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

Eric Ceschia, Suzanne Reynders

► 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 webinar, Japan. pp.1-17. hal-04222003

HAL Id: hal-04222003

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

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

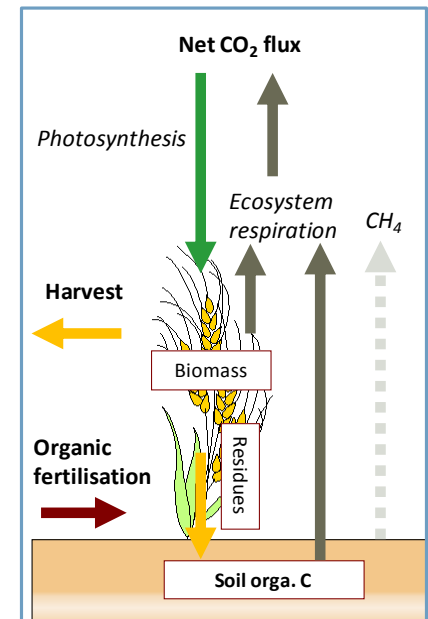
➤ Represents a change in soil organic C content → objective is to calculate it yearly over large areas (at 10m/plot level) but can be aggregated at rotation/farm scale,

➤ 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 CO₂ 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-CO₂ model (biomass, yield, CO₂ 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



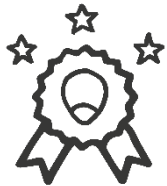
Objectives:



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



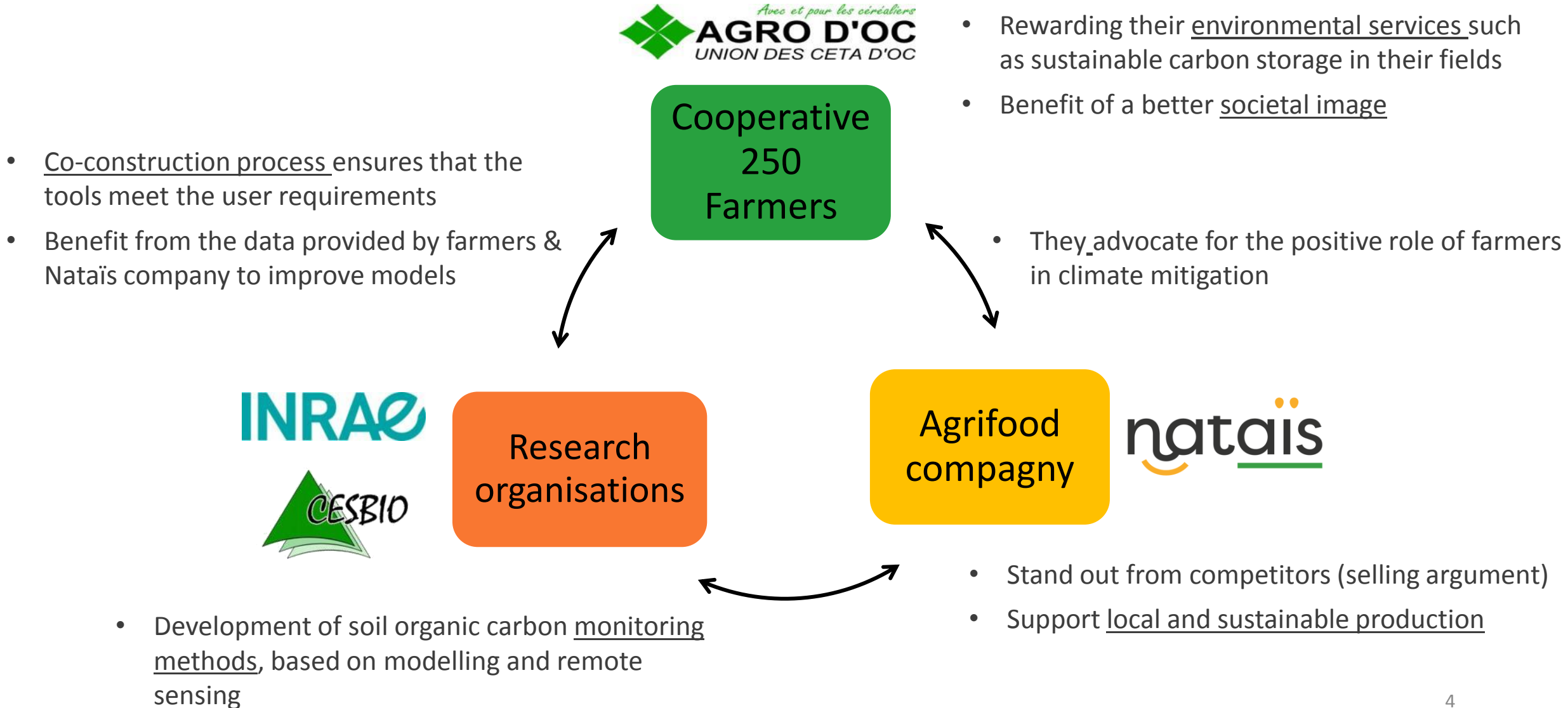
Enabling a higher revenue for farmers reducing their carbon footprint



