

# GES et agriculture

15

%

des GES anthropogénique  
[Pörtner et al., 2022]

0.6 - 9.3  
Gt CO<sub>2</sub>/an

Potentiel de stockage dans le sol  
[Skea et al., 2022]

Stocker le carbone dans le sol



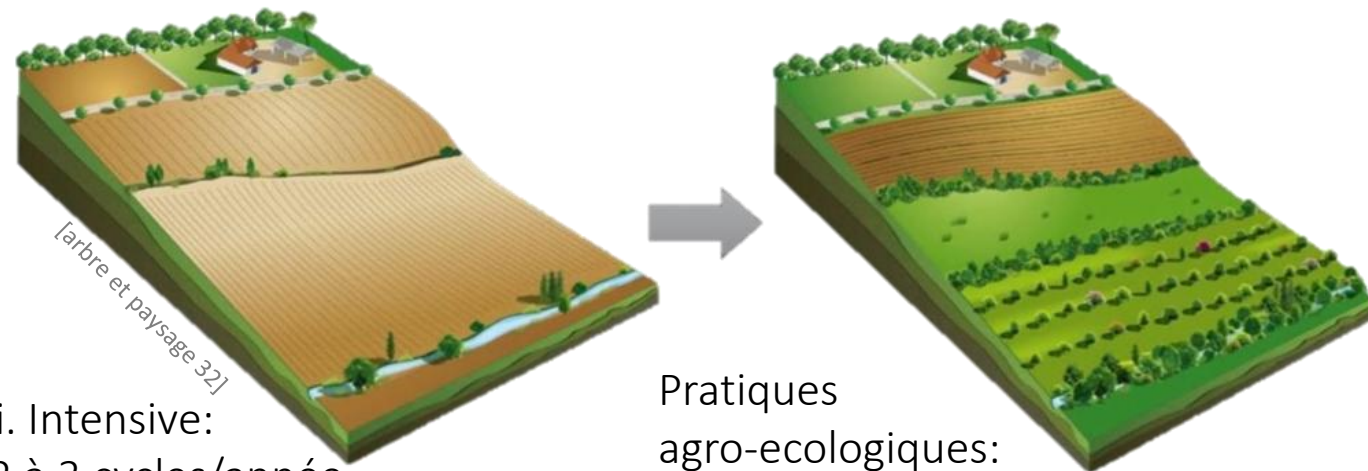
# Bilan Carbone des Grandes Cultures avec AgriCarbon-EO

Ahmad Al Bitar, Eric Ceschia,

Taeken Wijmer, Ludovic Arnaud, Veronica Antonenko,  
Andrea Geraud, Ainhoa Ihasusta



Des outils pour accompagner la transition agro-écologique et le soil carbon farming »



Agri. Intensive:

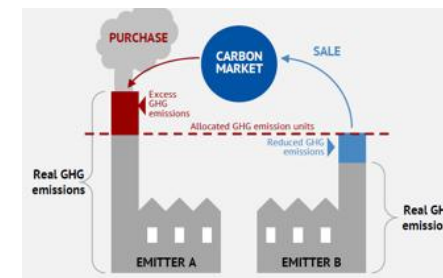
- ▶ 2 à 3 cycles/année
- ▶ Fertilisation forte
- ▶ Labour profond

Pratiques agro-écologiques:

- ▶ Stockage de carbone
- ▶ Labour en surface
- ▶ Culture intermédiaire



Emergence du marché volontaire « offsetting » et « insetting »



# Comment quantifier le bilan carbone ?



Observer

*Echantillons,  
télédétection*



Obs. en  
surface

# Comment quantifier le bilan carbone ?



Observer

*Echantillons, télédétection*

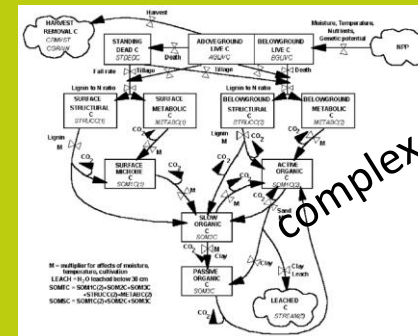


Obs. en surface

Modéliser

*Sol, végétation, pratiques.*

Daycent model

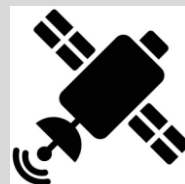


# Comment quantifier le bilan carbone ?



## Observer

*Echantillons, télédétection*

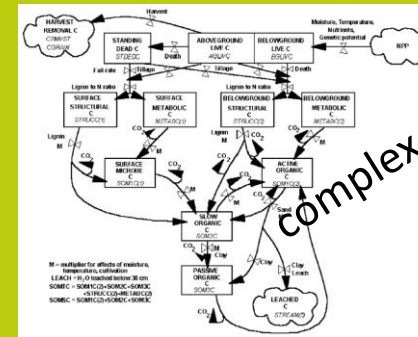


Obs. en surface

## Modéliser

*Sol, végétation, pratiques.*

Daycent model



complex

## Apprendre

*ML, Deep Learning...*



Variabilité des pratiques, climats, nuisibles...

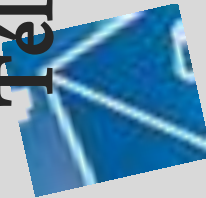
Approche multidisciplinaire  
et intégrative



Flux net de CO2 - NEE

Blé d'hiver, Sud-Ouest, 110x110 km à 10 m

Téledétection



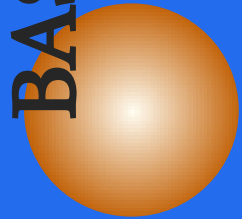
*Téledétection de  
dynamique de la  
végétation*

SAFYE-CO2



*Modèle agronomique  
parcimonieux*

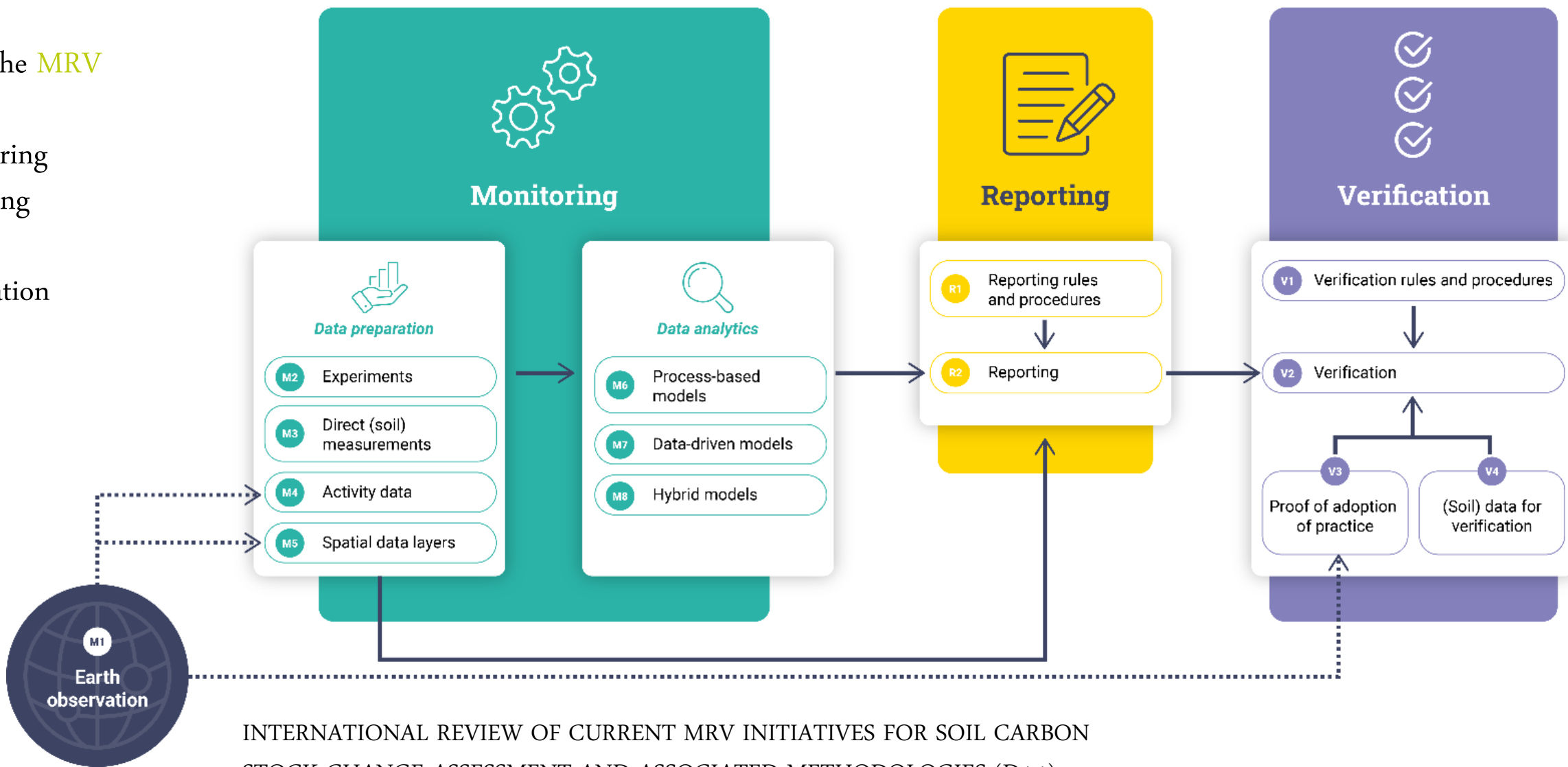
BASALT



*Méthode d'assimilation  
Bayésienne*

# Approche MRV

## Monitoring Reporting & Verification



INTERNATIONAL REVIEW OF CURRENT MRV INITIATIVES FOR SOIL CARBON STOCK CHANGE ASSESSMENT AND ASSOCIATED METHODOLOGIES (D4.1)

ORCASA project



## Diagram de la chaine ACEO

### Implémentation



sur cluster ACEO, CALMIP, CNES HAL; CNES TREX

### Dépot :



### AAP

Wijmer T., Al Bitar A., Arnaud L., Ceschia E.

