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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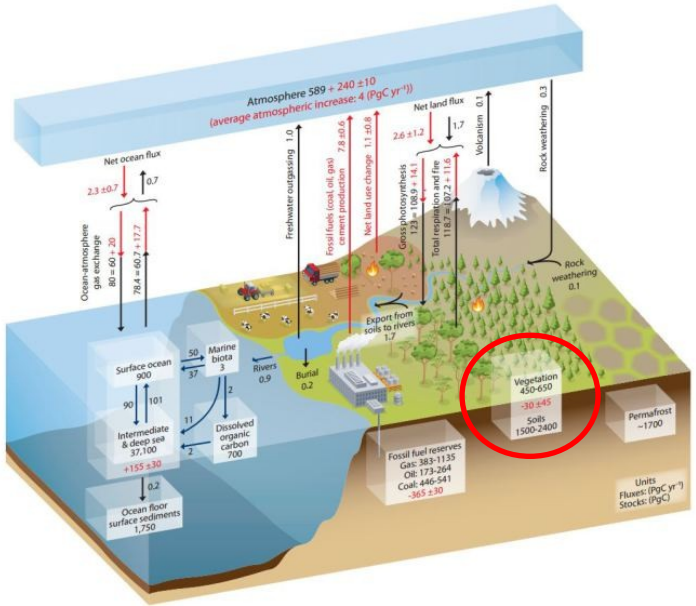
Introduction

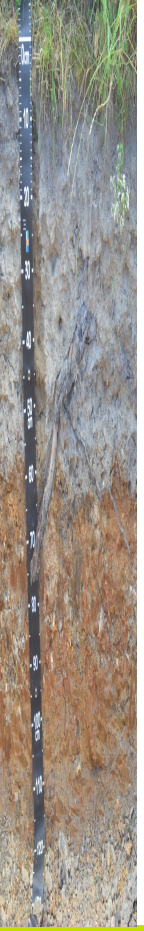
Background, Conceptional framework and Objectives

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:**
  - Improve the understanding of SOC controls
  - Determine which data is specifically needed for subsoil SOC models

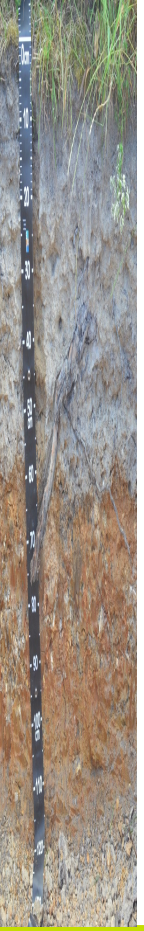


INTRODUCTION (II/II)

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

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

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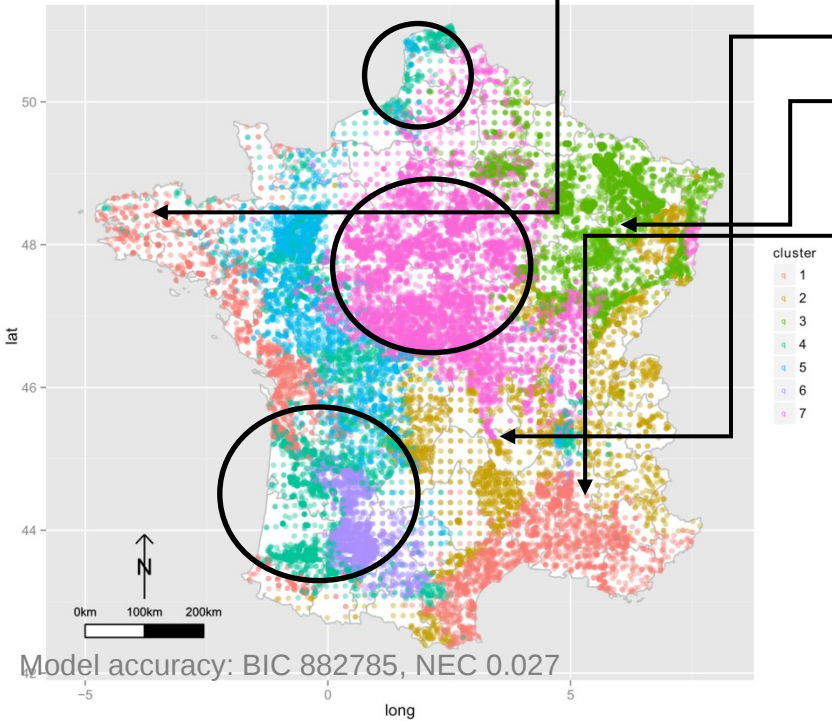
RESULTS & MAIN FINDINGS

RESULTS (I/V)