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

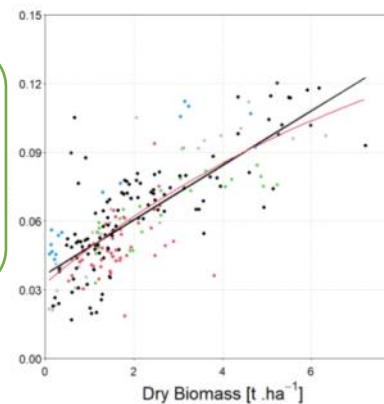
Cover crop: Yes/No

Fixed Bonus paid by Nataïs

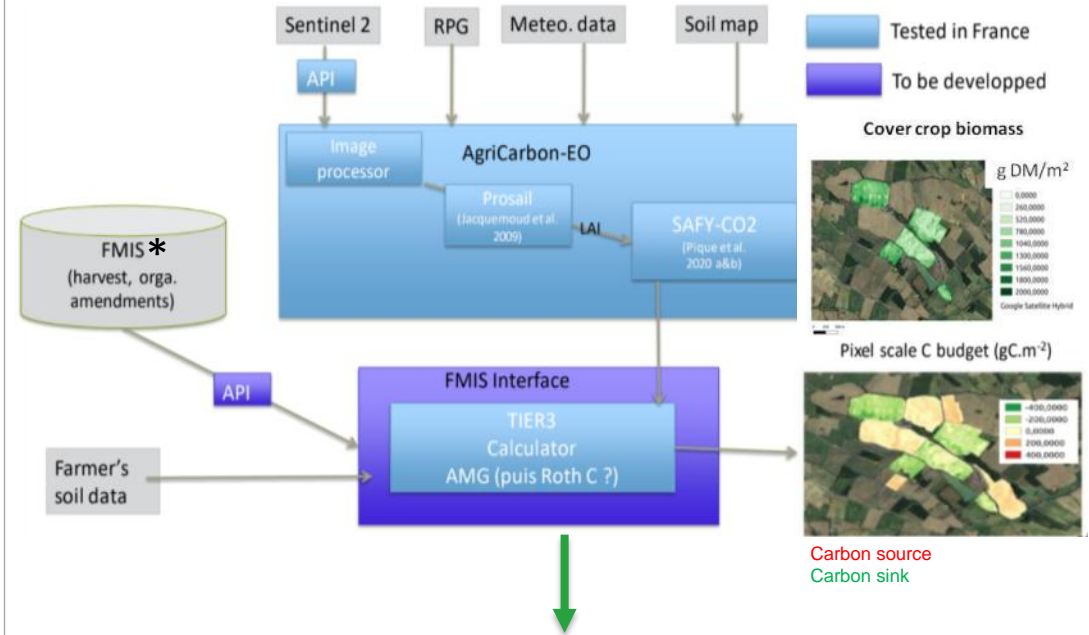
Calculation of biomass using satellite

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



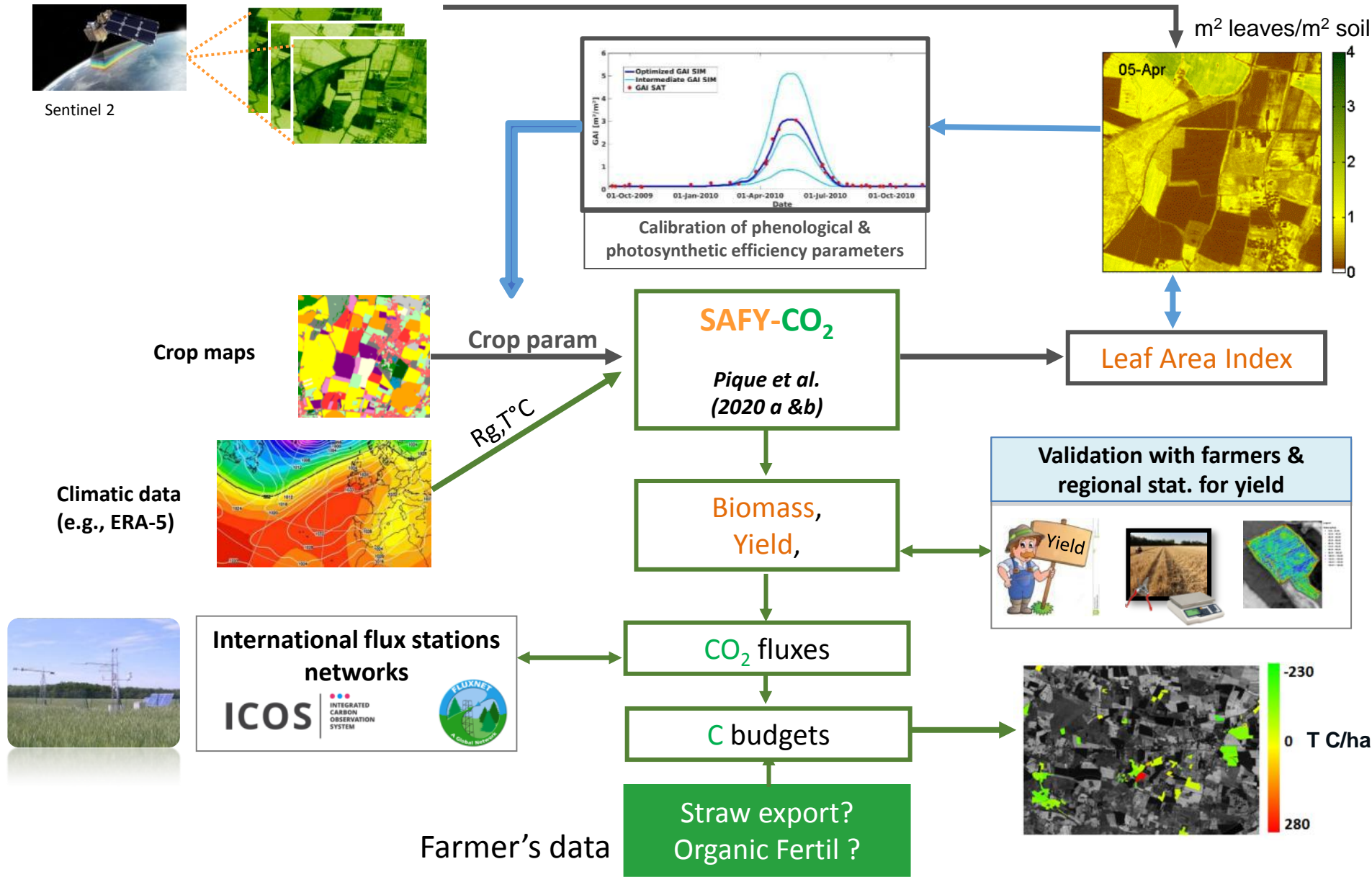
Annual Carbon budget

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



