



**Novafert**



# **Biogenic Carbon accounting modelling: State of the art, limitations, and global trends towards the integration of realistic modelling in LCA.**

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## **Soil Organic Carbon modelling: Assessing Soil Organic Carbon Changes in European Croplands and Grasslands**

Daniele De Rosa, Cristiano Ballabio, Emanuele Lugato, Matteo Fasiolo, Arwyn Jones, Panos Panagos

**January 16<sup>th</sup>, online**

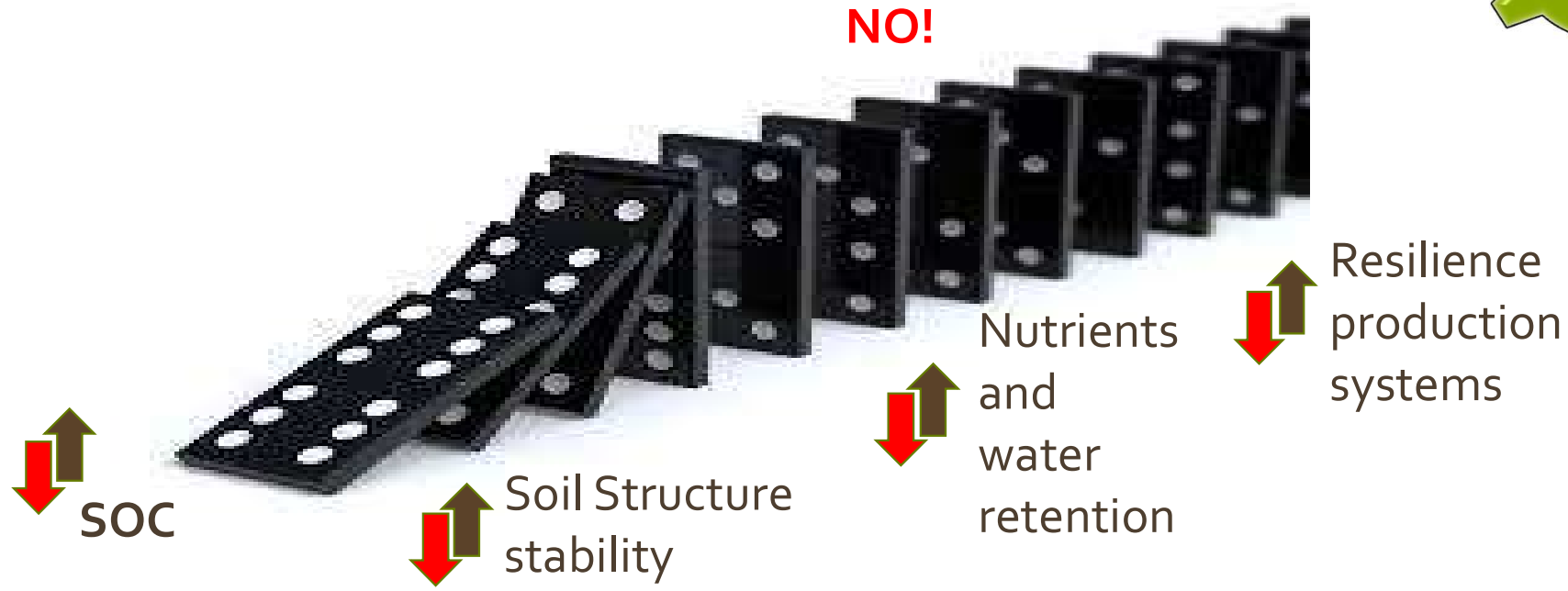
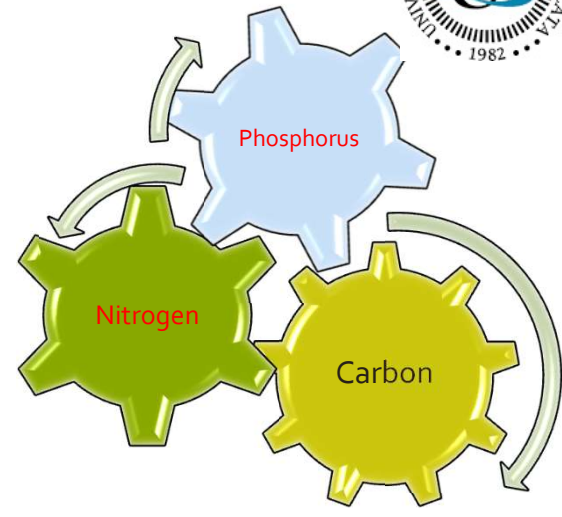


Funded by the  
European Union



# Soil Carbon Storage

Soil C sequestration is just reducing CO<sub>2</sub>?



