soil productivity. Concurrent spatial analysis of the suitability of soils for agricultural use and their sensitivity to physical and chemical degradation were carried out which resulted in a so-called ecotype-based characterization of land. Finally this classification was used for the designation of low productive areas suitable for hypogeous and cap fungi plantations.

P700

Spatial interpolating soil organic carbon using several interpolator predictors

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Several methods can be used to study the spatial variability of soil organic carbon at large scales. In this study, some interpolators were assessed for smoothing soil organic carbon (SOC) contents in 100 sites study in the Azna watershed, Iran. The employed interpolation techniques were consisted of inverse moving average, moving average, minimum curvature, nearest neighborhood, ordinary Kriging and universal Kriging. The precision of interpolation methods was measured by cross validation, using the mean absolute error (MAE) between the interpolated and observed values. The experimental variogram of SOC was then fitted to an exponential model. The results indicated that the MAE values were ranged from 0.212 to 0.368 percent depending on the method and the number of neighbors used for interpolation. The obtained results also indicated that the minimum curvature and moving average methods were the most precise methods to predict the SOC contents. The "inverse moving average" appeared to be the less precise method, for which the MAE values were 0.212, 0.220 and 0.368 percent, respectively. Although the MAE values for the two used techniques were similar, but the interpolated surfaces were different. It was therefore concluded that due to its precision for interpolation and the smoothness of the interpolated surface, the "minimum curvature" was the most appropriate method for smoothing SOC.

S09 Forest Management and Soils

P701

Soil quality changes under innovative agroforestry systems

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Agroforestry systems are known as one of the keys towards sustainable land use especially in subtropics and tropics where soil degradation is becoming a major threat. By integrating multipurpose trees into agriculturally landscapes traditional agroforestry can provide substantial supports for restoration of heavily used and degraded terrestrial ecosystems. On the other side the demand for production of biomass as a new energy source is becoming increasingly popular worldwide. The German-Chinese joint research project "ValWood" will combine the ideas of agroforestry and the production of woody biomass

by integrating production of timber wood, bamboo and woody biomass together in one cropping system.
The main research focus of the work package 3 is on soil quality changes under these newly established land use systems. The research area is located in the Red Soil Region of Southern China (provinces Guangxi, Zhejiang and Sichuan). Different management practices (monoculture plantation of bamboo and Chinese fir (Cunninghamia lanceolata), mixed secondary forest, agroforestry systems) will be compared regarding aboveground and belowground C-stocks and C-fluxes in order to model C-budgets of these land use systems as well as their effects on soil fertility parameters.
Soil fertility will be assessed by analysing stocks and contents of nutrients, mineralisation rates of C, N and P and microbial biomass C and N. Plant tissue analysis will complete the picture. Finally all assessed parameters will be integrated into forest growth models combined with soil organic matter model to evaluate effects of forest management systems on productivity and sustainability of forest-ecosystems.

P702
Combination of deterioration rate and weather factor in evaluating durability of small wooden check dams

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Forest conservation and soil erosion control are important issue in Japan since 67% of Japan's land is covered by forests. Recently, various measures have been taken for promoting the use of wood gathered from the thinning of forests. The new approach adopted in Japan is use of thinned trees instead of concrete as a construction material to build small wooden check dams for the environmental and landscape protection purposes. These dams have been built with commonly available wood species, *Cryptomeria japonica D.Don* and *Chamaecyparis obtusa Endl*. Wood is renewable, ecosystem-friendly, and available at lower cost, as compared to concrete which causes the environmental loading. However, unlike concrete, wooden materials deteriorate with weather conditions. Hence, for widespread use of wooden dams, the relationship between deterioration rate and weather factors needs to be studied in detail. Authors have measured the deterioration of wood from 6 to 9 years at seven different wooden dams in Kyoto Prefecture, Japan. In addition, two weather factors, moisture and temperature which are supposed to be dominant for the deterioration of wooden dams, were taken into consideration and estimated. The design high water level of overflow section is considered as the moisture factor and calculated from Manning's formula. The warm index and maximum snow depth at the dam site is regarded as the temperature factor and obtained from the maps of the Japan Society of Forest Environment. The obtained results showed that there exists a good relationship between deterioration rates with these two weather factors. Deterioration rates of wooden dams can be effectively evaluated from design high water level, warm index and maximum snow depth. This paper describes the in-field sampling, method for determining the deterioration rate based on the weather factors, and application of deterioration rate in evaluating the durability of small wooden check dams.

P703
Isolating the effect of soil moisture on the soil respiration - temperature relationship

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Soil temperature is considered the most important factor governing soil respiration. However, other factors can affect the soil respiration - temperature relationship, including the confounding effects of soil moisture. We examined the influence of soil moisture on this relationship in a spruce-birch forest chronosequence in Järvselja, in south-east Estonia. The chronosequence consisted of nine stands replanted during 1921-2001. All stands lie within 1 km2 and are underlain by gleyic podzol. Temperature and moisture were measured at a depth of 5 cm. Field measurements were taken at four-week intervals between May and December during 2004-2006.
Soil respiration and temperature data were divided into subsets based on overlapping intervals of 10% soil moisture, e.g. 5-15%, 10-20%. A modified Arrhenius formula was used to establish the soil respiration - temperature relationship for each soil moisture interval. The parameters of these relationships indicate that soil respiration is suppressed under very dry conditions (low soil moisture <10%). Soil respiration is most responsive when soil moisture is 15-25%. No appreciable suppression of respiration was noted with greater soil moisture, but soil moisture rarely exceeded 50%. The response of soil respiration to temperature was also calculated for each stand within each subset. Although the variability is high, middle-aged stands (15-35 years old) exhibit a stronger response to temperature than both the newly re-plants stands (aged 2-7 years) and the mature stands (aged 55-85 years). We attribute this difference in part to vegetation dynamics, such as root biomass and litter quality.

P704
Effects of parent soil material and tree species on litter decomposition in Hyrcanian Forest, Iran

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Foliar litter is the main input of organic C into forest soils and litter decomposition is one of the most important processes determining the amount of organic C remaining in the forest floor. Soil and site properties are crucial for litter decomposition. They determine the composition of the leaves which, in turn, affects its decomposition. Furthermore, litter decomposition depends on environmental conditions like temperature and precipitation. The complex interactions between these manifold properties did often not allow to quantify effects of the parent soil material on litter decomposition although it affects both properties of the leaves and the dynamic of soil processes.
In our study we aimed to quantify the effect of the parent soil material on decomposition of different types of litter. We wanted to distinguish between direct effects of the parent soil material and indirect effects caused by tree nutrition and therefore by different composition of the litter. Therefore, we collected different types of litter (beech, hornbeam, maple) from two sites where soils developed from granite and basalt. Then, each type of litter from each site was exposed in the field at the granite and the basalt site for up to 18 months. Mass loss and contents of nutrients were analyzed in the litter bags after 2, 4, 6, 9, 12, and 18 months.
We found significant effects of litter species and the parent soil material. Hornbeam litter was degraded faster than maple litter. Beech litter was the most stable one. In most cases litter derived from the basalt site was faster decomposed in comparison to litter from the granite site. However, we found the opposite for maple litter. From our results we conclude that direct effects of the parent soil material are more important on litter decomposition than indirect effects via affected leaf properties.

P705

Selection of tree species for the afforestation of halomorphic soils in Vojvodina

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The total forest area in Vojvodina is about 130 000 ha or 6 % of total area. It is too low and it is impossible to realise sustainable agriculture production in typical agriculture region as Vojvodina. The selection of tree species for the afforestation of halomorphic soils in Vojvodina is a special problem considering the very low productivity, as the consequence of a series of unfavourable properties of this site type. Low productivity determines the potential, level and character of this site type utilisation in forestry. Actually, afforestation on this site type is a spatial infrastructural investment, in the sense of improved growing stock structure and the increase of the total biological potential. By the implementation of the planned afforestation, it is possible to increase the yield in agriculture, timber production, protection against wind, to improve the environmental conditions, production of honey, development of hunting, sports, recreation tourism,and realisation of sustainable land use

The establishment of forest plantations in the aim of obtaining the timber volume is not economically justified. Due to unfavourable site conditions, a smaller number of tree and shrub species is represented on the halomorphic site type. The reason is low productivity, the characteristic mosaic pattern, and thus also the impossible use for commercial forestry, so that on this site type the main function is the ecological function.

This paper analyses the representation possibility of afforestation of tree and shurb species in different forms of nonforest greenery. The corect selection of tree species in the base of establishment of different forms of nonforest greenery aimed at the prevention of destructive processes. The greater representation of tree and shurb specie in forests and nonforest greenery on the halomorphic site type has a very significant role through their functions.