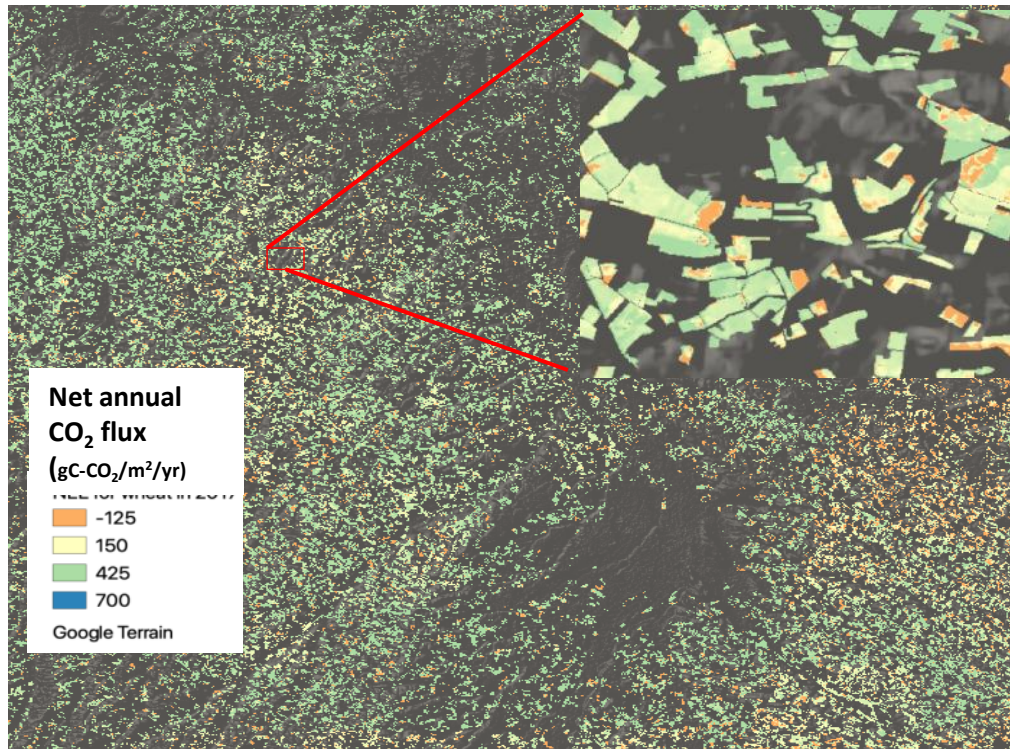
The SAFY-CO2 modelling approach (TIER 3)

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

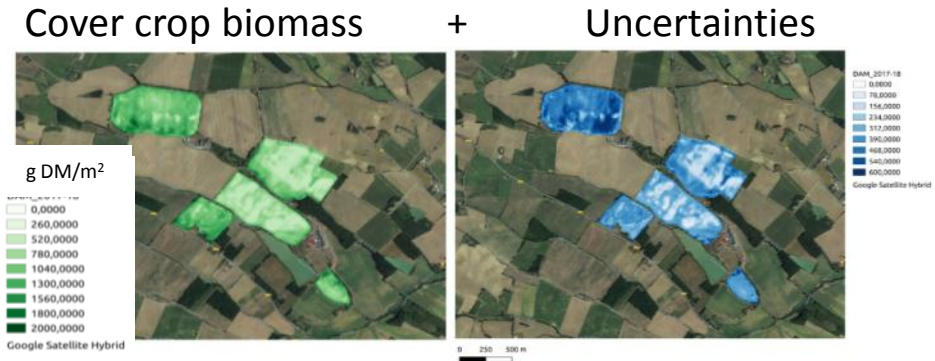
CO₂ fixation / soil C storage 😊

CO₂ losses / soil C loss ☹️

Net annual CO₂ fluxes for 2018 straw cereals in South West France

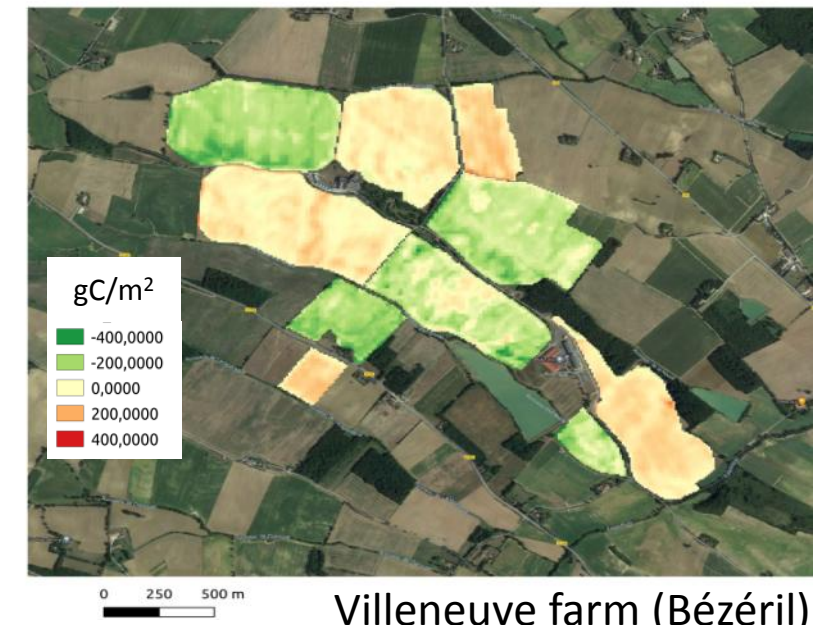


Whole Sentinel 2 Tile (31TCJ)



