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# Storing Carbon in agricultural soils through a collaborative approach involving farmers, an agrifood company and research

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## ► To cite this version:

Eric Ceschia, Suzanne Reynders. Storing Carbon in agricultural soils through a collaborative approach involving farmers, an agrifood company and research. Scaling up Climate Actions in Pacific Small Island Developing States (SIDS) Enhancing measurement capacities for improved soil carbon and health, FAO, May 2022, Online, Japan. pp.1-17. <hal-04222003>

**HAL Id: hal-04222003**

**<https://hal.inrae.fr/hal-04222003v1>**

Submitted on 28 Sep 2023

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# Storing Carbon in agricultural soils through a collaborative approach involving farmers, an agrifood company and research



Eric CESCHIA, Suzanne REYNDERS

Scaling up Climate Actions in Pacific Small Island Developing States (SIDS)

Enhancing measurement capacities for improved soil carbon and health

May 10th 2022

# Carbon budget calculation principles

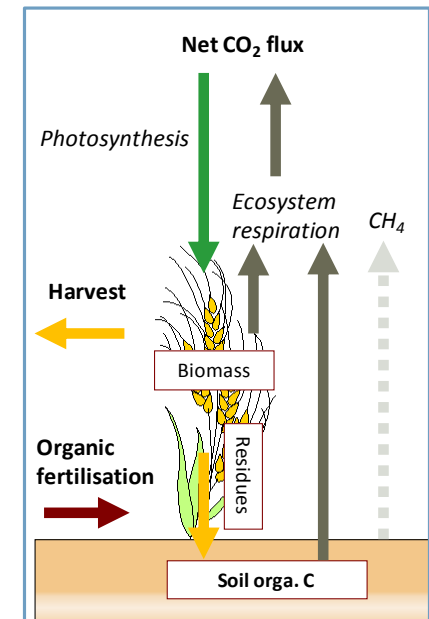
➤ Represents a change in soil organic C content → objective is to calculate it yearly over large areas (at 10m/plot level) but can be aggregated at rotation/farm scale,

➤ 3 methods (TIERS) with a similar conceptual approach:

$$\text{C budget} = \text{Annual net CO}_2 \text{ flux} - \text{C harvested} + \text{Organ. Amend.}$$

TIER 1 (Sentinel)

TIERs 2 & 3 (Sentinel + farmer's data)



➤ Increasing levels of accuracy/complexity:

- TIER 1 (net annual CO<sub>2</sub> fluxes) and TIER 2 (C budget ) are based on empirical approaches → can be applied to most temperate crop specie (not rice),

- TIER 3 based on the SAFYE-CO<sub>2</sub> model (biomass, yield, CO<sub>2</sub> fluxes ) calibrated by high resolution satellite data (e.g. Sentinel 2) → validated on wheat, maize, rapeseed, sunflower, assesses the effect of cover crops & straw management on Soil Organic Carbon storage.



# Naturellement popcorn Project



European  
popcorn leader



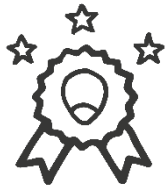
## Objectives:



Increase soil fertility through natural process by increasing soil carbon storage (cover crop, no till)



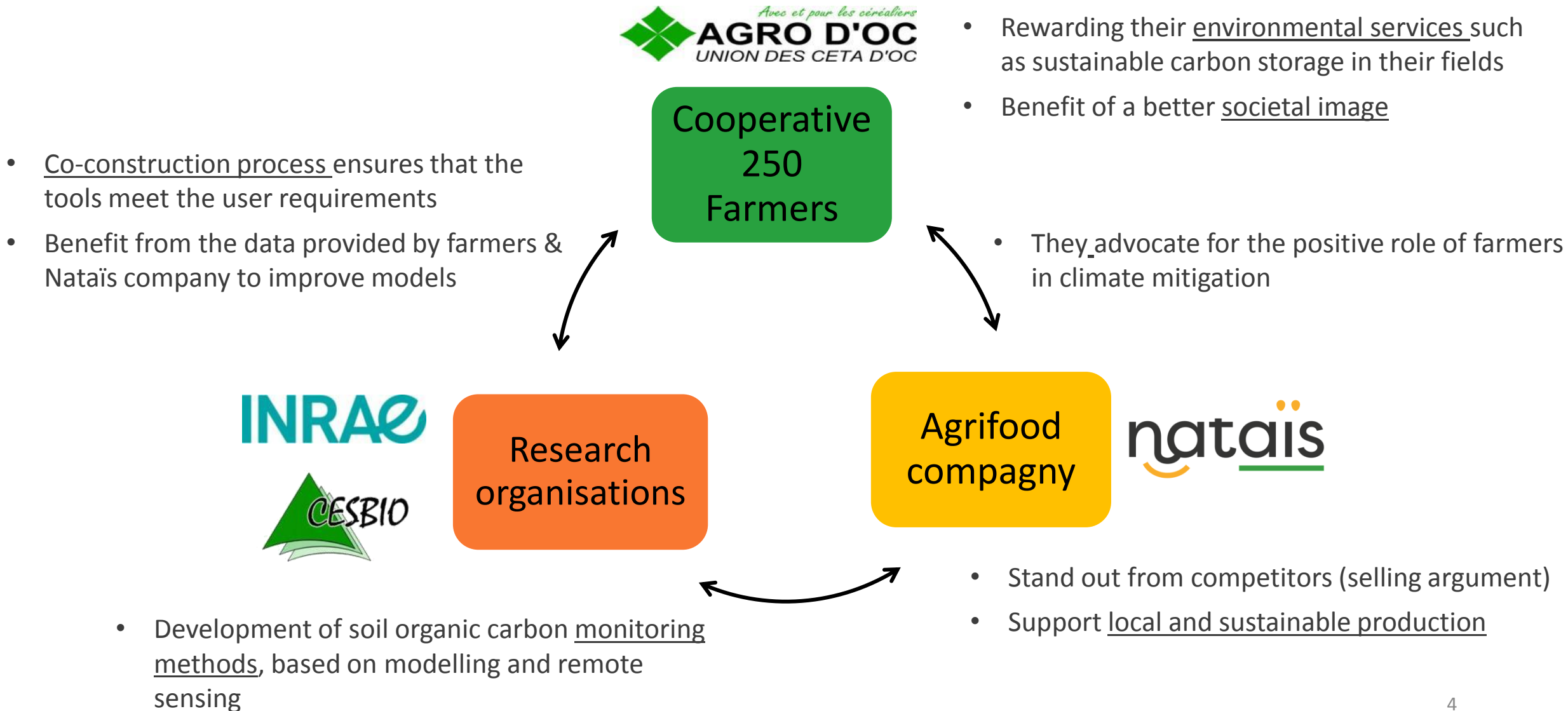
Enabling a higher revenue for farmers reducing their carbon footprint



Meet consumers' and industry's demands for sustainability, climate mitigation and agroecology