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Key words: tree species, afforestation, halomorphic soils

P706

How reliable are soil water measurements for estimation of water balance components? A comparative experimental study in spruce and beech stands in the Tharandt forest (Germany)

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Eddy covariance and sap flow measurements have become common techniques to determine forest evapotranspiration and its components at high temporal resolution. Eddy covariance measurements above the canopy provide all-the-year total evapotranspiration rates. Compared to eddy covariance, sap flow only covers transpiration at individual trees. Thus, sap flow measurements cover a much smaller area than eddy covariance. However, a distinct advantage of sap flow technique arises from the fact, that it can indicate short-term physiological response of forests to changing environmental conditions. Simultaneous measurements of sap flow/eddy covariance and soil water content is another method to estimate water fluxes in forests. Observation of soil water dynamics is useful for studying spatial and temporal patterns of root water uptake. Furthermore, it can provide insight on the water supply for plants during the season. However, monitoring soil water is linked to the inevitable problem of soil heterogeneity. Hence, the question may arise how representative are evaporation rates calculated from soil water content readings. It is well known that soil hydraulic properties and soil water content can considerably vary within an apparently homogeneous site. Nevertheless, this small-scale variability of soil properties is often neglected when comparing eddy covariance/sap flow and soil water measurements or even when defining the potential limitation of transpiration by soil water availability.

Here, we report on a comparative study of water fluxes in a beech and spruce stand in the Tharandt forest (Saxony, Germany). The focus is on small-scale variability of soil water. For this purpose, 60 soil moisture sensors were installed in a beech, respectively a spruce stand. In addition, sap flow, precipitation, and eddy covariance were measured at both sites. The objective is to discuss the plausibility of calculated soil water fluxes by using eddy covariance and sap flow measurement data.

P707

Soil Solution Chemistry and Impact of Forest Thinning in Temperate Forests in Taipingshan, Northeastern Taiwan

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Sugi plantation (*Cryptomeria Japonica)* is the largest man-made forest in Taiwan. Based on the inventory of the third forest resources survey in Taiwan, the area of sugi plantation is about 1.3% of total national man-made forest around the Taiwan; therefore, the sugi plantation is the most forest type in the temperate area in Taiwan. Usually, in the past, sugi plantation was made in monoculture way for the major purpose on timber production. Nowadays, to be consistent with the forest ecosystem management, how to apply thinning practice on existing sugi plantations to enhance the heterogeneity of stand composition and structure to meet the goal of biodiversity conservation, land productivity promotion, and stability of ecosystem becomes a quite important issue for the sustainable forest management. The soil solution of temperate sugi plantation forest in the Taipeishan, the northeastern Taiwan, was studied over a one-year short term monitoring with regard to the dynamics of solutes and the impacts of different thinning treatments on the solution chemistry. Soil solution was obtained monthly by extraction in the lab from three depths (10, 20, and 30 cm). Bulk soil sample, throughfall, and rainfall were also collected monthly. The dry (month 11, 12, 1~5) and wet season (month 6~10) were separately for discussion. The results showed that alkali and alkaline earth cations are characterized by high concentration. Solution chemistry in topsoil (0-20 cm) significantly influenced by atmospheric input. Less significantly difference was found between different thinning treatments, but it showed more significantly difference between dry and wet seasons within same thinning treatment. The results also suggested that even removal of 36% of the trees (about 20% basal area) was not caused strong changes of the solution chemistry. The thinning intensity seemed to meet the goal of stability of ecosystem on existing sugi plantations in Taiwan.

P708

Fly ash impact on soil physical properties of forest soils

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From the end of the 19th century until the 1990s energy for the chemical industries in Saxony and Saxony-Anhalt in Germany was produced in brown coal power plants to a great extent. Thereby alkaline fly ashes and aerosols from burning coal have been exhausted and accumulated in the adjacent regions. The question is addressed how these accumulations influence soil physical characteristics of forest soils. Along a deposition gradient, soils with a higher fly ash accumulation in the forest floor horizons show a higher hydraulic conductivity, a higher air capacity, while available soil moisture and water repellency are decreased. Additional studies on soil physical characteristics of a pure fly ash were conducted. It also shows a high porosity and hydraulic conductivity, water repellency values are low despite of a high organic carbon content.

P709

Impact of Mn^{2+} addition on carbon release (DOC and CO_2) from forest floor horizons

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Litter decomposition is of crucial importance for sustainable production of forest ecosystems. Lignin concentration of organic residues exerts a major control on their decomposition. Several factors affect the rate-retarding degradation of lignin. Among them, manganese plays a key role, as it is essential for the activity of manganese peroxydase (MnP), an enzyme of the lignin degrading system secreted by the white-rot fungi.
This study is aimed at investigating the effect of Mn^{2+} addition on forest floor horizons decomposition through laboratory incubation followed by water extraction.
We used two forest floors from beech stands (*Fagus sylvatica L.*); a mor (Soignes, Brussels) and a moder (Transinne, Belgian "Ardennes"). Litter lignin and manganese contents were larger in moder than in mor. For each forest floor, three horizons (Olv, Of2 and Oh) were separately incubated with or without Mn^{2+} addition (1.5 10^{-3} M $MnSO_4$). We measured the carbon release through CO_2 and DOC determinations.
The impact of Mn^{2+} addition depended on the horizon:
In Olv, lignin is still hardly degraded; Mn^{2+} addition induced an increase of CO_2 release in both forest floors. In Of, an increase of CO_2 release was observed in mor after Mn^{2+} addition. In Oh, Mn^{2+} addition had no impact on carbon release Thus, Mn^{2+} addition mostly promoted carbon mineralization during the first stages of litter decomposition.
The impact of Mn^{2+} addition depended on the forest floor:
The addition of Mn^{2+} seemed to have a stronger influence in mor than in moder. In Of horizon, Mn^{2+} addition increased CO_2 release only in mor.
Our data suggest that Mn^{2+} likely plays a role in the control of litter decomposition particularly during the first stages. The larger natural Mn content of the moder litterfall studied here could contribute to the faster litter decomposition in this forest floor.

P710

Impact of historical fly-ash immission on chemical properties of forest soils

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The report presents the long-term impacts of industrial fly-ash immission on forest soils and its growth potential and risks. The investigation was conducted in the Dübener Heide, Eastern Germany, strongly influenced by atmospheric depositions originating from surrounding coal-fired power plants and chemical industry. In the past 100 years approximately 12 millions tons of fly ash were emitted. A sequence of 12 sites were systematically sampled distributed along a fly ash deposition gradient of over 35 km length. The soil samples (organic and mineral horizons) are analysed for pH, cation exchange capacity, base saturation, mobile and total amount of heavy metals and evaluated using different multivariate statistical procedures. The cation exchange capacity as well as the amounts of carbon and nitrogen don't exhibit no gradient with the distance to the power plant, but are more dependent of the soil texture, the substratum and the vegetation. In contrast the pH-values and the base saturations reflect the effects of the fly ash. This parameters are elevated significantly of the Of-horizons of all sites and of the sites near Zschornewitz even till a depth of 30 cm. This classification is supported by the statistical methods - canonical discriminate analysis, agglomerative cluster analysis. The influence of the fly ash is especially clear in the current stocks of exchangeable calcium and magnesium. The stocks of these basic cations, which are ecologically effective, are high to extremely high near the polluter, what is of prime importance for forest management.

P711

Spatial variation of enzyme activity in wood soil types of Adygea

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The purpose of the present researches was to track changes of biological activity at transition from chernozem into brown wood soil. Objects of researches were soils of the Apsheronsk timber enterprise located in Northern Caucasus foothills and covered by hornbeam-oak-beech wood. The soil covered with homogeneous vegetation and relief, is presented by leeching compact chernozem and brown wood soil. In field conditions on the distance of 20m was detected sharp transition between investigated types of soils.For this purpose transaction of 50 m was made, with sampling capture through every 2 m, from the depth of 10 cm. In the selected samples defined activity of dehydrogenase, invertaze, catalase, humus, pH. Values of catalase activity vary from 5,5 up to 9,6 ml O2/g/min. Values of dehydrogenase activity change in a range from 3,3 and down to 13,2 mg TPF/10. Data of activity of investigated enzymes correlate among themselves (r=0,61). Essentially change data of invertaze activity from 51 up to 12,5 mg of glucose/10g/24h. The maintenance humus smoothly decreases from 5,48 up to 2,34 in a direction from chernozem to brown wood soil, and average correlated with parameters of all three enzymes. Investigated soil do not contain carbonates in the structure. Results of definition pH have basically neutral value, on the average nearby 7,2, with amplitude from 6,6 up to 7,6. Average positive correlation of activity dehydrogenase with pH (r=0,53) was revealed. The received results allow to approve, that parameters of enzyme activity are in connection with changing soil type, and they are influenced by growing plants. The further researches are necessary to find out the dependence of variation activity of enzymes in investigated soils. Researches are supported by grants of the RFFI (06-05-64722a and 07-05-10101k).