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

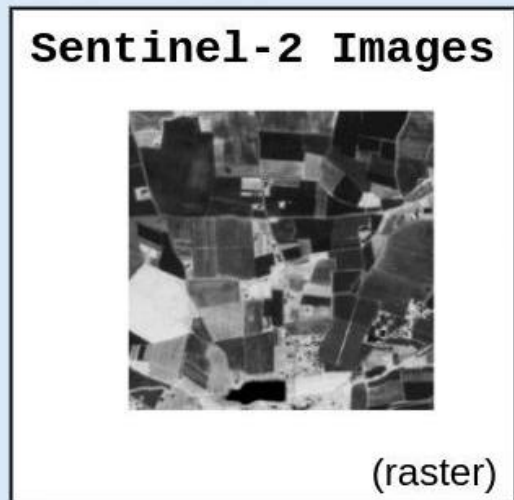
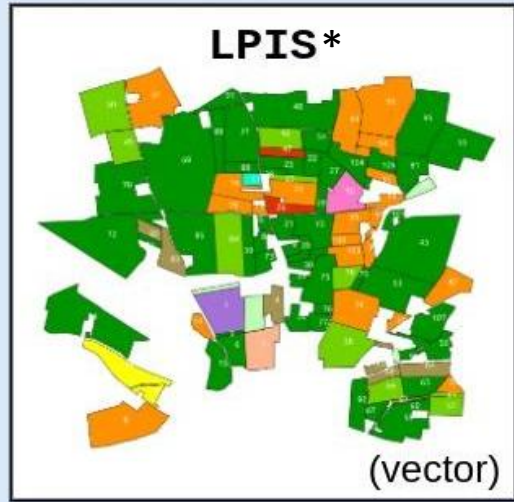
+ Farmer's data



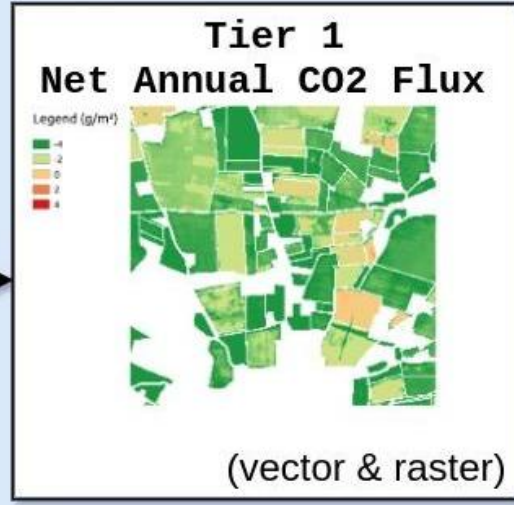
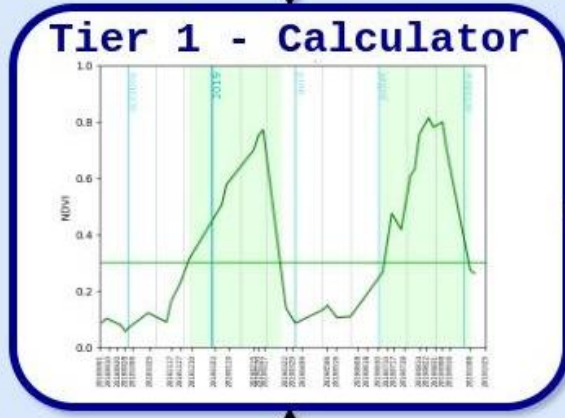
Villeneuve farm (Bézéril)

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

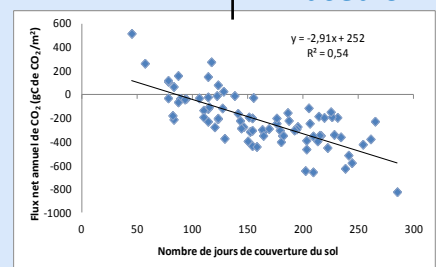
* Land Parcel Identification System (crop map)



Net annual CO₂ flux depends on the number of days of active vegetation



Open tool available at https://gitlab.com/nivaeu/uc1b_tier1_co2



Based on Ceschia et al. (2010)





NIVA'S algorithm + Iota2 software

With the support of

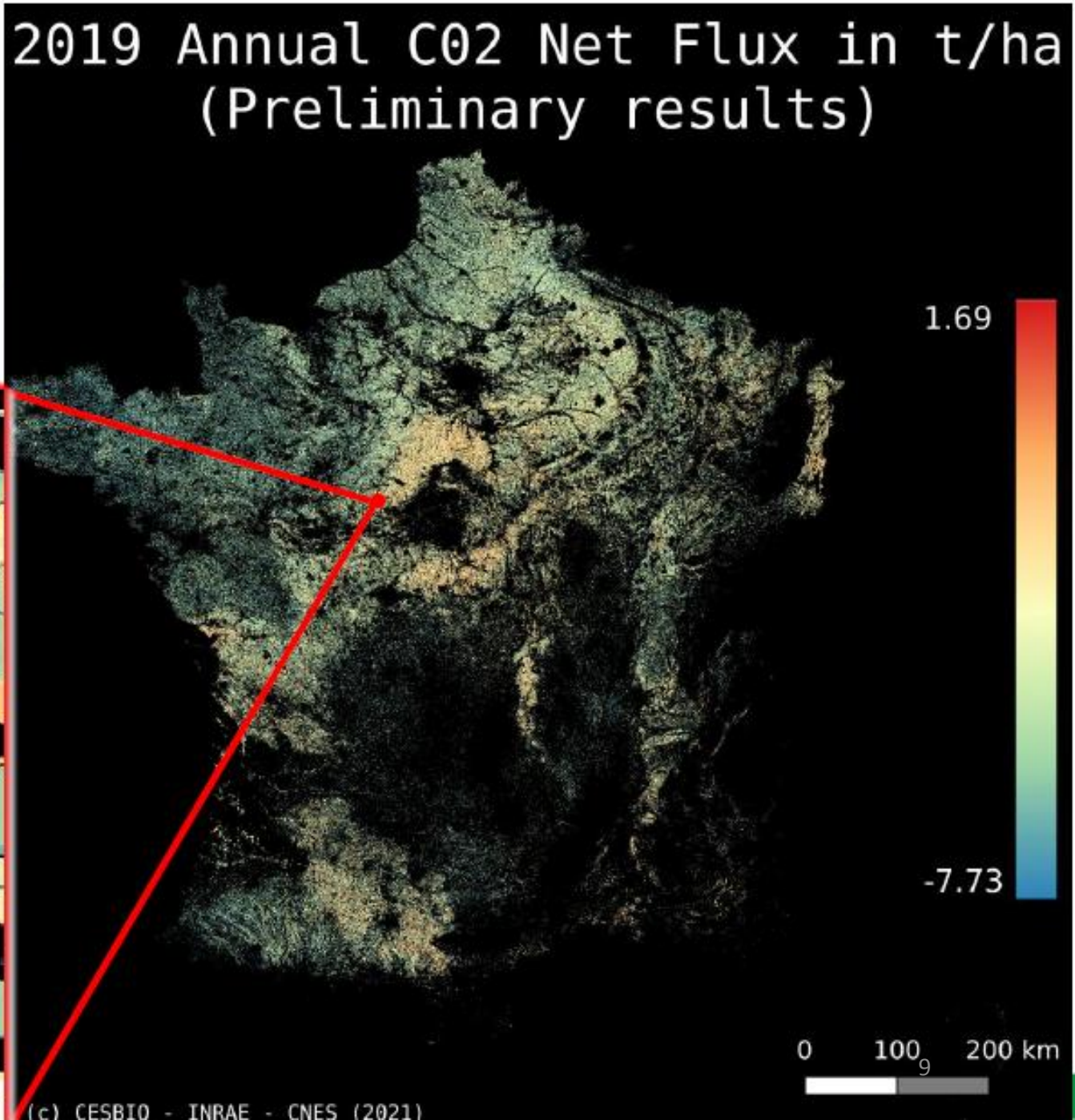
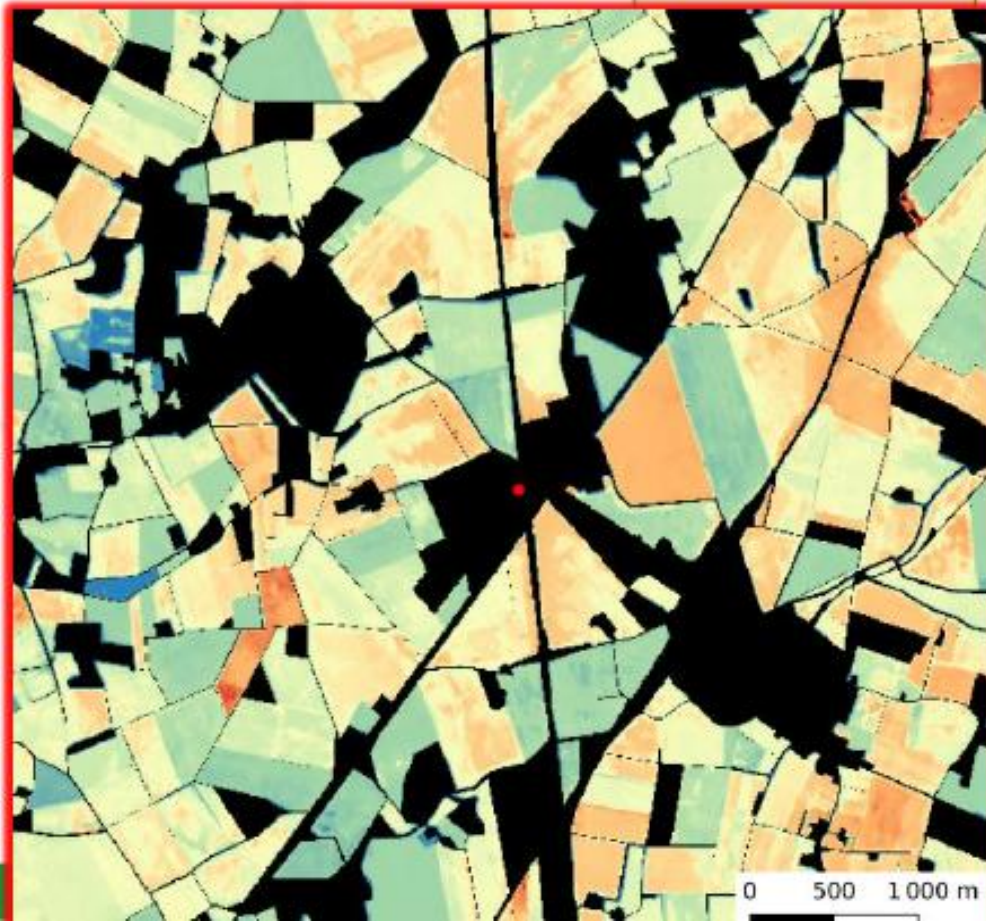


