



**HAL**  
open science

# An innovative hybrid approach for soil carbon farming MRV

Ahmad Al-Bitar, Eric Ceschia, Taeken Wijmer, Ludovic Arnaud, Veronika Antonenko, Andrea Geraud

► **To cite this version:**

Ahmad Al-Bitar, Eric Ceschia, Taeken Wijmer, Ludovic Arnaud, Veronika Antonenko, et al.. An innovative hybrid approach for soil carbon farming MRV: Session on: Hybrid MRV for actionable data of national carbon sequestration. COP28, UN, Dec 2023, Dubai, United Arab Emirates. hal-04528501

**HAL Id: hal-04528501**

**<https://hal.science/hal-04528501>**

Submitted on 1 Apr 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Session on:  
Korea Carbon Project: Hybrid MRV for actionable  
data of national carbon sequestration

# An innovative hybrid approach for soil carbon farming MRV

Ahmad Al Bitar [CESBIO | CNRS]

Ceschia E., Wijmer T., Arnaud L.,  
Antonenko V., Geraud A. , Ihasusta A.

ahmad.albitar@univ-tlse3.fr



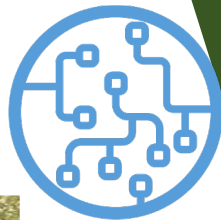
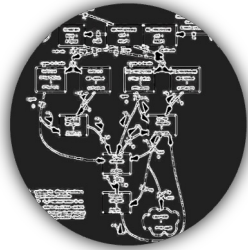
# Carbon Dioxide Removal

Technology	Afforestation and reforestation	Soil carbon sequestration	Biochar	Bioenergy with carbon capture & storage	Direct air carbon capture and storage	Enhanced weathering	Peatland and coastal wetland restoration	Blue carbon management	Ocean alkalinity enhancement	Ocean fertilization
Capture mechanism	Land-based biological	Land-based biological	Land-based biological	Land-based biological	Chemical	Geochemical	Land-based biological	Ocean-based biological	Geochemical	Ocean-based biological
Feasibility/readiness	●	●	●	●	●	●	●	●	●	●
Scalability	●	●	●	●	●	●	●	●	●	●
Ease of MRV*	●	●	●	●	●	●	●	●	●	●
Potential consequences	●	●	●	●	●	●	●	●	●	●
Public perception	●	●	●	●	●	●	●	●	●	●
Cost (US\$/tCO <sub>2</sub> )	< 100	< 100	100–500	100–500	> 800	100–500	< 100	< 100	Too early to quantify	
Storage medium	Buildings, vegetation, soils and sediments			Geological reservoirs		Minerals	Vegetation, soils and sediments		Minerals	Marine lime'n's

Sources: UNEP - Emissions Gap Report (2023), Adapted from Geden et al. (2022) and Pisciotta, Davids and Wilcox (2022).



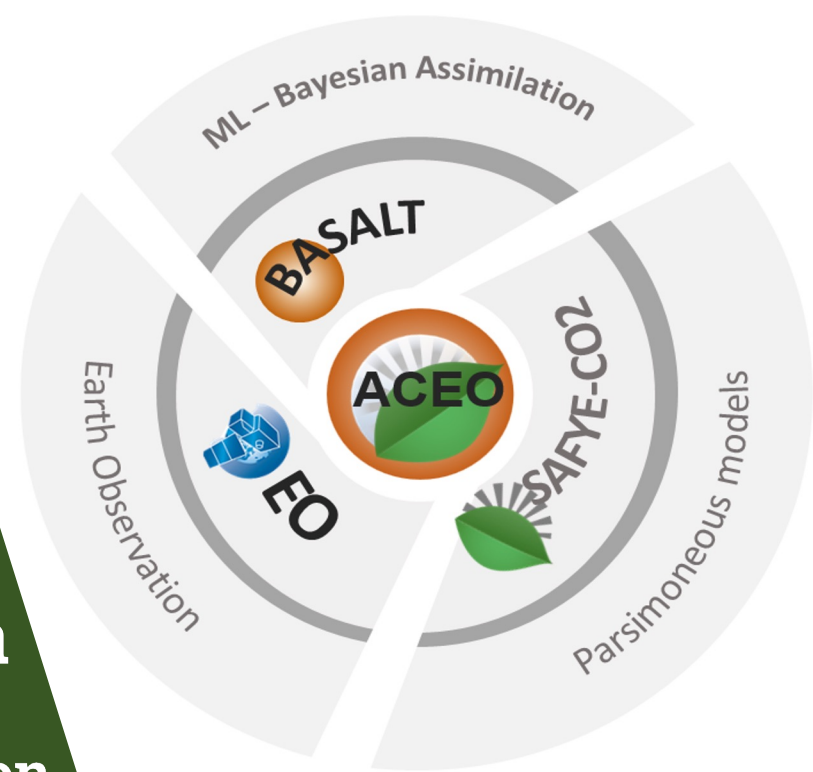
# Monitoring soil carbon



**ORCaSa**



**Soil Carbon**  
International Research Consortium



## AgriCarbon-EO

A hybrid MRV approach that combines: modeling, remote sensing, and assimilation.

