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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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11-14 November, 2014, Nanjing, China



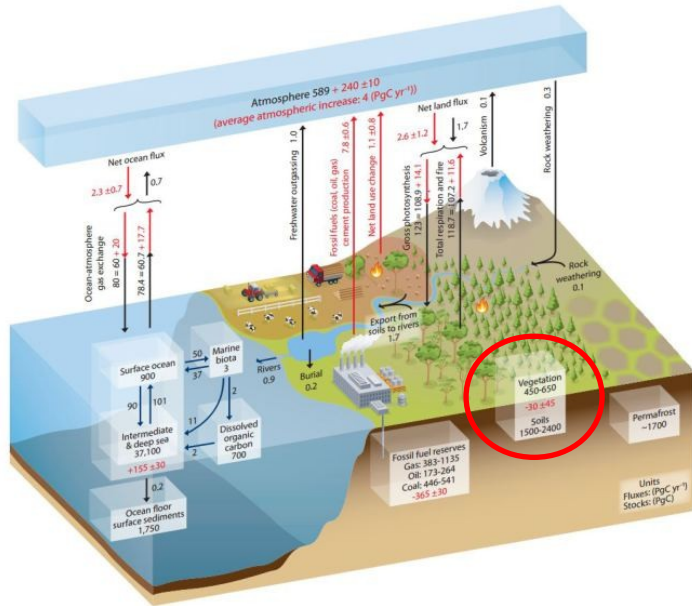
01

Introduction

Background, Conceptual 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:

- Improve the understanding of SOC controls
 - Determine which data is specifically needed to improve subsoil SOC models
- N°3
24/03/2015



INTRODUCTION (II/II)

CONCEPTUAL 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

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

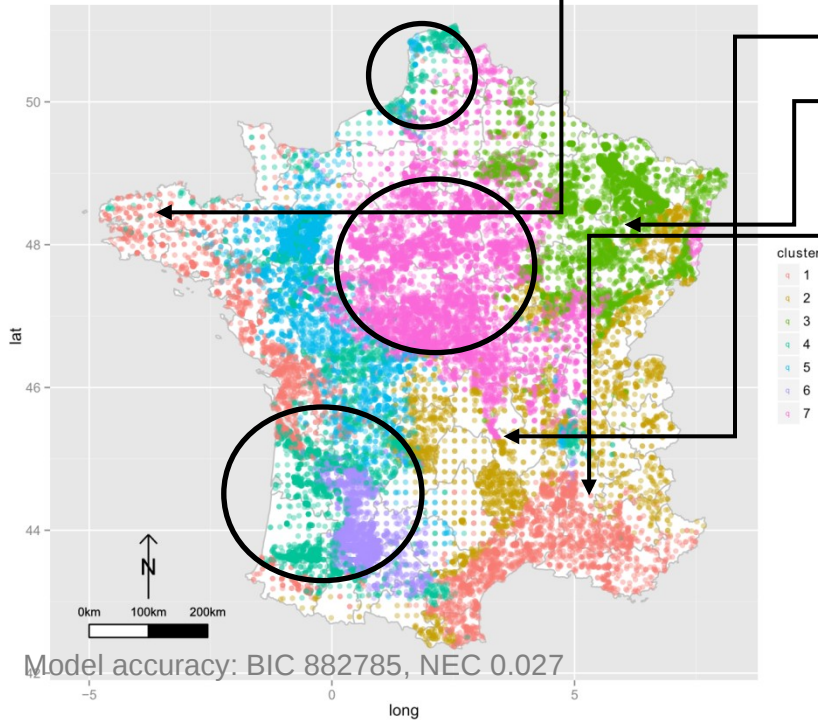


03

RESULTS & MAIN FINDINGS

RESULTS (I/IV)

