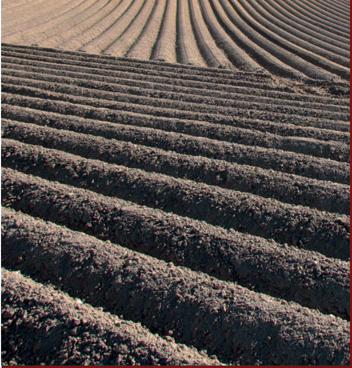
Mapping of trace element contents and enrichment factors in topsoils in the Nord-Pas de Calais region (France)

Denis Baize, Francis Douay, Hocine Bourennane, Estelle Villanneau, Thibault Sterckeman, Henri H. Ciesielski, Dominique D. King



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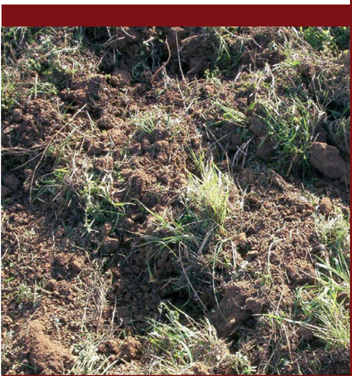

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SOIL - SOCIETY - ENVIRONMENT

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

(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.