P712

Development of Assessment Method for Forest Soil Compaction

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Reduced tree volume and height growth caused by compaction have been reported in various parts of North America and it can take decades for compacted soils to naturally recover to their pre-disturbance conditions. The widespread use of heavy equipment during timber harvesting and site preparation can lead to reduced soil productivity and warrants development of new methods to assess compaction. We evaluated effects of soil particle density, organic matter, particle size distribution, extractable oxides, and plastic and liquid limits on the maximum bulk density (MBD) of forest soils in British Columbia (BC), Canada. Soil samples were collected from 33 sites throughout BC covering the major forest and soil types of the province. The standard Proctor test was used to determine MBD, and related parameters including gravimetric water content (W_{MBD}) and porosity (f_{MBD}) at which MBD was achieved. The significance levels of single soil properties in predicting MBD were in the order of plastic and liquid limits, organic matter, oxalate extractable oxides, and particle size distribution. For all samples, liquid limit and clay were most closely related to MBD (R^2=0.83). Addition of organic matter to the model increased the regression coefficients and oxidisable organic matter caused a greater increase than did total C. Stratification of the sample set into groups based on plasticity led to higher R^2 values in multiple regressions, and different soil properties were important for non-plastic soils compared to those with high, moderate, and low plasticity. Prediction with multiple regression explained the most variation in MBD for non-plastic soils, while properties of highly plastic soils explained the least variation in MBD, and moderately plastic soils were intermediate. Based on our findings, we propose an approach for using MBD to help better interpret bulk density data in forest soil compaction studies.

P713
Does stump harvesting modify forest soil decomposer community?

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According to the European energy politics the use of bio-energy should be substantially increased. Stumps harvested from clear felled coniferous stands are increasingly used to produce wood fuel (forest converted chips). However, the effects of stump harvesting on diverse soil decomposer community and its functioning are poorly known. We studied the short-term responses of decomposers (microbes, nematodes, enchytraeids, collembolans and macroarthropods) to two treatments in boreal spruce forest (*Picea abies*) after clear felling: traditional site preparation (mounding) and stump harvesting. Forest regeneration practices were carried out four, three or one year before soil samples were taken both in spring and autumn to extract each decomposer organism group. Forest floor in the undisturbed patches was under the focus. There were no differences in microbial communities between the site preparation and stump harvesting sites. The numbers of nematodes were lower at the stump harvesting sites compared to the traditionally prepared sites especially three years after the treatments. Nematode numbers also increased during the summer only at the site preparation sites. The abundance of enchytraeids was not affected by the stump harvesting. Three years after the treatments the total numbers of collembolans were lower at the stump harvesting sites compared to the site preparation sites. In addition, microbivorous macroarthropods seemed to do better at the site preparation sites than at the stump harvesting sites. It seems that decomposer communities in the fragments of undisturbed forest floor slightly differ between the site preparation and stump harvesting sites. However, more data are needed to understand also the longer term effects of stump harvesting on forest soil decomposers and their functioning. This study is a part of the larger ongoing project focusing on stump harvesting and its effects on forest decomposers and vegetation.

P714
Changes in physico-chemical properties of forest soils affected by fires in the Osogovo Mountain, Bulgaria

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Over the last decade, the number of forest fires has drastically increased worldwide, including in Bulgaria. The overall actual losses caused by forest fires, are; however, not easily evaluated because timber destruction is accompanied by an increased rate of soil degradation, extinction of rare and protected plant species, and even human lives are sometimes lost.

In this work, changes in soil properties such as soil texture, macro-aggregates stability, acidity and organic matter resulting from surface and crown forest fires that occurred on the soil under *Pinus nigra* Arn. and *Pinus sylvestrys* L. in the Osogovo Mountain have been studied. It was found that the fire affected the macro-aggregate fractions by increasing the amount of aggregates smaller than 5 mm in size and decreasing that of bigger ones. This effect was more clearly observed in the soil affected by surface fire. The documented changes in aggregate composition are related to inter-aggregate bonding desegregation. Soil acidity of the burned sites decreased from pH 5.6 to 6.7 in the 0-5 cm soil depth in comparison to unburned ones. We found more pronounced changes for sites, affected by crown fire as compared to surface fire. Total organic carbon (C, %) and nitrogen (N, %) content increased after the surface fire occurrence by 1,0 % and 0.2 % respectively. However, we did not detect any significant differences in the carbon and nitrogen content in the soil of burned sites due to crown fire as compared to unburned ones.

These results demonstrate that besides its intensity, the type of fire (surface or crown) is responsible for distinct differences in the monitored soil physico-chemical properties.

P715
Cattle Grazing in British Columbia, Canada's Forested Rangeland: an Example of Integrated Land Use

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Forest grazing is a common practice in British Columbia, occurring on about 11 million ha (90% of the province's total rangeland area). Forest grazing takes place either in open forest stands or replanted or naturally regenerated cutblocks. A recent mountain pine beetle (*Dendroctonus ponderosae*) epidemic has led to high mortality of lodgepole pine (*Pinus contorta Dougl*. ex Loud. var. *latifolia* Engelm.) throughout the province. This creates open canopy condition and opportunities for future forest grazing. In 1988, a study was initiated on three sites that were winter harvested, seeded with forages, and planted to lodgepole pine to evaluate the effects of cattle grazing. The sites were fenced into 5-ha grazing pastures and a 0.5-ha exclosure was constructed. Grazing by mature (4-5 yr) Hereford cows with crossbred calves occurred during July-August for 10 years, at the grazing rate of 50% forage utilization. Only 2% of seedlings were browsed, while trampling damage was more common. The highest trampling damage (30%) was observed during first three years after planting and dropped to <10% by the fourth year. Not all trampled trees died. Evaluation of timber harvesting and cattle grazing impacts on soil was done 11 years after the initiation of grazing. Soil conditions on ungrazed and grazed forest pastures were compared to adjacent mature forest. Greater CEC, Ca, C, and N on treatments disturbed either by harvesting or grazing indicate that these soils have a better rooting media relative to the undisturbed forest. Soil bulk density and mechanical resistance, although less favorable for the two disturbance treatments than the mature forest, showed that a majority of the soil profile was not compacted severely enough to restrict root growth. Low to moderate detrimental impacts of combined timber harvesting and grazing on regenerating cutblocks indicate that cattle grazing is a feasible practice under appropriate management.

P716

Spatial diversity of lead concentration in forest soils in the area of Karkonosze National Park

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The main aim of this study was to assess the variability of Pb concentrations in soils in the forested zone of the Karkonosze National Park, on the basis of 250 representative monitoring sites. The data on Pb concentrations in soils were discussed and evaluated in relation to Polish soil quality standards for protected areas.
From among 630 circular monitoring areas established by Park authorities, 250 were chosen for this study. They represented various forest habitats and various altitudes: 510-1250 m.
Mineral soil samples were taken from the depths 0-10 cm and 10-20 cm, and the samples of forest floor were collected as well. Organic soils were treated differently, and soil samples were taken from their layers: 0-10, 10-20 cm, and from mineral sub-soil if it was present within the depth of 30 cm. Basic soil properties: grain size distribution, organic matter content, and pH were determined using common methods. Total concentrations of Pb in soil samples were determined by AAS after microwave digestion with concentrated acids HNO_3 + HCl, 3:1.
Pb concentrations in organic horizons, both in forest floor and in organic soils, exceeded considerably the value of 50 mg/kg set up as a soil quality standard for the areas of protected nature. In individual organic samples, Pb concentrations varied in a broad range: 24-248 mg/kg, and rarely remained below 100 mg/kg. In mineral samples, Pb concentrations were lower, in the ranges of: 18-97 mg/kg in upper layer (0-10 cm) and 3,8-88 mg/kg in the lower layer (10-20 cm), poor in organic matter. Relationships between Pb concentrations in soils and soil type, basic soil properties, as well as the altitude, geographic and topographic factors, and the kind of forest habitat were examined and discussed in this study.

P717

Relations of soil and forest vegetation in an area of intensive forest management and land up-lift at the Olkiluoto Island, Finland

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The Olkiluoto Island on the eastern coast of the Bothnian Sea has been selected for the location of a repository for spent nuclear fuel waste in Finland. The island has for years been under intensive environmental studies due to large-scale construction works.
Owing to the relative rapid land up-lift (6 mm/y) connected to flat topography, the soils are 0-2500 years old. Till is found to be a predominant soil type, but some peat, sand and clay soils are found, as well. The forests have long been under intensive management.
In this study, 85 forested field plots have been used, of which comprehensive soil analyses have been obtained. The field plots are distributed on different forest types in an area covering about 500 ha. In addition, e.g. 13 deep soil pits and shallow groundwater observation data since 2001 have supported the interpretations.
The differences in soil properties are interpreted by using field measurements, time series of aerial photographs, forest and vegetation inventory data, coarse digital soil maps, DEM and spatial analyses. The preliminary spatial analyses confirmed, that there was a strong difference in the N and C values of the surface soil between the youngest soils in the coast and the oldest soils in the centre. Next, the other data sources will be added, their effects studied and finally an effort will be done to generalize the scarce data to create a wall-to-wall map.