# Scientific partnership with mutual benefits





# Monitoring cover crop carbon storage effect

2012

2022

2024

2025

Farmers inquiry

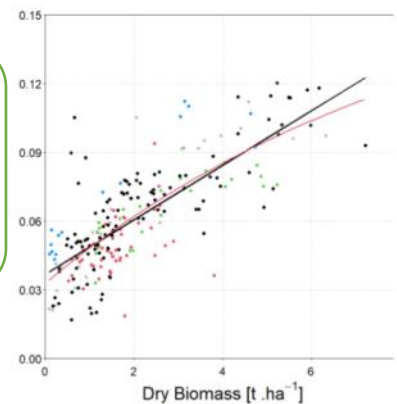
Cover crop:  
Yes/No

Fixed Bonus  
paid by Nataïs

Calculation of  
biomass using  
satellite

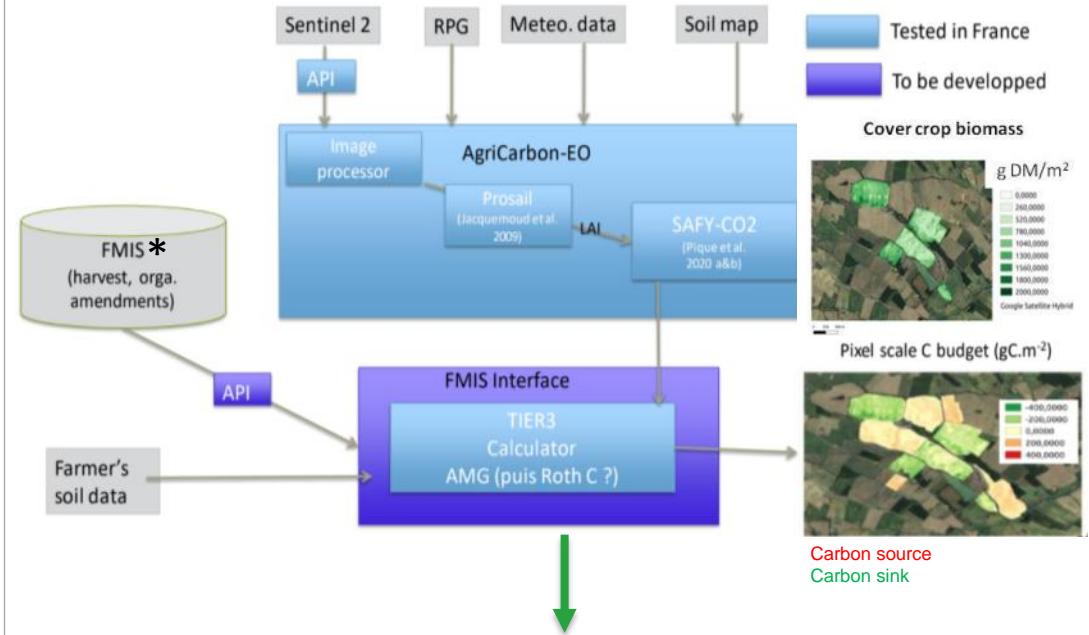


Empirical relation  
between vegetation  
index and biomass



Bonus paid by Nataïs  
according to additional C  
storage by cover crops

AgriCarbon-EO chain/SAFY-CO2 model



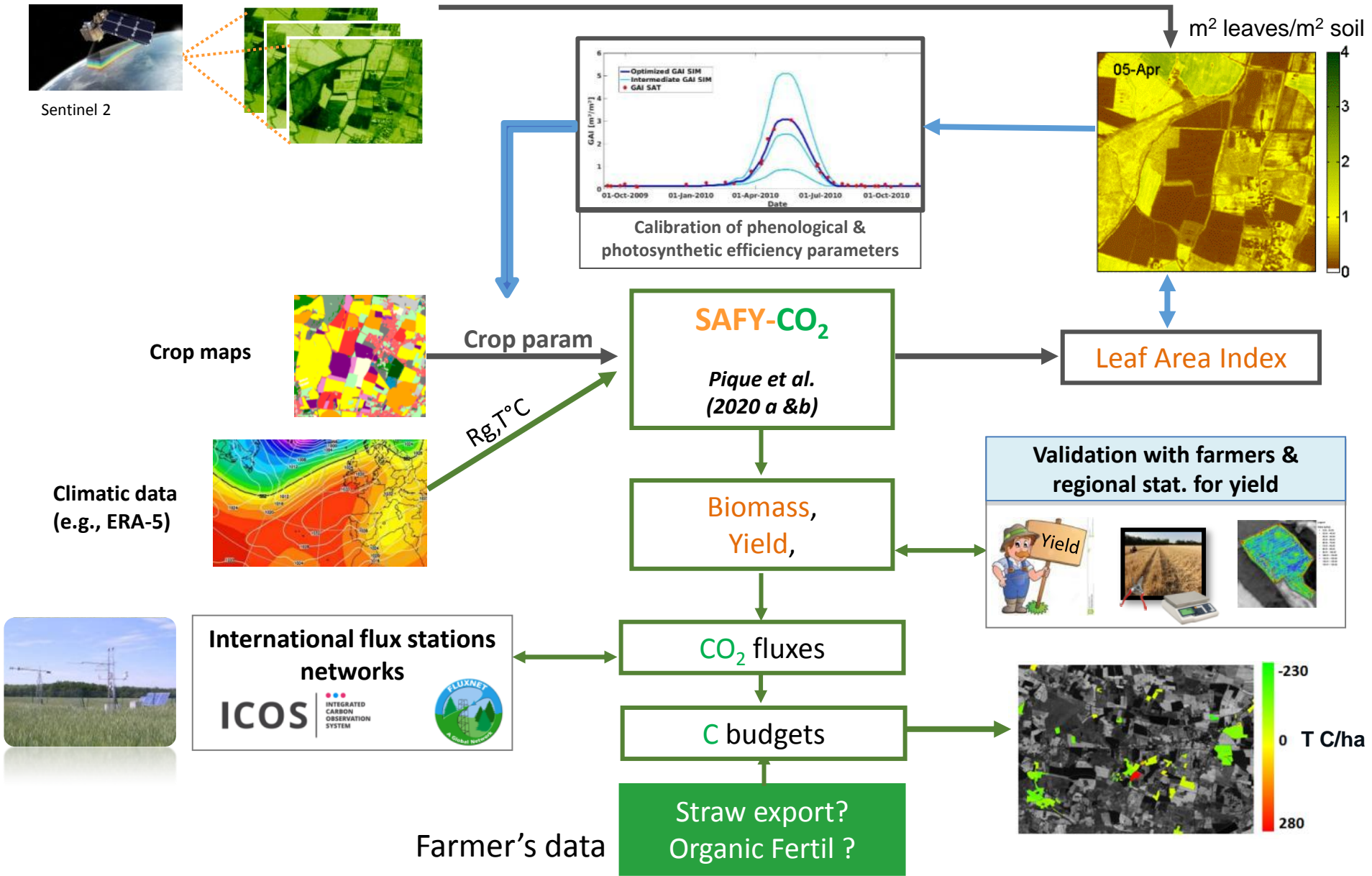
Annual Carbon budget

Carbon payment for farmers  
(→ international Carbon market)