### Publi. Scientifique:

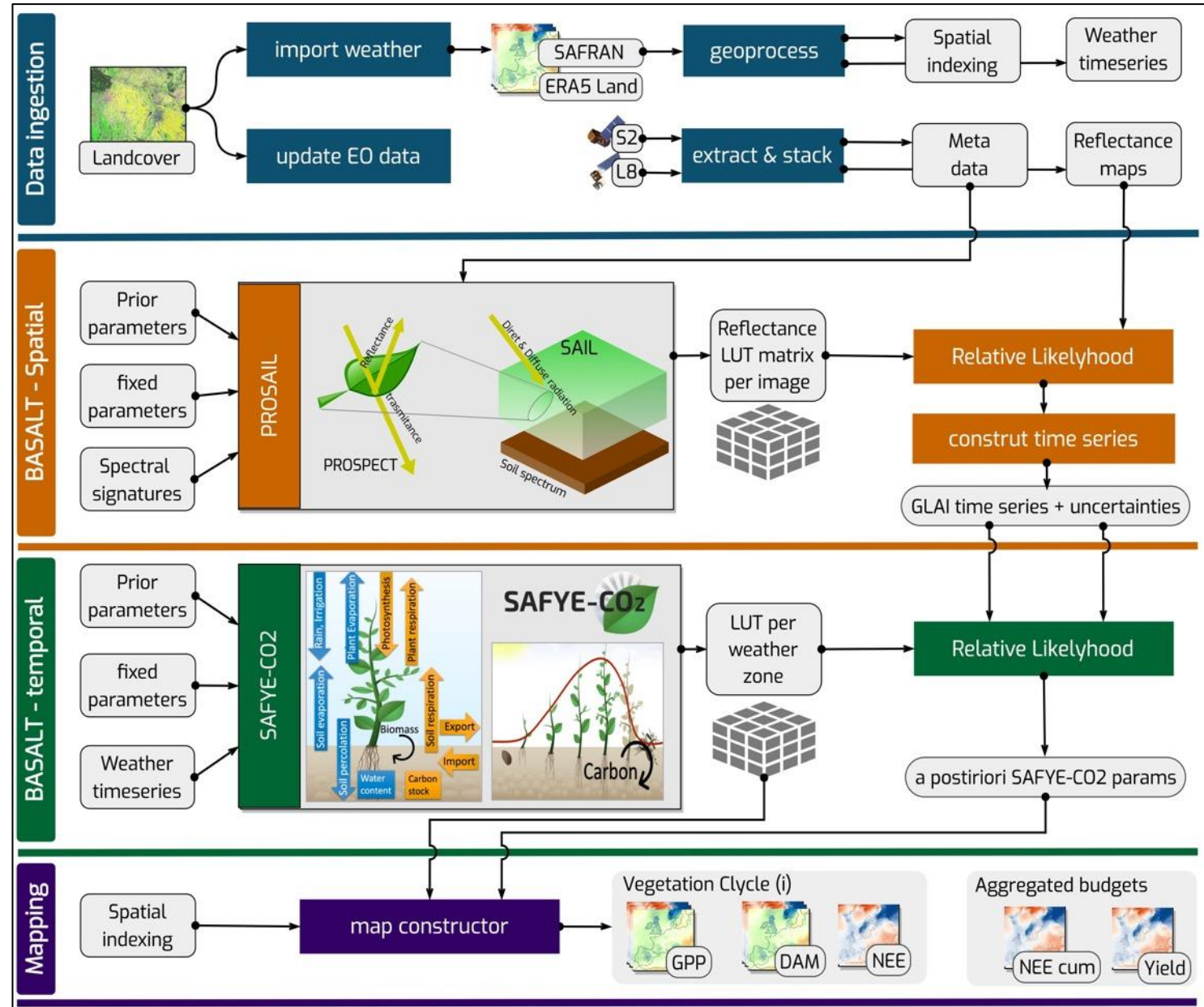


The EGU interactive community platform

ABSTRACTS & PRESENTATIONS PREPRINTS ABOUT

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



Carte d'occupation du sol

Vecteur (RPG) ou raster (OSO)



Données de télédétection

Multispectral TOC L2A

- Sentinel-2, Landsat8 (via api)
- Planet (en cours avec NetCarbon)

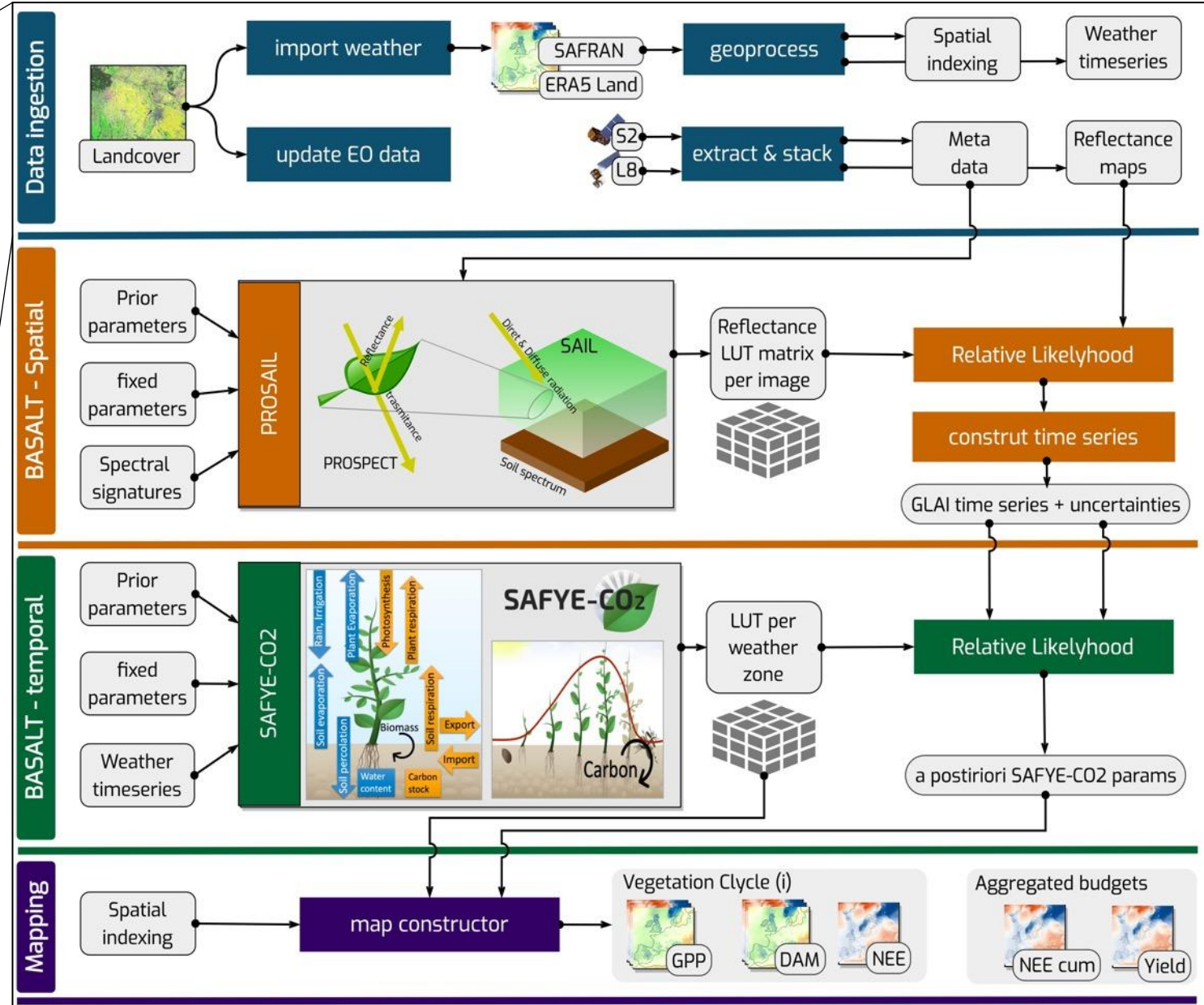


Données météo

Temp. de l'air, rayonnement, precipitation

ERA5-Land (via api)

SAFRAN



# BASALT - spatial

Génération des **Look-Up Tables (LUT)** de réflectance **par image** avec PROSAIL

Évaluation **Bayésienne** de chaque solution de la **LUT PROSAIL** face aux **reflectance sat.** pour chaque pixel

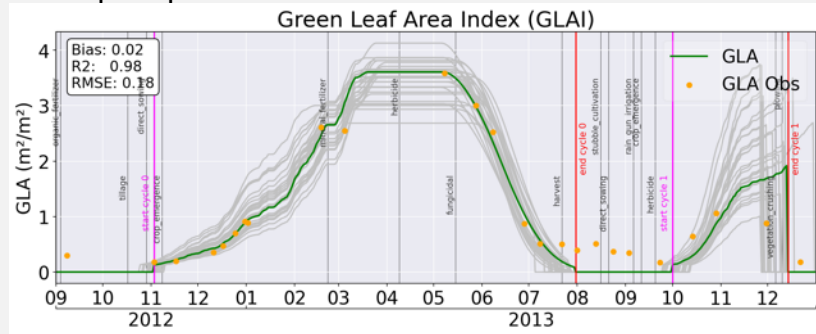
Generation des series temporelles d'indices foliaires (**Green Leaf Area Index - GLAI**)



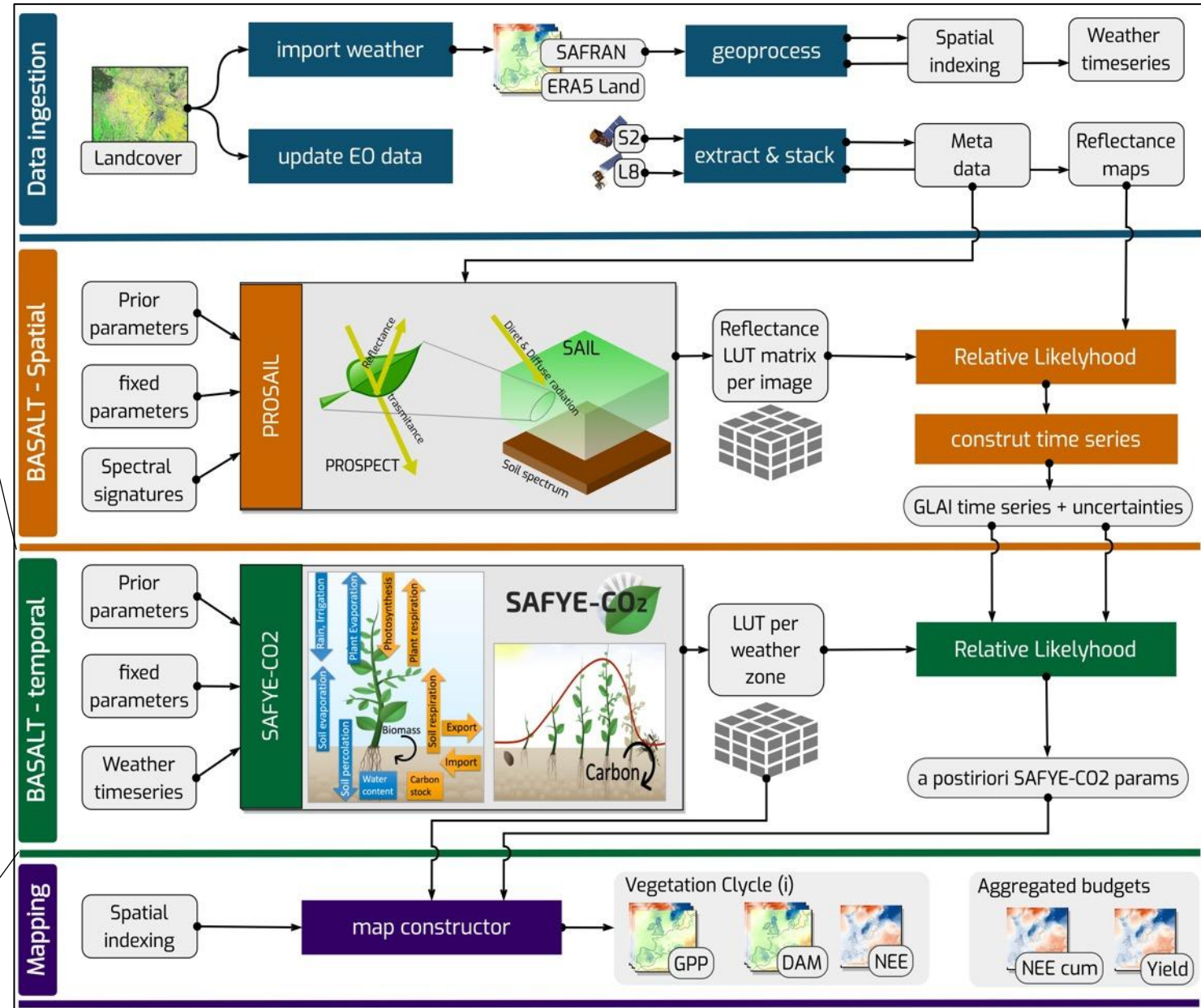
# BASALT - temporal

Génération des **Look-Up Tables (LUT)** de GLAI **par zone météo** avec SAFYE-CO2 sur un cycle de végétation

Évaluation **Bayésienne** de chaque solution de **la LUT SAFYE-CO2** face aux **GLAI** pour chaque pixel.