# AgriCarbon-EO

Is also a processing chain that process the data from end-to-end.

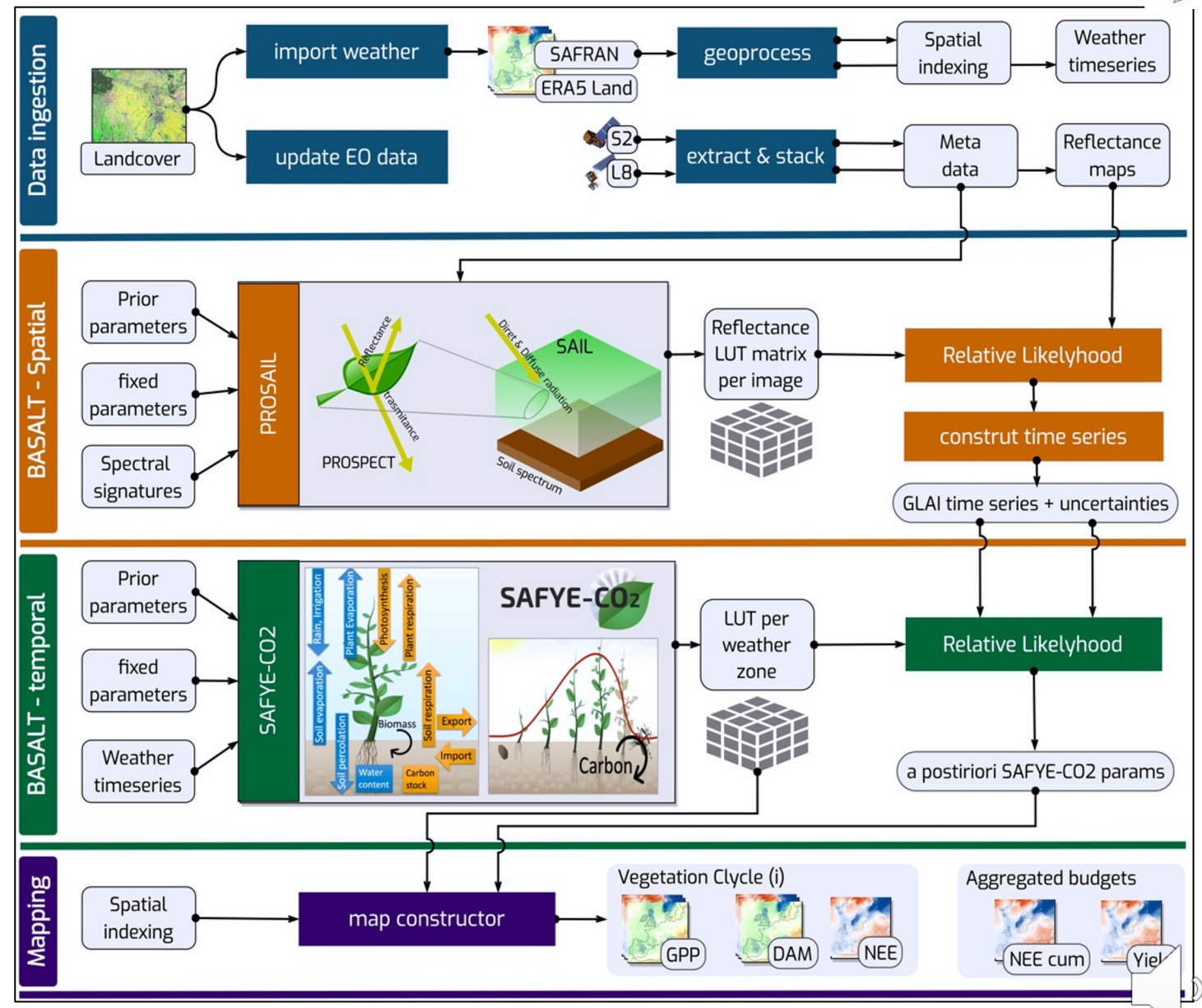


**Geoscientific Model Development**

AgriCarbon-EO: v1.0.1: Large Scale and High Resolution Simulation of Carbon Fluxes by Assimilation of Sentinel-2 and Landsat-8 Reflectances using a Bayesian approach