\* Farm Management Information System



# The SAFY-CO2 modelling approach (TIER 3)



**Combining high resolution remote sensing data and a simple crop model**

**The model is forced to reproduce what the satellite « sees »**

**Few field management data needed → easy to upscale**



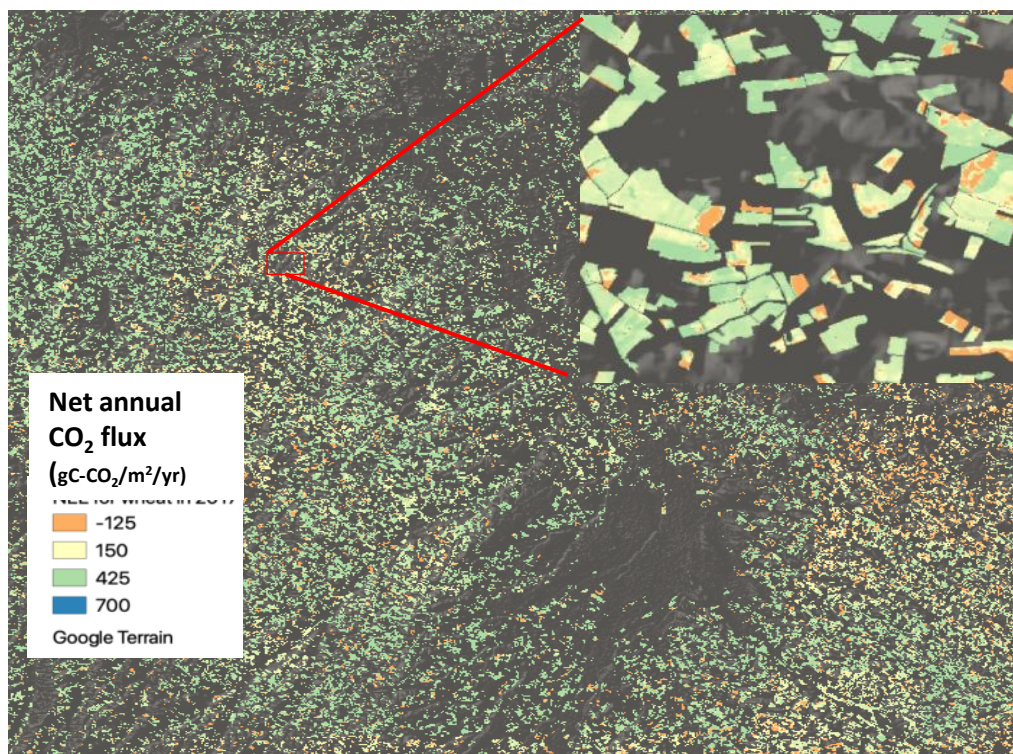
# The SAFY-CO2 modelling approach (TIER 3)

AgriCarbon-EO processing chain + SAFYE-CO2 model → large scale, high resolution, uncertainties

CO<sub>2</sub> fixation / soil C storage 😊

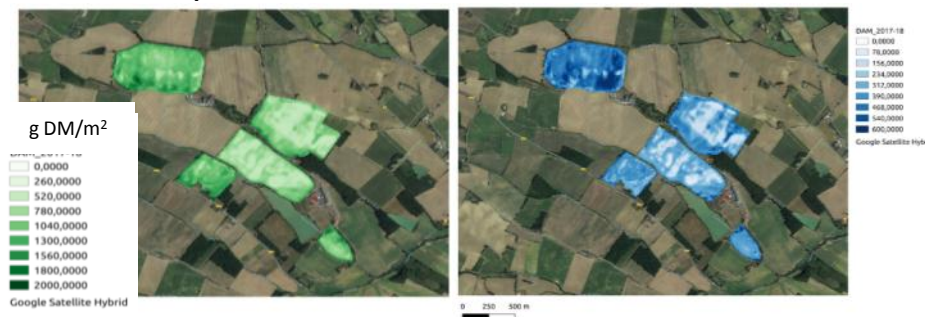
CO<sub>2</sub> losses / soil C loss 😞

Net annual CO<sub>2</sub> fluxes for 2018 straw cereals in South West France



Whole Sentinel 2 Tile (31TCJ)