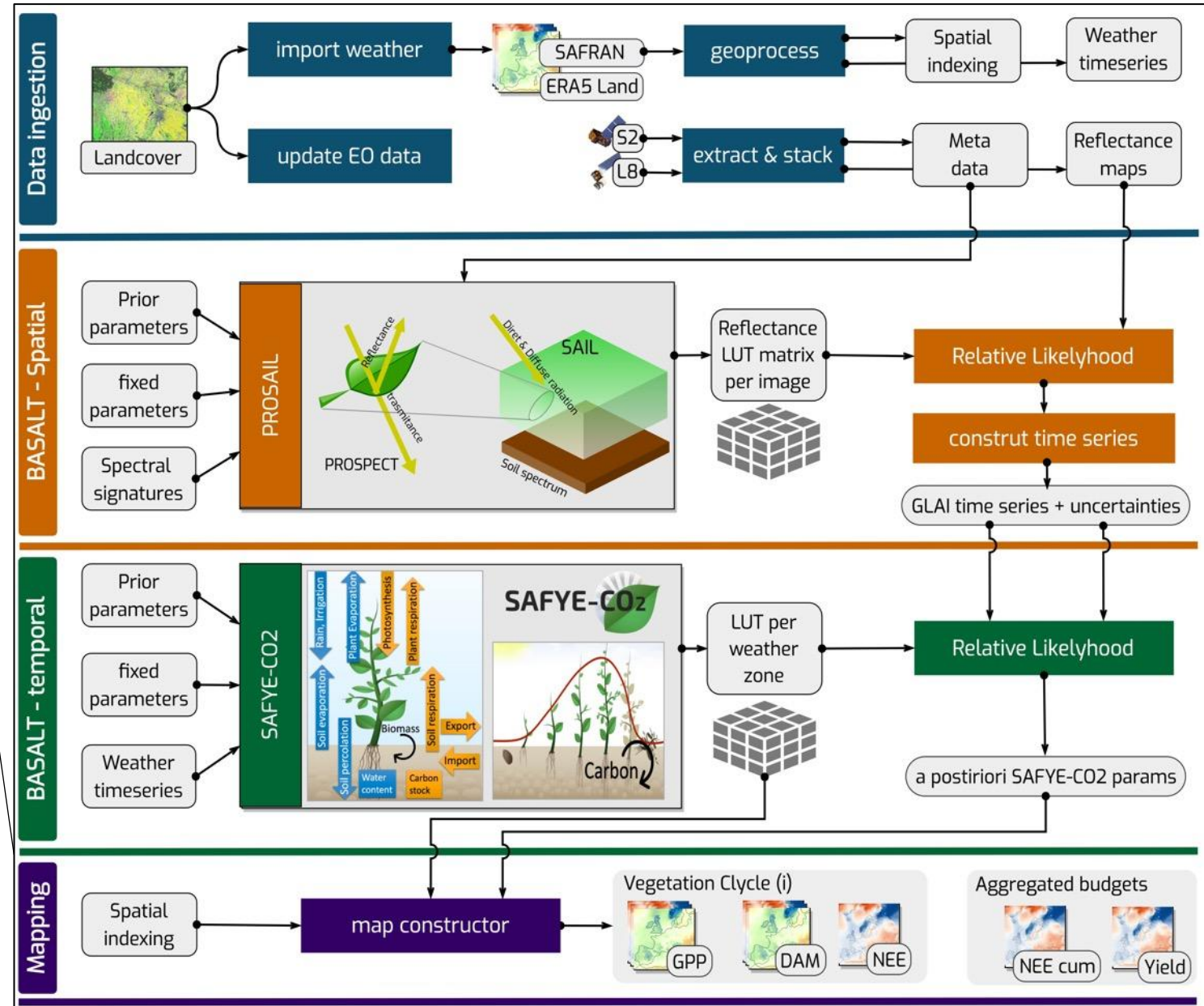
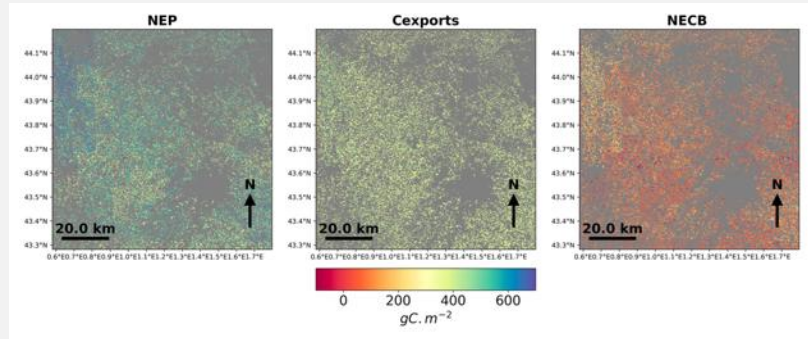


Stockage de l'apport en information (likelihood) par pixel.



# Mapping

Generation des cartes de valeurs moyennes ET des incertitudes associées pour les variables d'intérêts.



Flux C

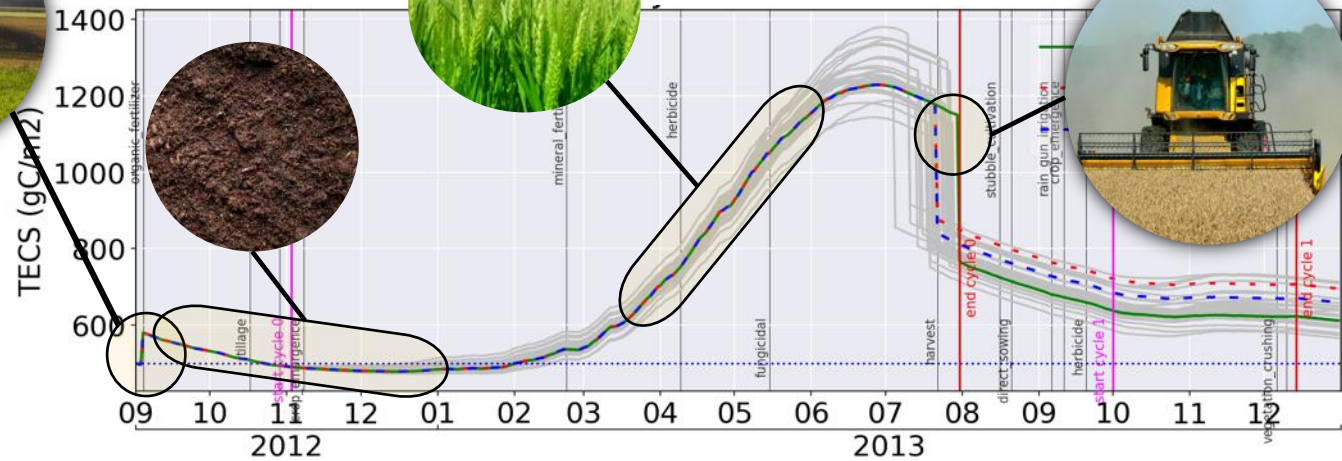
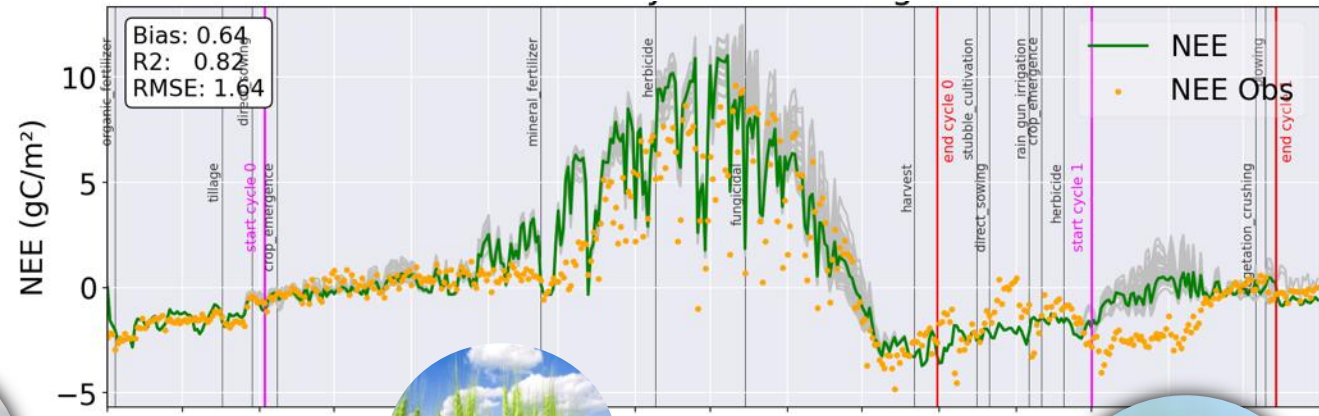
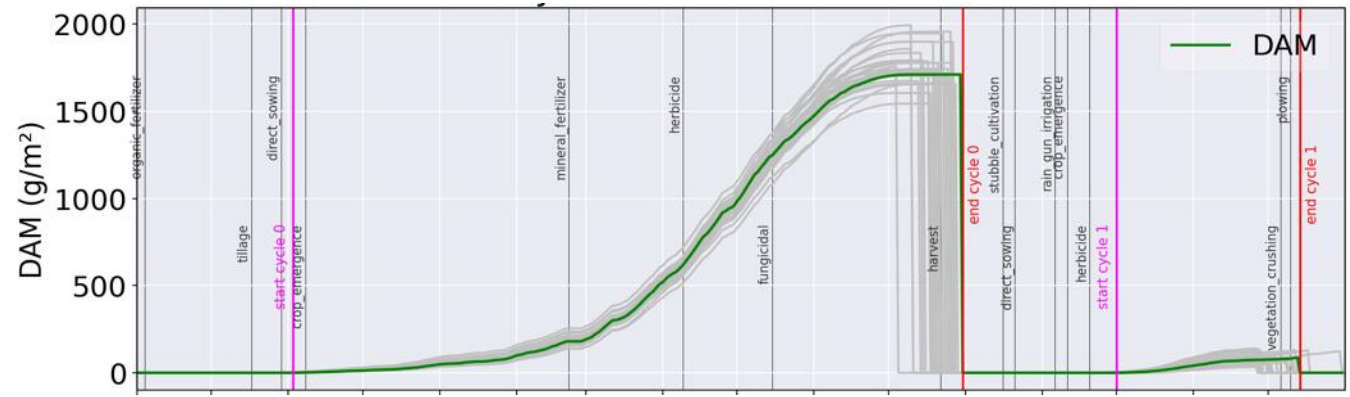
# Dynamique de biomass et de bilan carbon avec