# Soil Carbon Storage

The spatial identification of the main drivers of SOC depletion is paramount in the preparation of agricultural policies aimed at enhancing the resilience of EU AG systems

**Estimate WHERE and HOW MUCH at spatial scale?**

# Land Use and Coverage Area frame Survey

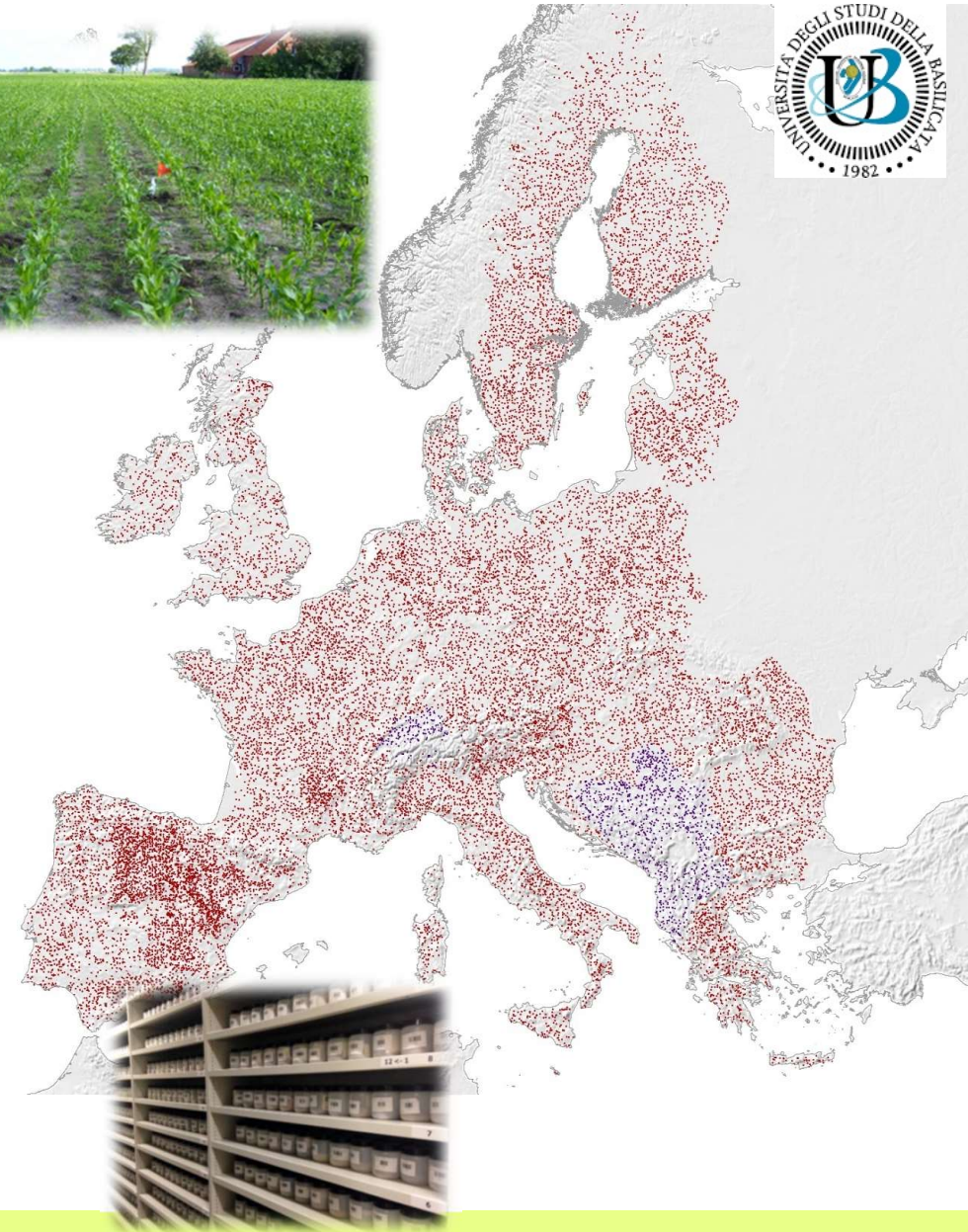


## Soil component

- ~ 22'000 topsoil samples
- main physico-chemical soil properties
- 2009, 2015, 2018 completed
- 2022 ongoing analysis 40K (Samp. Framework SOC)
- Next ?

## Is it a SOC monitoring framework?

- Only topsoil 0-20 cm – For 2022 0-30cm
- No systematic bulk density – For 2022 updated
- Limited management information