Cover crop biomass + Uncertainties



Farm C budget map (10m resolution) for cover crop/maize/wheat crop rotations



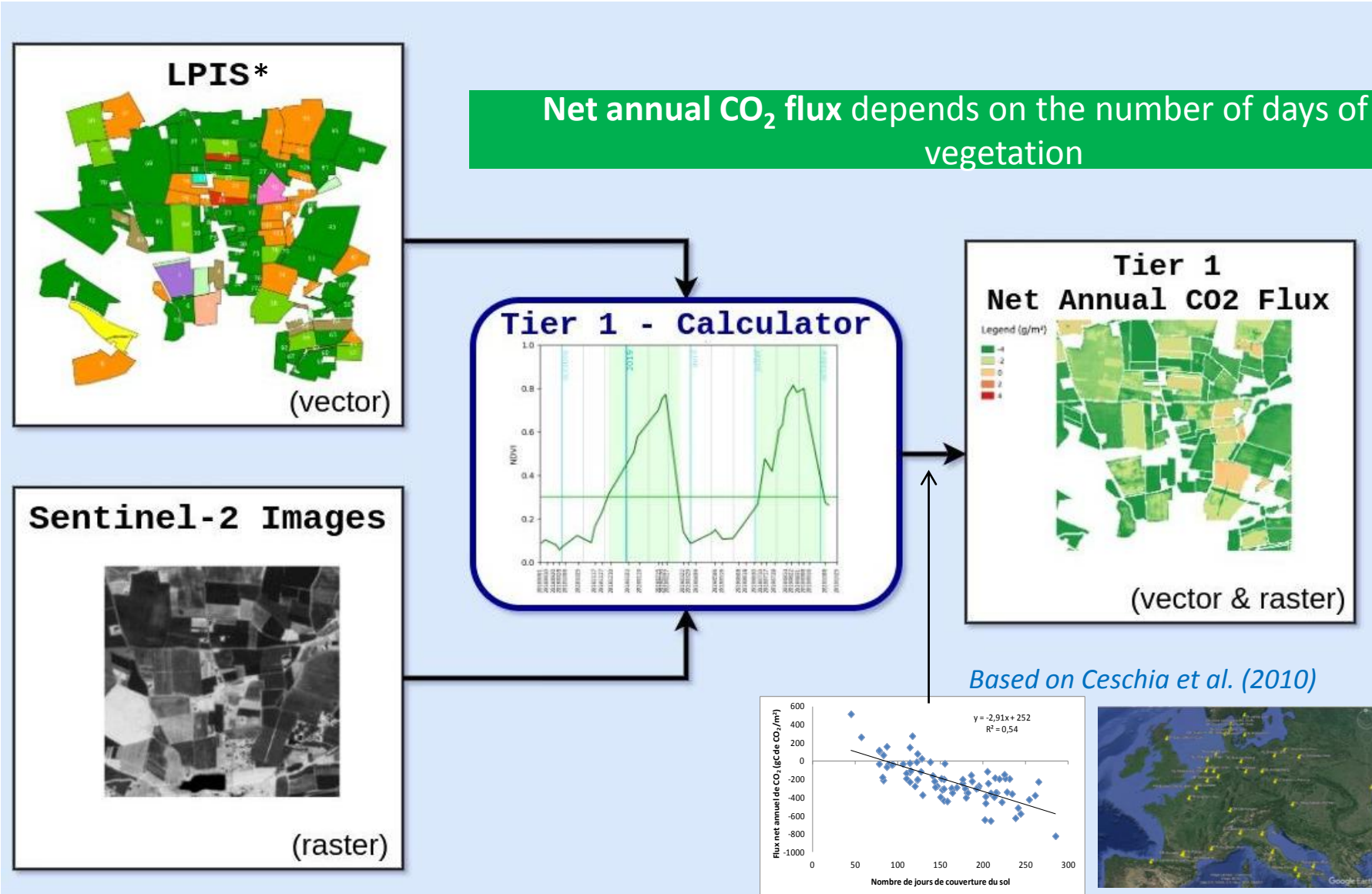
+ Farmer's data



Villeneuve farm (Bézéril)

# Empirical C budget approach for the European Common Agricultural Policy (TIER 1)

\* Land Parcel Identification System (crop map)