Annual CO₂ fixation 😊
Annual CO₂ losses ☹️

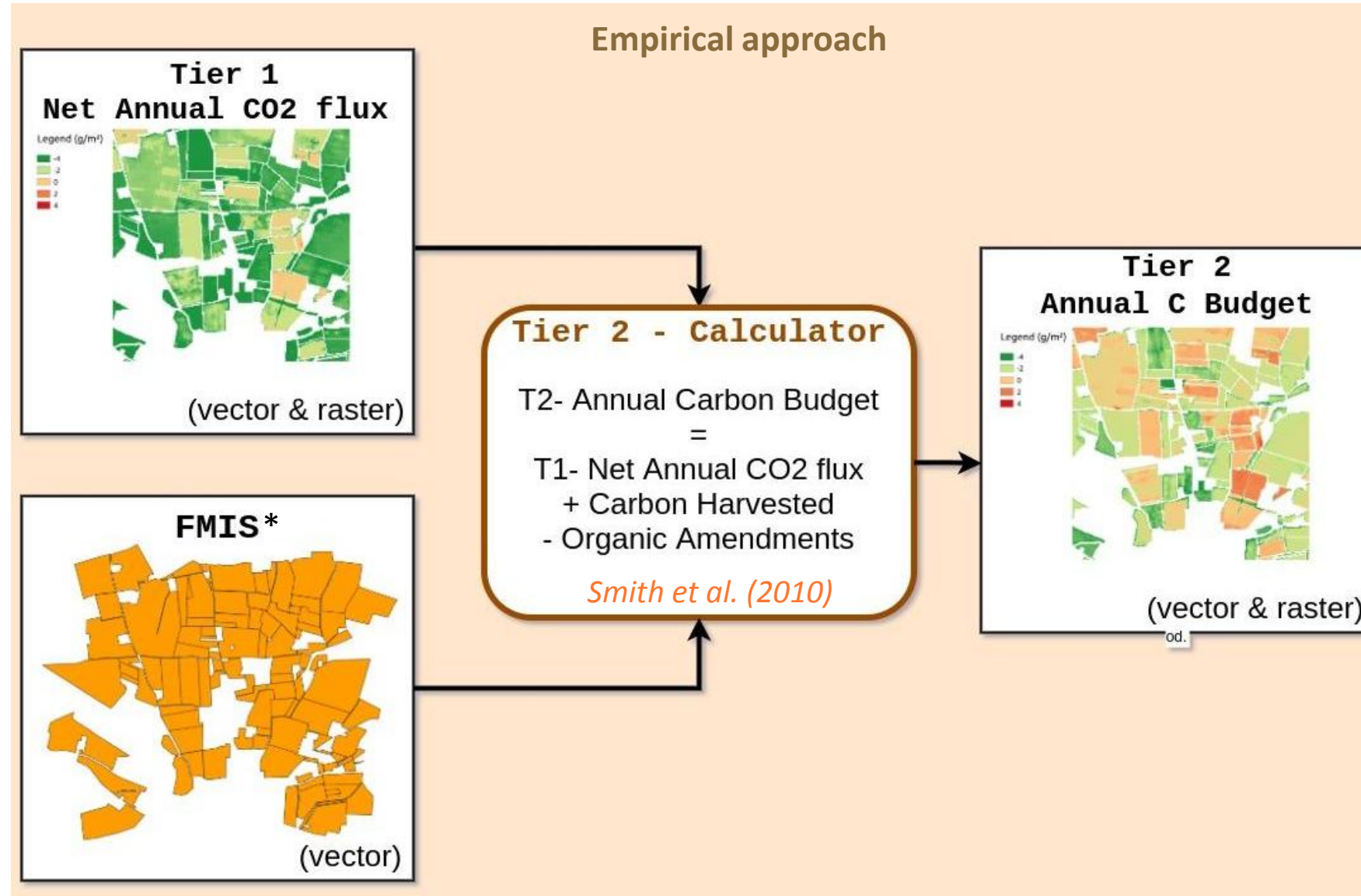


France = 94 Sentinel-2 tiles

2019 Annual CO₂ Net Flux in t/ha (Preliminary results)



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



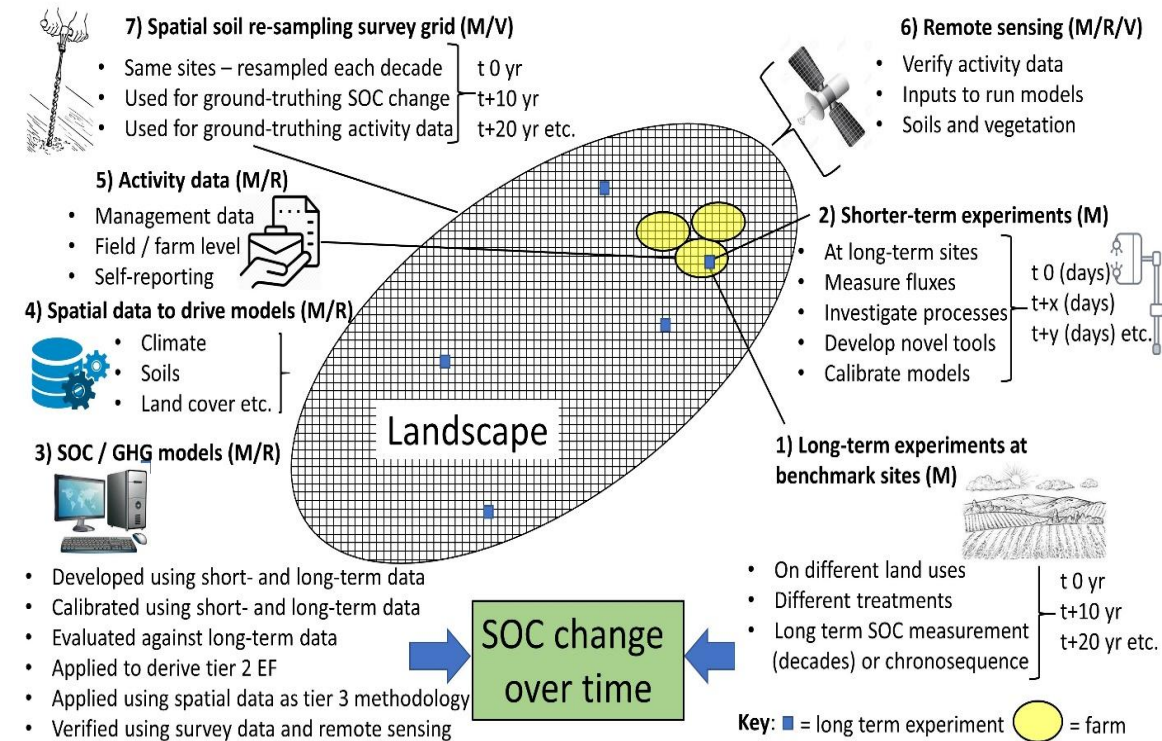
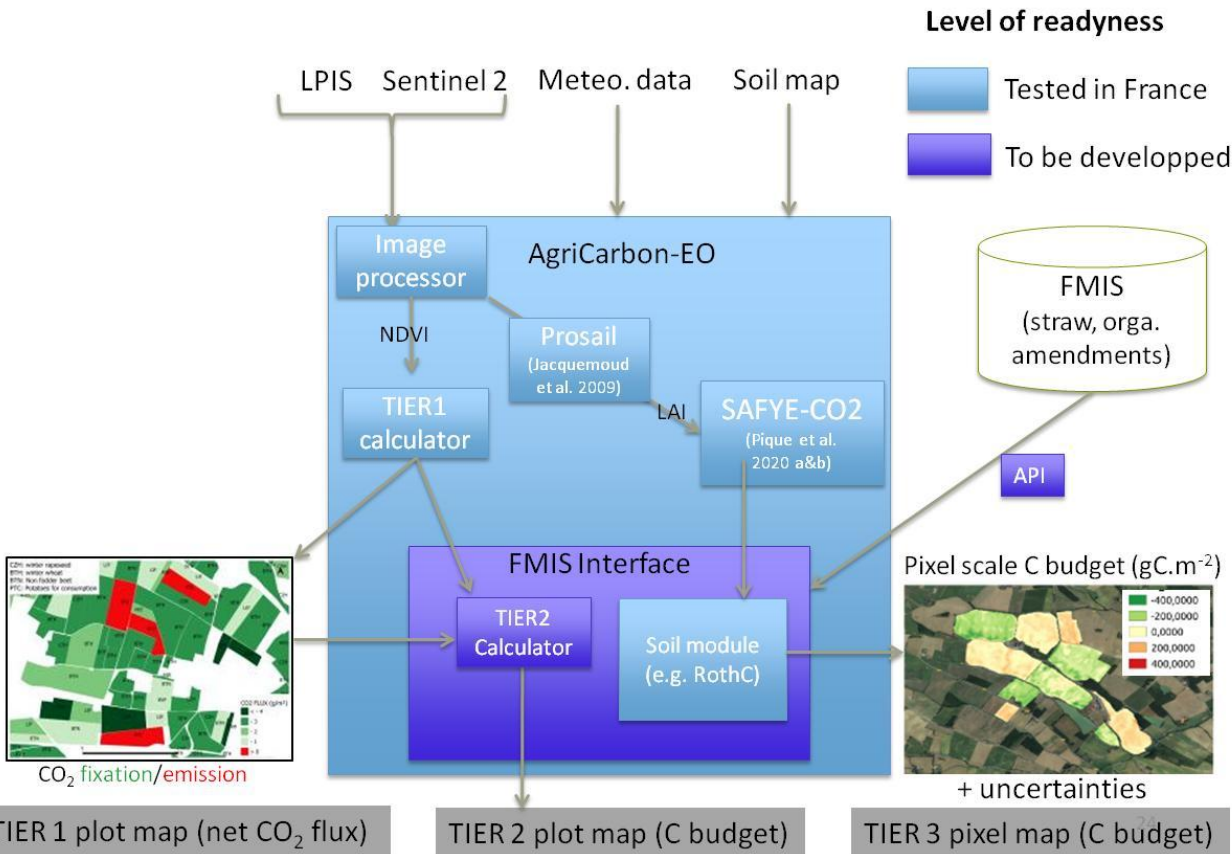
* Farm Management Information System