SOIL LANDSCAPE SYSTEMS



Model accuracy: BIC 882785, NEC 0.027

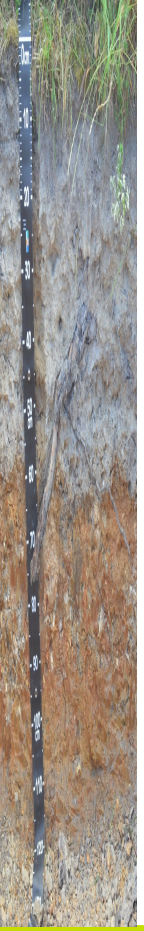
1) Dry climate

2) Mountain areas

3) Undulating areas + agriculture

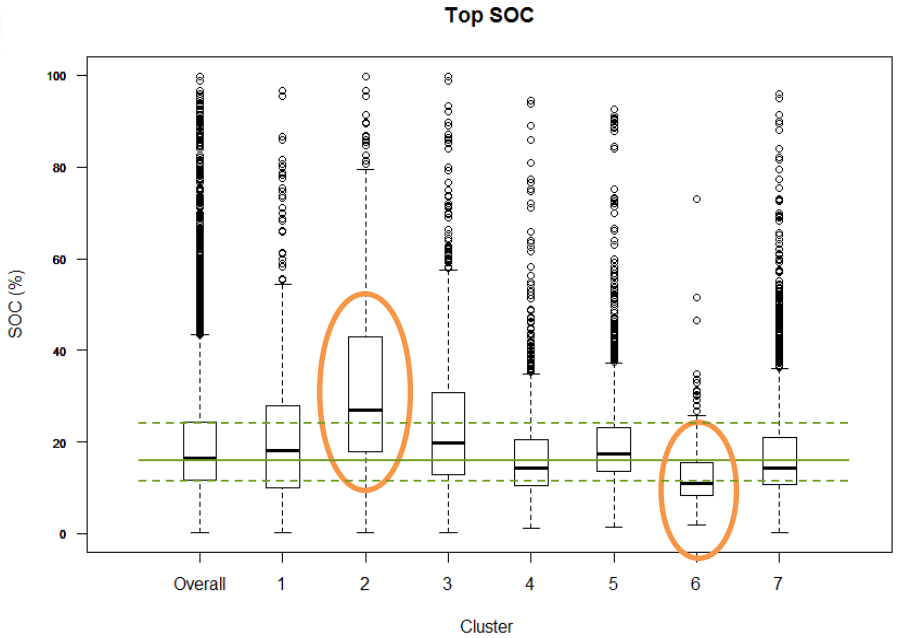
4, 5, 6) Similar climate but different parent material and land use