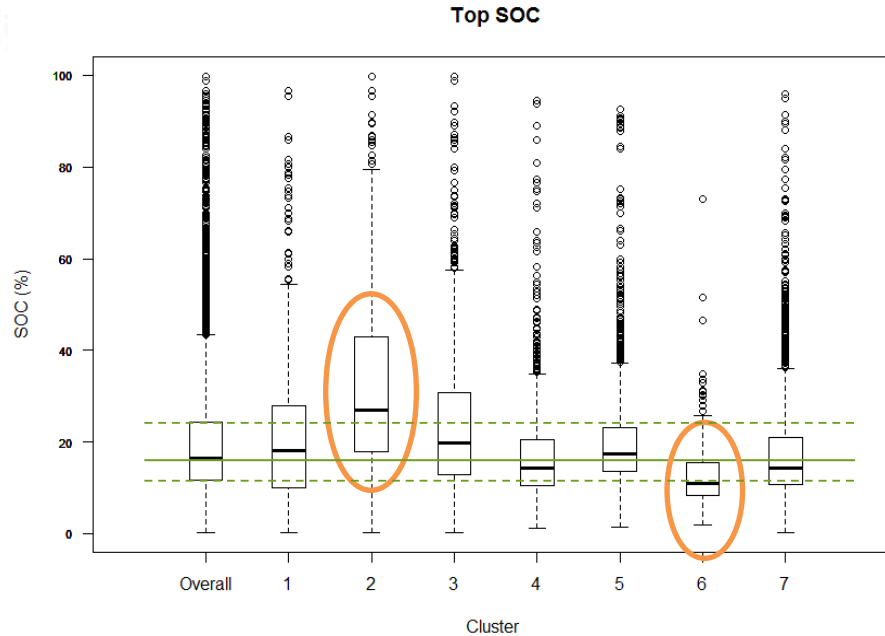
SOIL LANDSCAPE SYSTEMS



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

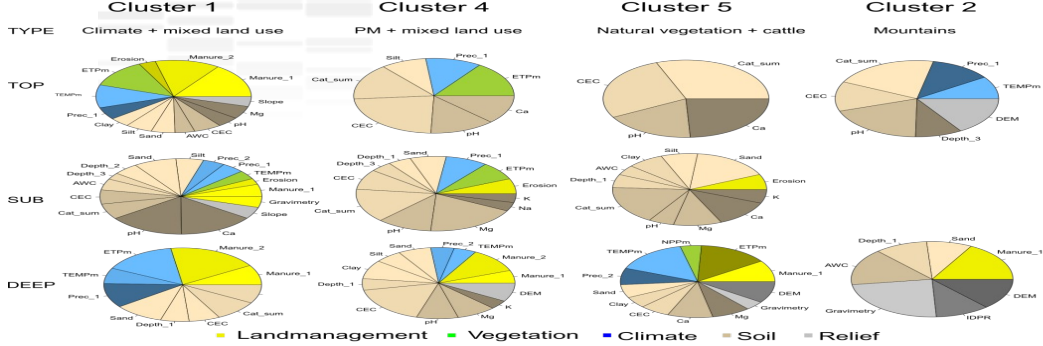
RESULTS (II/IV)

SOC content within Soil Landscape Systems

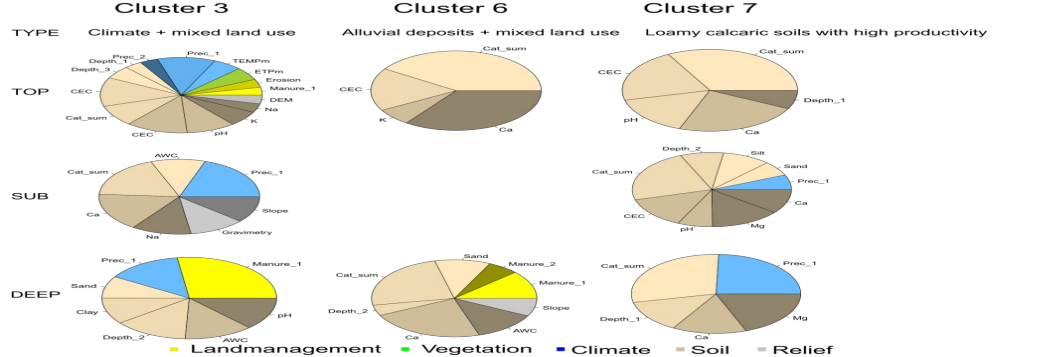


RESULTS* (V)

A) Land management and land use



B) Precipitation / water availability



Land management

Vegetation

Climate

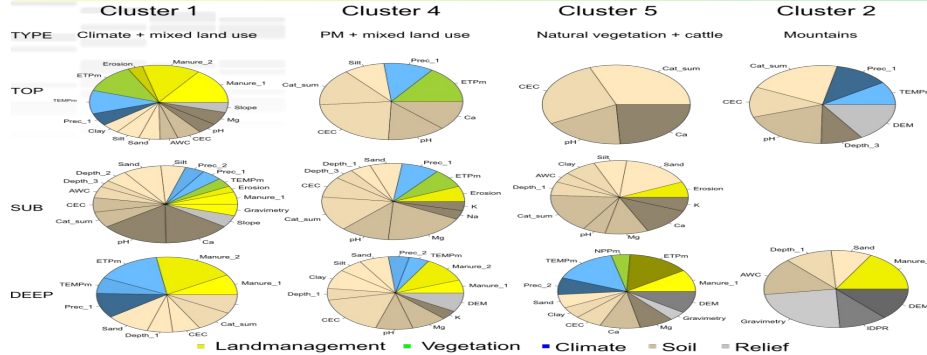
Soil

Topography & geomorphology

* Presented variables: regression weight > 0,1

RESULTS* (V)

A) Land management and land use



Land management

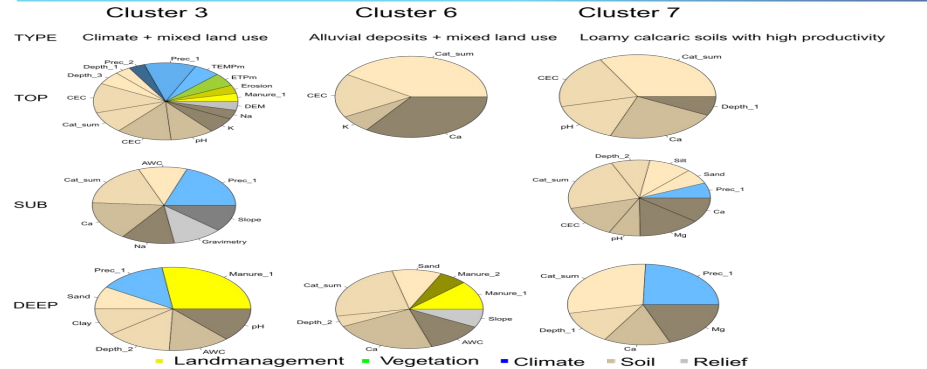
Vegetation

Climate

Soil

Topography & geomorphology

B) Precipitation / water availability



* 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 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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