# SOC CHANGES - Modelling approach- Methods

1) MODEL DATA



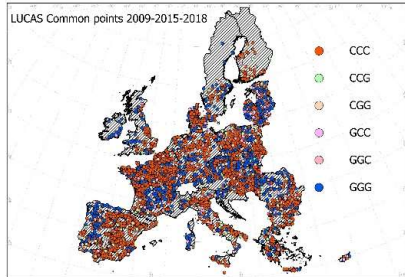
2) MODEL TRAINING



3) SPATIAL DEPLOYMENT

POINT DATASET

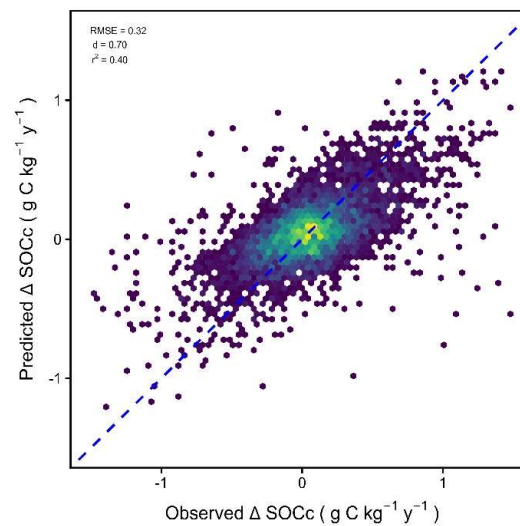
**LUCAS**



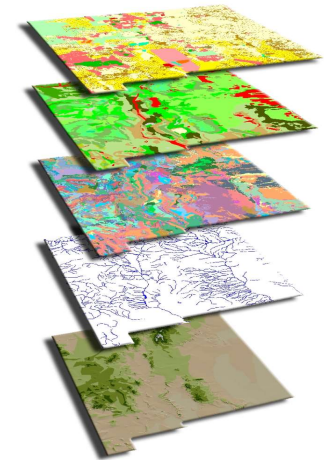
$$\Delta SOC \text{ g C kg}^{-1} = SOC(2018) - SOC(2009)$$



**VALIDATION**

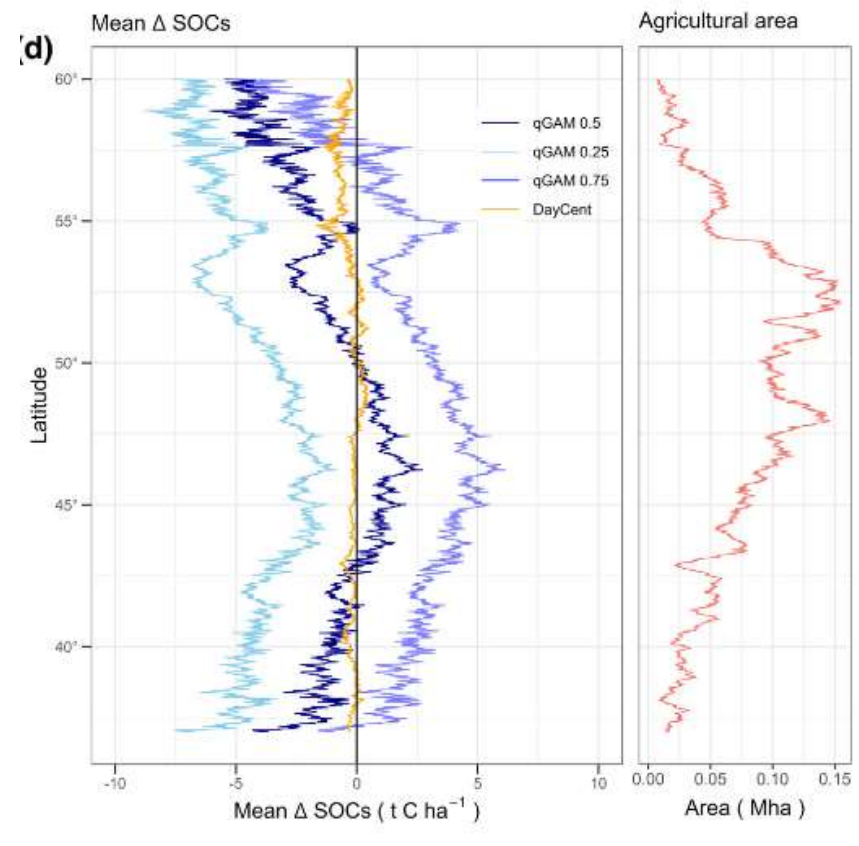
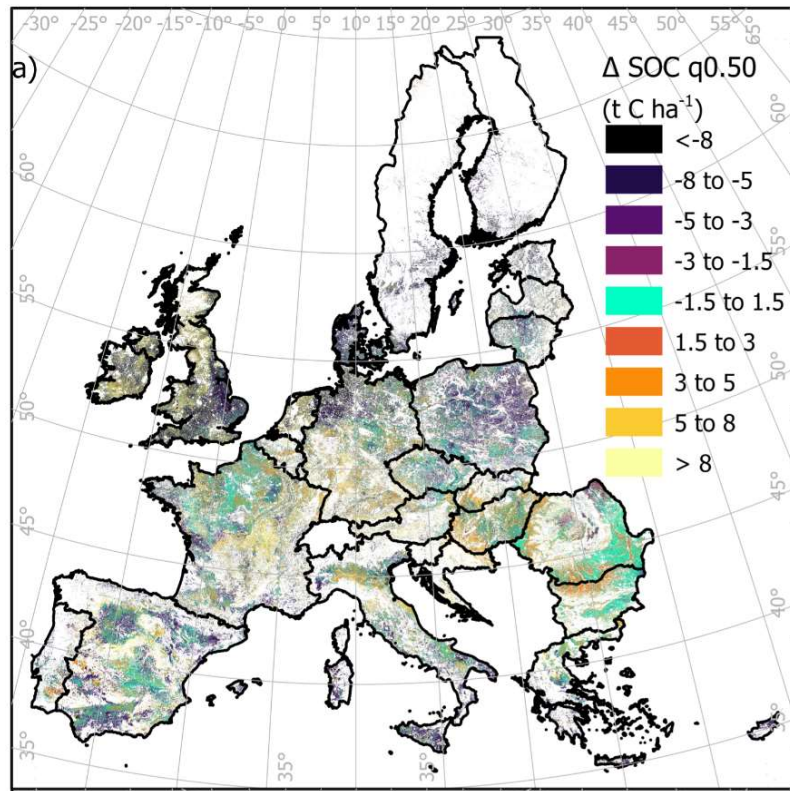


