An approach to study the effect of a business-as-usual scenario on the soil organic carbon stock in Flanders' arable fields

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EJP SOIL
European Joint Programme

Soil important role in C-cycle
→ contribution to mitigation of climate change by creating C-sinks

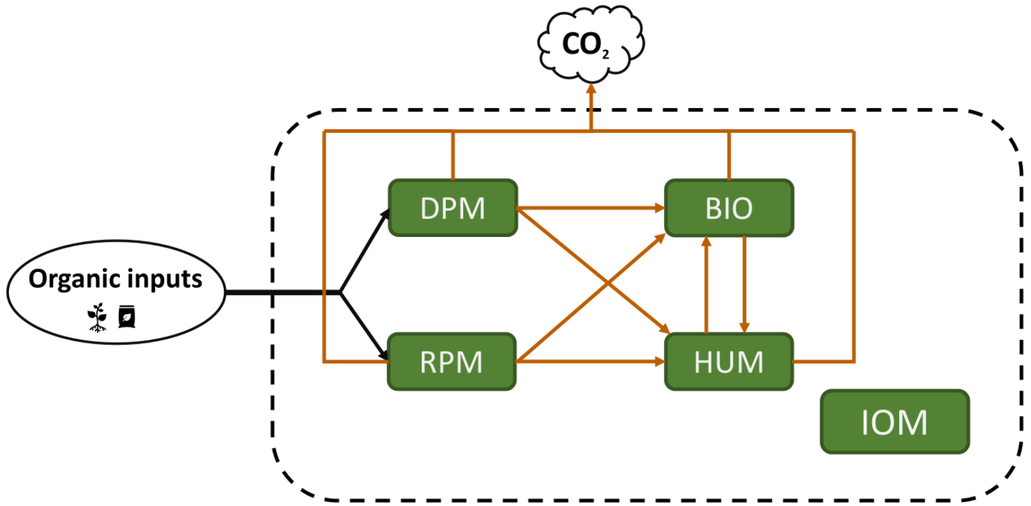
Agricultural management practices can increase the soil organic carbon stocks

Knowledge gap: Impact of current management practices on evolution of the soil organic carbon stock in Flanders' arable fields