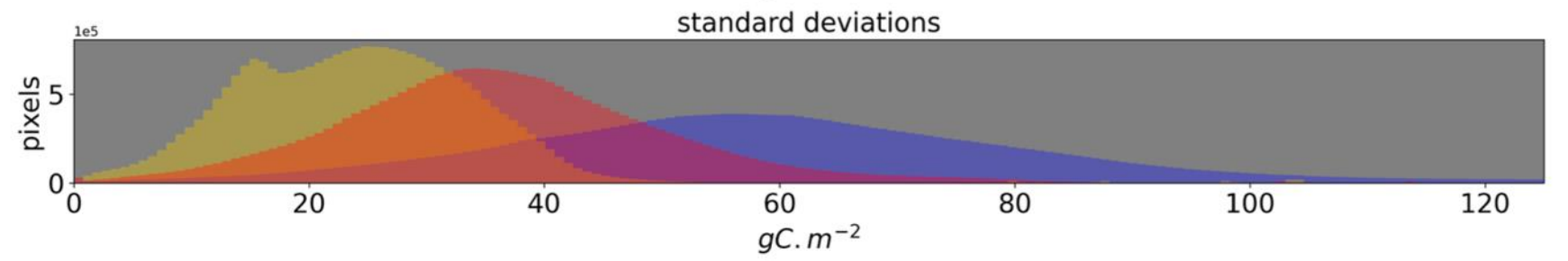
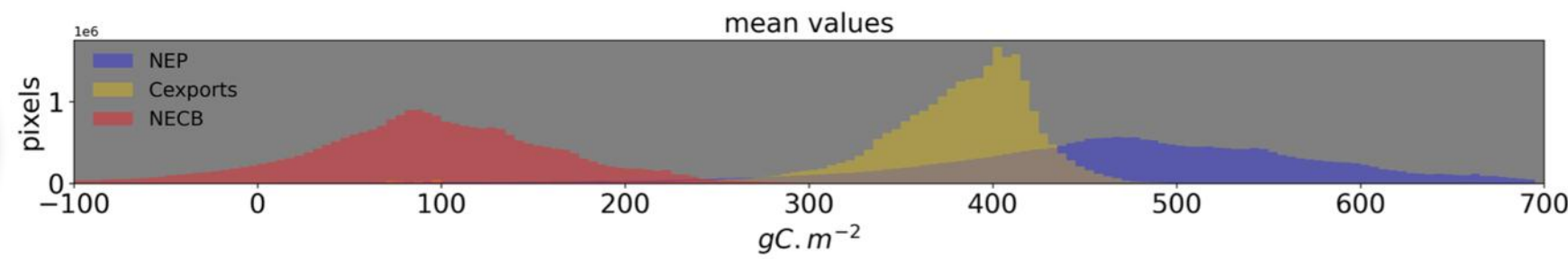
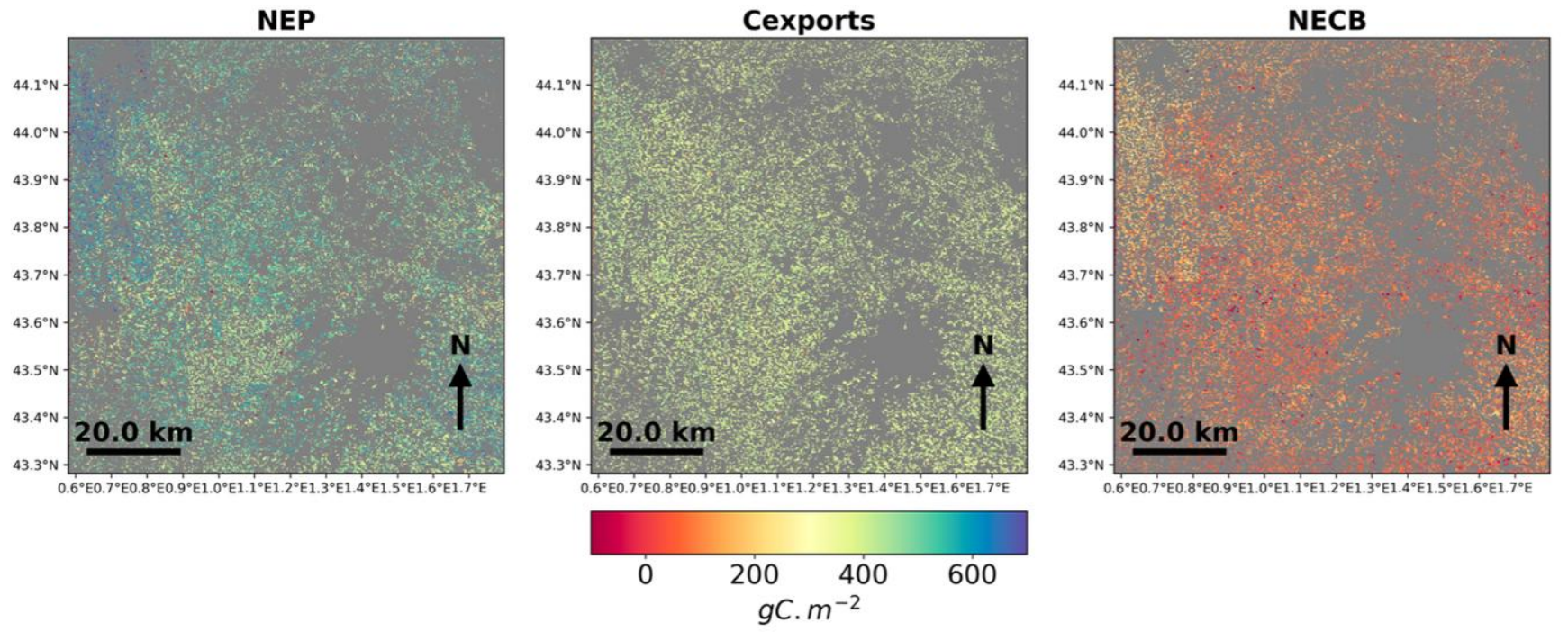
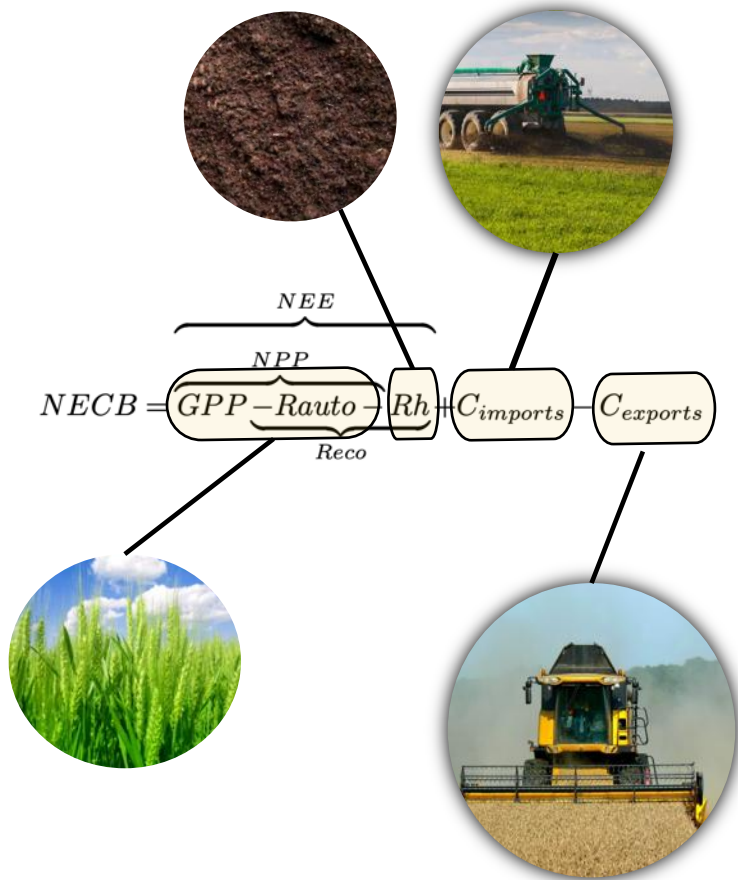
Biomass  
Aérienne  
[Plante]

Flux Net  
Carbon  
[Atm. → plant]

Stock de car  
de l'écosystème  
[Sol + Plante]



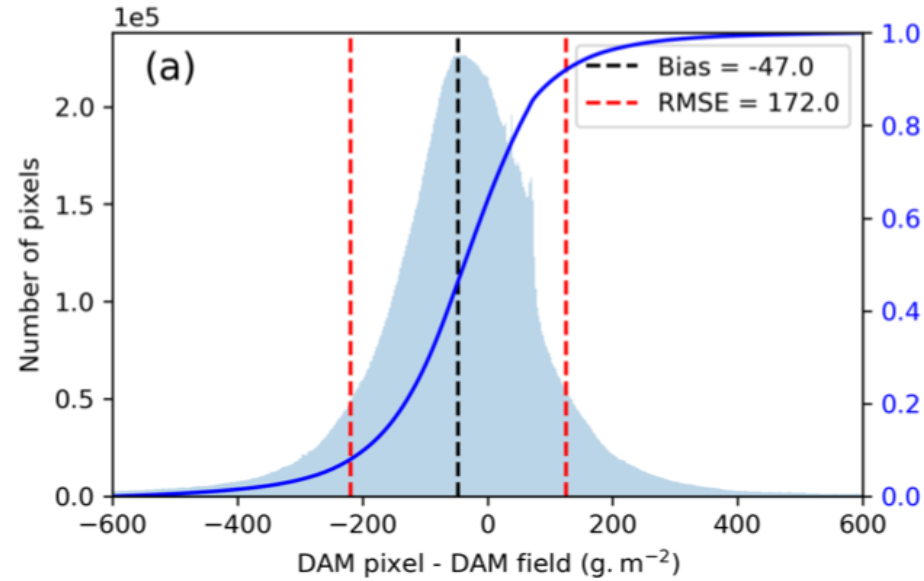
# Bilan C



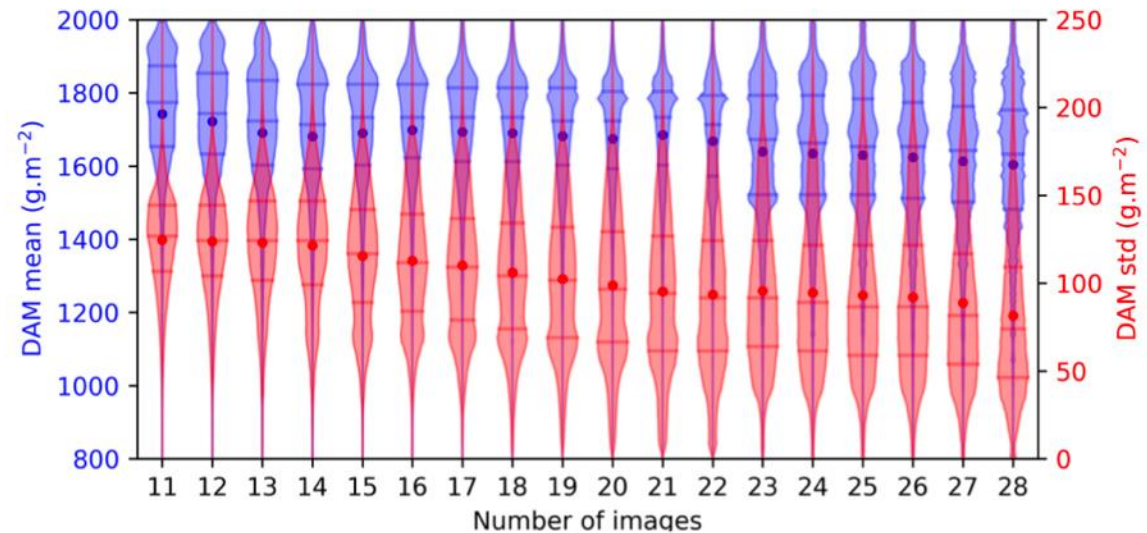
# Analyse de l'impact de la résolution spatiale et de la revisite