P718

Development of soil chemistry on intensively monitored forest ecosystems plots in the Czech Republic during 1995 - 2005

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Forest soils in Central Europe were exposed to significant air pollution load during the 1970's and 1980's. During this period, various levels of acidification and degradation have been documented for several regions. Since 1990, the pollution has decreased rapidly; some models still predict, however, the exceeding of critical limits for the acidification of forest soils. The article evaluates changes in chemical properties of forest soils sampled repeatedly on seven plots of the Intensive monitoring programme in the Czech Republic during 1995-2005. Changes observed in two to three successive sampling campaigns are evaluated in relation to the soil type and forest type. Attention is paid also to the level of deposition and to the chemistry of the soil solution on individual plots. Smaller changes of acidity were recorded in mineral horizons than in humus. On most of the plots, data shows increased values of pH or, at least, the deceleration of acidification since 2000. In many cases, however, the storage of basic cations, in particular of calcium and magnesium, is still distinctly declining. The increase of nitrogen content was found in mineral samples. This pattern was not true for all localities and for all soil depths, but it could be recognized as the prevailing tendency. The continuous levelling of the nutrient store of the upper mineral horizons could be seen from the 2005 data set both for broadleaved as well as for coniferous forest stands. Despite the various absolute values, no significant differences were found in the soil chemistry development among spruce, beech and mixed forests. The presented results from a limited number of plots represent a case-study with a possibility of utilizing a complex set of surveys, including pollution and environmental characteristics. The large scale European BIOSOIL project will show whether these findings are representative in general.

P719

Change in the chemical properties of forest soils two and five years after liming

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Despite a decrease in the acid deposition load during the last two decades, the health state of the forest stands has not improved. In the late 1990's, on the contrary, vast areas in the Hercynian Mountains exhibited yellowing of Norway spruce stands caused by magnesium deficiency and soil acidity. On the basis of a government resolution, aerial liming has been used in the Czech Republic since 2000 as a revitalizing measure. Between 2000 - 2007, dolomite lime (MgO content > 17%) with the dose of 3 $t.ha^{-1}$ has been applied on nearly 40,000 ha of forest. The article is focused on the monitoring of changes in chemical properties of the forest soils on the treated localities. The humus layer, organomineral and upper mineral horizon to the depth of 30 cm are evaluated. These were sampled and analysed before the treatment and then two and five years after the liming. In total, data from more than 80 localities are evaluated. As expected, the major development was found in the humus layer, where increased pH(H_2O), pH(KCl) and basic cations content (Ca, Mg, K) was detected. The decrease of the molar ratio of Al/basic cations was also proved. In organomineral horizons (an average depth of 0-8 cm) the exchangeable pH(KCl) exhibits a more distinct increase than pH(H_2O). The significant increase of Mg content is general in this horizon. Ca also has increased significantly, with the exception of the Eastern Ore Mts. where various treatments of mechanical and chemical amelioration had been used in the 1970's and 1980's, enormously increasing the variability of the forest soil condition. The weakest changes could be observed in the mineral horizon (cca 8-30 cm), indicating a certain increasing trend in the pH(KCl) and Mg content. On some localities, however, the decline in exchangeable phosphorus and/or potassium was detected.

P720
Compaction of forest soils; a traffic experiment with heavy forestry machinery - Soil biological, physical and mechanical aspects

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Problem / Introduction
The use of heavy machinery on forest soils can cause damages to their structure and can interfere with important soil functions. In order to investigate the consequences of soil compaction on the ecological functionality of soils, we carried out a traffic experiment under controlled conditions in June 2007.
Objectives
The objective of this study is to investigate the correlation between three categories of ruts (type I: low disturbance, type II: intermediate disturbance, type III: severe disturbance) and physical, biological and mechanical soil properties. These three categories of ruts are morphologically described.
Method
The traffic experiment was performed on a beech forest site in the eastern part of Switzerland near Kreuzlingen. The technical characteristics of the forwarder and its weight were exactly defined. Soil characteristics were homogeneous and the slope was under 10% on the entire surface. We brought the soil moisture contents to a gradient along the planned tracks before the traffic experiment in order to get all three types of rut. After the experiment, we described the occurrence of the different types of rut and performed DNA-based microbial community profiling. Results were compared for each of the different types of rut with physical and mechanical results.
Results
First results show that biological and physical characteristics of different rut-types allow a separation between soil disturbance and soil damage. With the help of this information we are able to classify the rut types which exert potential damage on soil functions.
Perspectives
The traffic experiment allows us to monitor the changes of biological and physical parameters with time. Alder was planted last autumn in the track in order to follow the regeneration of the compacted soils. A further traffic experiment is planned for this year near Bern on the Swiss Plateau.

P721
Monitoring of soil parameters after a forest soil restoration

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A acid-degraded forest soil (pH 3,2) on the location of Östrong (Austria, Height 650m, annual precipitation ~1000mm) was restored by the concept of ,,BOWASAN". The change in the chemical and physical parametres was monitored und documented for the period of six years. As a basis of comparison served an untreated area and a limed area (3t/ha limestone).
Repeated annual soil analyses, the capture of the seeping water with suction cups in different depths and the measurement of the infiltration ability, as well as the water-hold-capacity are procedures of the monitoring programme.
On the restored area acid parameters, allocation of the sorption-complex and aggregate stability have been brought to the desired range gradually. The changes have been traced back to the fact that part of the raw humus was converted into moder humus. The roots of the spruces have penetrated again into the Bv and Cv horizon. The infiltration ability of precipitation water has risen by 300%. The water-hold-capacity has risen by 3-5%.
Within the limed area a limited effect was ascertained. The pH-values easily rose for a short time and sank again after three years to the original value. During the first two years part of the raw humus got mineralized and increased amounts of Nmin in the seeping water (up to 300mg NO_3-N/l could be attested). Lasting positive consequences on the aggregate stability and the water household could not be proved.
Indeed, the liming is able to attenuate the soil acid, but only leads to a limited ecological improvement of the overall system. Because of the restoration with the concept of "BOWASAN" the forest soil is able again to fulfil his originally desired and to the preservation of the material cycle and the water quality necessarily functional achievements.

P722
Soil conditions on sites of autochthonous European black poplar in Slovenia

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European black poplar (*Populus nigra* L.) is autochthonous but now rather rare tree species in Slovenia. Many of its sites are changed due to intensive past river regulations or its stands due to introductions of faster growing hybrid poplars etc.
In alluvial forests (the priority habitat type 91E0*) along rivers Soca, Sava and Mura autochthonous black poplar still has high genetic potential and therefore should be protected. Suitable knowledge of black poplar population ecological needs is of large importance.
Soil conditions on selected sites with old, tick and tall black poplar trees along three rivers were examined by sounding and with description and sampling of representative soil profiles. Black poplars grow the best in lowlands with temperate winters, on moist, well aired, eutric soils with ample water supply, high groundwater levels but without or with rare floodings. On examined poplar sites Haplic Fluvisols with Calcaric, Oxyaquic, Eutric, Arenic to Siltic qualifiers are prevailing.
On 3 ha large plot at the Sava river near Ljubljana 4 sites (river island, river bank, floodplain, unflooded area) with different water regime and different site conditions were selected. In spring 2007 soil chemical and physical characteristics on each site were analysed. Meteorological parameters, through fall, soil moisture content with TDR, temperature in the upper soil layer and biotic parameters of black poplar on all sites were monitored. The impact of stress factors (drought, early frost, floods) on poplar trees on selected sites was assessed. Low soil moisture contents were measured already in April 2007, indicating drought stress progressing during summer months till September 2007. Measured soil moisture contents were extremely low on the island with pioneer regeneration of black poplars and willows on very shallow alluvial soils, indicating unfavourable growth conditions.