Develop approach to simulate SOC evolution specific for Flanders

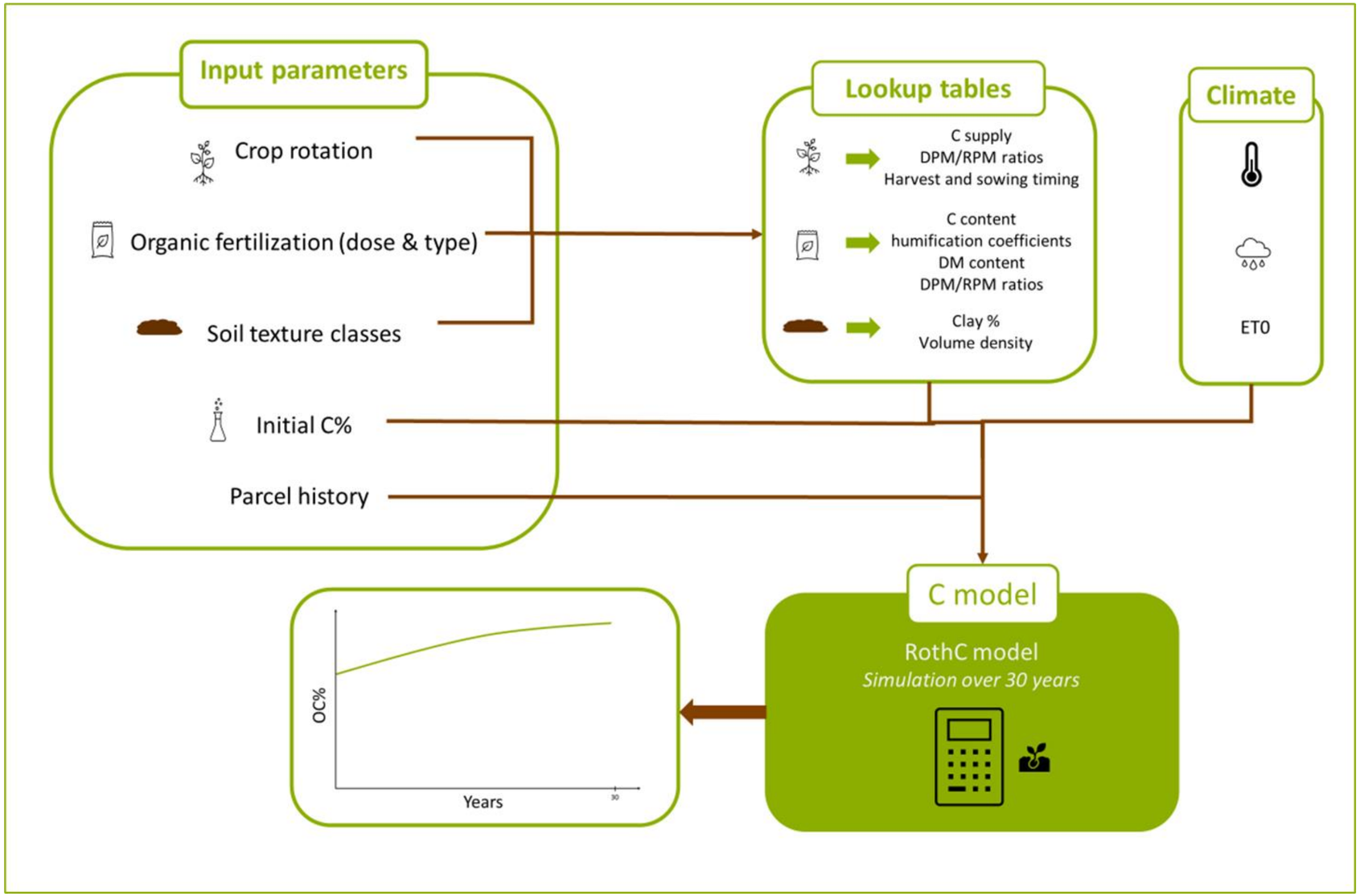
BeSOCC model

- **Roth-C based** model to calculate the overturn of SOC in agricultural fields
- Calibrated for Flanders
- Developed as tool for farmer
  - Carbon calculation module in the digital tool “Soil passport”
- Differs from other European approaches by:
  - Method of initialization based on parcel history
  - Calculation C-input from crops and organic fertilizers



: decay
RPM: Resistant Plant Material
DPM: Decomposable Plant Material
BIO : Microbial Biomass
HUM: Humified Organic Matter
IOM: Inert Organic Matter

BeSOCC Model



Data

- Climatic data
- Data on the crop rotation
- Data on organic fertilization
- Data on texture classes
- Data on initial SOC content