GRIDDED PREDICTORS



# SOC, how much have we lost in the past decade?

-0.75% between 2009 and 2018 ----> ~ 70 Mt C (0-0.2m depth) = **28 MtCO<sub>2</sub>e per year**



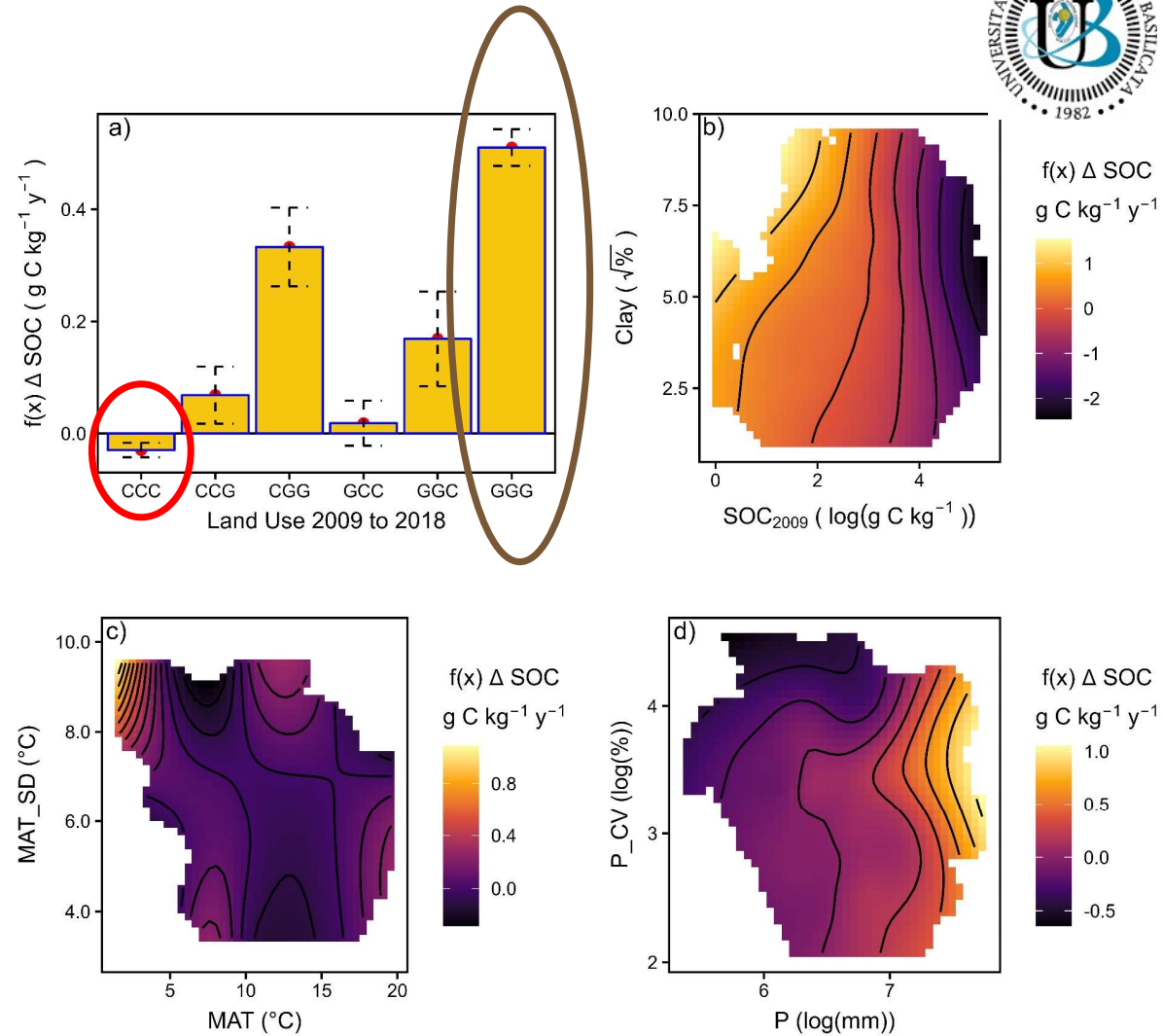
# SOC losses drivers

- LAND USE

Continuous Grassland (GGG)

Continuous Cropland (CCC)