P723

Seepage water quality before and after clear cutting of Norway spruce stands at Ballyhooly (Ireland) and Höglwald (Germany) under high sea salt and nitrogen deposition

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We compared the ion concentrations of seepage water before and after clear cutting of two long-term experimental Norway spruce forest plots at Ballyhooly (Ireland) and Höglwald (Southern Germany). Both stands exhibited similar soil and stand properties and comparable stand history, but Ballyhooly was influenced by sea salt deposition and was considered as "non N limited", while at the Höglwald plot N deposition was high and the site was "N saturated". These differences were clearly reflected in the seepage water concentrations (40 cm depth) of the mature stands. Ion concentrations at Höglwald were dominated by NO_3^- (mostly above the EU level for drinking ater of 806 µmolc L^{-1}) and Al. Ballyhooly exhibited high concentrations of Na^+ and Cl^-; elevated NO_3^- and Al concentrations were only observed at discrete events. After clear cutting the stands showed similarities in their response on NO_3^- leaching. Average peak concentrations at Höglwald reached a maximum of 2595 µmolc L^{-1} and at Ballyhooly of 2018 µmolc L^{-1}. At Ballyhooly the NO_3^- concentrations were continuously elevated over 1.5 years. At the Höglwald clear cut sub-plot, which was replanted with spruce or beech saplings, periodically elevated NO_3^- concentrations occurred with two distinct NO_3^- peaks over a two year period, but in between also lower concentrations were found in comparison to the control. A sub-plot with a pre-existing dense regeneration of Norway spruce exhibited the lowest nitrate concentrations before and also after the clear cutting. Aluminium showed the same trend as NO_3^- on both sites. Potassium concentrations were hardly impacted at Höglwald, while at Ballyholly a sharp increase was observed after the cutting. Calcium and Mg^{2+} peaks were also more pronounced at Ballyhooly. Generally, lower concentrations were observed for Na^+, Cl^-, and SO_4^{2-} at both sites after clear cutting. Some implications for forest management are given in the presentation.

P724

Nutrient cycling and soil properties after harvester thinning in an nutrient poor Norway spruce stand

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New skid trails have to be created when harvesters are used for the first time during thinning operations. For this purpose a brushwood mat is recommended to protect the soil from compaction. However, brushwood material contains significant amounts of nutrients. Therefore, the removal from the forest interior and the accumulation on the skid trails may have a significant effect on nutrient cycling. New skid trails were established in spring 2007 during a thinning operation in a Norway spruce stand in north east Bavaria. Five skid trails were investigated, where each was divided into parts with and without a brushwood mat. Each replication consists of 4 subplots: (a) stand interior, (b) stand edge, (c) wheel track, and (d) median strip. On each measuring place seepage water was sampled with suction cups in 40 cm depth and volumetric water content was measured online with ECHO soil moisture sensors (0 to 20 cm depth). Further, soil physical properties were analysed in relation to the thickness of the brushwood mat. Additionally, translocation and export of nutrients after thinning were calculated. Total pore volume was lowest underneath the wheel tracks without brushwood mat to a maximum depth of 40 cm, while under mat the impacts were mostly restricted to the upper 5 cm. However, the coarse pore volume decreased in all cases after harvester operations. The same did water and air conductivities down to 30 cm depth. Anyhow, the values under the mat indicate impaired, but still tolerable conditions for root development in contrast to tracks without mat. Elevated NO_3^- concentrations were until now only exhibited in the median strip of one of the five skid trails with brushwood mat (up to 15 mg l^{-1} NO_3^-) in winter 2007/08. At all other subplots very low NO_3^- concentrations (mostly below 2 mg l^{-1}) were detected.

P725

The evaluation of deforestation effects on some soil chemical characteristics in four different regions of Guilan province

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Guilan province forests are stable ecosystems. When these forests are cleared and brought under intensive cultivation, it results in soil disturbance leading to change in soil physicochemical properties. This study was conducted in 2004 on four different sites in Guilan province, to show the adverse effects of land use converting on soil chemical characteristics. Soil samples were collected from adjacent natural forest and tea gardens. These were taken at upper 20 cm and use to measure soil reaction (pH), cation exchangeable capacity (CEC), electrical conductivity (EC) and soil organic carbon (OC). Results showed after 10 - 40 years of shifting forest to tea garden caused that the soils in the natural forest lands had significantly higher pH, CEC and OC compared to soils under tea gardens (P>0.01). In contrast changes of EC due to time of harvesting and use of fertilizer were irregular. Sustainable use of natural resources will lead to their long-term workability, while negligence of conservational practices including appropriate farming management practices will result in the destruction of these resources.

P726

Evaluation of effects of converting forest to tea on soil fertility characteristics: case study in Guilan province

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Due to high organic matter and strong structure, the forest soils in Guilan province are potentially productive. A study was conducted in 2004 on 4 different sites in Guilan province to show the effects of land use converting on soil fertility properties. Soil samples were collected from adjacent natural forest and tea gardens. These were taken at upper 20 cm and use to measure soil total Nitrogen, available Phosphorous, and Potassium, Calcium and Magnesium contents and C/N ratio.

Results showed after 10 - 40 years of change forest to tea gardens caused that the soils in the natural forest lands had significantly different total Nitrogen, available P and K, Ca and Mg exchangeable contents, compared to tea gardens (P>0.01). In contrast changes of C/N ratio didn't have significantly differed.

P727
Effect of clear-cutting on soil carbon pool and CO_2 fluxes from boreal forest soil

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Due to their large land area and large carbon pool forests have an important role in the management of soil carbon stocks. Upon such disturbances as forest fire or clear-cutting, the carbon balance of forest is profoundly changed. First the carbon assimilation in photosynthesis of trees is ceased and secondly a large amount of fresh litter is released to the soil. When the tree canopy is removed, solar radiation on the soil surface is increased resulting in higher soil temperature, which can increase the decomposition rate of organic matter. There is also a major shift from autotrophic to heterotrophic respiration due to removal of trees. We studied soil CO_2 efflux and carbon stocks on 5- to 12-year-old clear-cut sites and on adjacent non-cut Scots pine and Norway spruce forest stands in Southern Finland.
Soil CO_2 efflux at the sites showed a typical seasonal variation following soil temperature the fluxes ranging from 0.2 g CO_2 m^{-2} h^{-1} in the beginning of June to 1.2 g CO_2 m^{-2} h^{-1} in July. Soil temperature was substantially higher on the clear-cut sites than in the control forests during the growing season. Except for young Scots pine sites the CO_2 effluxes measured from the clear-cut sites did not differ statistically from those measured in the control forests even if a major proportion of the actively respiring root biomass was killed upon clear-cutting. The CO_2 efflux from root and rhizosphere respiration was probably masked by the decomposition of logging residue remained in the soil and the respiration from emerging ground vegetation on the clear-cut sites. We will continue studying the carbon stocks and fluxes at the sites with a process based model taking into account the decomposition rates of different fractions of soil organic matter, root and rhizosphere respiration and carbon input from photosynthesis.

P728
Using dissolved organic carbon for Norway spruce transformation

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Transformation of secondary Norway spruce forests has become a highly relevant issue for forest policy, management, and research in the Czech Republic. The attention for the transformation of Norway spruce is due to changing forestry objectives and an enhanced understanding of forests, which allows for a better insight into the consequences of different management practices. The main advantage of transformation into mixed or uneven-aged forests is the increase in ecological stability. In terms of organic litter, acidity and nutrient cycling, the litter of broadleaves tends to decompose faster than litter of conifers. Consequently, organic residues do hardly accumulate on the soil surface, pH values in the top soil are generally higher and the release of nutrients is faster. This leads to a better conservation of base cations and an accelerated turnover. The study deals with the evaluation of the concentration of DOC in lysimetric waters sampled from forest stands of various species composition in the Drahanska vrchovina Upland. The purpose of the places was to study soil water by means of lysimeters. Data obtained were measured in pure spruce monocultures (*Picea abies* Karst.), in pure beech monocultures (*Fagus Silvatica L.*). In precipitation waters and waters intercepted in underground lysimeters, the amount and chemical composition of water was determined in every sampling. DOC was determined by means of a SHIMADZU TOC VCSH/CSN analyser according to the CSN EN 1484 (1998) standard. For the transformation of spruce monocultures to mixed forest dissolved organic carbon is suitable characteristics.

P729
Time-related changes in size distribution and quality of charred materials set down on soil following a wildfire in a pine forest in Central Italy

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Charcoal is a highly recalcitrant organic component that is currently incorporated in Mediterranean soils in great quantities following wildfires. Despite its very long residence time in soil and its contribution in limiting the greenhouse effect, in situ studies on charcoal are few. Fresh charcoal added to soil is quickly reduced in size and possibly in time suffers some moderate chemical changes. In this study, charcoal was collected from the ground of a burned *Pinus pinea* forest in Tuscany, Central Italy two weeks, three months and six months after fire. Charcoal was separated in 4 dimensional fractions (>2 mm; 2-1 mm; 1-0.5 mm; <0.5 mm) and studied for chemical properties by elemental C, N and solid state CP-MAS ^{13}C NMR analysis and for reactivity by acid oxidation. The size fractions appeared to have different composition, char from wood and bark being comprised in the coarsest fraction, pine needles fragments in the intermediate fractions and highly condensed BC in the finest fraction. The BC in the fine fraction was closely blended with soil particles and aggregates and could hardly be separated from them. The variation in the relative abundance of the fractions through time was investigated in the first year following fire. The observation of the charcoal fraction at ESEM-EDX allowed assessing some effects of the on going degradation processes occurring in the field.