Climatic data

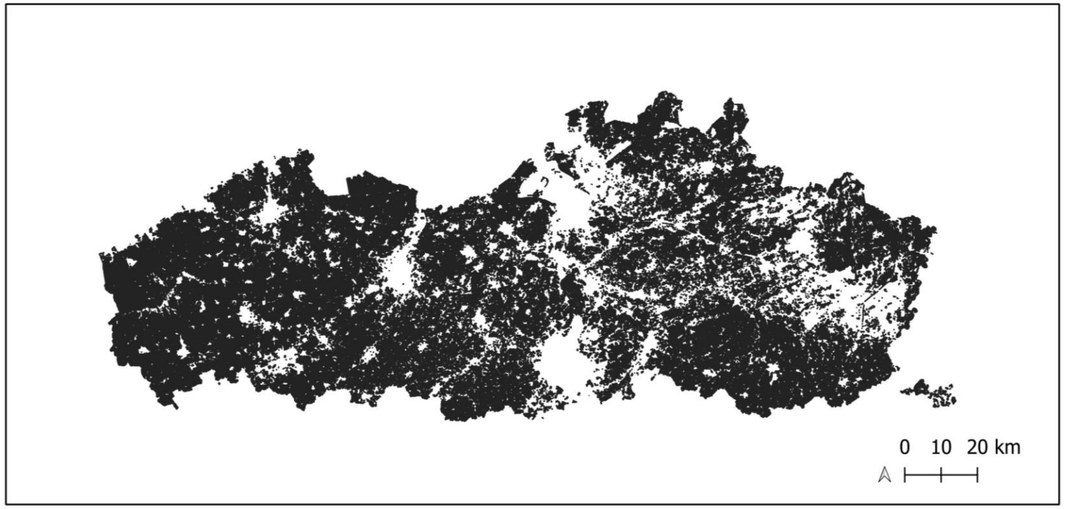
Climatic data

- Table with monthly averages
- Mean climatic data from last 30 years
- ET0

Crop Rotation data

- Land Parcel Identification System (LPIS)
  - 585 083 polygons

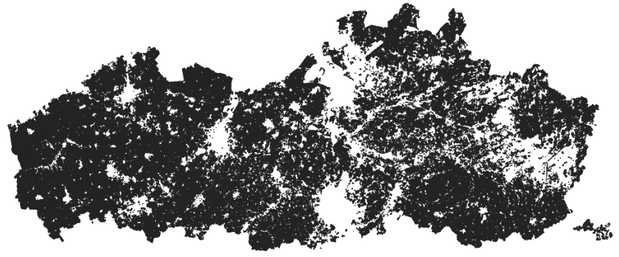
- Difficulties & limitations:
  - Look-up table “crops” misses some crops grown in Flemish parcels
  - Permanent grassland: excluded
  - Accuracy of cover crops around 60%
  - Arable fields boundaries can change every year



Methodology

Crop rotation

Most Recent LPIS dataset: 2022



Overlay

Datasets previous years

Dominant crop rotation in parcels dataset 2022

Dataset crop rotation

Dataset containing a crop rotation of several years

Organic fertilization data

- Fertilization allocation model (BAM) developed by Flanders Environment Agency
  - Allocates amount of organic fertilization to Flanders' agricultural fields

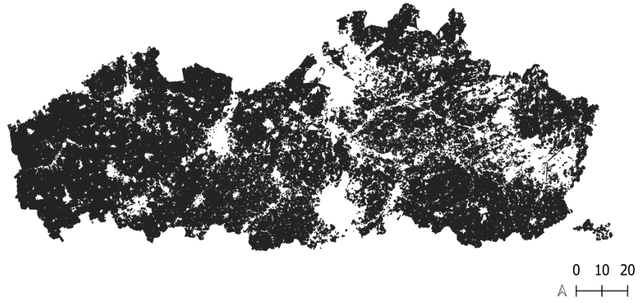
- Limitations & difficulties
  - Privacy-related data
  - Most recent data: 2022
  - Not all organic fertilizers have an associated C-content