Net annual CO<sub>2</sub> flux depends on the number of days of active vegetation

Open tool available at [https://gitlab.com/nivaeu/uc1b\\_tier1\\_co2](https://gitlab.com/nivaeu/uc1b_tier1_co2)



NIVA'S algorithm + Iota2 software

With the support of

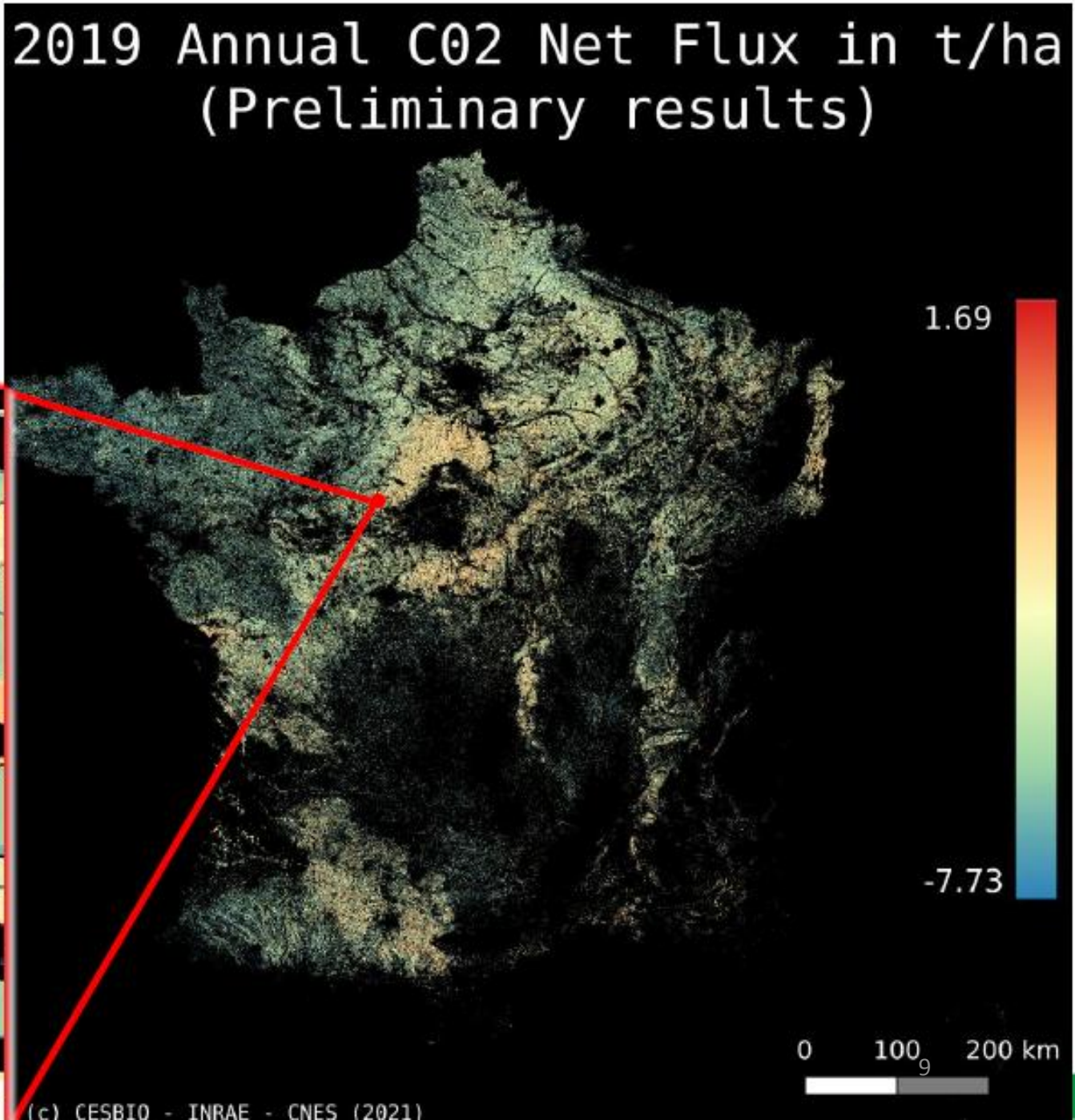
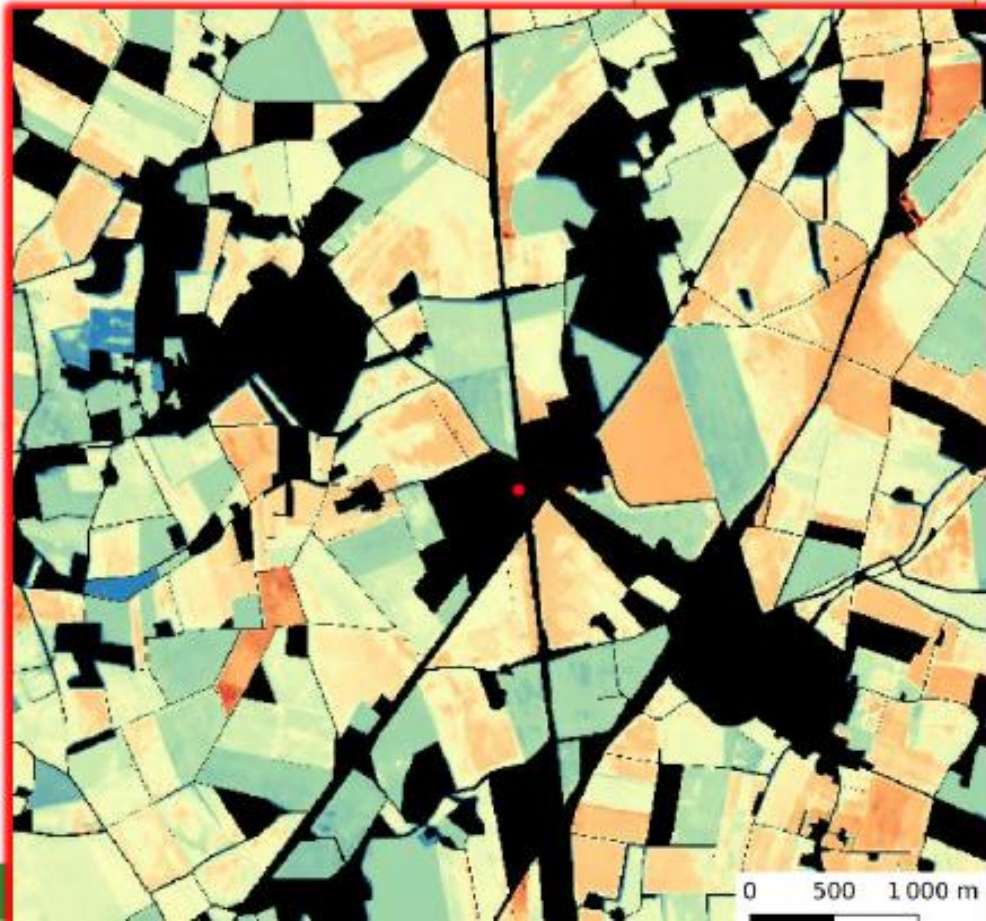


