

Determining land systems of pedogenesis for large-scale soil modelling

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Controlling factors explaining soil carbon within large, heterogeneous environments

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Project: GlobalSoilMap

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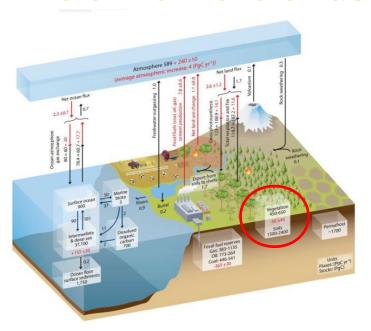
01 Introduction

Background, Conceptional framework and Objectives



INTRODUCTION (I/II)

GLOBAL CARBON CYCLE & SOIL CARBON



- Soils are not an unlimited resource
- Importance of soil carbon
 - Carbon pool mitigation and adaptation to climate change
 - Food security
- Topsoil well modelled (only 30% of the global soil carbon stock)
 - · Methods: Kriging, Regression tree modelling
- Subsoil modelling
 - Decrease in model performance
 - Lack of understanding on controlling factors of SOC within large areas
 - Data availability
- This work aims to:



N°3



INTRODUCTION (II/II)

CONCEPTIONAL FRAMEWORK

HYPOTHESIS:

"Variability in SOC may be better explained by modelling SOC within different soil-landscape systems (SLSs). These may be defined by broad-scale data of climate, land use, parent material, relief and soil type, as supported by the Soil-Landscape paradigm described by Jenny [1941]"





OVERVIEW RESEARCH

Input data

- Soil sample data (source: French Soil Monitoring network & Soil Inventory programmes)
- Exhaustive covariates capturing biotic and abiotic conditions (Soil type and properties, parent material, relief, climate and vegetation)

Analysis

- Modelling Soil-Landscape Systems (SLS)
 - MB clustering undirected datamining
- Explanatory SOC models within SLSs, for each soil layer
 - Multiple linear regression

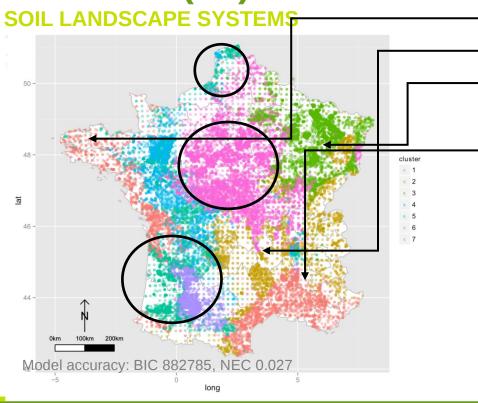




03 RESULTS & MAIN FINDINGS



RESULTS (I/V)

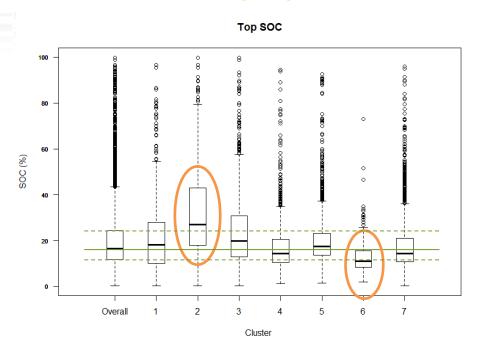


- 1) Dry climate
- 2) Mountain areas
- Undulating areas + agriculture
- 4, 5, 6) Similar climate but different parent material and land use
- 7) Well-developed loamy calcaric soils, agriculture



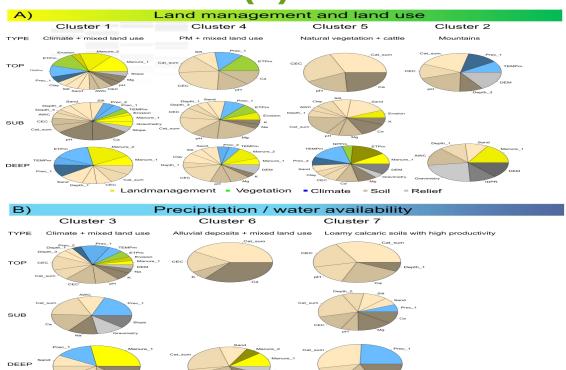
RESULTS (II/V)

SOC content within Soil Landscape Systems





RESULTS* (V)



Soil

Relief

Land management

Vegetation

Climate

Soil

Topography& geomorphology

* Presented variables: regression weight > 0,1



Landmanagement Vegetation Climate

Land management and land use Cluster 1 Cluster 4 Cluster 5 Cluster 2 TYPE Climate + mixed land use PM + mixed land use Natural vegetation + cattle Mountains Landmanagement Vegetation Climate = Soil B) Precipitation / water availability Cluster 3 Cluster 6 Cluster 7 Alluvial deposits + mixed land use Loamy calcaric soils with high productivity TOP - Landmanagement - Vegetation - Climate

Land management

Vegetation

Climate

Soil

Topography& geomorphology

* Presented variables: regression weight > 0,1





Current state and on going research

Major findings

- Shift in controlling factors both in space and depth
 - Carbon controlled by Soil-Landscape characteristics
 - **Human influence on Soil-Landscape relations**
 - Climate precipitation/water availability
 - Subsoil data availability needs to be improved, current data relates poorly to subsoil SOC

Ongoing research

- Improvement of data on controlling factors
 - Geostatistical modelling for large datasets (Kriging)
 - Soil depth and soil texture
 - Development of up-to-date database with remote sensing data and products

THANK YOU ALL! Essentially, all life depends

Essentially, all life depends upon the soil.

There can be no life without soil and no soil without life; they have evolved together.

American naturalist Charles Kellogg, 1938.

REFERENCE:

Mulder et al., (under review). Understanding large-scale soil organic carbon controls in relation to soil depth and soil-landscape systems. *Global Biogeochemical Cycles*.

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