    ➡ Exclusion of fields

Methodology

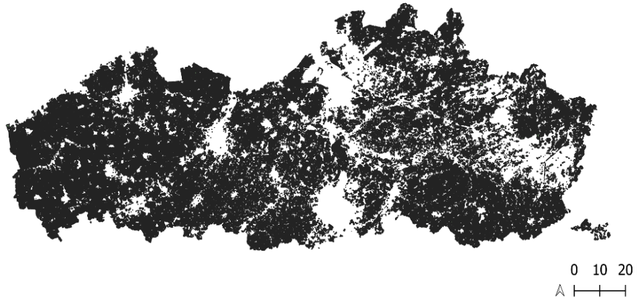
Organic fertilization

Most Recent BAM dataset: 2022



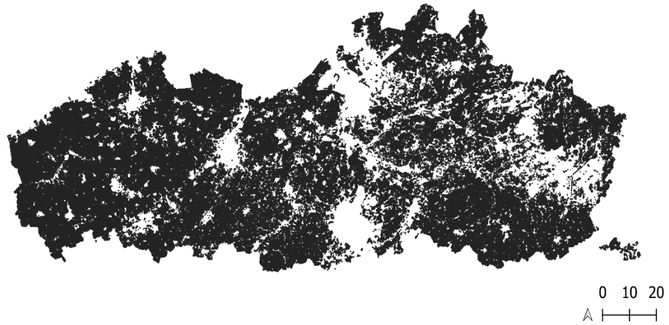
Overlay

Datasets previous years



Dominant fertilization in parcels dataset 2022

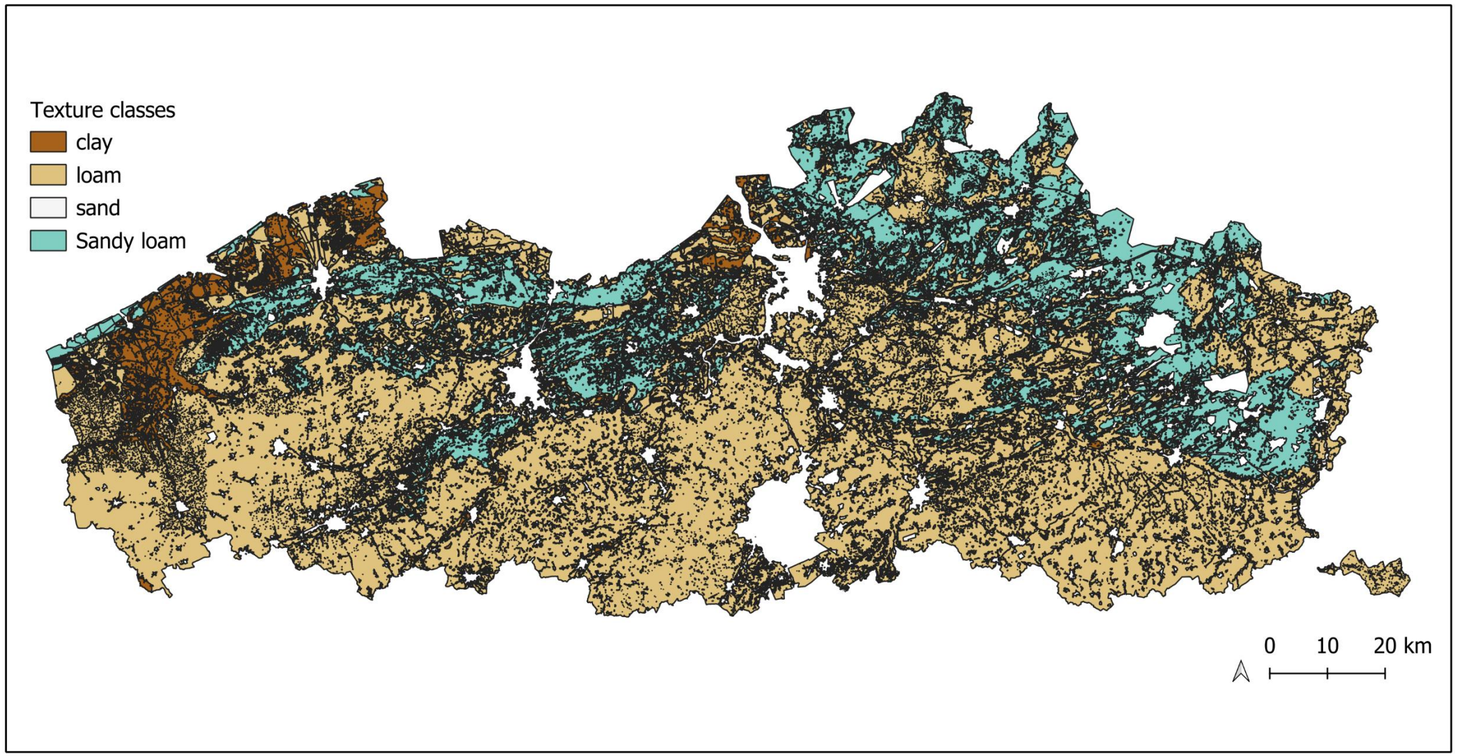
Dataset organic fertilization



Dataset containing organic fertilization of several years

Texture class data

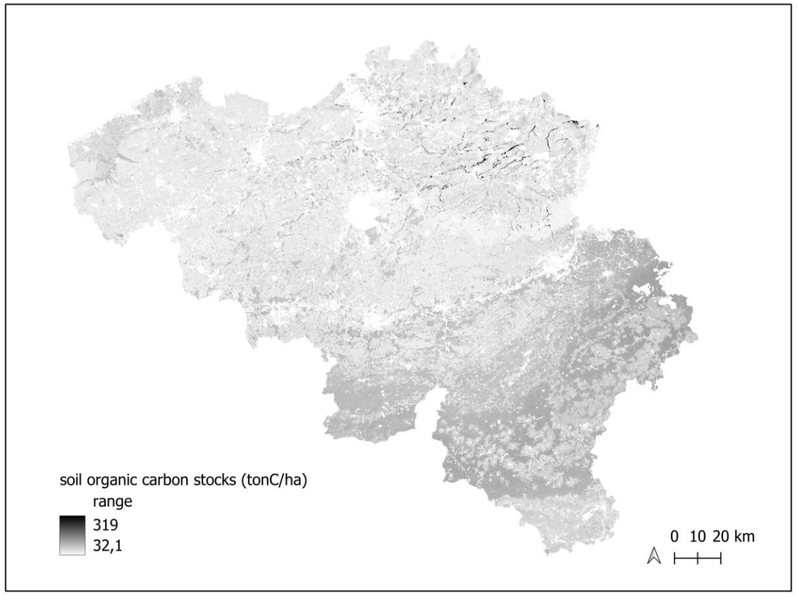
- Map layer obtained from Database Subsoil Flanders (DOV)
- Limitations