Taeken Wijmer, Ahmad Al Bitar, Ludovic Arnaud, Rémy Fieuzal, and Eric Ceschia

**Agri sector:**

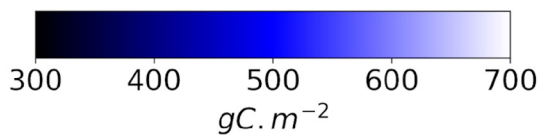
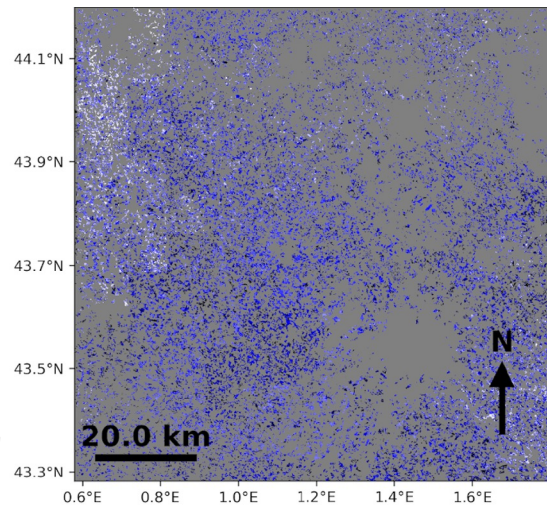


# Carbon budget components

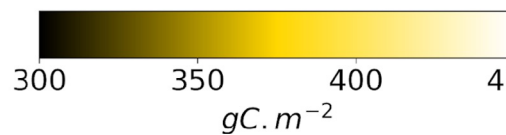
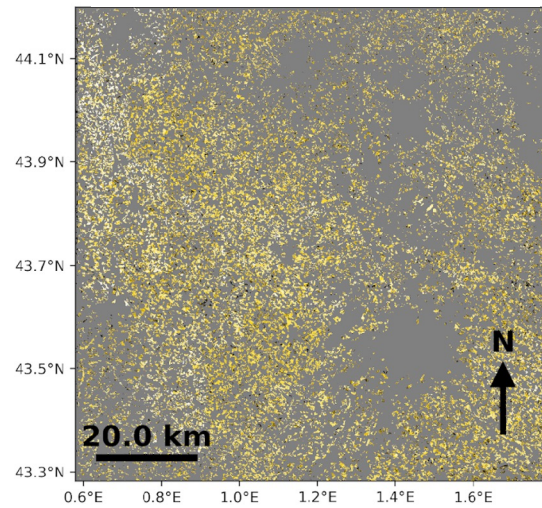


$$\Delta\text{carbon} = \text{Net flux} + C_{\text{import}} - C_{\text{export}}$$

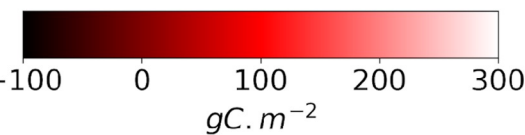
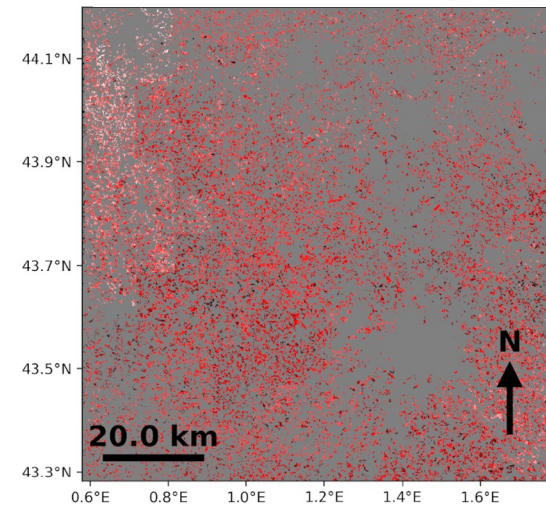
Net annual CO<sub>2</sub> flux (NEP)