## Impact de la résolution spatiale (parcelle vs pixel)



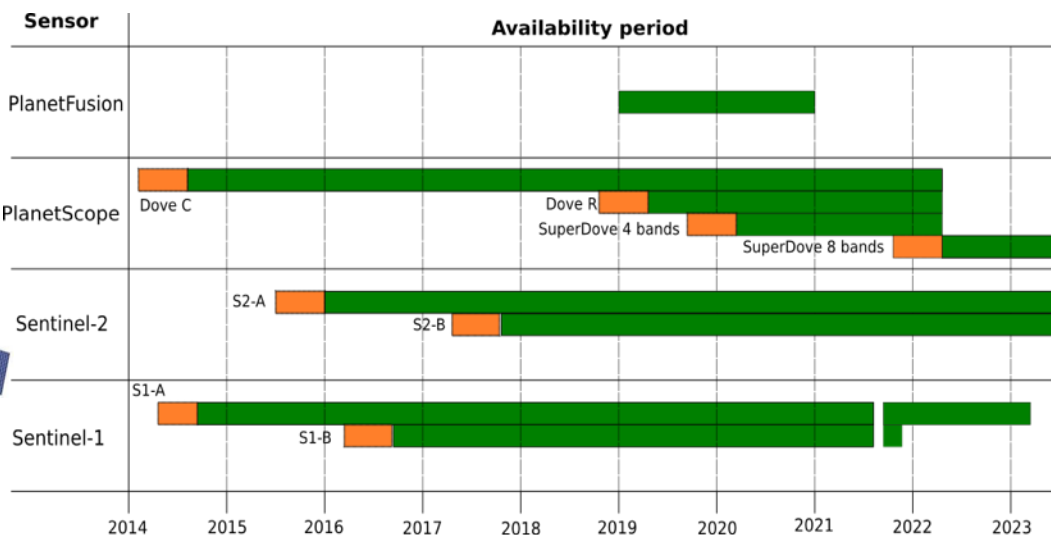
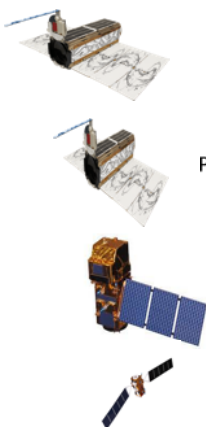
## Impact de la densité d'images



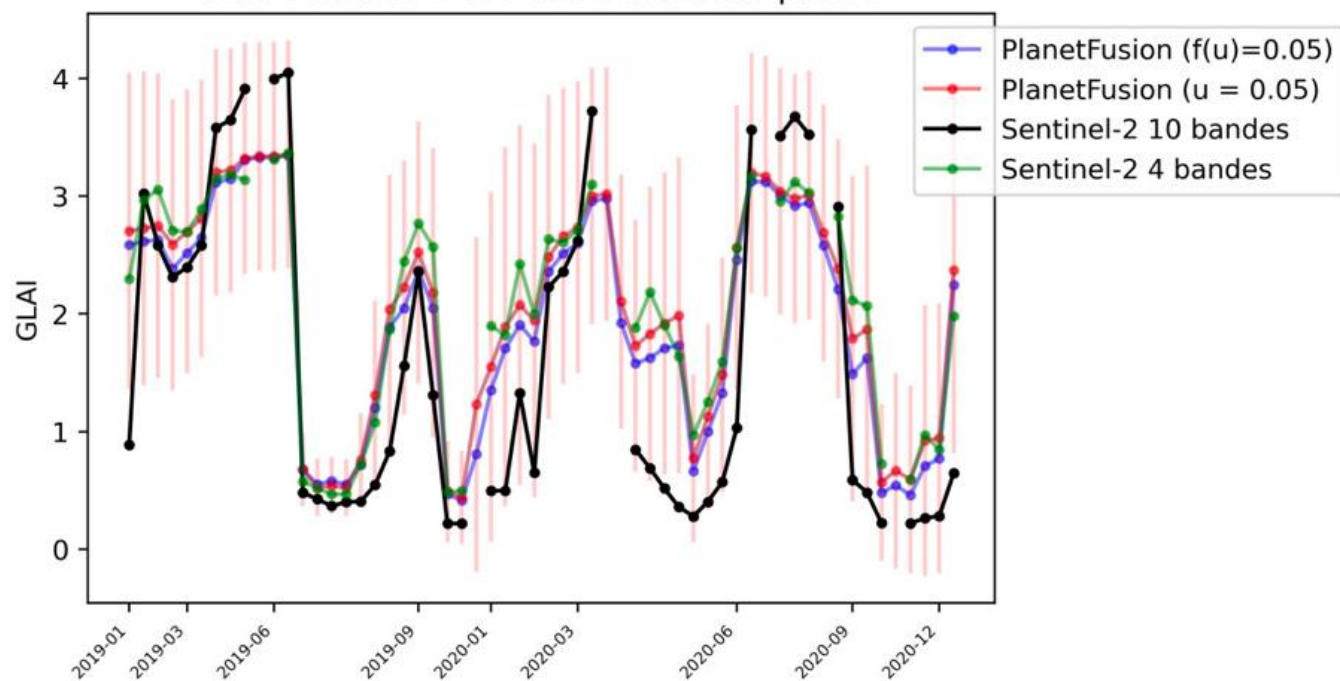


# Investigation données Planet et Radar Sentinel-1

3 m - journalières



GLAI Sentinel-2 et PlanetFusion sur pixel B

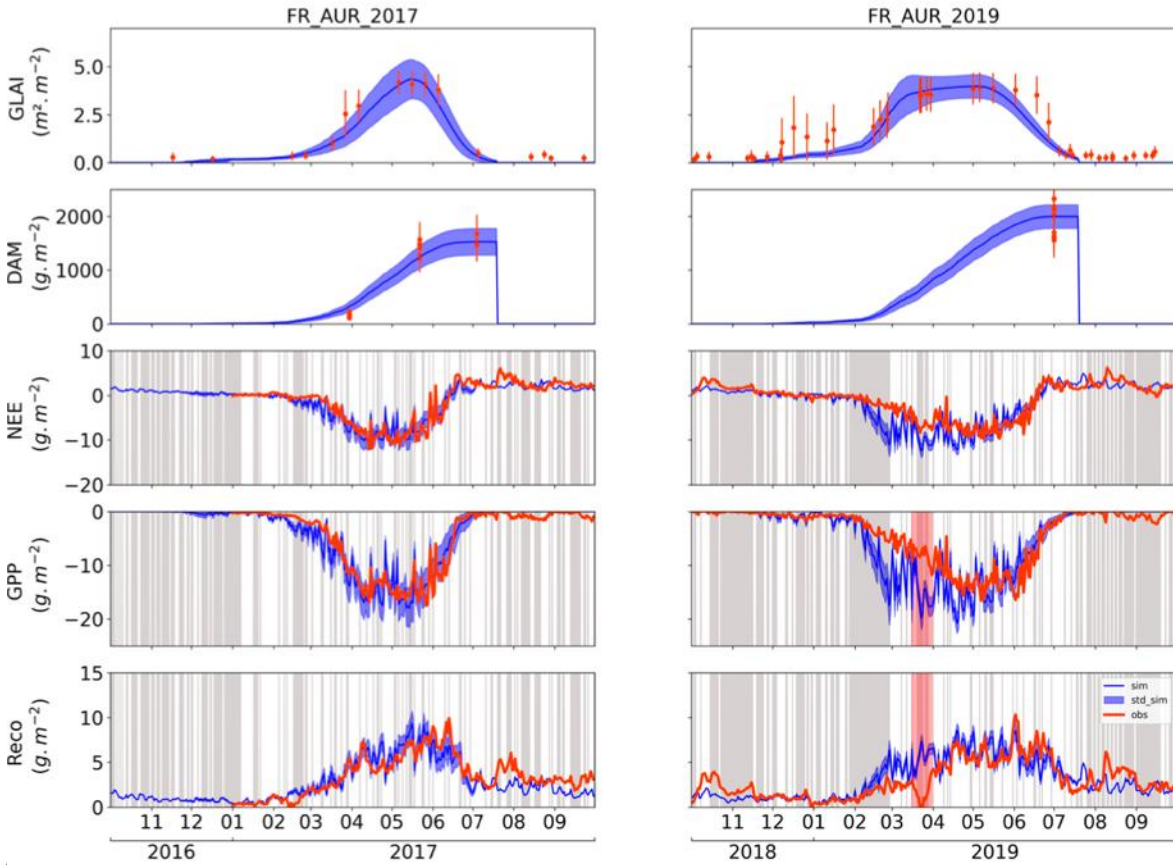


[Geraud A. Thèse CIFRE CESBIO/ Netcarbon]