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

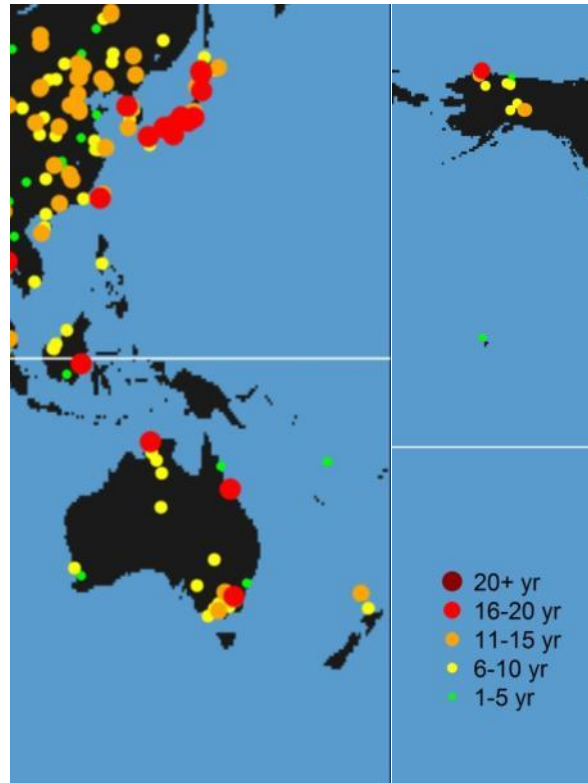
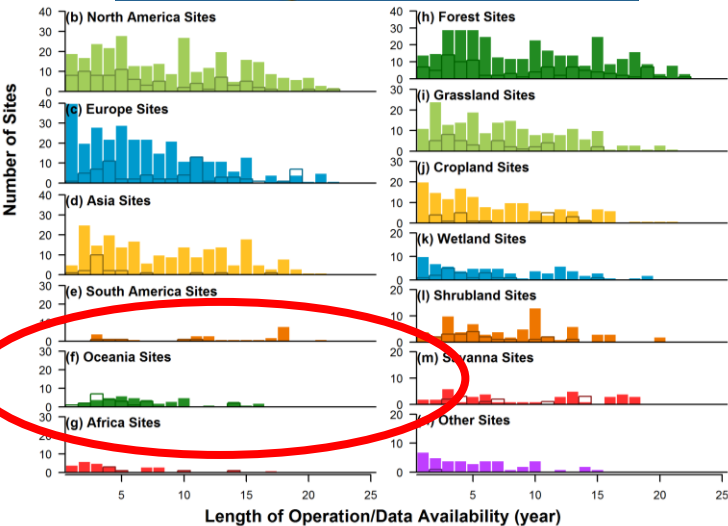


Local/regional adaptations will be needed

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

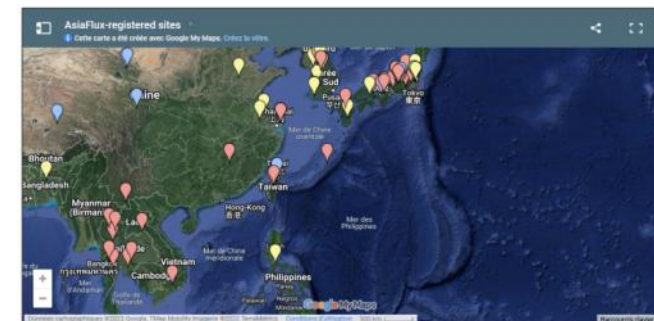
<https://fluxnet.org/sites/site-summary/>