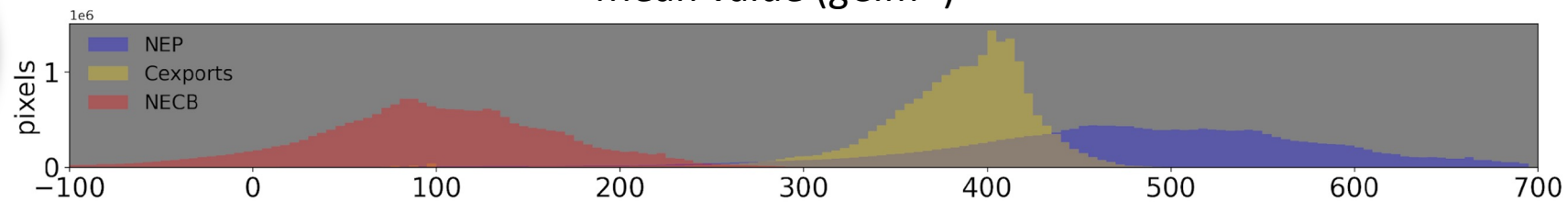
C exported at harvest



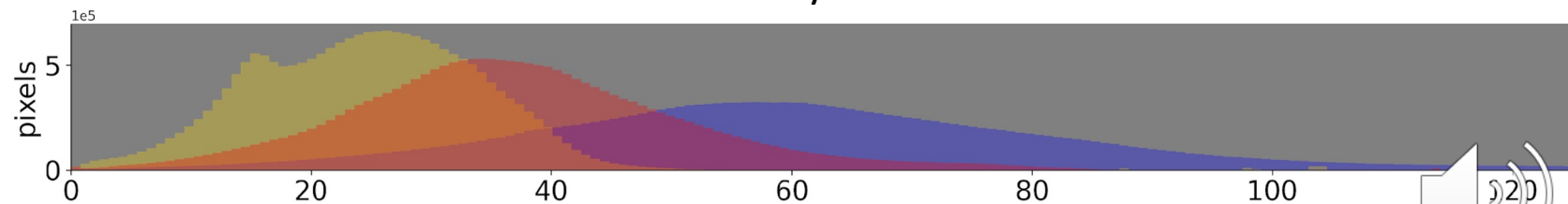
Annual C budget (NECB)



Mean value (gC.m<sup>-2</sup>)

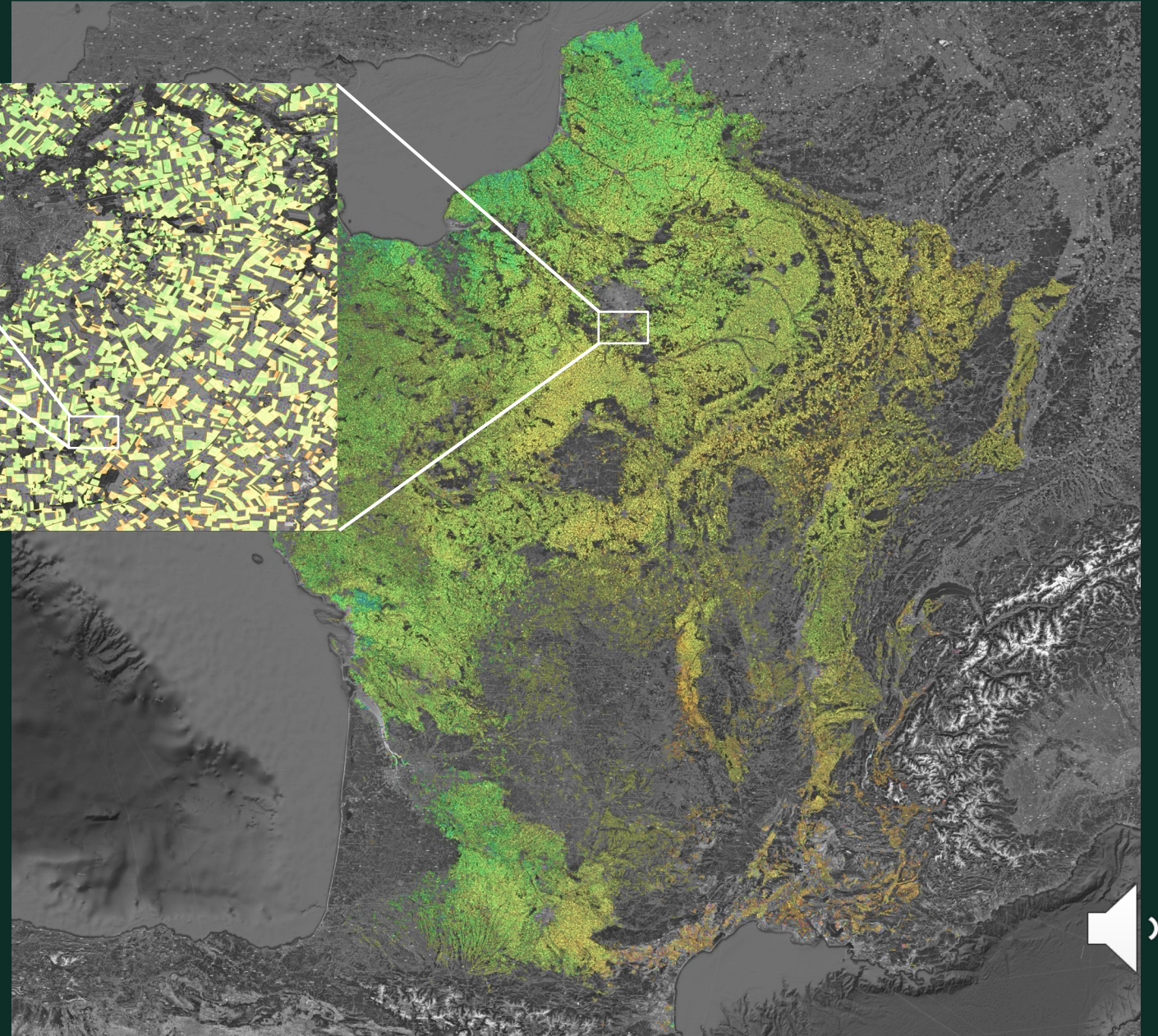
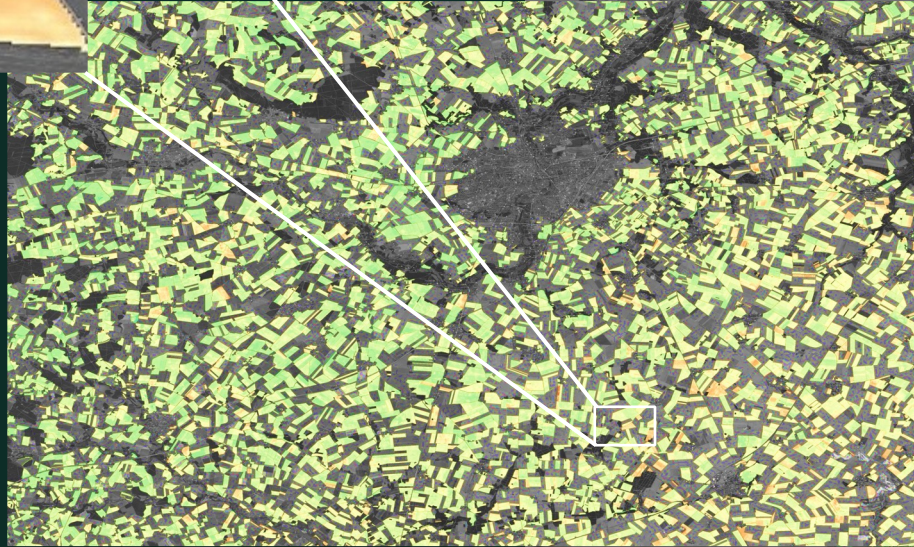