  - No consideration of spatial variability at field scale



Methodology

SOC content data

- Raster layer for Belgium obtained from Database Subsoil Flanders (DOV)
  - Resolution of 40 m
  - Based on digital soil mapping approaches
- Limitations
  - Based on the soil map
  - Some uncertainty on accuracy



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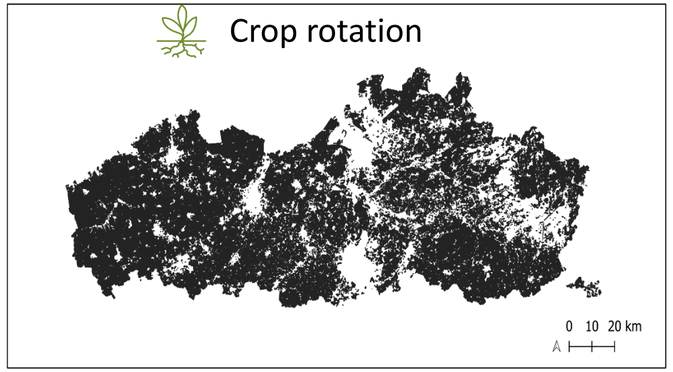
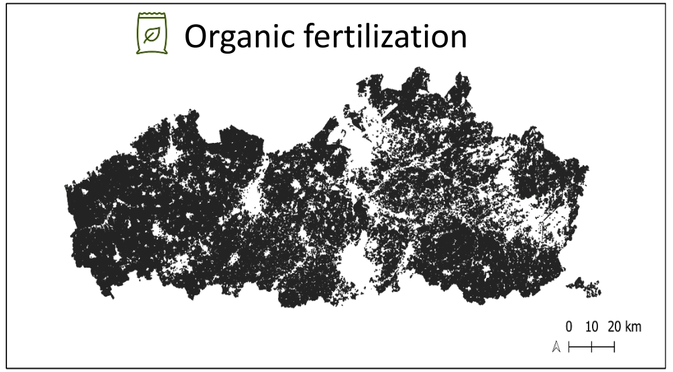
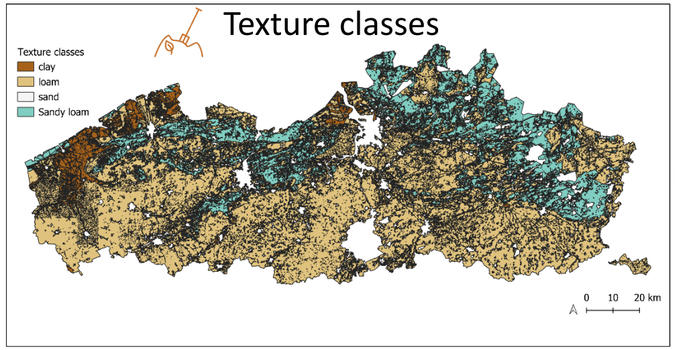
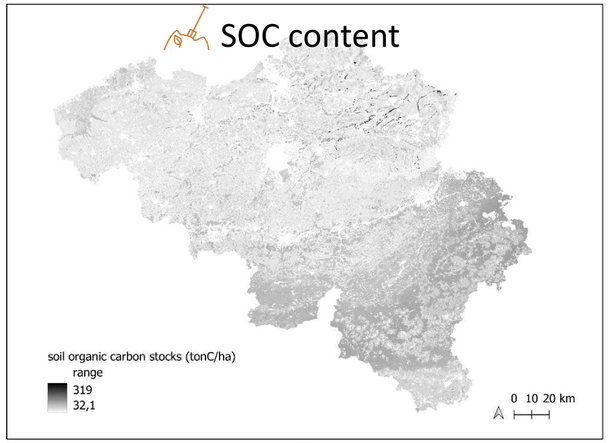
Methodology