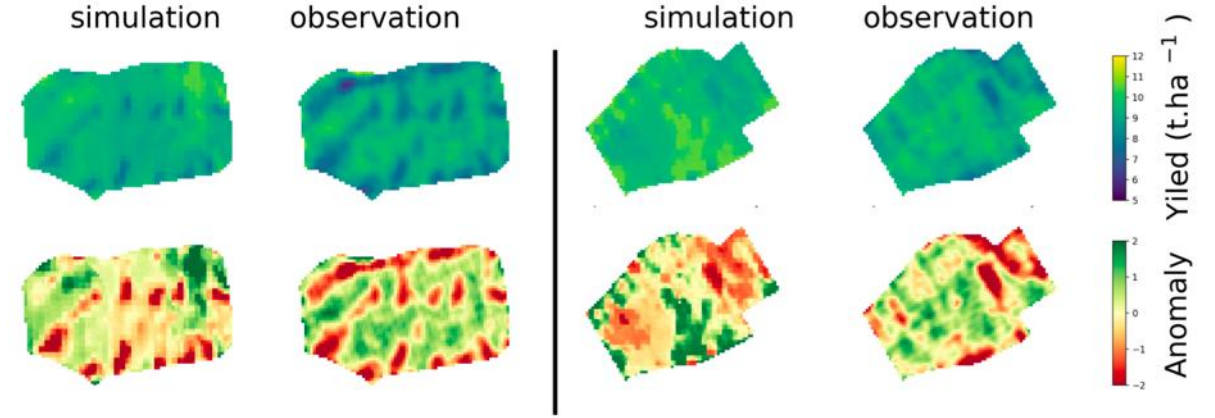


# Validation Blé d'hiver SO France

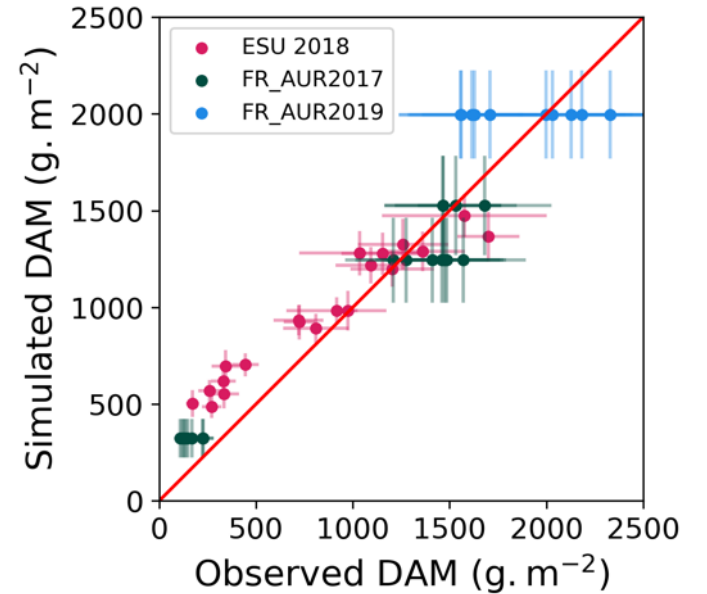
## Flux



## Rendement

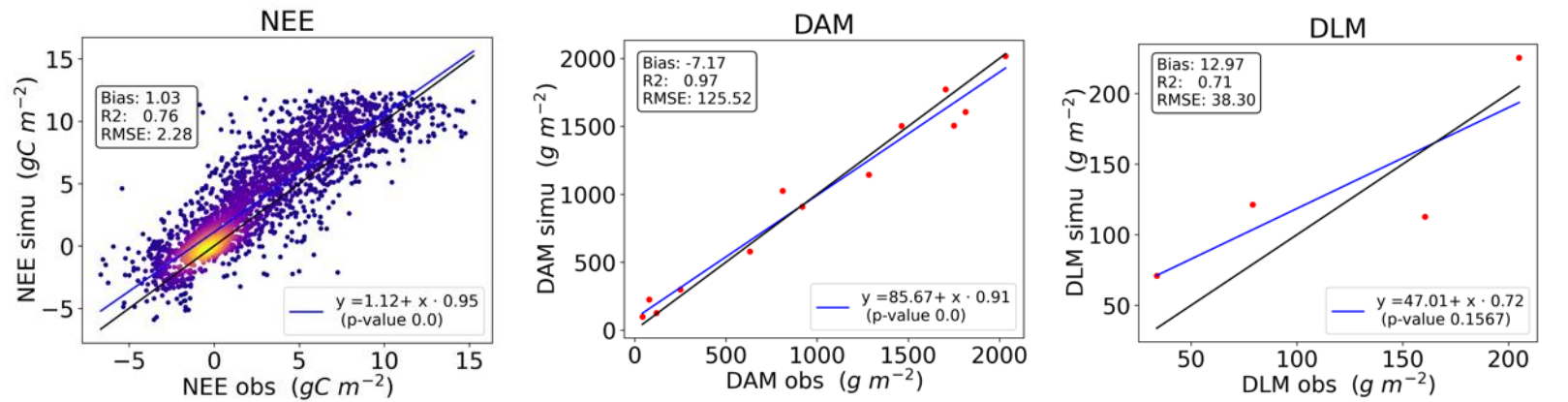
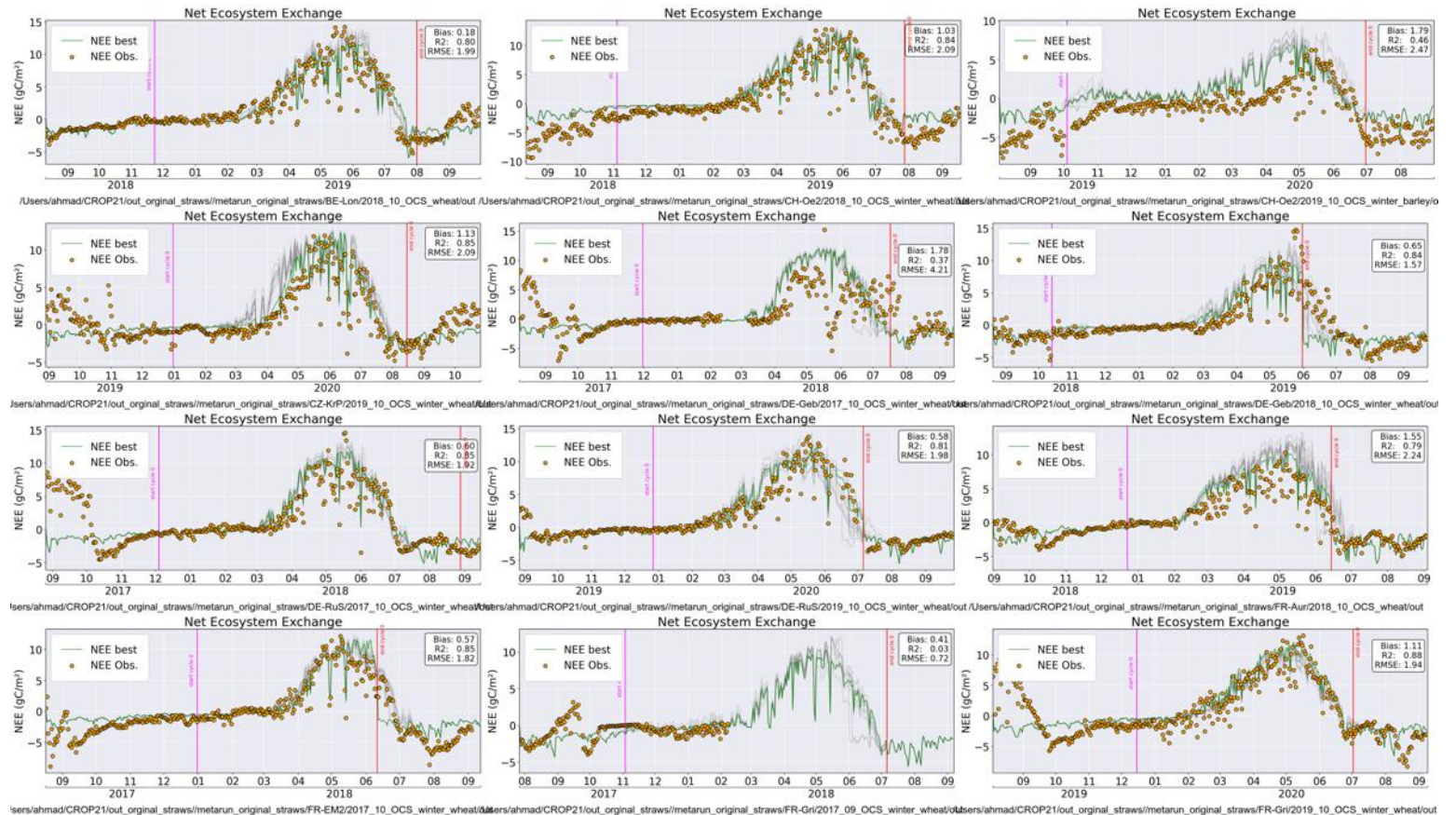


## Biomass



Robustesse et transférabilité de la méthode

Validation sur les sites de flux ICOS à travers l'Europe.



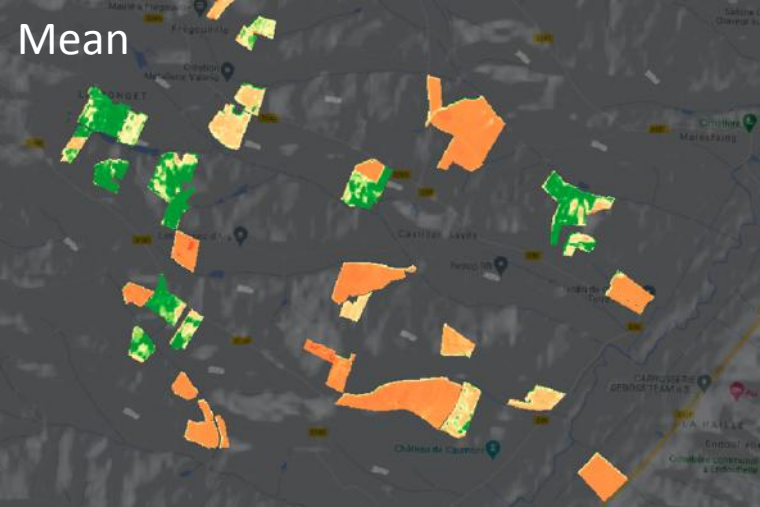
[Al Bitar A., 2023]

# Modélisation Maïs et cultures intermédiaires

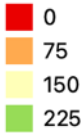
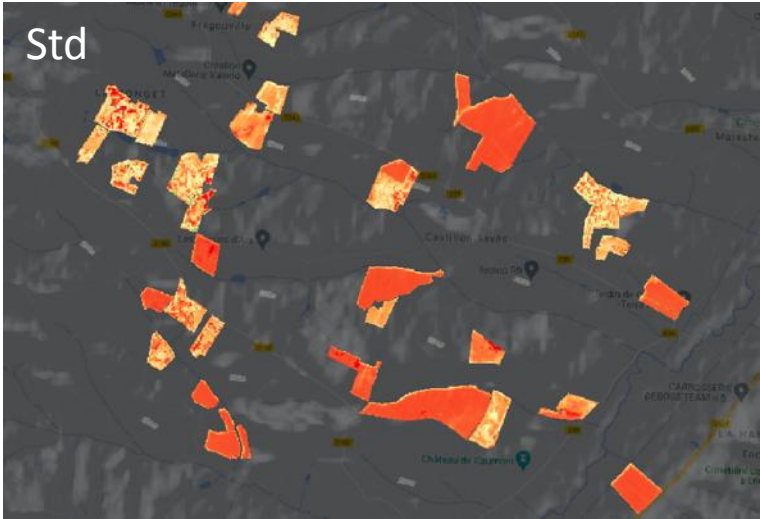
DAM - Crop cover



Mean



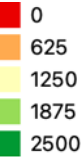
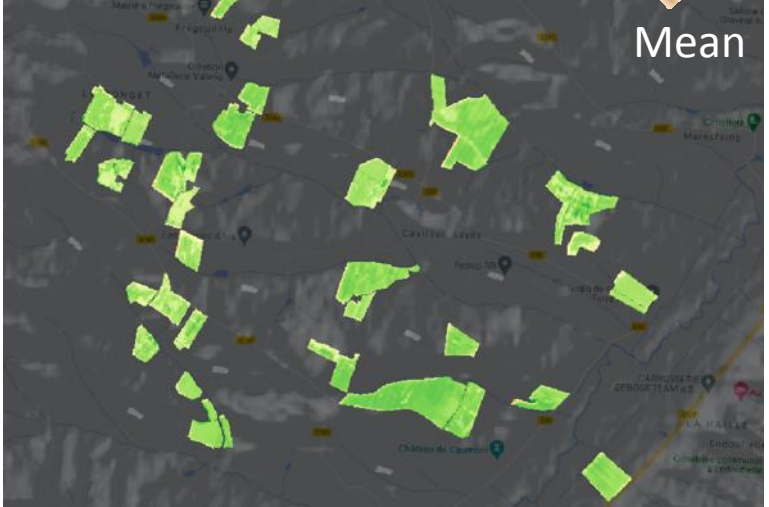
Std



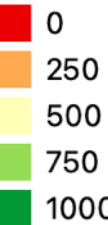
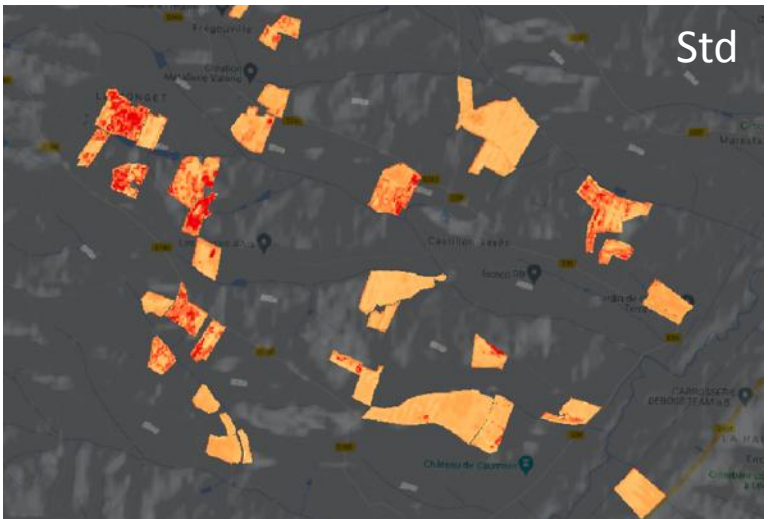
DAM - Maize