Uncertainty estimates



# Scaling-up

Capturing changes from intra-field to national scale



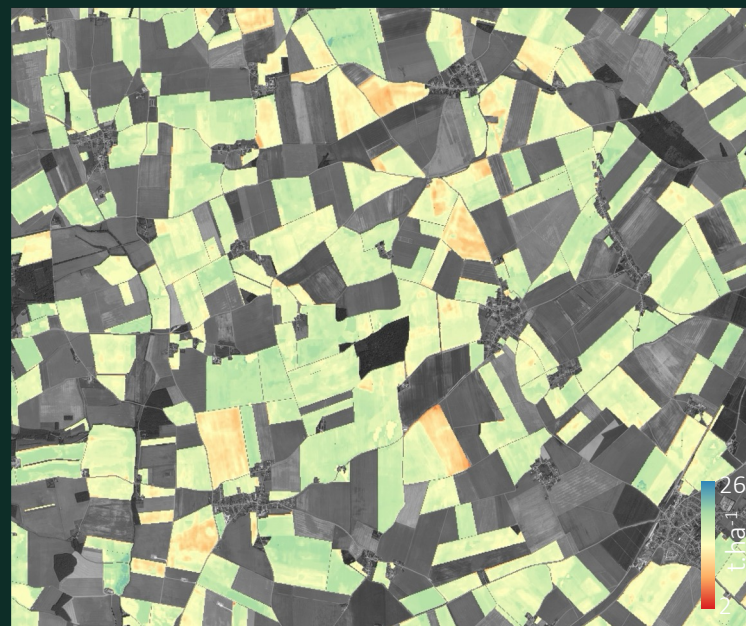
Dry above ground biomass  
Winter wheat 2019 in France