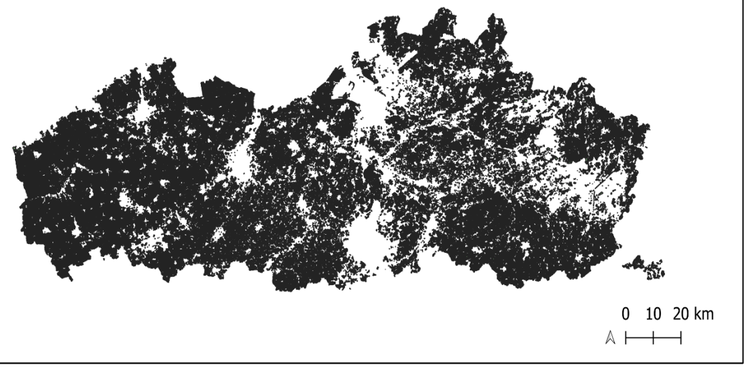


Dominant texture class



Mean SOC content

Input data



Export table

Parcel ID	Crop rotation	Organic fertilization	Texture class	SOC-content

Input for model

BeSOCC model

Simulation over 30 years for each field

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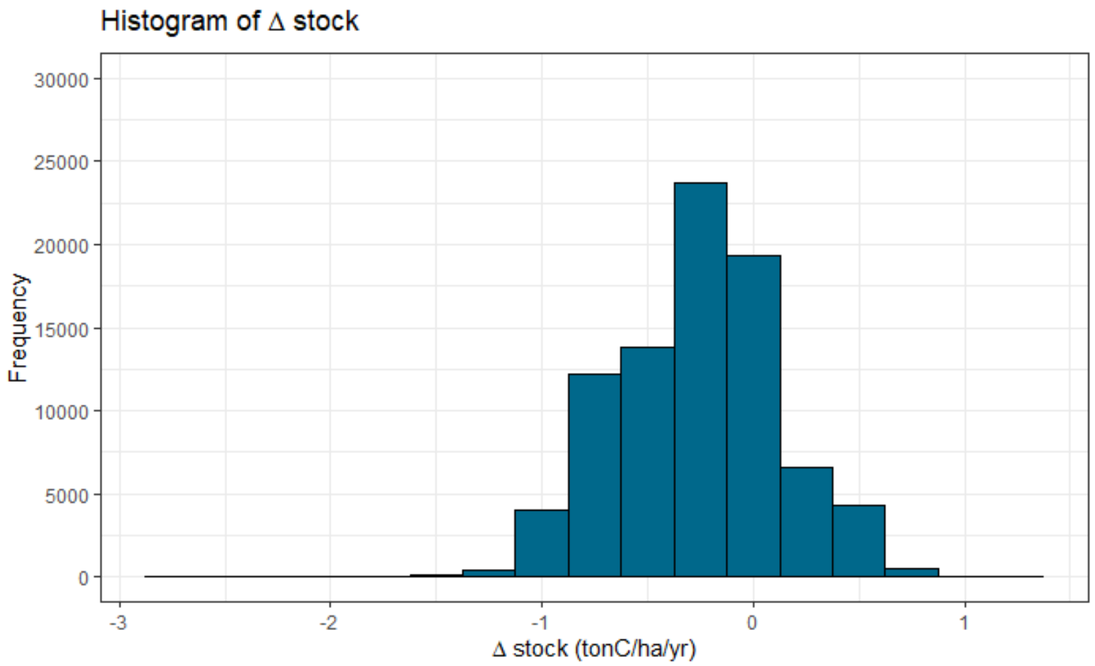
Intermediate results