Annual CO<sub>2</sub> fixation 😊  
Annual CO<sub>2</sub> losses ☹️

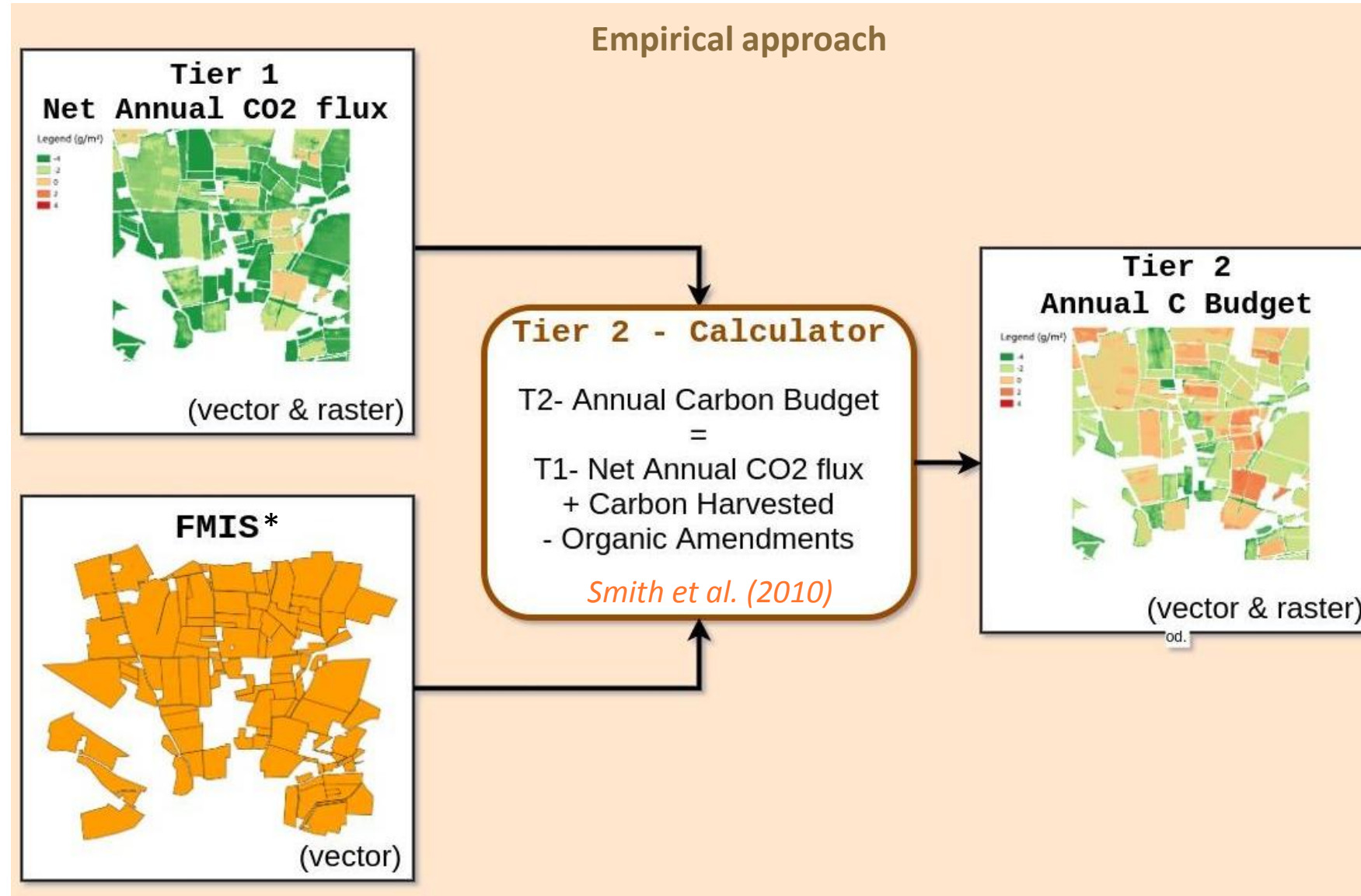


France = 94 Sentinel-2 tiles

# 2019 Annual CO<sub>2</sub> Net Flux in t/ha (Preliminary results)



# Simplified C budget approach for the European Common Agricultural Policy (TIER 2)



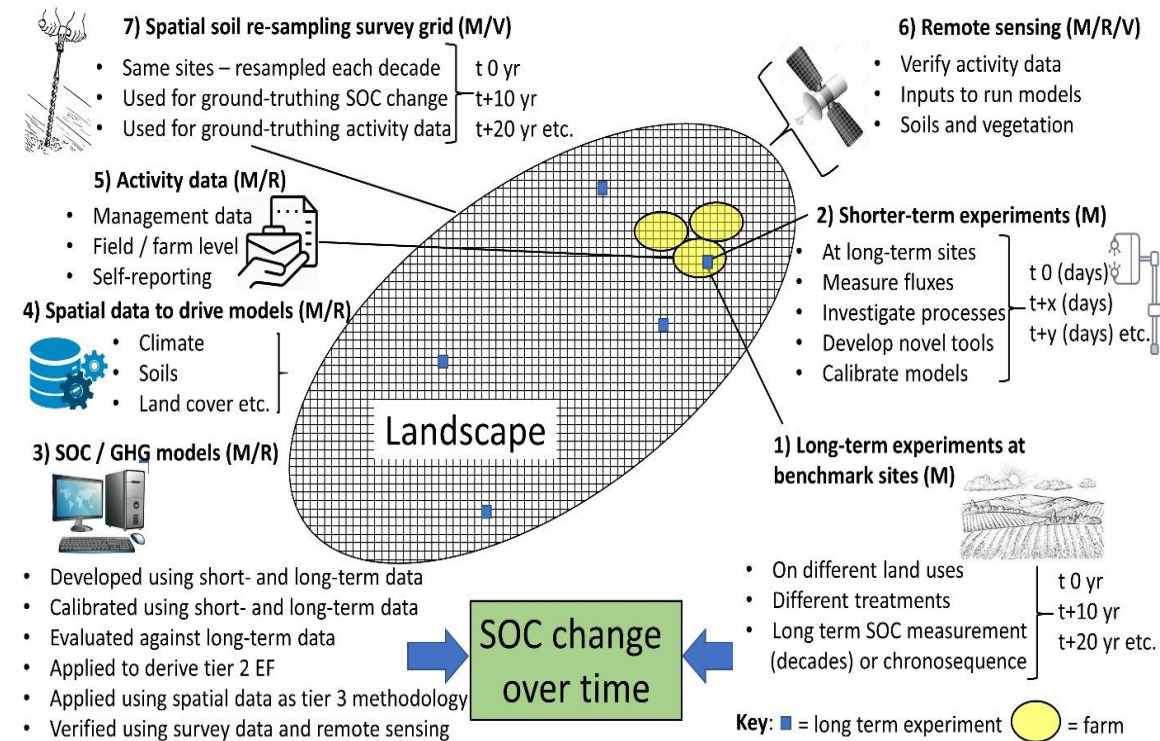
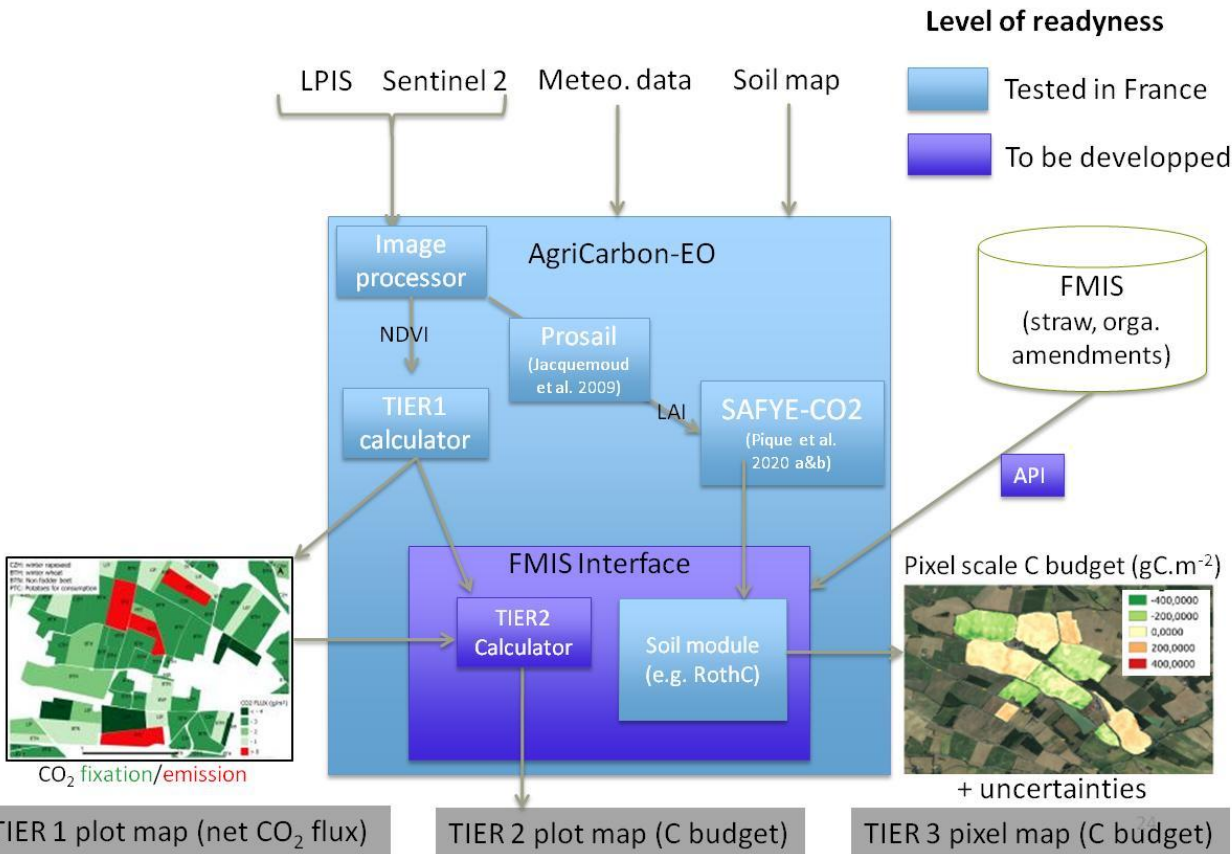
\* Farm Management Information System

# Towards a unified methodological framework ??

➤ A range of tools that will be integrated in AgriCarbon-EO

➤ Compliant with CIRCASA's recommendations for MRV on SOC for agricultural soils

SMITH, SOUSSANA, et al, Global Change Biology 2019



AgriCarbon-EO could prefigure a prototype for a future International Research Consortium on Soil Carbon (see OrCasa in slide 14)