P730
Soil temperature and moisture conditions: effect on tree vitality

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The global average surface temperature will likely increase by 2 to 4.5 °C during the course of the 21st century. In the meantime, changes in precipitation and the melting of ice and snow are expected to increase flood risks in some areas while causing droughts in others. Forest productivity and vitality depend on in addition of nutrient status of soil also on moisture and temperature conditions of soil. We wanted to study how the soil temperature and moisture conditions effect on forest vitality (defoliation and discoloration) and annual litterfall flux. According to our previous studies we have found positive correlation between total flux of litterfall and defoliation degree in spruce stands. The study was carried out on six Norway spruce (Picea abies L. Karst.) Level II plots during 1996 to 2004 that form a part of the UN-ECE/ICP Forests and EU/Forest Focus forest condition monitoring programmes. Temperature and moisture of soil have been monitored in these sites at depth of -10 cm and -20 cm, in addition to temperature within and above the tree stand and precipitation under the tree canopy. These parameters are measured and stored once an hour. Defoliation was assessed on 60 trees on each plot. Defoliation of spruce was estimated on the upper half of the living crown. Litterfall was collected using 12 traps located systematically over the 30 x 30 m plots. The top of the funnel-shaped traps (collecting area = 0.5

m2) was located at a height of 1.5 m above the forest floor. Litterfall was collected at two-week intervals during the snow-free period, and once at the end of winter. The mass of each fraction was weighed. Preliminary results indicated correlations between soil parameters and defoliation degree and litterfall flux in some of the studied sites.

P731
Decomposition rate in the floodplain forest

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The submitted work indicates the preliminary results of study evaluating the humus ratios in the floodplain forests in Lednice na Morav[[Unable to Display Character: ě]] and Vranovice, belonging to territory of the forest enterprise Židlochovice in Czech republic. The basic characteristics of the surface humus layer in a mixed growth, in the oak and the ash growth are here assessed. The first research locality in Lednice is situated in an altitude 151-153m. Average of annual temperature is approximately 9-10 ° C, average of annual rainfall is 500-550mm. The second research locality in Vranovice is situated in an altitude of 170 m. Average of annual temperature is approximately 10°C, average of annual rainfall is 400-500 mm. In the removed samples of a litter fall (oak, ash) the contents of carbon, nitrogen and C/N ratio were determined and the microscopic pictures of foliage decomposition were made. The humus reserves and release of CO_2 by the soil in natural conditions was determined, too.

P732
Confrontation of soil quality under limed and non-limed stand in the mountain forest

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The North-East part of Czech Republic ranks among regions with highest level of acid deposition in Europe. This study deals physical and soil chemistry in the mountain region of Moravien - Silesian Beskids in the Czech Republic. Stands are situated at the experimental study site of Bílý K[[Unable to Display Character: ř]]íž. The forest stands of Norway spruce (*Picea abies* [L.] Karst) are situated at an altitude of 908 m, the age of monocultural is 30 years. It is a case of a moderately cold, humid and rich in precipitation climatic region. Mean air temperature is 4,9°C, mean annual precipitation 1100 mm and mean relative air humidity 80%. Research area have three stands FD, FS and FK. The area of each individual research plot is 0.25ha. Stands FD and FS was limed with dolomitic limestone at a total rate of 9 $t.ha^{-1}$ in 1980s. Plots FD and FS has a different density. The density of the FS and FD stands is 2100 and 2600 trees per ha, respectively. The control plot (FK) has not been limed. Parent rock is formed by flysh layers predominated by Godula sandstone. The soil type is humo-ferric podzol with mor-moder humus type with relatively low nutriet content. In took samples of soil the contents of carbon, nitrogen and C/N ratio were analysed. Total nutrients, available nutrient and physical properties of soil were analysed too.

P733
Forest floor vegetation as indicator for soil deformation

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One important possibility for protecting forest soils against further soil compaction and soil deformation is the use of former skidding lanes for future machinery movement. In order to "recycle" old skidding lanes, they have to be identified in the field. This can easily be accomplished if the vegetation composition of compacted soils differs notably from the vegetation of well structured forest soils.
At eight different forest stands in Lower Saxony, Germany, the interaction between several soil deformation indicators such as bulk density, pore size distribution, CO2-concentration or field classification tools and the composition of vegetation was investigated.
It was shown that changes in soil physical parameters result in changes of forest floor vegetation. Plant species which normally indicate high moisture are more competitive on compacted and badly aerated soils too. Carex remota, Impatiens noli-tangere or Juncus effusus, well known indicator plants for wet soil conditions, are apparently suitable indicators for compacted soils. On well structured soils, species which typically point out less soil humidity were found. Indicator plants for well structured soils are Vinca minor, Asarum europaeum or Gymnocarpium dryopteris as well as seedlings of Fagus sylvatica and Fraxinus excelsior.
If the percentage of damaged and compacted soils shall be minimized, old skidding lanes and compacted areas have to be integrated in new skidding trail systems. Indicator plants for soil deformation are particularly suitable for identifying those areas.

P734
Does species composition affect soil carbon pools in Mediterranean mountain forests?

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Forest species composition influences soil carbon (C) pools in temperate areas, although this effect has been scarcely studied in Mediterranean ecosystems. We examined soil C stocks, organic C input through aboveground litterfall and estimated C turnover rates at forest transects, each consisting on a pure Pyrenean oak (Quercus pyrenaica Willd.), a mixed Pyrenean oak-Scots pine (Pinus sylvestris L.), and a pure Scots pine stand, on three Mediterranean forest ecotones. Soil oxidizable carbon (Coxid) content by wet combustion method and soil organic matter (SOM) content by loss on ignition method were calculated for both surface (0 to 5 cm deep) and subsurface (5 to 10 cm deep) layers. Aboveground litterfall was quantified during two years. Both parameters (Coxid and SOM) showed similar patterns among sites and stands, although estimations of total organic C were not completely coincident; so caution should be paid if we are to estimate absolute C pools. Coxid content was higher in Scots pine stands than in Pyrenean oak ones for the surface layer, although the pattern was less clear for the subsurface layer. Topsoil (0-10 cm) Coxid stock was 18.7 ± 1.9 T C ha-1 for Pyrenean oak stands, 25.2 ± 1.0 T C ha-1 for mixed stands, and 30.5 ± 2.3 T C ha-1 for Scots pine stands. Aboveground litterfall ranged from 2.9 ± 0.3 T C ha-1 y-1 in Pyrenean oak stands to 4.3 ± 0.3 T C ha-1 y-1 in Scots pine stands. The resulting rate of soil C turnover was 15.4 and 14.2 % y-1 for Pyrenean oak and Scots pine stands, respectively. Our results suggest that forest composition influence surface C content likely through C input from litterfall, but not through differences in turnover rates, and that the effect of this input is less obvious in deeper soil layers.

transpiration in the abovementioned seasons due to the influence of the active transpiration by the A. mangium trees.

P735

Spatial and temporal variability of nitrate and other ions and elements in seepage water below a N saturated mature spruce stand

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121 suction cups were implemented in spring 2005 in a 2 x 2 m grid below the main rooting zone (40 cm depth) of a mature spruce stand. Seepage water was collected monthly during the vegetation period and analyzed for NO_3^-, SO_4^{2-}, PO_4^{3-} and Cl^-. For the samplings in July and October additionally pH and the concentrations of Al, Ca, Mg, Mn, K, Na, and NH_4^+ were measured. Data were examined with conventional statistics and with geostatistical methods. Semivariograms were calculated and models were fitted for most ions and elements in the soil solution.

Mean concentrations of NO_3^- (35-21 mgl^{-1}) and SO_4^{2-} (17-20 mgl^{-1}) were highest while other ions and elements had means between 1 and 5 mgl^{-1}. PO_4^{3-} and NH_4^+ could not be detected in the soil solution. Spatial variability was highest for NO_3^- and lowest for Na. Temporal variability was lower compared to the spatial variability for most ions. NO_3^- was significantly correlated with concentrations of Al, Ca, Mg, Mn and pH. This indicates the importance of NO_3^- with respect to cation leaching and soil acidification. Also several other ions and elements were significantly correlated among each other.

Geostatistical analysis revealed that NO_3^- had autocorrelation ranges between 17-19 m and high structural variances (65-81 %). Al, Ca and Mg had ranges between 10 and 13 m and between 60 and 80 % of the semivariance could be explained by structuring. SO_4^{2-}, Cl^-, K, Na, and Mn showed spatial dependencies below 10 m. The calculated structural variances were between 65-80% for Cl^- and Mn while the other parameters had structural variances below 50 %. Some ions and elements showed a periodical behaviour in the semivariograms.

The spatial and temporal variability as well as autocorrelation range and strength have important implications for sampling strategies depending on the parameter under investigation.

P736

Effects of thinning on the soil moisture content of Acacia mangium plantations in Northeast Thailand

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We attempt to convert fast-growing tree species into indigenous tree species by using the underplanting method along with thinning, in the tropical monsoon regions.

