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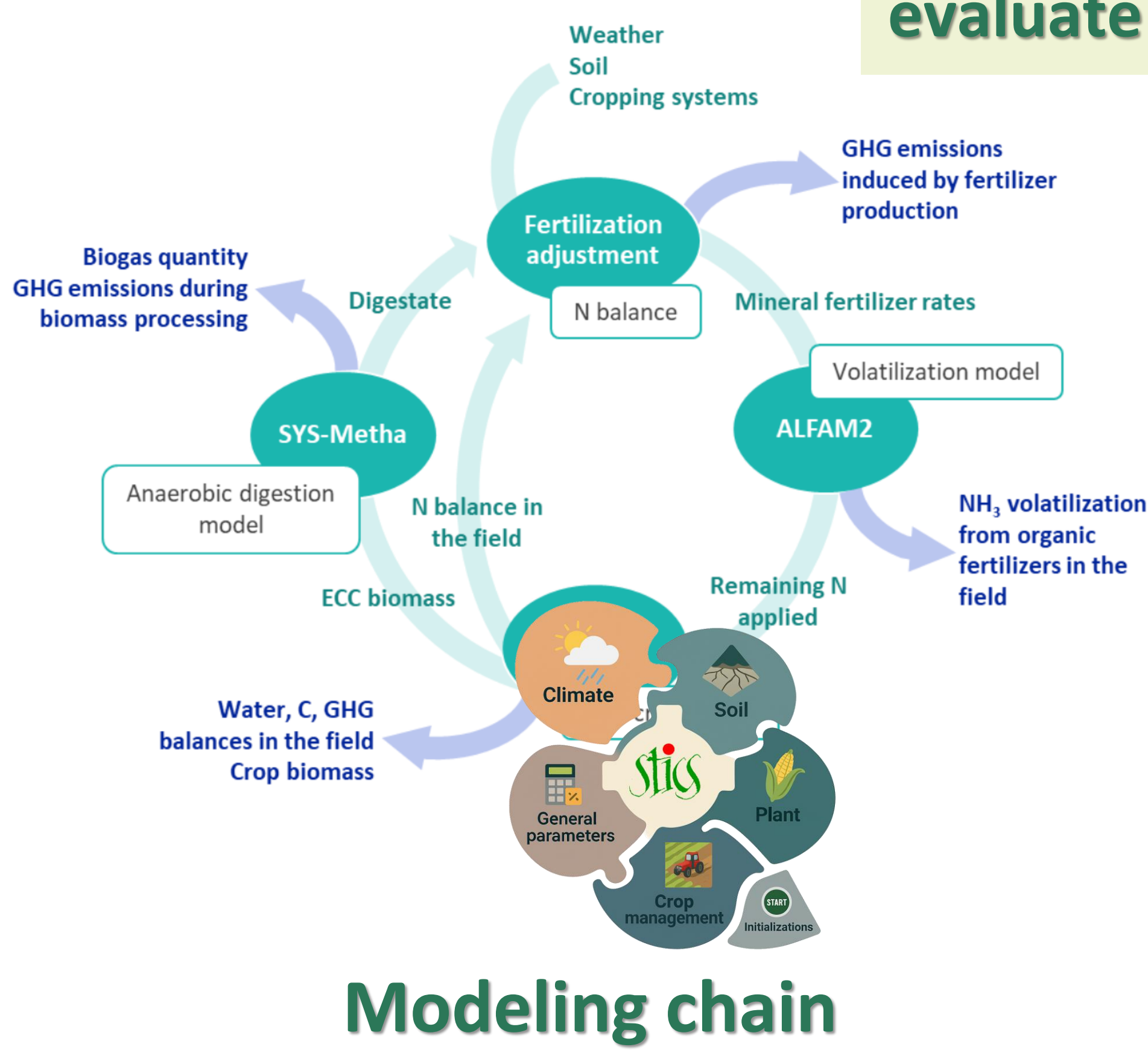
# Modeling and assessment of the sustainability of bioeconomy scenarios in contrasting large-scale territories in France and Europe

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**Context:** achieving carbon (C) neutrality by 2050 is based on reducing greenhouse gas (GHG) emissions and increasing C sinks. Agriculture, as a source and sink of GHG emissions, is at the heart of strategies that aim to replace fossil-based resources with renewable resources such as agricultural residues to fuel various bioeconomy sectors, storing C in the soil (C farming), and adopting practices that limit the use of fossil-based inputs and reduce GHG emissions

**Objectives:** developing and applying a generic modeling framework integrating STICS to evaluate different bioeconomy scenarios in contrasting regions of France and Europe by 2050



## Modeling chain

reproduced and adapted from Launay (2023) <sup>1</sup>

## Methods:

- comparing and selecting **databases for climate, soil, crop rotations and crop management**
- sampling data to achieve a reasonable number of agro-pedo-climatic units to be simulated
- determining crop management through decision rules
- using a **modeling chain** <sup>1</sup> based on 4 models: *STICS*, *N ferti* <sup>2</sup> (N fertilization), *ALFAM2* <sup>3</sup> (NH<sub>3</sub> volatilization) and *SYS-Metha* <sup>4</sup> (anaerobic digestion)
- designing and simulating **baseline and prospective agroecological scenarios**
- **Scenario analysis through multi-criteria assessment** will relate to:
  - feed, food and energy biomass production
  - agro-environmental performances: soil C storage and soil fertility, N losses (NO<sub>3</sub> leaching, NH<sub>3</sub> volatilization and N<sub>2</sub>O emissions) and GHG balance
  - N self-sufficiency of the investigated territories

## Information system

### Climate data

❖ Selected products <sup>5</sup> :

**Agri4Cast** (JRC): daily chronicle by **25 km<sup>2</sup> grid cell**. Comparison with other historical datasets shows:

- Better sensitivity to heat wave events, precipitation, or strong winds
- Less than 1% of mean relative difference in values between Agri4Cast and control stations (per variable and per day)

**ISIMIP** data for future climate projections

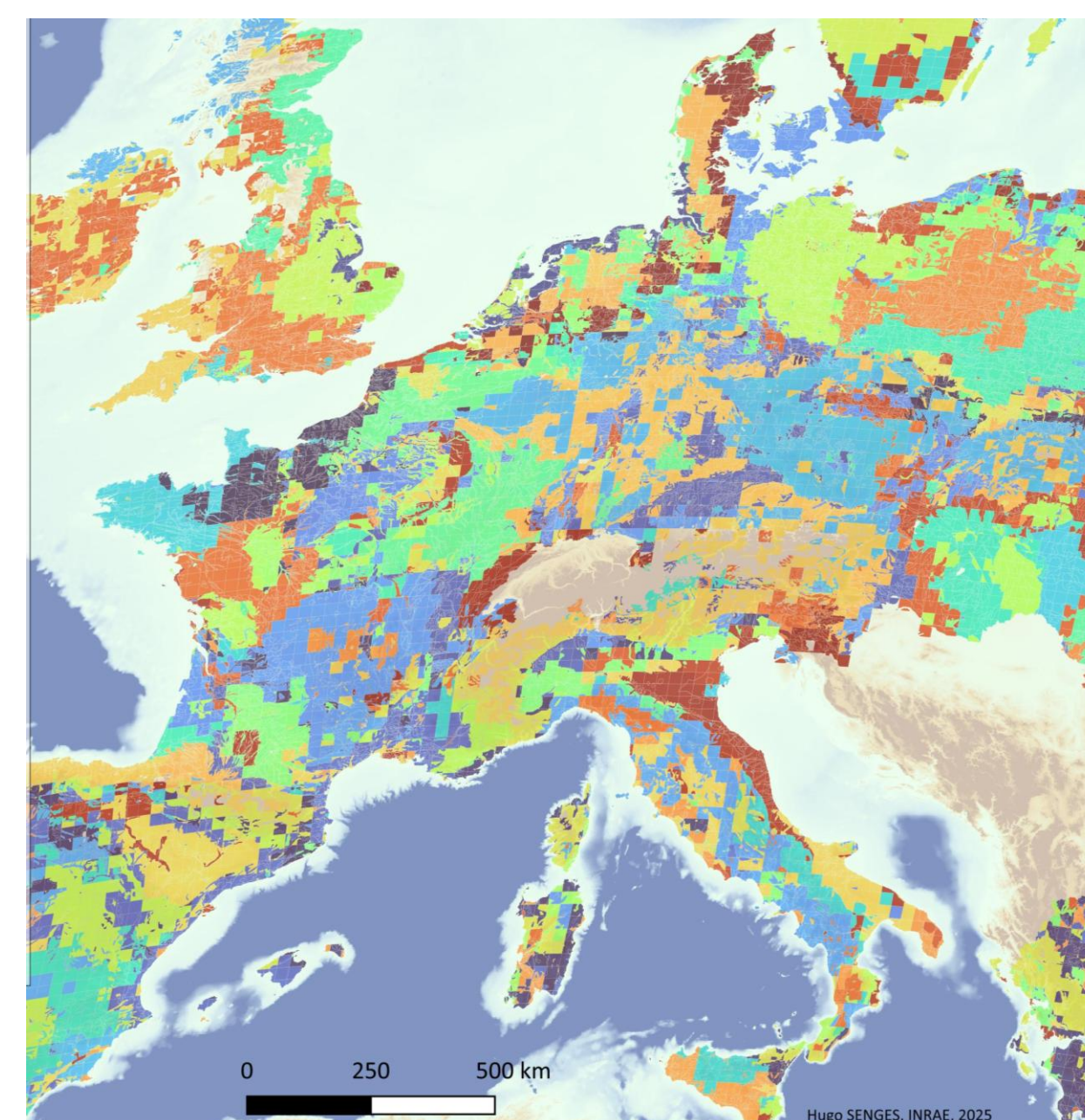
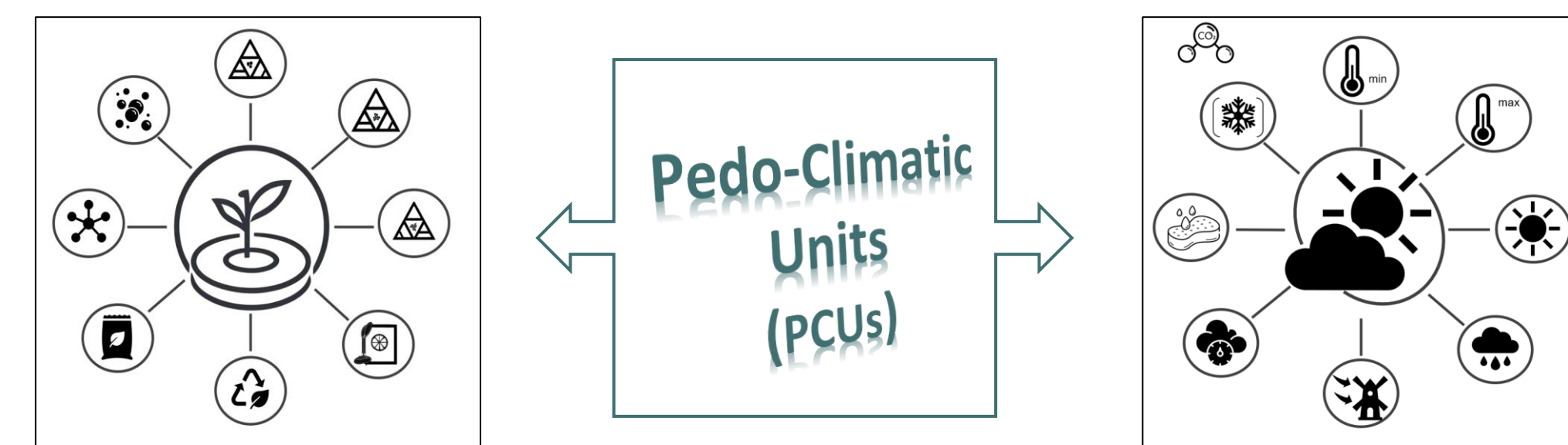
### Soil data

❖ Selected products <sup>6</sup> :

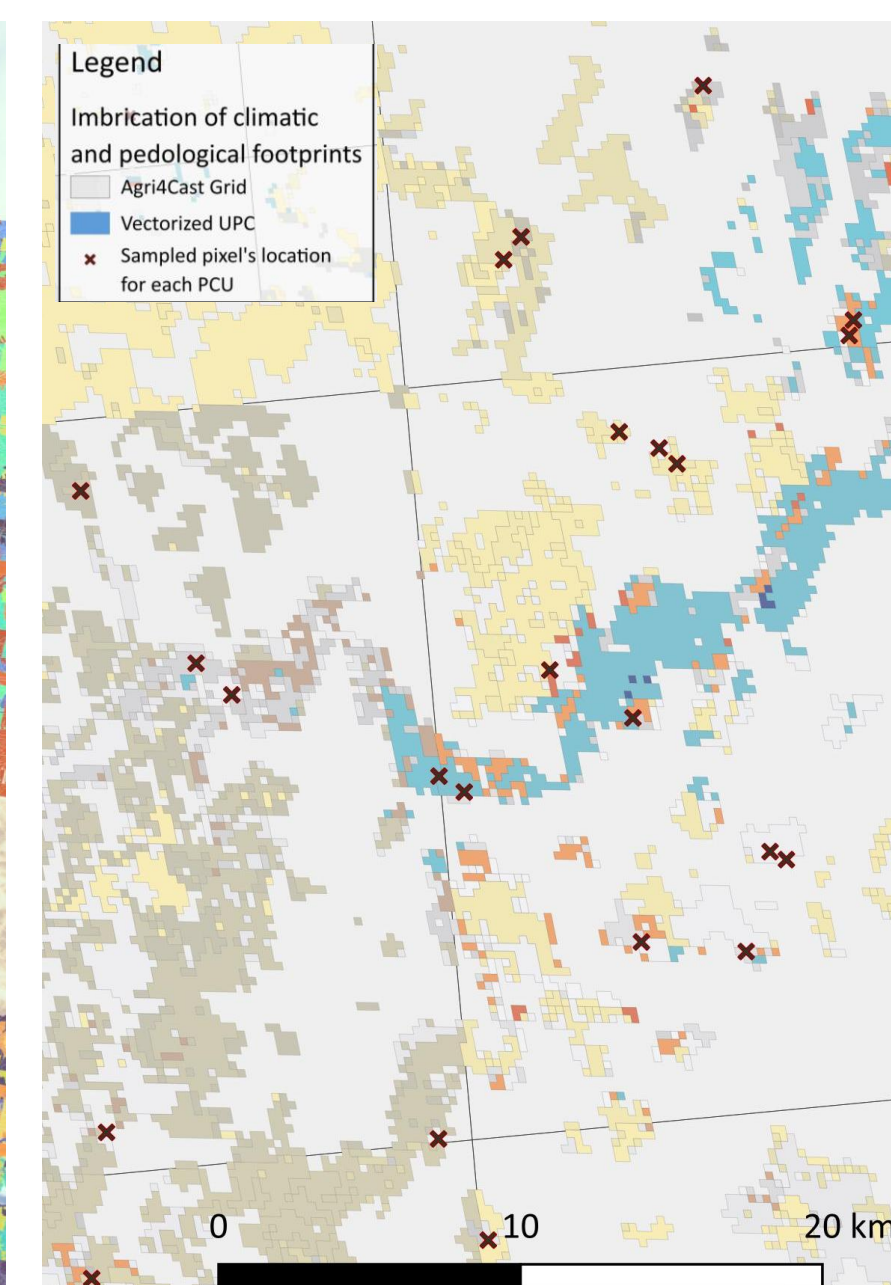
**SoilGrids**: available information system for soil horizons below 30 cm and at a resolution of **250 m**

**LUCAS** program (JRC): relevant for topsoils, completes the soil data set with CaCO<sub>3</sub> data

**Pedotransfer functions** are further used to estimate STICS soil input parameters



Newly produced soil mapping units by k-means clustering based on soil texture, structure and composition data (80 classes)



Pedoclimatic units

Data preparation on **cropping systems** (considered options: LPIS or remote sensing data) and **crop management** is under progress

## Simulation plan

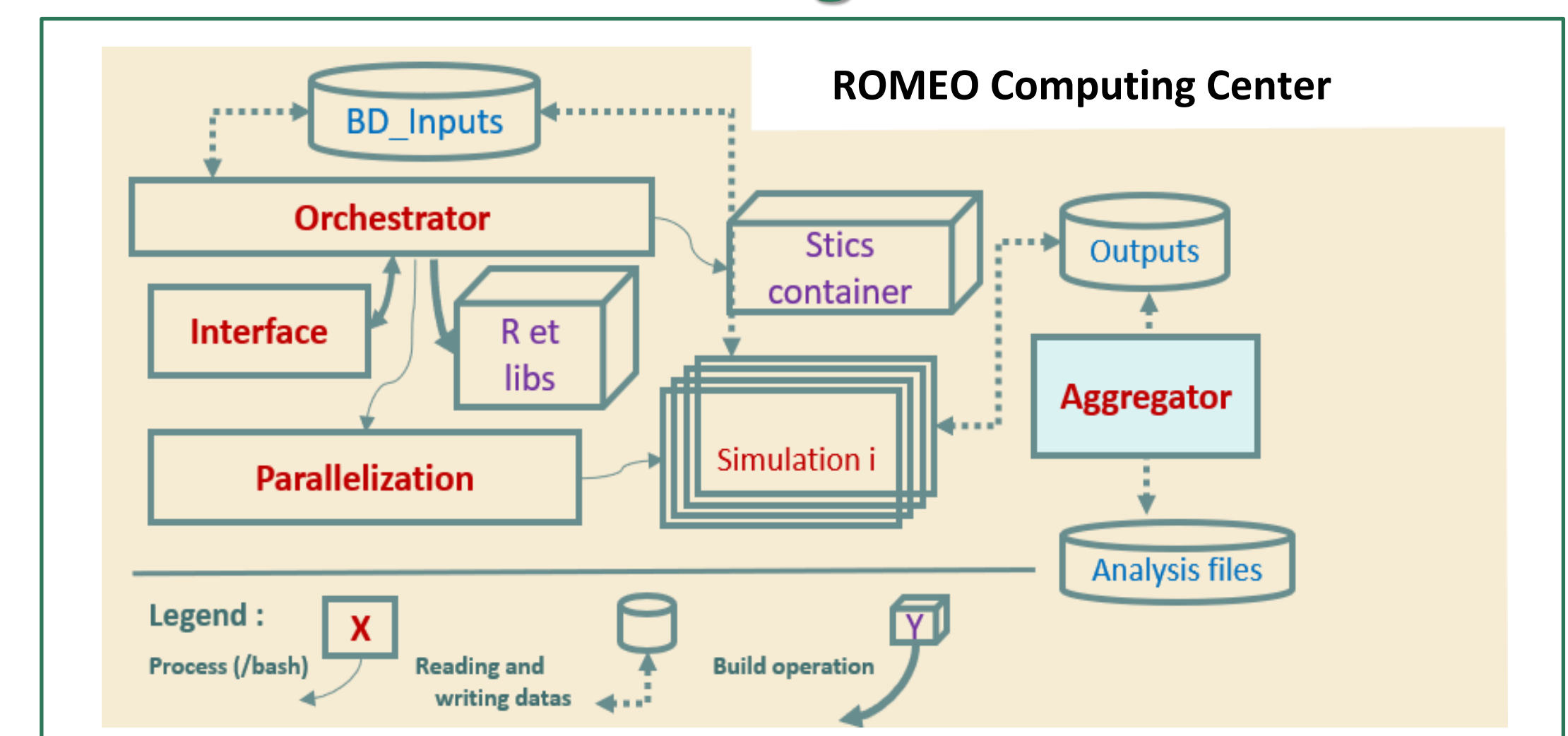
PCUs (~50 000) x representative crop rotations x crop management

X

Baseline and prospective scenarios including energy cover crops and crop residue mobilization



## Deployment on cluster of the modeling chain



## Scenario analysis on output data

**Expected outcomes:** (i) quantification of different **production potentials** and their **short- and long-term impacts**, evaluation and identification of scenarios and associated trade-offs (e.g. C storage vs N losses ; residue management vs soil health) that would enable the agricultural sector to cope with various food, energy, and environmental production issues

(ii) a **generic information system** and **modeling framework** that could be reused or adapted for further research or decision support projects

## References:

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