Transition C to G



# SOC losses drivers

- LAND USE

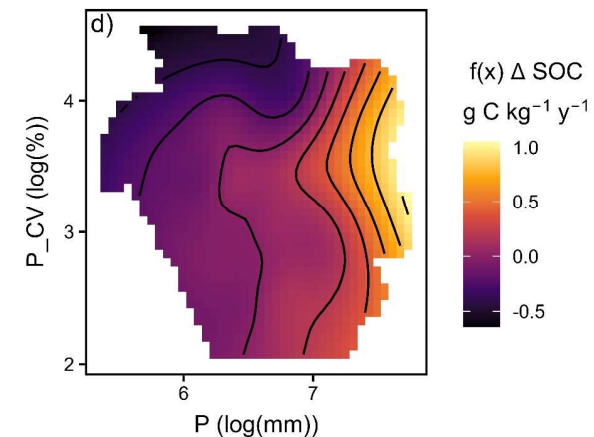
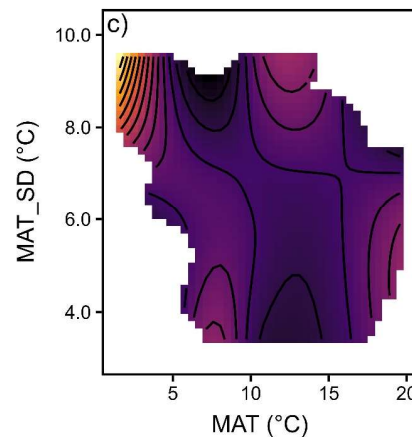
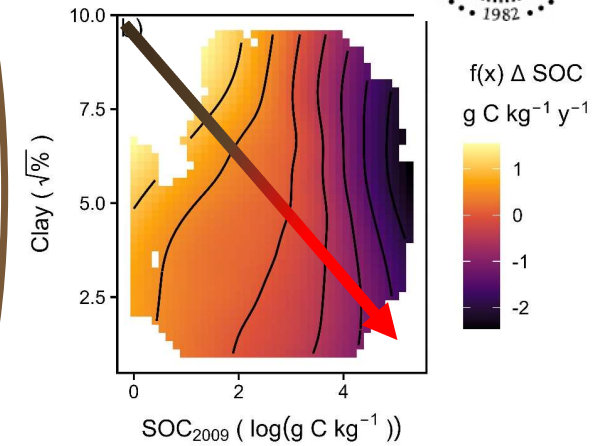
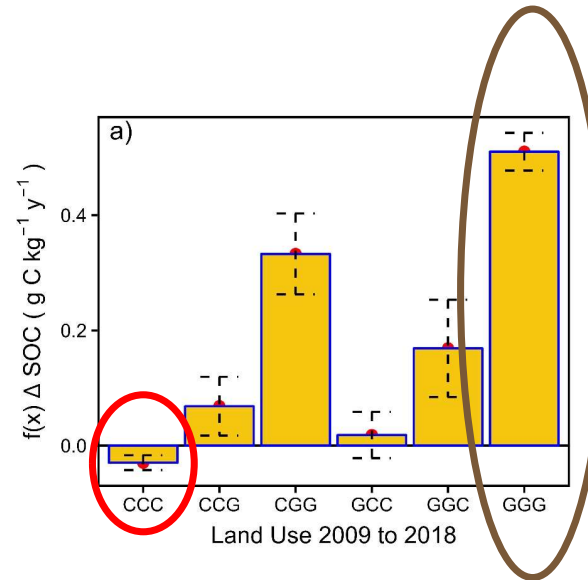
Continuous Grassland (GGG)

Continuous Cropland (CCC)

Transition C to G



- 2009 SOC and clay
- High SOC High losses
- Clay protects SOC





# SOC losses drivers

- LAND USE

Continuous Grassland (GGG)

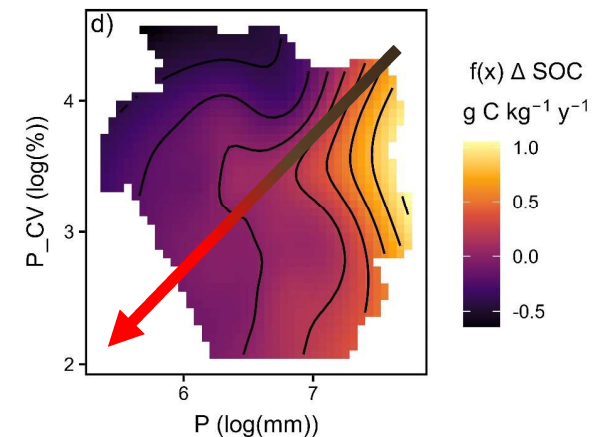
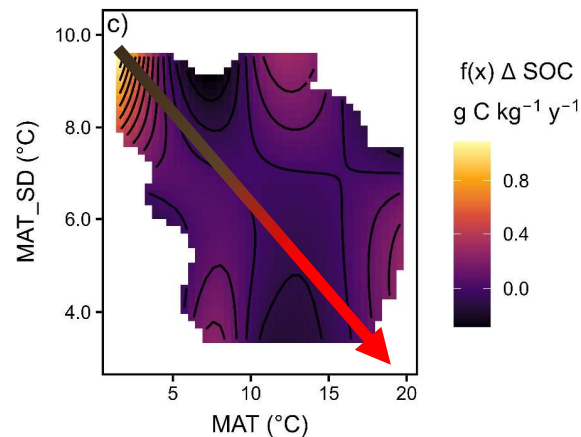
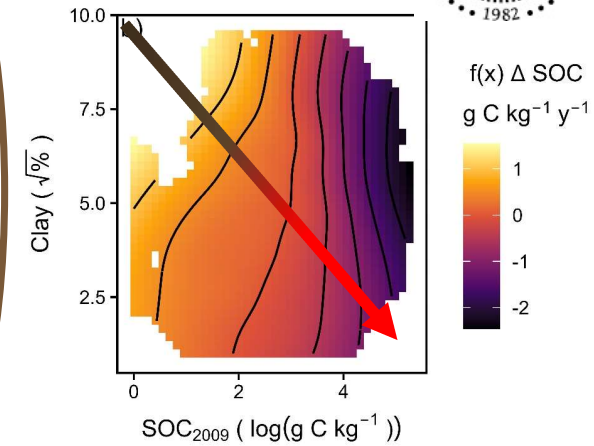
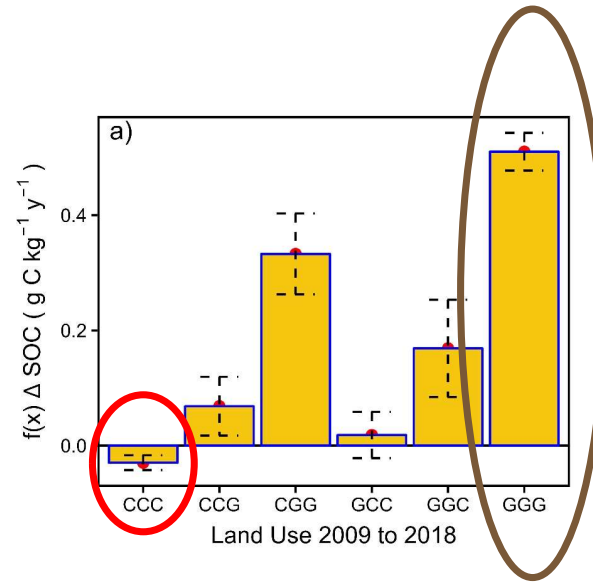
Continuous Cropland (CCC)