This study describes the effects of thinning on soil moisture content, using the ADR (amplitude domain reflectometry) method.

The study site was located at Sakaerat field station (14º28′06.1″N, 101º54′15.0″E; alt., 420 m) belonging to the Royal Forest Department, Nakhon Rachasima, Northeast Thailand. Meteorological conditions were 26ºC, annual mean air temperature and 1,100 mm, annual precipitation during the dry (November-April) and wet (May-October) seasons.

Three conterminous plots have been set in the Acacia mangium plantation: a plantation plot without thinning activity, a thinning plot, and an open plot. We have been measuring the moisture of surface soil 6 cm in depth at regular intervals by using the ADR sensor (Theta Probe type ML2x).

During the wet season and the beginning of the dry season, the soil moisture content among the 3 plots was statistically different. The soil moisture content decreased in order of the open plot, thinning plot, and plantation plot. The surface soil in the plantation plot was drier than that of the other plots. This indicates that the soil moisture content was greatly affected by

P737

Natural regeneration of Norway spruce 16-18 years after intensive forest management

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Mechanical site preparation (MSP) with Marttiini-plough inverts Podzol soil profile and creates following microsites: untreated control (UTC), tilt and trench. We studied natural recruitment of Norway spruce at five sites (compartments) underlain by silty glacial till in Finnish Lapland (67°09'N, 29°05'E). Prior to clear-cutting and subsequent MSP and planting with Scots pine the sites hosted mature spruce stands. Pine plantations had failed at four sites, but survival at one site was 90%. Stocking of spruce was 1000-400 saplings/ha, respectively. For each sapling, 100 per compartment, apparent soil electrical conductivity (σ_a) and dielectric (ε) values were measured. The soil σ_a measured at 0-30-cm depth with an electrical conductivity fork (Geological Survey of Finland), and the soil ε at 0-15-cm depth with TDR (Tektronix 1502). We found majority of saplings (60%) established on UTR (mean σ_a=0.54±0.34 mSm^{-1}), while the proportion on tilt (34%, mean σ_a=0.35±0.18 mSm^{-1}) and trench (6%, mean σ_a=0.12±0.11 mSm^{-1}) were minor. The saplings at UTC (mean height 127±89 cm) and tilt (111±74 cm) were significantly (*p*=0.000) taller as compared to those in trench (32±44 cm). Soil ε was highest in trench position. Soil solution conductivities (σ_w) of UTR (σ_w=11.7±9.1 mSm^{-1}) and tilt (σ_w=10.7±9.2 mSm^{-1}) were significantly (*p*=0.000) higher as compared to that in trench (σ_w=2.2±2.9 mSm^{-1}). Even though the sites were surrounded by mature Norway spruce stands the natural establishment of spruce was hampered on the exposed mineral soil. Removal of the organic soil may have contributed to leaching of nutrients during acidic (pH≈4.5) snowmelt events 16-18 years post-MSP.

P738

A case study of soil removal affected soil-forest environment in the industrializing area

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The urbanization and industrialization of developing countries required a large amount of soil to reinforce earth foundation, especially in the coastal area where the foundation usually needs to be elevated. Sometimes, soil removal by construction equipment caused deforestation in both of mountainous area and coastal area. The trees were cut off in mountainous area to get the soil material, which caused the phenomenon of bare land and soil erosion. In the other side, the mangrove area was reduced by soil filling in coastal area. Thus, the situation of topsoil loss, soil erosion and soil dust pollution became worse. It needs more general considerations of soil-forest environment. This paper discusses on soil removal that affected soil-forest environment in an industrializing area.

P739

Humus forms under Quercus spp. in Mediterranean conditions

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In order to expand the knowledge base on variability of humus forms in Mediterranean forest soils, humus profiles under different oak species (Quercus ilex, Quercus suber, Quercus cerris and Quercus pubescens) and in sites of different climatic and edaphic conditions, were compared.
A morpho-functional criterion was adopted to describe humus forms. The thickness of holorganic layers, together with the properties of A horizons, were considered. The presence/absence of the OH horizon, in relation with the C/N ratio and nature of the A horizon was as the basis for the differentiation between Mull and Moder.
Even in climates characterised by a pronounced dry season, like in the Mediterranean region, biological activity plays a major role in shaping the soil profile. Whereas seasonal precipitation is a constraint on biological activity, intense activity and nutrient cycling is often achieved when water is available. The nature and agents of biological activity may actually be quite different in the different seasons.
Seasonal variations influence chemical and microbiological factors controlling humification and mineralization. Understanding soil-plant feedbacks in forest ecosystems is a major research frontier, made challenging by the variety of organisms, of their distribution and of their interactions. One potentially useful approach is the analysis of humus layers, whose architecture is strongly dependent on physiological factors. This could allow an improved understanding of the way soil-plant interactions influence the soil profile.
Widely different humus forms, ranging from Dysmoder to Mull, were found, independent of forest types. This large variability allows an insight into the factors controlling nutrient and organic matter cycling in such ecosystems.

P740
Spruce resin affects C and N transformations in birch soil

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Canal oleoresins are sticky compounds emitted from coniferous trees after injury or wounding. These resins compose predominantly of terpenes and their oxygen-containing derivatives, terpenoids. Volatile compounds of resins are mainly monoterpenes. There is evidence that monoterpenes may play an important role in controlling N cycling in forest soils. We have examined the effects of Norway spruce (Picea abies (L.) Karst.) resin on C and N transformations in silver birch (Betula pendula L.) soil.
Laboratory experiments were designed to study these effects. Soil samples were taken from the humus layer of a 13 years old birch stand, sieved and incubated in airtight glass bottles. In some experiments spruce canal resin was frozen and mixed with soil, in other experiments melted resin was absorbed in nets hanging inside the bottles. Microbial activity during the incubation was studied by determining the CO2-concentrations inside the bottles. After the 14 and 28 day incubation periods microbial biomass C and N, net N mineralization and net nitrification were determined. Also the effect of pH on nitrification was studied by using nutrient-enriched soil suspensions with continuous shaking.
Both resin mixed with soil and resin volatiles decreased net N mineralization and simultaneously increased C mineralization. Net nitrification was greatly decreased or completely stopped. Effects on microbial biomass C and N were not consistent. Resin effects were dependent on concentration and pH. Based on this, we concur that resin affects C and N transformations in soil, especially nitrification. We are currently continuing studies of the chemical composition of resin and resin effects on soil C and N transformations.

P741
N-P-K retranslocation in *Pinus taeda* L. needles in Rio Grande do Sul-Brazil

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Leaves are the main cell metabolism place in plants, so the study of its nutrients composition and its retranslocation is very important to indicate the nutritional status. This study had as objective to evaluate the nitrogen, phosphorus and potassium translocation in a .7,5 years old *Pinus taeda* L. stand, located in Cambará do Sul, RS - Brazil. The stand was implanted upon a Humic Cambisoil that has in its first layer (0 - 20 cm), 4,37% of organic matter, 2,33 and 28,73 mg dm^{-3} of phosphorus and potassium Four plots were distributed inside the stand, each plot represented compound sample of 10 analyzed trees. The collections were done in the average third from the canopy in the four orthogonal points (N, S, E, W). Young needles were collected (2 to 4 months) and senescent (deposited upon the soil). To determine the percentage of translocated nutrients the following formula was used: %NutRe = {1 - [$(Nut./Ca)_{senescent}$ / $(Nut./Ca)_{green}$]} x 100, described by Negi and Sharma. The amounts (g kg^{-1}) of N found in the needles was 11,17; 11,62 and 4,69, for P was 1,18; 0,77 and 0,31, although for K was of 4,21; 2,40 and 0,39, respectively for young needles, mature and senescent. The percentage of it nutrient retranslocated was of 96, 4; 89, 6 and 83, 5% respectively for K, P and N. These values show the high mobility of these elements inside the plant; being them very important to maintain the nutritional balance, favoring the growth through the development of new structures since the cell metabolism; that is only possible when the mineral elements are present in requires amounts in the needles in each development stage.