10m resolution  
0.6 billion pixels  
Daily estimates

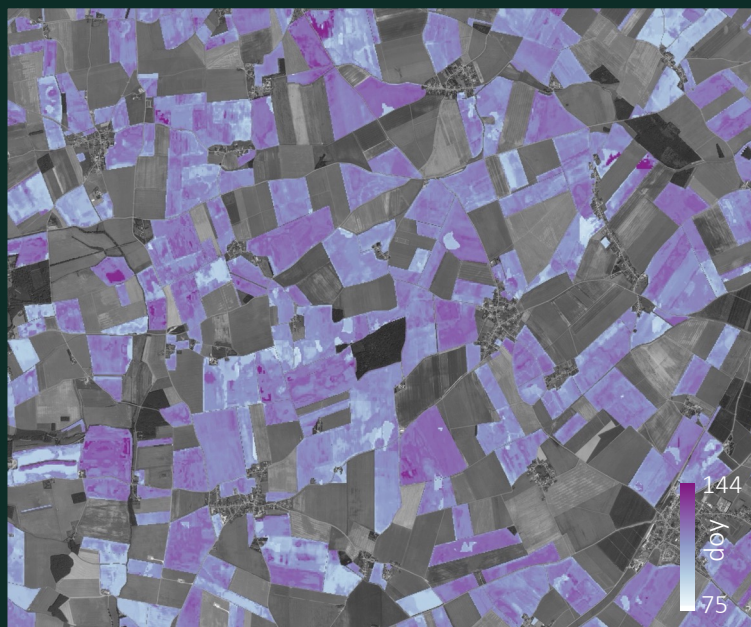


# Coherent-set of agri-environmental variables

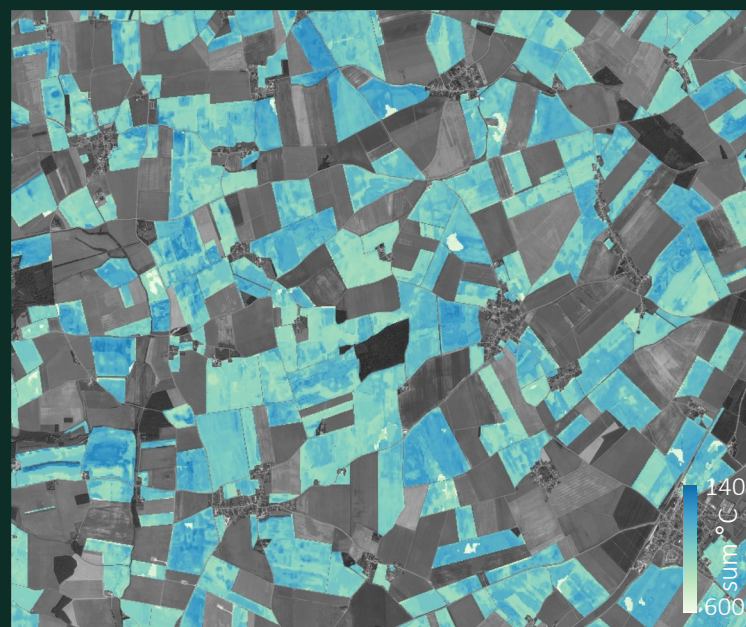
Dry Above ground biomass



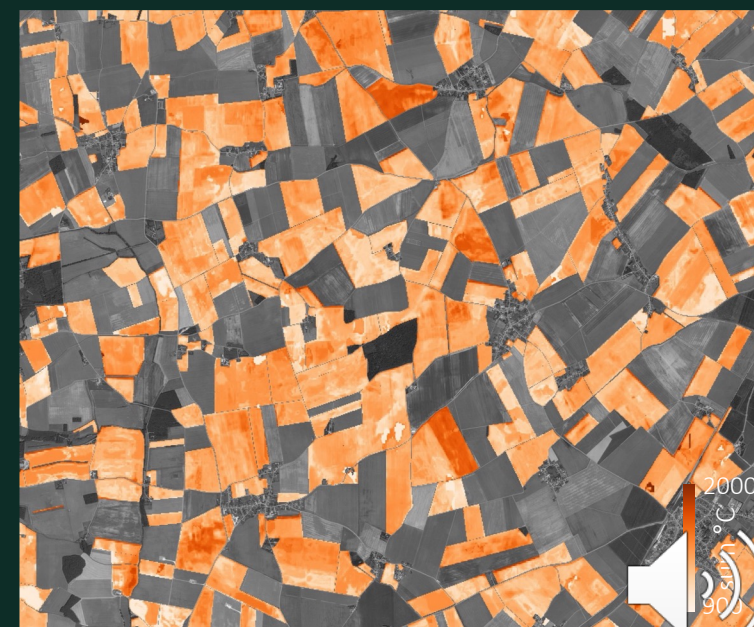