Transition C to G



- 2009 SOC and clay
- High SOC High losses
- Clay protects SOC

- TEMPERATURE AND RAINFALL
- High temperature high losses
- Low rainfall low gains

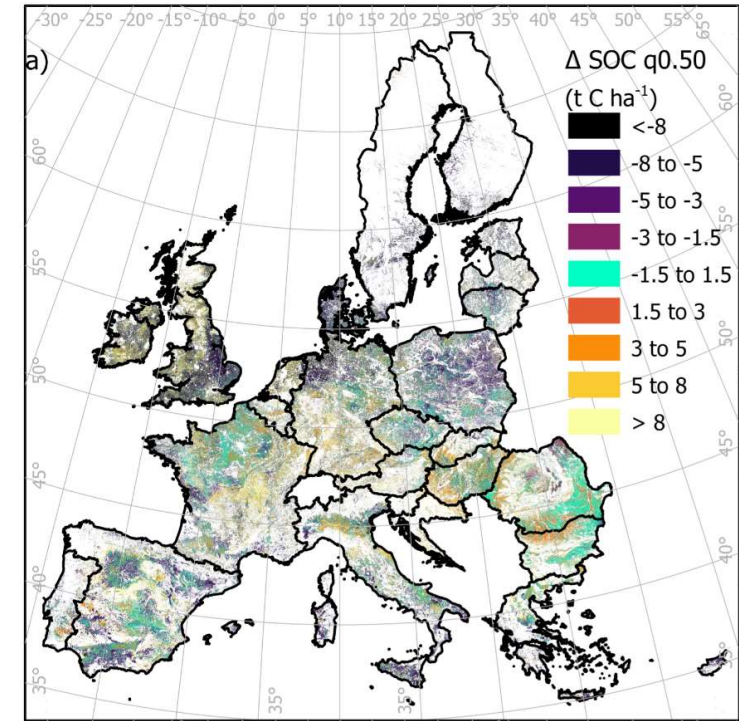


# Land Use Change – Basic Scenarios



## Strategic approach:

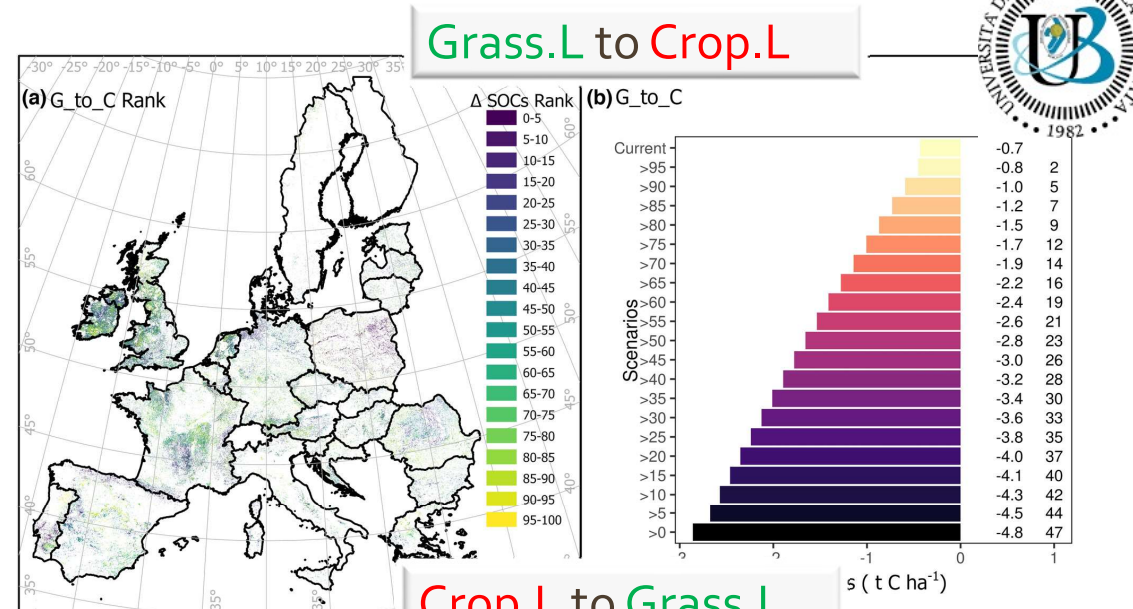
- Where is more convenient?
- How much do I need to convert?
- What's the best trade-off?