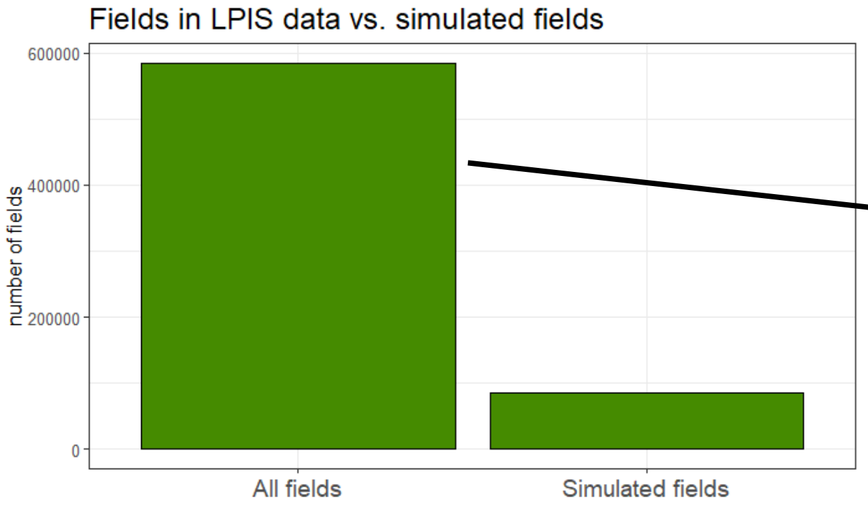
- Simulation with a 2-year crop rotation
  - Mean decrease of 0,265 tonC/ha/yr

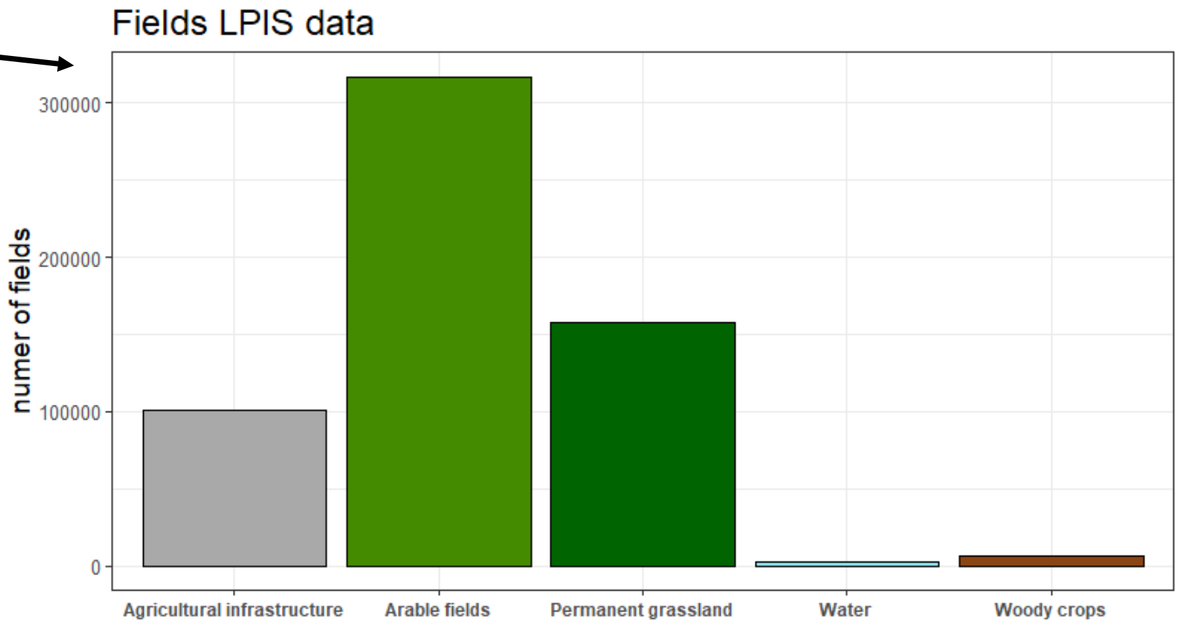


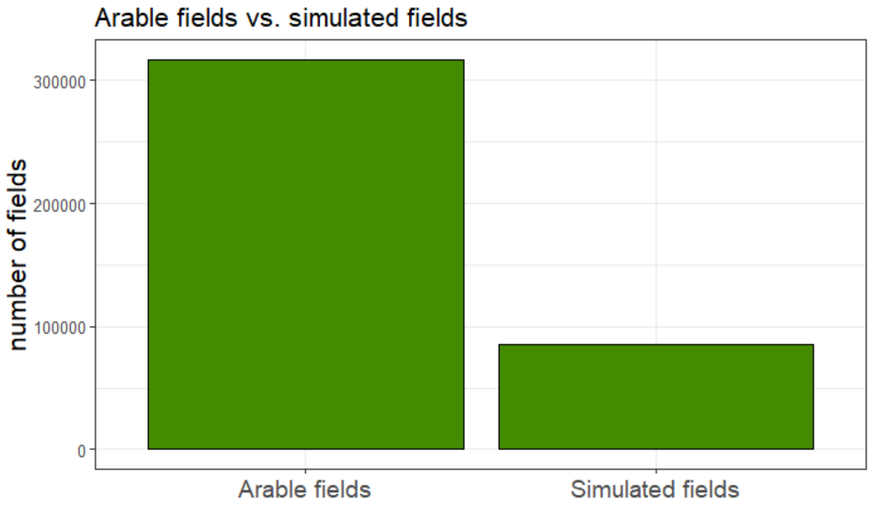
Results

Results

- 317 000 of 585 083 fields are arable





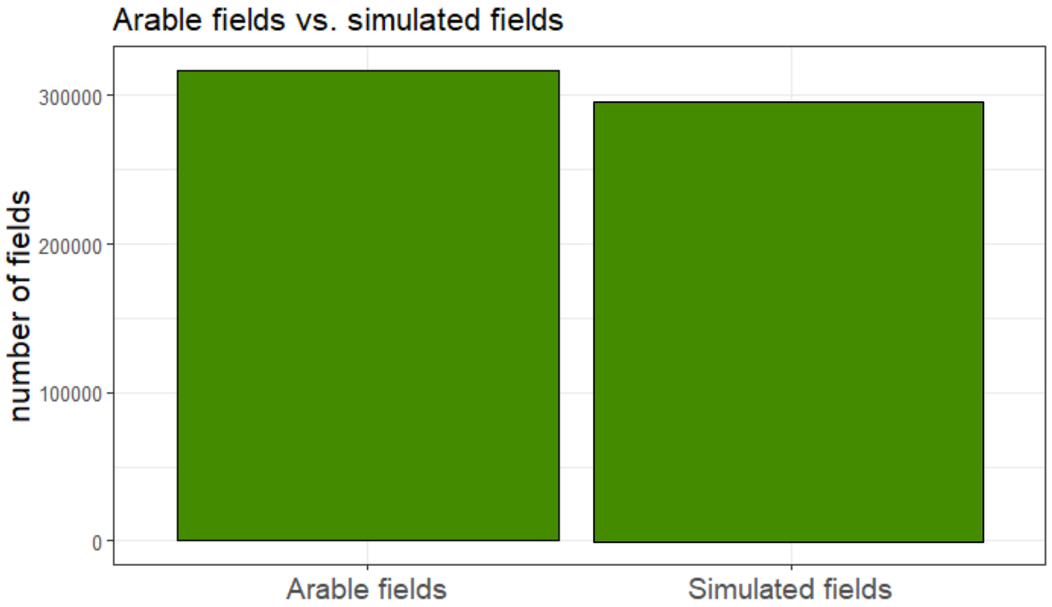


Next steps

- Some crops not included in look-up table
- Many fertilizers missing in look-up table
- Exclusion of fields if field non-existent in one of rotation years

➡ Many fields excluded from simulations

- Next steps:
  - Extend table with organic fertilizers
  - Extend the crop rotation



Take home message

- Feasible to simulate the evolution of soil organic carbon stock at field level
  - Critical of data
  - Adjustments to the simulation necessary to obtain more realistic business-as-usual scenario