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



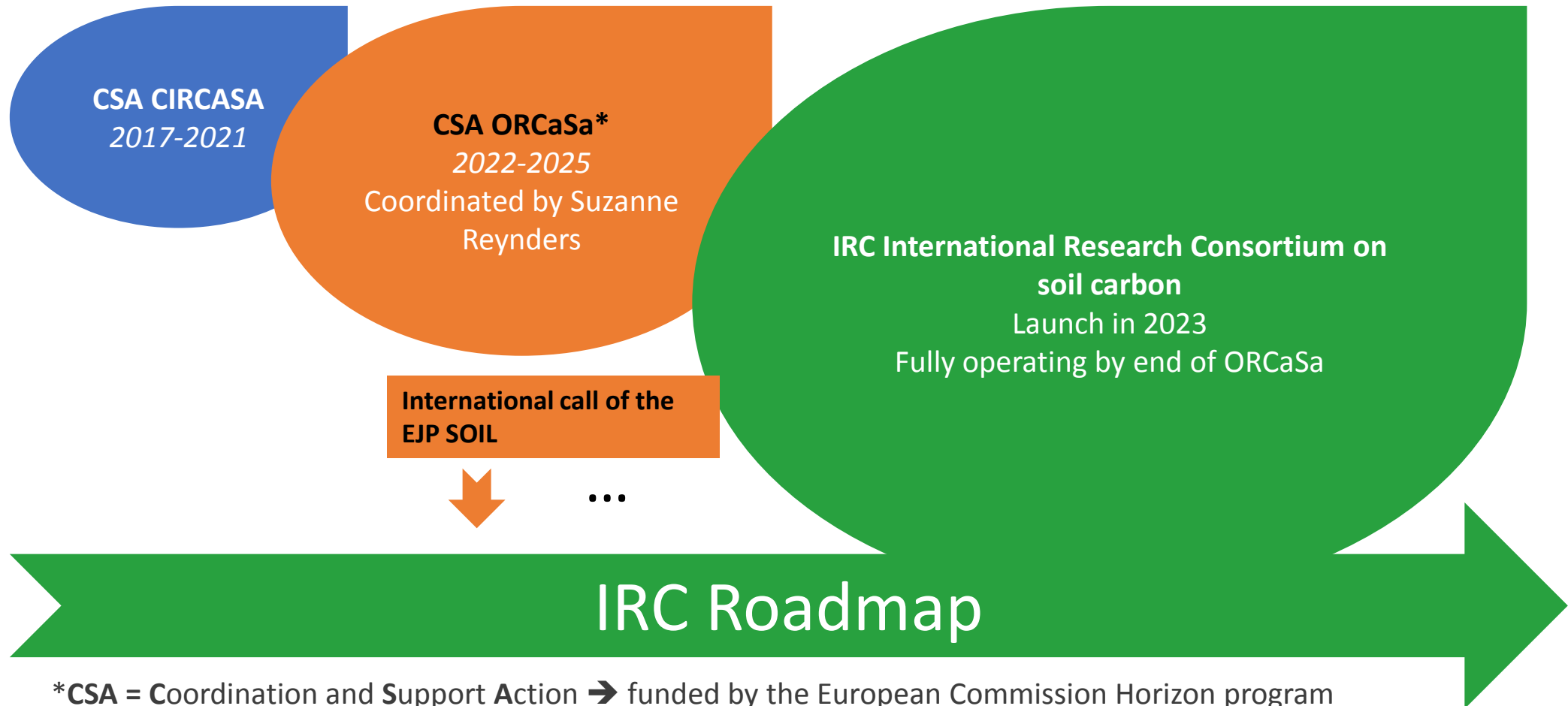
Forest, Plantation, Fruit farm, Paddy, Meadow, Crops, Grassland, Wetland, Shrub, Steppe, Tundra, Desert, Urban area



http://asiaflux.net/?page_id=22



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



*CSA = Coordination and Support Action → funded by the European Commission Horizon program

*ORCaSa: Operationalising International Research Cooperation on Soil Carbon (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 :

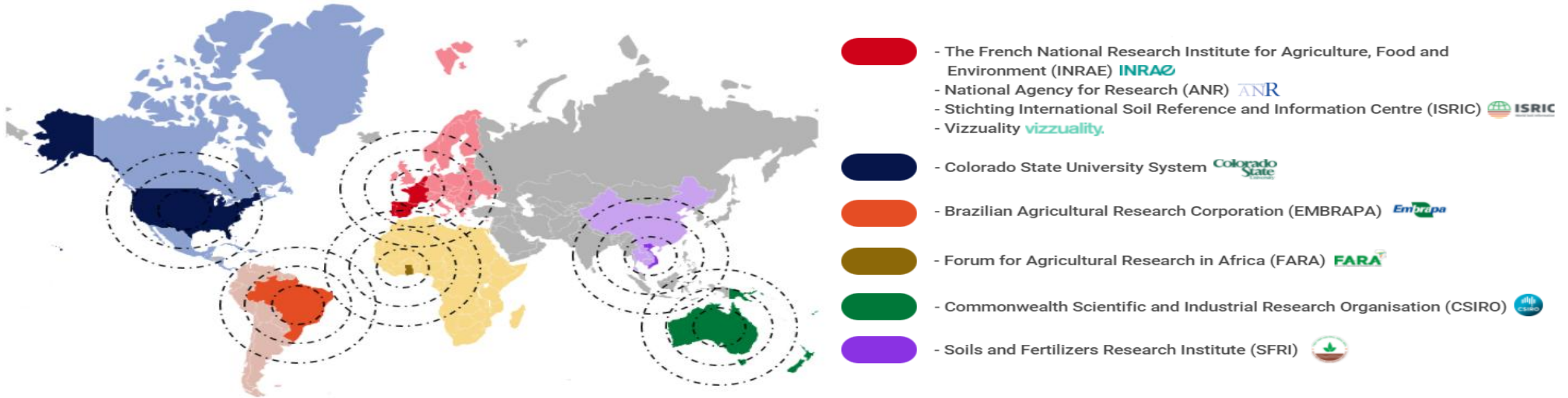
- an initial Strategic Research and Innovation Agenda on agricultural Soils
- an initial community of 100 stakeholders and 500 scientists
- A conceptual methodological framework (Smith et al., 2019) + AgriCarbon-EO MRV prototype (see slide 11)

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:



Anne Marie Joliet
a.joliet@popcorn.fr

- Cultural Technical Manager at Nataïs



Eric Ceschia
eric.ceschia@inrae.fr

- INRAE Senior scientist at CESBIO
- 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



Suzanne Reynders
suzanne.reynders@inrae.fr

- 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