# Land Use Change – Scenarios

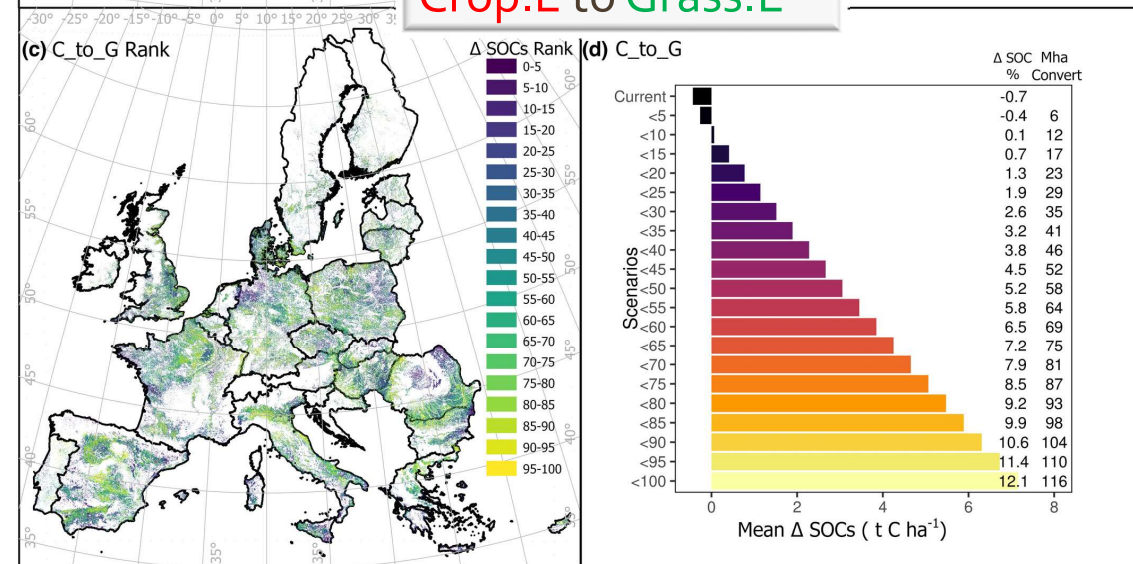


- Conversion of **Grass.L** to **Crop.L**  
 $\Delta SOC$  up to **-4.8%** (~ 47 Mha)



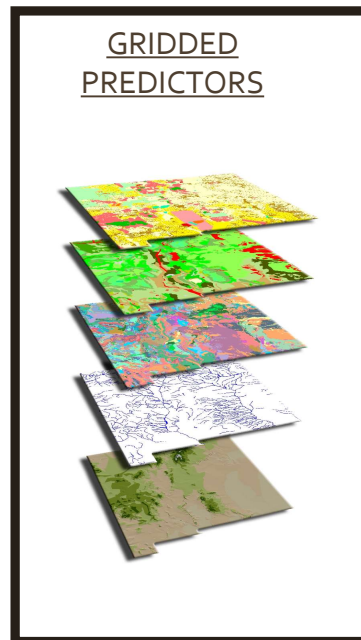
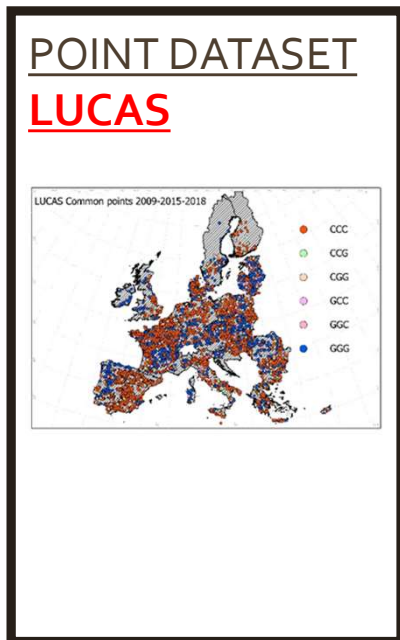
- Conversion of **Crop.L** to **Grass.L**  
 $\Delta SOC$  up to **+12.1%** (~ 116 Mha)