Net annual CO<sub>2</sub> flux



Day of emergence



Maturation phase

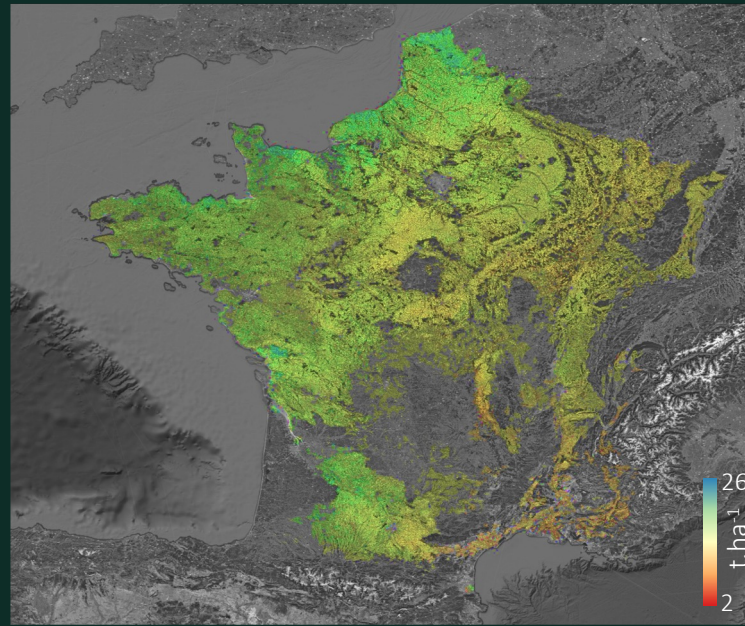


Senescent phase

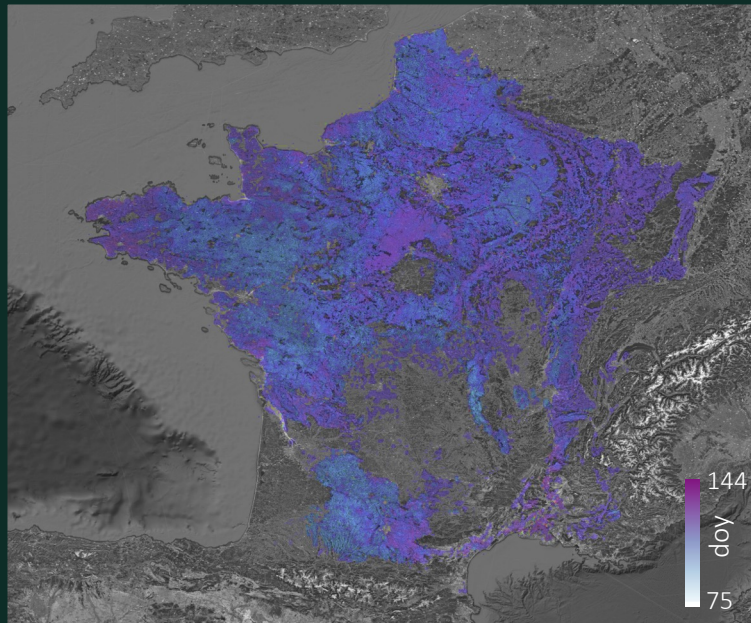
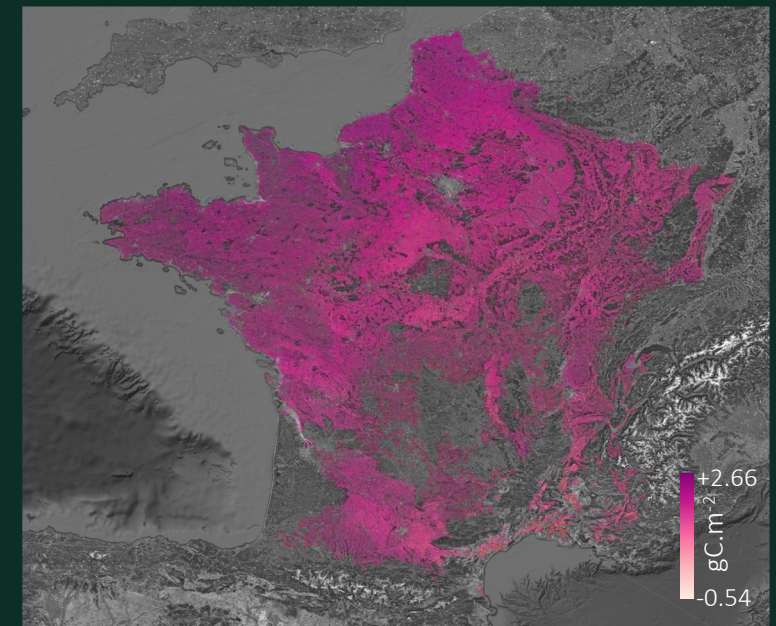