# Local/regional adaptations will be needed

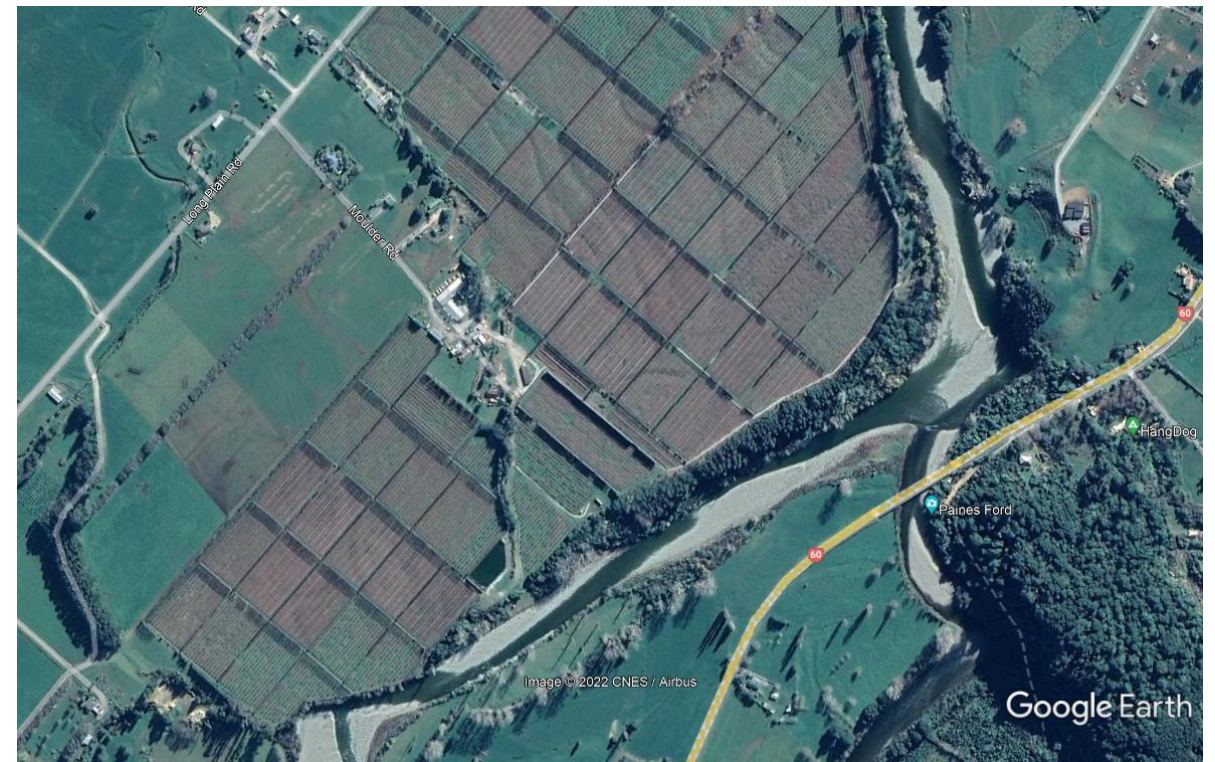
## The Small Island Developing States specific features

- Small plots → use of higher resolution satellite data (e.g. Planet at 5m) or drones

Pineapple fields in Moorea (French Polynesia)



Root crops in Tonga Island

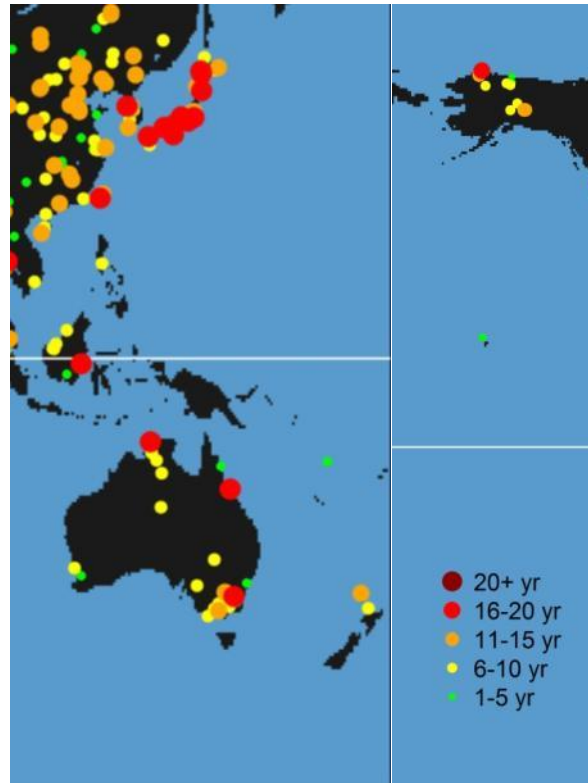
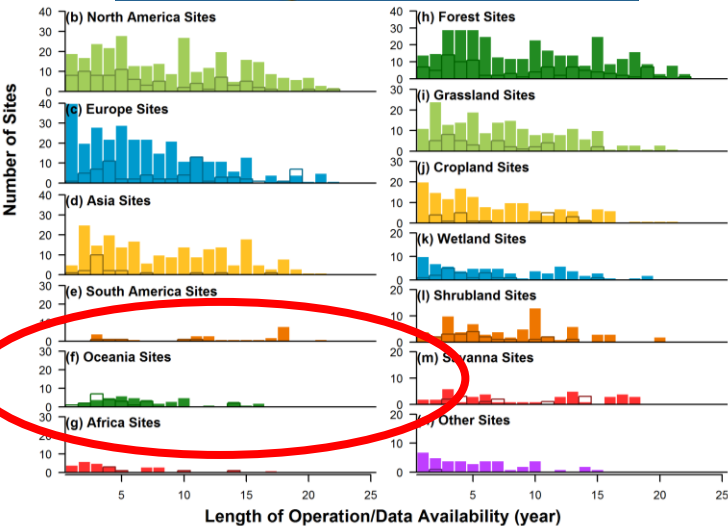


# Local/regional adaptations will be needed

## The Small Island Developing States specific features

- Small plots → use of higher resolution satellite data (e.g. Planet at 5m) or drones
- Crop types/soils → Fluxnet network to calibrate/validate TIER 1 & SAFY-CO2 tools

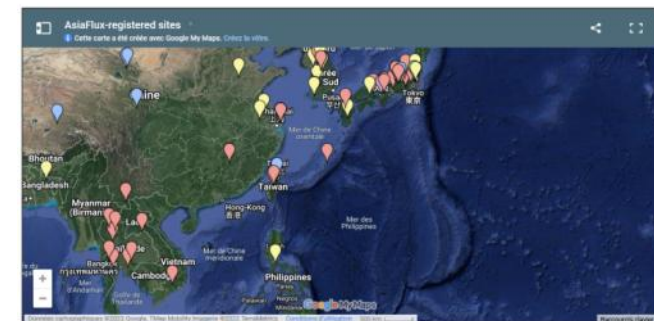
<https://fluxnet.org/sites/site-summary/>