P742
Impacts of four tree species on forest soil chemistry and nutrient fluxes: a Sr isotopic approach

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Determining the impact of tree species on soil chemical properties is critical to enable a sustainable forest management and to preserve the quality of the environment. Calcium has a major nutritional role in forest ecosystems; a comprehensive understanding of its cycling is therefore desirable.
The aim of this study is 1) to determine the impact of several tree species and the mechanisms implicated in the distribution of nutrients in the soil profile and 2) to identify the origin of Ca involved in the nutrition of these species.
This research was conducted in four adjacent pure stands (maple, sequoia, spruce and oak) on an acid leached soil (on a Pleistocene loess in central Belgium). Stands were planted hundred years ago on an ancient pure beech forest. The substrate is identical at the four stands and very homogeneous down to the occurrence of a deep carbonated layer at 250 cm depth.
We used natural strontium isotopes (87Sr/86Sr ratio) as tracers of Ca source. Sr isotopes have been analysed in vegetation (leaves, roots from 0 to3 m depth) and in the main soil horizons.
Hundred years of monocultures induced marked differences in soil chemical properties (pH, CEC, nutrient concentrations...) under the four species. Spruce clearly decreases the soil nutrient reserves as opposed to sequoia and maple which improve the soil resources. By contrast, oak stand does not show any significant difference compared to the reference beech stand.
The coupling of Sr isotopes with root distribution data highlighted differences in nutrient capture strategy by the tree species studied. Major calcium uptake occurs in the deep carbonated layer (< 250 cm depth) for sequoia and maple stands, in intermediate horizons (1 to 2 m depth) for oak stand whereas

spruce stand derives its nutrient from the upper layers and the atmospheric inputs.

P743

CH4 uptake of soils of a temperate deciduous forest with different abundance of European beech (Fagus sylvatica L.)

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Well drained forest soils are a sink for atmospheric methane (CH4). We analysed soil properties and net-uptake of atmospheric CH4 in a broad-leaved forest on loess over limestone with large gradients in beech abundance to i) quantify the function of these soils as a sink for atmospheric CH4, ii) to determine the main controls of CH4 uptake in these soils and iii) to analyse the influence of different abundance of beech on the CH4 sink strength.
Organic carbon accumulation in the humus layer and topsoil acidity were much higher in beech stands (0.81 kg m-2) than mixed stands (0.27 kg m-2). In addition stocks of exchangeable calcium and magnesium in the upper 30 cm of the mineral soil increased with decreasing abundance of beech. Subsoil clay content and differences in litter composition were identified as important factors that contributed to the observed variability of top soil acidity and forest floor carbon accumulation. Measured CH4-C uptake rates ranged between 5 and 60 µg m-2 h-1. The seasonal variation of the CH4 uptake could be explained to a large extent by changes in soil moisture content and the resulting changes of the effective diffusion coefficient (R2 = 0.7). The mean annual CH4 uptake was higher in soils of beech stands (3.3 kg CH4-C ha-1 yr-1) than mixed stands (2.1 to 2.3 kg CH4-C ha-1 yr-1). The top soil (0 - 5 cm) clay content was the main factor that determined the annual CH4 uptake (R2 = 0.52). The results indicate i) that CH4 uptake was controlled by soil physical properties that influence gas diffusivity, ii) that the abundance of beech had no effect on the CH4 uptake, and iii) that the activity of the “high affinity” methanotrophic bacteria, that consume atmospheric CH4, was not reduced by the acid soil conditions beneath beech.

P744

Processes of soil solution P supply in a very low P sorbing forest soil

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Plants absorb phosphorus as ionic species from the soil solution which is replenished by the soil solid phase. The release of ionic P species from soil constituents to soil solution is potentially governed by several physico-chemical and biological processes. Among the former processes, the diffusion of ionic P species at the solid-to-solution interface of soils is one of the key mechanisms. For the latter, P mineralization can be of importance, especially where organic P represents a high proportion of total P, such as in forest or grassland soils.
With the objective of quantifying and comparing the role of both processes, we monitored the gross amount of diffusive P and net and gross P mineralization rates in a forest soil using isotopic dilution techniques during an incubation experiment of 154 days. We used a very low P sorbing soil from 0-15 cm soil depths having a high proportion of organic P (90% of total P) and thus hypothesized that mineralization would have a more important role than diffusion in supplying P to soil solution. Results showed an important P remineralization (gross rate from microbial biomass P; 1 µg g^{-1} day^{-1}). Basal P mineralization (gross mineralization of organic P) was not detectable with the used isotopic dilution technique (< 0.03 µg g^{-1} day^{-1}) but was alternatively estimated as 0.005 µg g^{-1} day^{-1} using carbon mineralization rate. Net P mineralization (basal mineralization + remineralization - immobilisation) was 0.014 µg g^{-1} day^{-1}. Despite the high proportion of organic P in this soil and contrarily to our hypothesis, results also showed that cumulated values of diffusive P during the 154 days of the incubation experiment (1-4 µg g^{-1} soil) were slightly more important than cumulated values of basal P mineralization (0.8 µg g^{-1} soil) and net P mineralization (1.73 µg g^{-1} soil).

P745

Mechanical mixing of moder humus promotes mineralization of older soil organic N

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In forests, the morphology of the humus layer reflects both composition and activity of the soil fauna and the micro-organisms which in turn depends on environmental conditions and soil chemistry. Depending on the humus type, litter decomposition and mineralization known as a key process for the recycling of nitrogen in terrestrial ecosystems, is more or less rapid and/or complete. Thick moder humus is built up in beech forests within a forest rotation of 150 years on poor acidic soils. Mechanical mixing of the humus layers is applied as a widespread forest management technique in western France to enable a natural regeneration of the forest.
This technique increase the mineralization of the humus but little is known about the mechanisms responsible (litter quality, priming, C or N limitation of microbes).
Six years before the treatment, ^{15}N-labelled beech litter was deposited on the top of the humus layers (15 m^2) and the fate of litter N was monitored using a budget approach once a year (2001 - 2006). In 2006, on half of the ^{15}N labelled plot the mixing treatment was applied. Compared to the non treated plot, the ^{15}N enrichment in the whole humus layers was higher and more evenly distributed in the treated plots. N mineralization and nitrification were twice higher in the humus of the treated plot, but similar in the mineral soil in both plots. In the humus, δ^{15}N of mineralized N (NH_4 + NO_3) was close to bulk δ^{15}N in the non treated plot whereas mineralized δ^{15}N was much lower than of bulk δ^{15}N in the treated plot. Probably, mineralization of older, unlabelled N benefits from the input of more recent SOM which may indicate a kind of activation process of soil micro-organisms maybe due to the biochemical composition of the partly decomposed litter.

P746

Polyphenol oxidase, tannase and protease activity in relation to tannin concentrations in soil under silver birch and Norway spruce

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The aim of this study was to compare enzyme activities (tannase, polyphenol oxidase and protease) with concentration of tannins and their ability to precipitate proteins in litter layer and humus layer under silver birch (*Betula pendula* Roth.), and Norway spruce (*Picea abies* L.). In addition we estimated the influence of studied enzymes on protein-tannin complex. The study site was a tree species experiment in Eno, Eastern Finland, having replicated plots dominated by silver birch and Norway spruce. Samples were taken from the litter layer and humus layer. Tannin concentration and enzyme activities were usually higher in humus layer than in litter layer and the highest values were obtained for birch humus layer. However, tannins from litter layer had higher ability to precipitate protein.

Hydrolysable tannin concentrations were strongly correlated with tannase activities. Polyphenol oxidase activities were high in both layers. On the contrary, proteolytic activities were very low.
Studies with commercial enzymes and enzymes extracted from the soil showed a decrease of tannin concentration in time from tannin-protein complex, but only negligible decrease in protein concentration. Condensed tannin-protein complexes were more recalcitrant than tannic acid-protein complexes. Tannins, depending on concentration and chemical structure, showed an inhibitory effect on proteolytic activity; condensed tannin showed stronger inhibitory effect than hydrolysable tannin.

P747

Relations between soil properties and growing characteristics of Grey alder (*Alnus incana L.*) stands in Western part of Latvia

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This article represents results of research about gray alder growing characteristics in different soils implemented in Zemgale region, which characterizes with nutrient rich, heavy and carbonaceous soils. Soil properties (*like organics, nitrogen, pH, texture*) evaluated in 90 gray alder dominant stands of different age. The objective of the research was to find correlations between different soil properties and growing characteristics of gray alder stands on former agricultural and forest soils. Results of the research were used to elaborate recommendations on gray alder stands' early management and improvement of growing conditions depending on growing conditions.
Analytical methods utilized Forest soil monitoring program *BioSoil* were used to determine soil properties. Forest stand inventory was done using methodology of the *National forest resource monitoring program*. Information about soil properties were used in regression model, comparing different chemical and physical parameters with forest inventory data, like stand age, site index, share of gray alder in forest stand.
Results of the research demonstrated that pure gray alder stands in this region are growing mostly on nutrient rich former agricultural lands with destroyed drainage system (*gleic soils*). Gray alder stand productivity (*site index*) don't correlates with soil chemical content, but may be dependent from soil physical properties (*texture and compaction*) and water regime. Gray alder don't like permanently wet areas and heavy clay soils, especially if they contains free carbonates in upper soil layers. Correlation between stand age and total carbon (C) in soil argue that gray alder contributes to C sequestration as well as to nitrogen (N) sequestration, but generally in young stands (less than 20 years) which don't suffers from exceeding moisture. Concentration of N in soil is higher in stands with higher site index growing on sandy and loamy soils.

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