# Coherent-set of agri-environmental variables

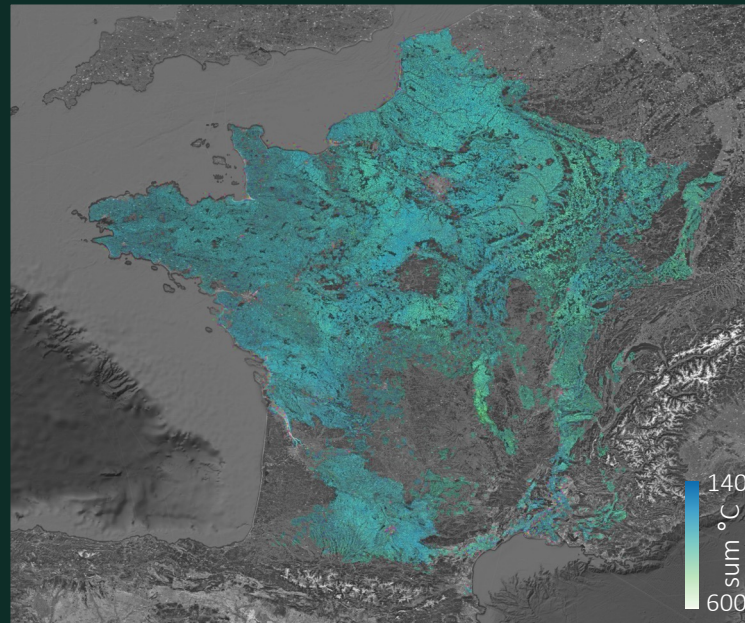
Dry Above ground biomass



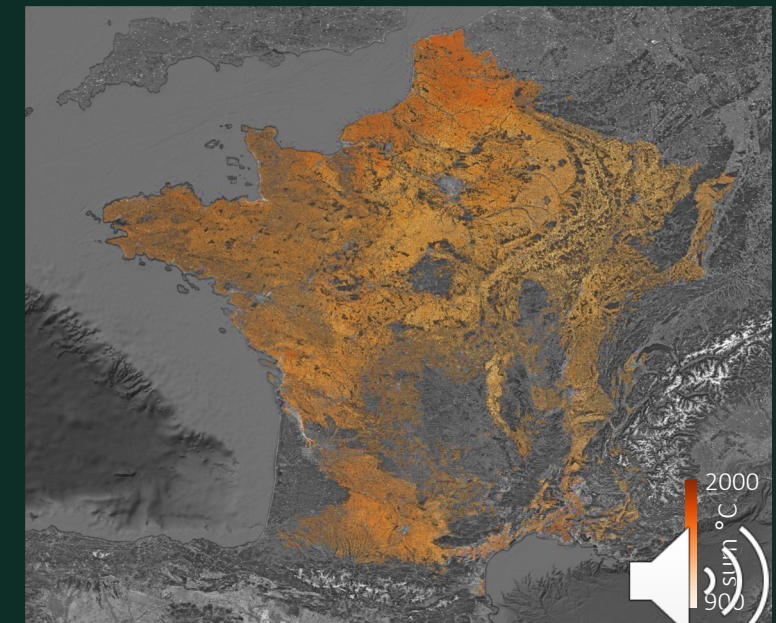
Net annual CO<sub>2</sub> flux



Day of emergence

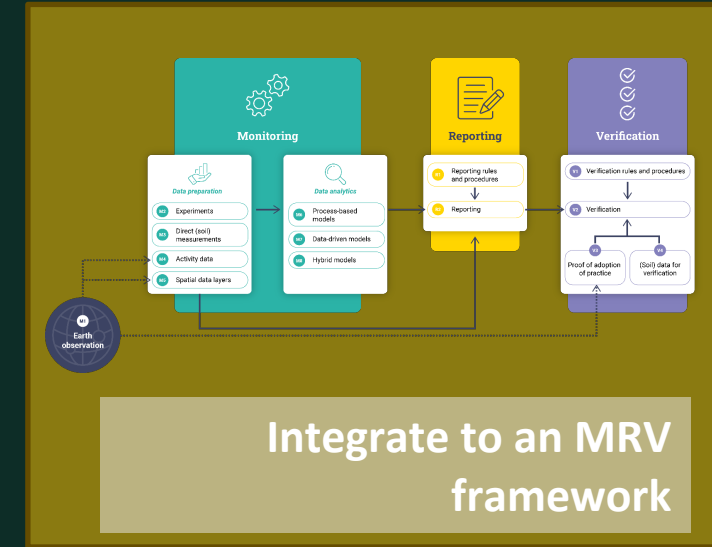
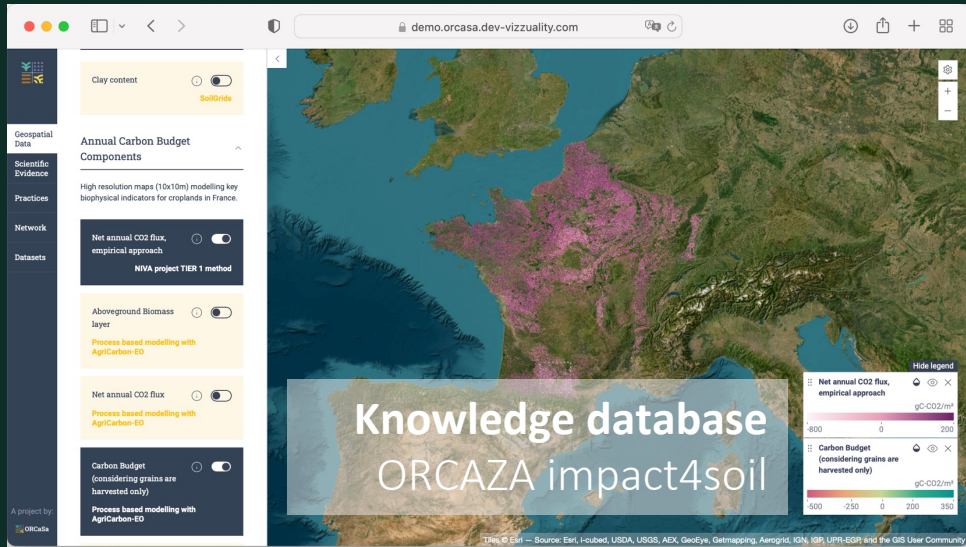


Maturation phase



Senescent phase

# Collaborating...to address the challenges



Soil Carbon  
International Research Consortium

5 REGIONAL NODES

A Horizon Europe project to restore soil health

Knowledge sharing  
CIRCASA | ORCASA | IRC Soil Carbon

Kerk  
INSTITUTE FOR RURAL STUDIES

# Thank you and follow us!



[www.irc-orcasa.eu](http://www.irc-orcasa.eu)



[@orcasa\\_project](https://twitter.com/orcasa_project)



[www.linkedin.com/orcasa](https://www.linkedin.com/orcasa)



*The ORCaSa project has received funding from the Horizon Europe Programme under grant agreement n° 101059863.*