Mean



Std



# NEE avec et sans culture intermédiaire

NEE : Cover crop



+ Maize

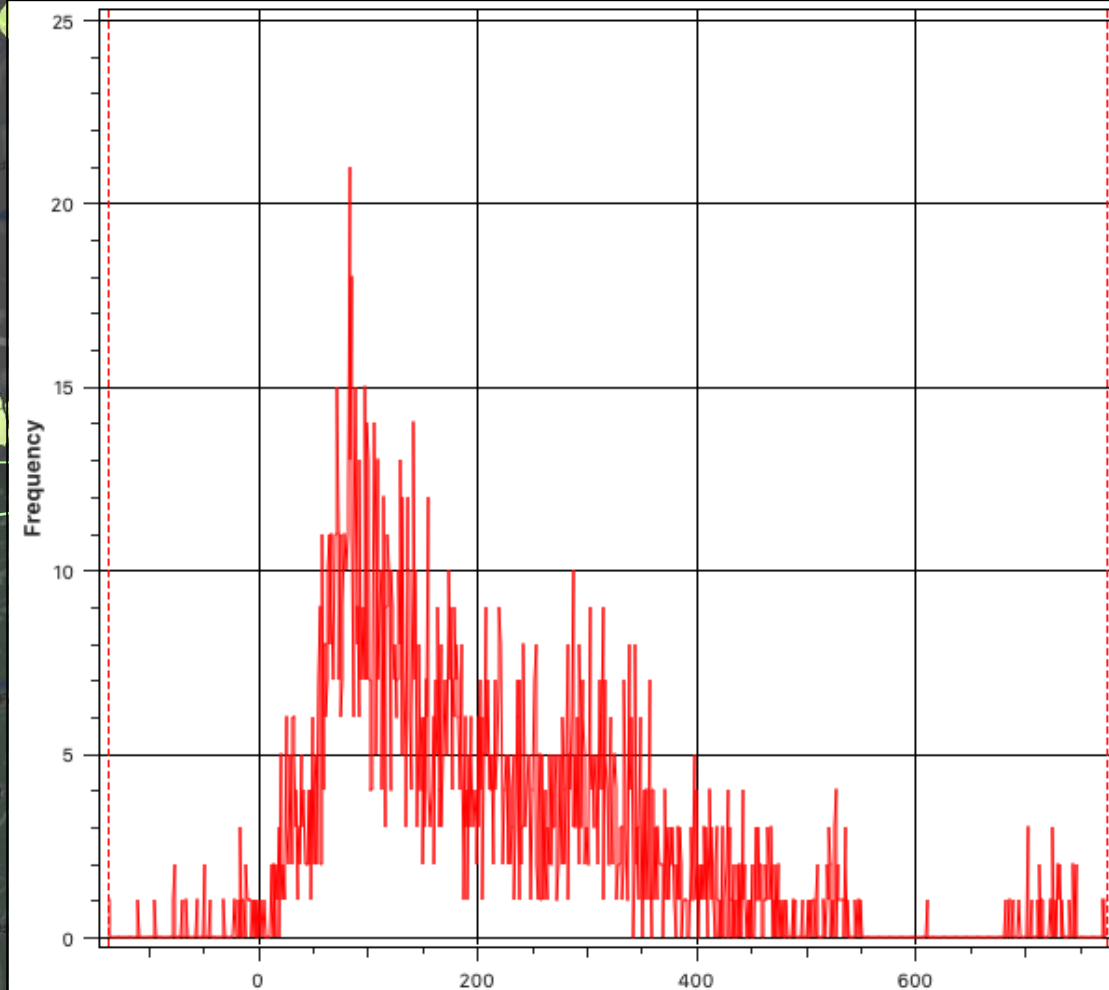
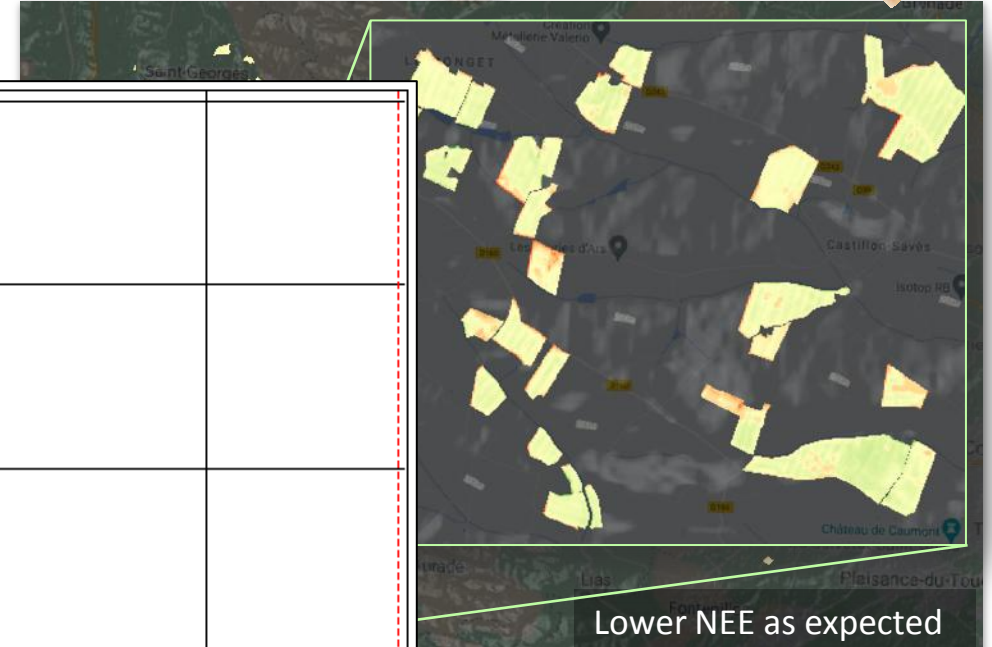
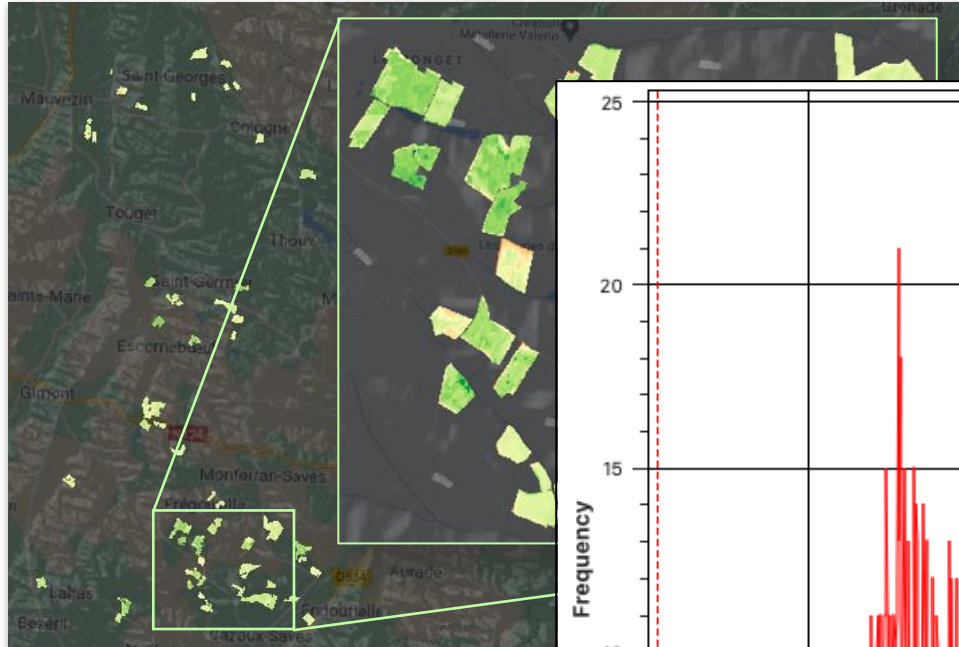


NEE : Bare soil

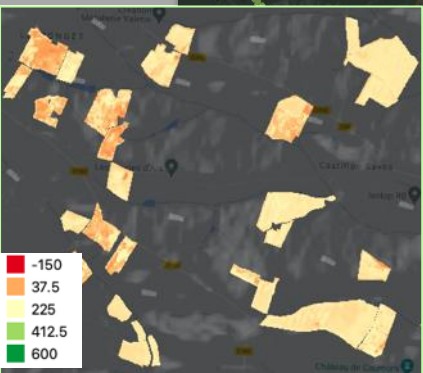


+ Maize

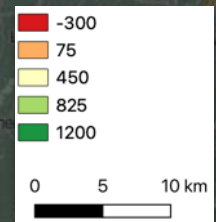
Maize

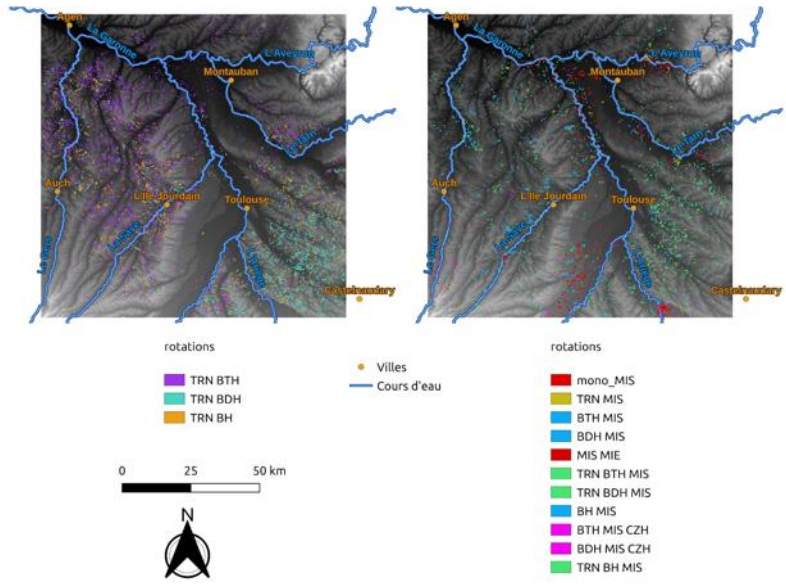
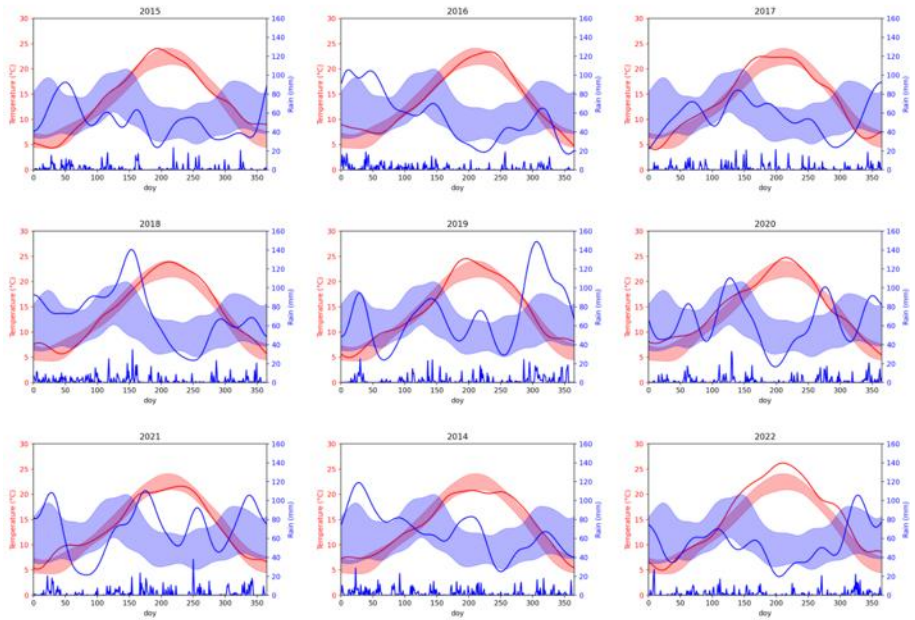