7% of **Crop.L** to **Grass.L**  $\Delta SOC$  0



# SOC - Data driven approach

## Uncertainties



- Generic set of predictors (no activity data)
- No specific management information
- High uncertainty when projecting Beyond the observed time-frame
- Sensitive to dataset "boundaries"

BUT

More data = High SPATIAL confidence

Baseline

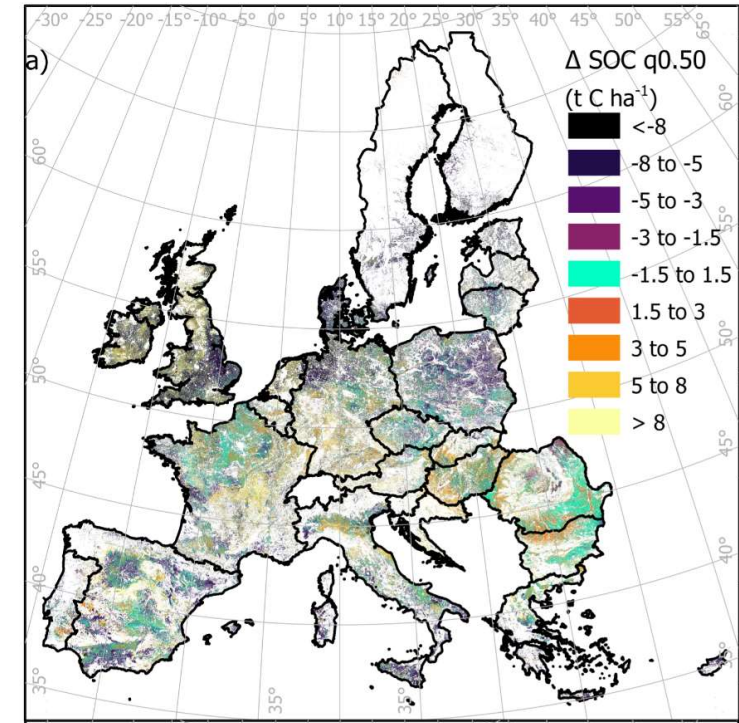


# Land Use Change – Basic Scenarios



Strategic and **Tactical** approach?

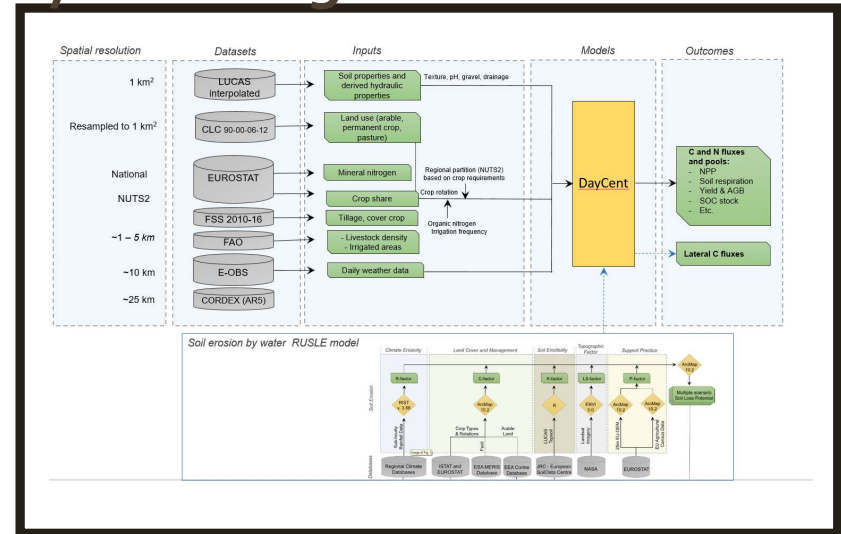
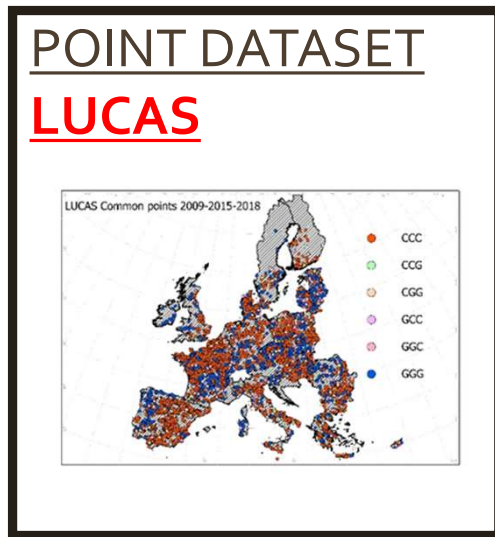
Moving beyond the dataset boundaries



# SOC – at spatial and temporal scale- NEXT?

## Hybrid Approach (work in progress)

### DayCent *large-scale* framework



SPATIAL PREDICTIONS  
CONFIDENCE ↑

Bringing together

TEMPORAL PREDICTION  
CONFIDENCE ↑



# Thank you!!!

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RESEARCH ARTICLE

 Global Change Biology **WILEY**

## Soil organic carbon stocks in European croplands and grasslands: How much have we lost in the past decade?

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Matteo Fasiolo<sup>2</sup>  | Arwyn Jones<sup>1</sup>  | Panos Panagos<sup>1</sup> 

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