<https://www.ozflux.org.au/monitoringsites/index.html>



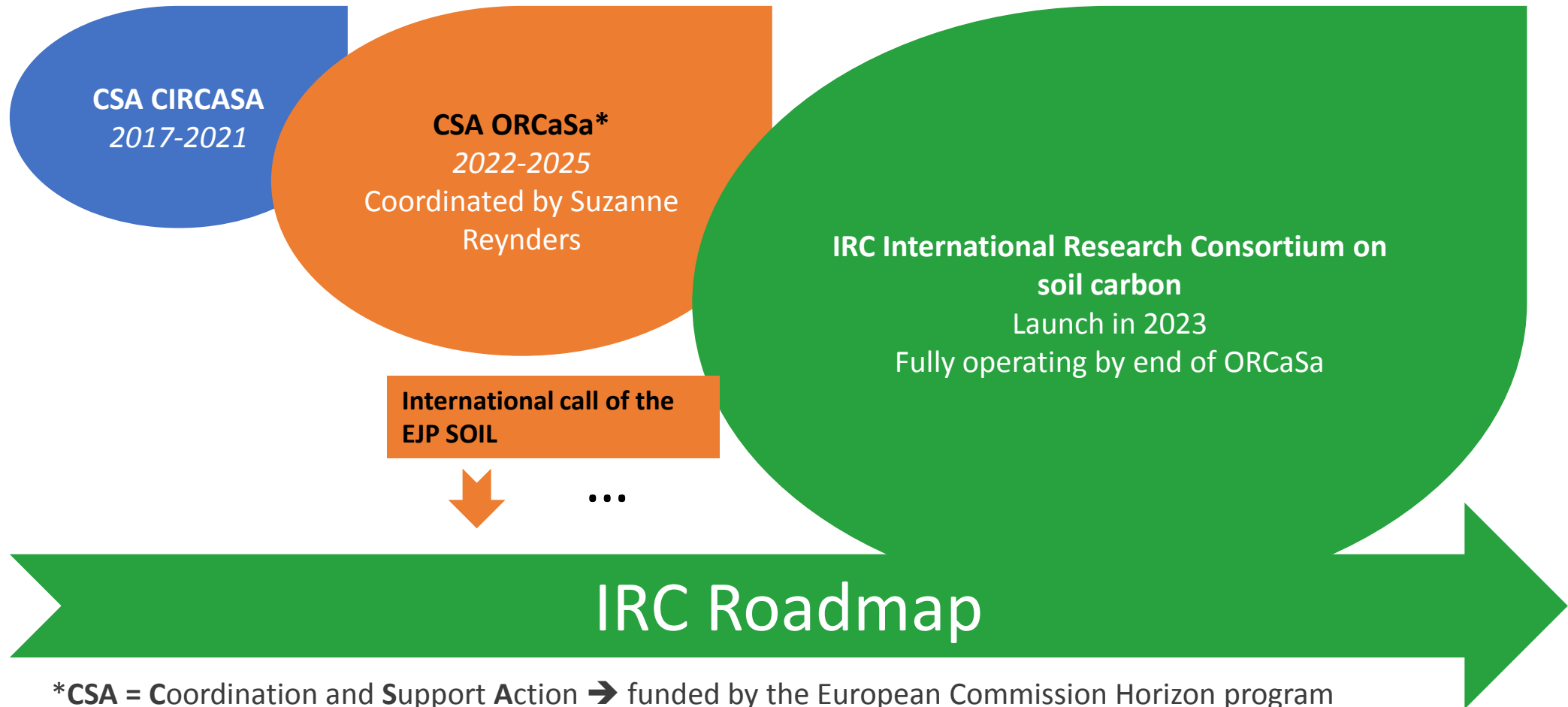
Forest, Plantation Fruit farm Paddy, Meadow, Crops Grassland, Wetland, Shrub, Steppe, Tundra, Desert Urban area



[http://asiaflux.net/?page\\_id=22](http://asiaflux.net/?page_id=22)



# Roadmap: from CIRCASA towards a fully operating International Research Consortium (IRC) on Soil Carbon



\***CSA** = **C**oordination and **S**upport **A**ction → funded by the European Commission Horizon program

\***ORCaSa**: **O**perationalising **I**nternational **R**esearch **C**ooperation on **S**oil **C**arbon (funded by EC)

EJP Soil (European Join Program on Soil) Launches an international call in the coming months



# Main Objectives of the International Research Consortium on Soil Carbon

## What was done in the last 3 years :

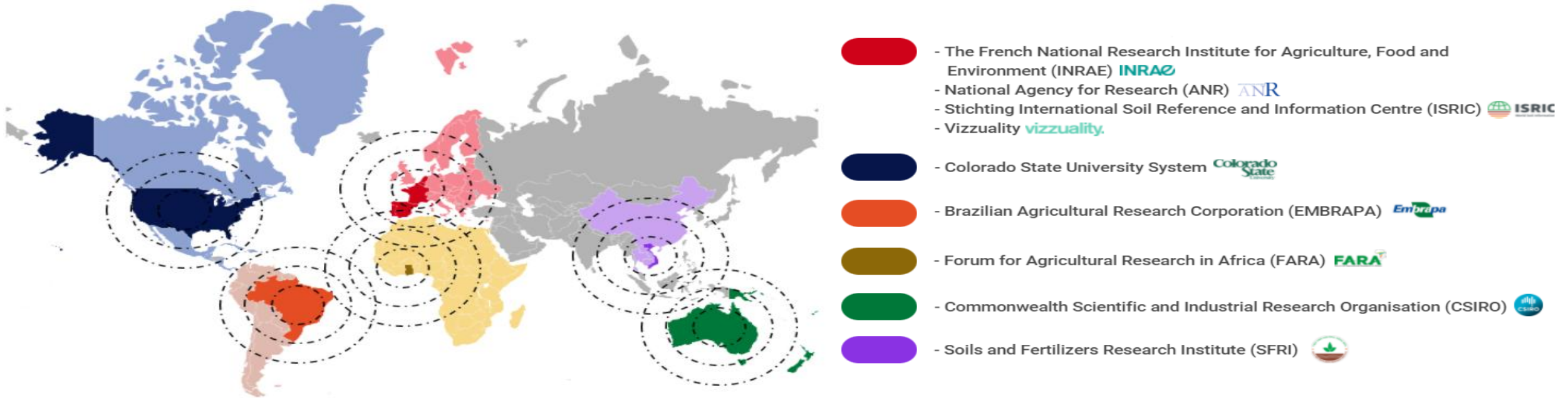
- an initial Strategic Research and Innovation Agenda on agricultural Soils
- an initial community of 100 stakeholders and 500 scientists
- A conceptual methodological framework (Smith et al., 2019) + AgriCarbon-EO MRV prototype (see slide 11 )

## Next steps for the IRC :

- To **join and coordinate** Europe's research and Innovation **forces** on soil carbon **with those around the globe**
- To create **synergies with existing initiatives** (EJP soil, Soil Health and Food Mission, FAO and GSP ...),
- To align international research **cooperation**,
- To facilitate **synergies** between programs,
- To enlarge the **Strategic Research Agenda** to non-agricultural soils & implement it
- To better **share best practices and knowledge** through a **Knowledge Platform**
- To enable **low-cost disruptive monitoring tools (e.g. building on AgriCarbon-EO, NIVA's empirical approaches, regionally validated soil models and observation networks)**



# ORCaSa's Regional nodes for the IRC on Soil Carbon



- Connection with Oceania's Partners are most welcome 😊
- We are willing to enlarge the IRC scope and welcome future IRC General Assembly Members signing a "declaration of intent"
- Find regional partners for developing/adapting/improving our tools



# Thanks for your attention !!

Want to know more ? Please contact us:



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- Lecturer in Ecology at the University of Toulouse III
- Former PI of the Auradé and Lamasquère ICOS sites
- Former Co-PI of the Spatial Regional Observatory
- PI of the SAFY-CO2 and AgriCarbon-EO platforms
- Specialist in agricultural climate mitigation strategies



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- PI of the **ORCaSa/IRC project**
- [EIT Climate-KIC governing board](#) member
- PI of [EIT C-KIC project carbon farming](#)
- PI of study : [recommendations for drafting a low carbon label method](#) and [evaluation of business models for carbon farming](#)
- 12 years experience Climate Change and Agriculture