NEE uncertainty

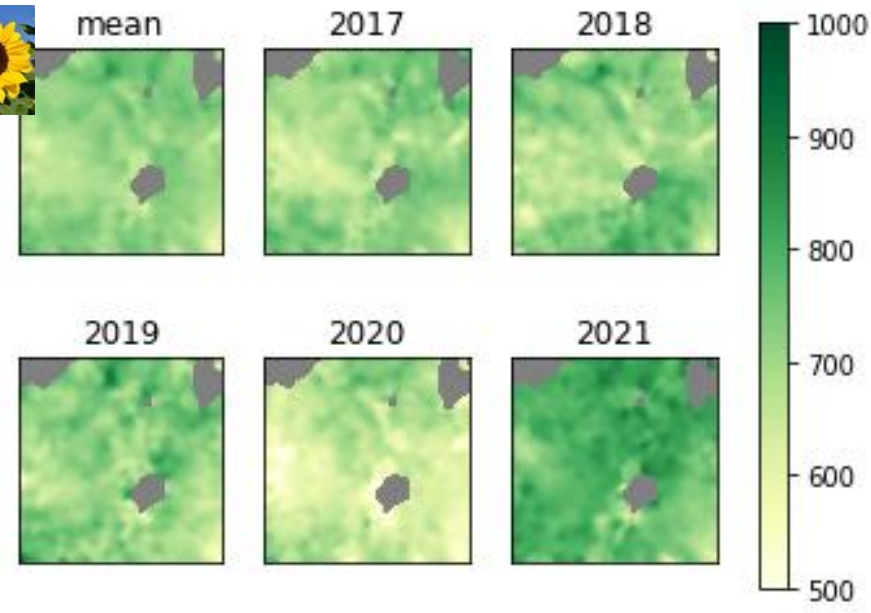


Lower NEE as expected

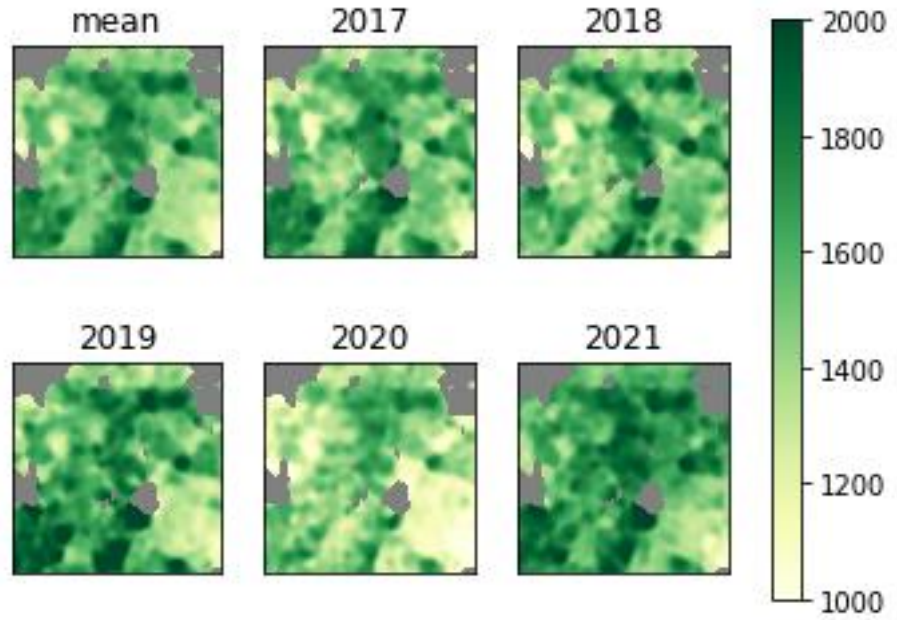




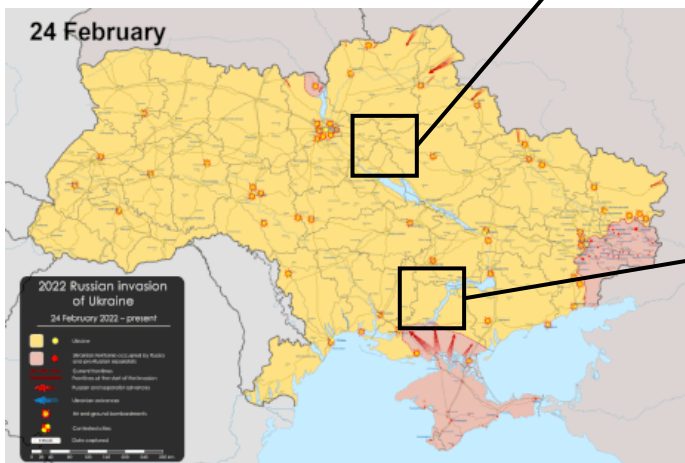
Biomasse  
aérienne



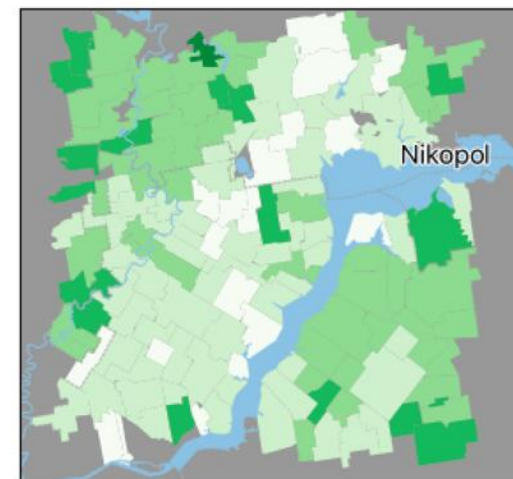
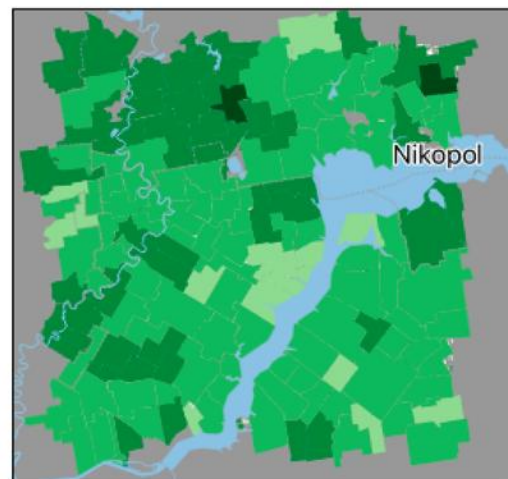
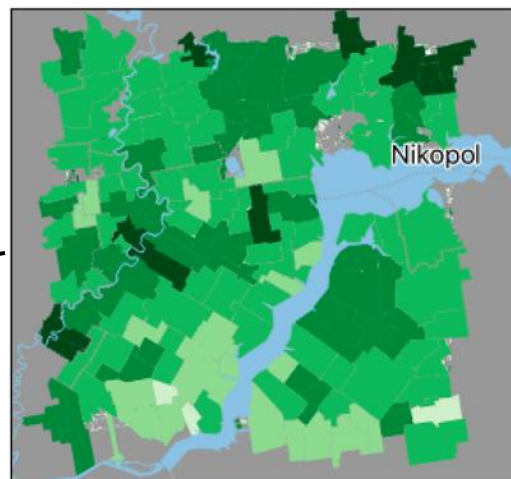
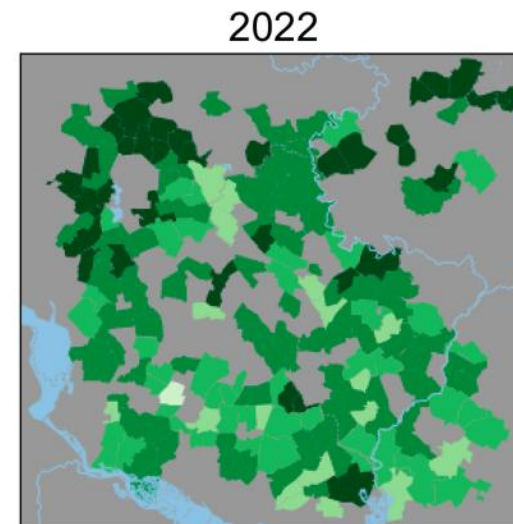
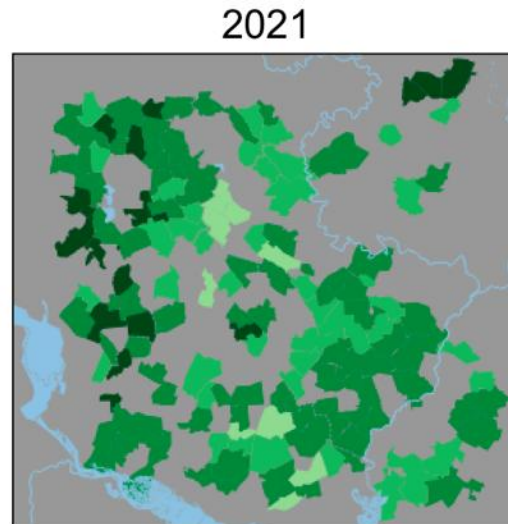
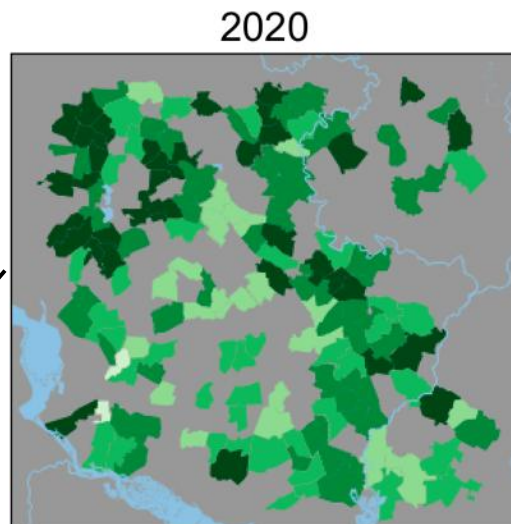
Biomasse  
aérienne



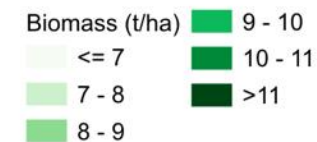
# Impact de la guerre en Ukraine sur la production de Blé



Carte de l'invasion en 2022 (wikidata)



Mean dry above ground biomass by admin level 3 (Межі рад) where retrieved area is above 0.1%.





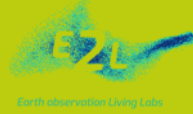
Thèse Cifre  
A. Geraud

Amélioration  
des estimations

Planet / SAR /  
Vigne



myeasyBiomass  
SAFYE-CO2+AMG



Quantica  
Bilan C culture  
intermédiaire



Ukrain Crisis

Impact guère  
sur la  
production de  
Blé



Naturellement  
Popcorn

Insetting  
Filiaire



Projet Niva



IRC  
International  
Research  
Consortium

MARVIC



MRV for Soil  
Carbon Farming







<https://www.cesbio.cnrs.fr/agricarboneo>