7) Well-developed loamy calcaric soils, agriculture

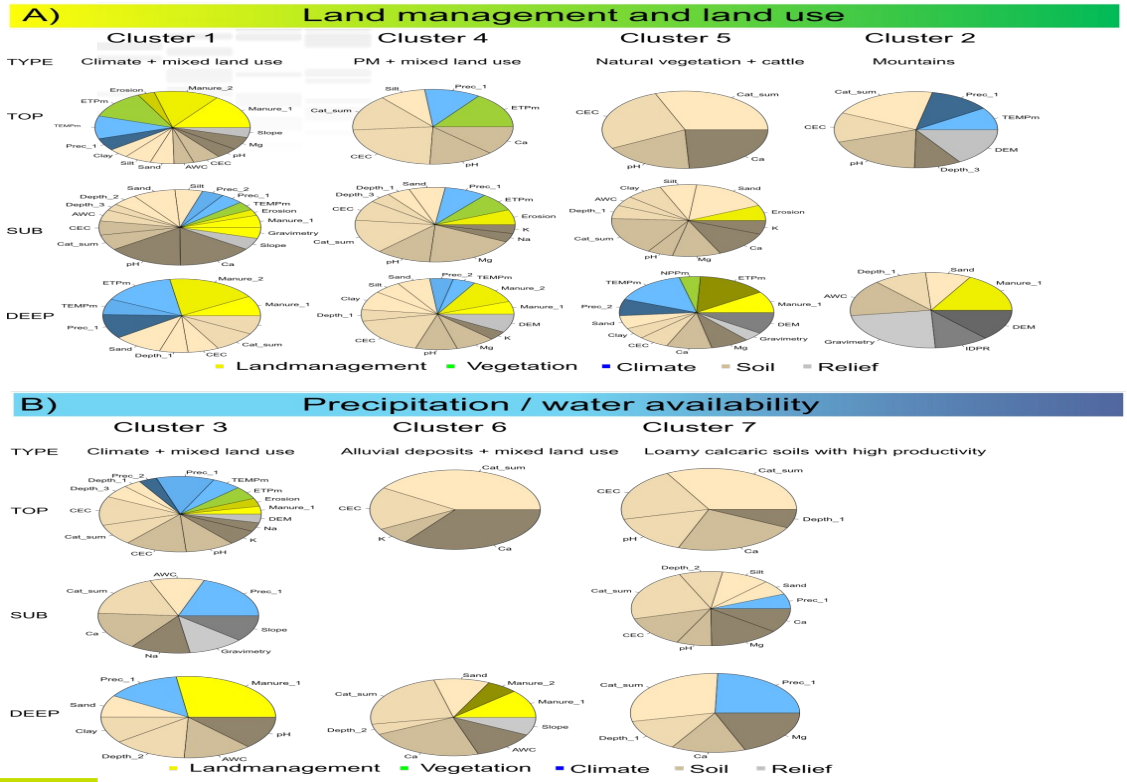


RESULTS (II/V)

SOC content within Soil Landscape Systems



RESULTS* (V)



Land management

Vegetation

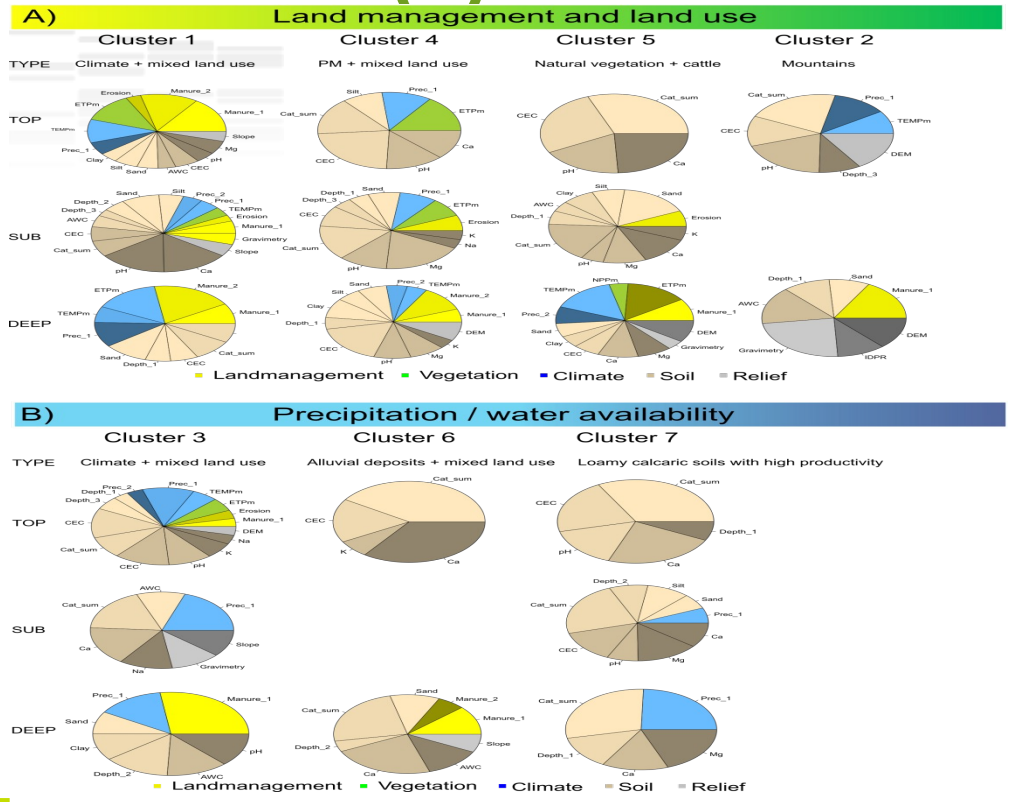
Climate

Soil

Topography& geomorphology

*** Presented variables: regression weight > 0,1**

RESULTS* (V)



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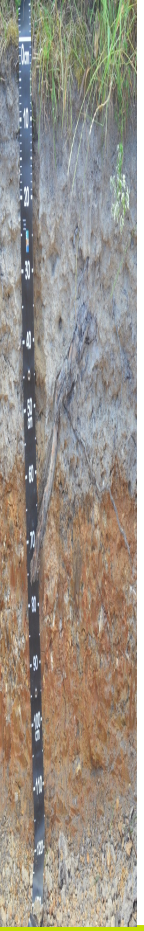


Current state and on going research

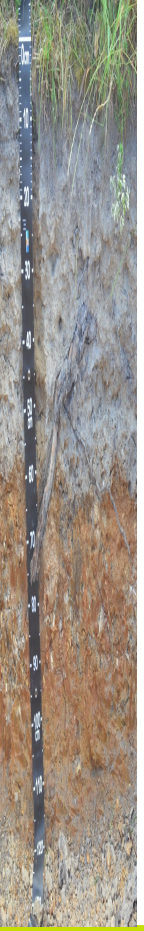
Major findings

- **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

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



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.*

FINANCIAL SUPPORT: