Food and Agriculture Organization of the United Nations

GLOBAL SOIL PARTNERSHIP
12th Plenary Assembly
03-05 June 2024

Opening remarks on MRV tools and systems - tentative definition

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Eric Ceschia (INRAE/CESBIO)

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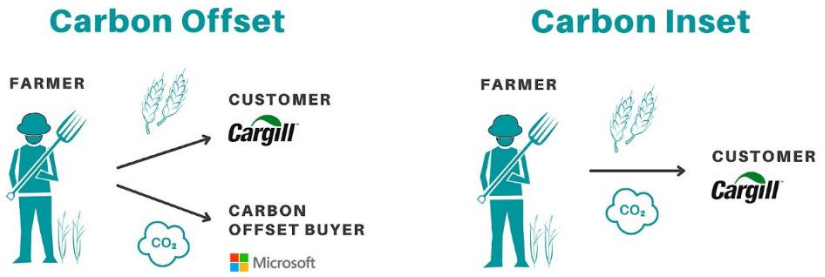
Different contexts of MRV for Soil Organic Carbon

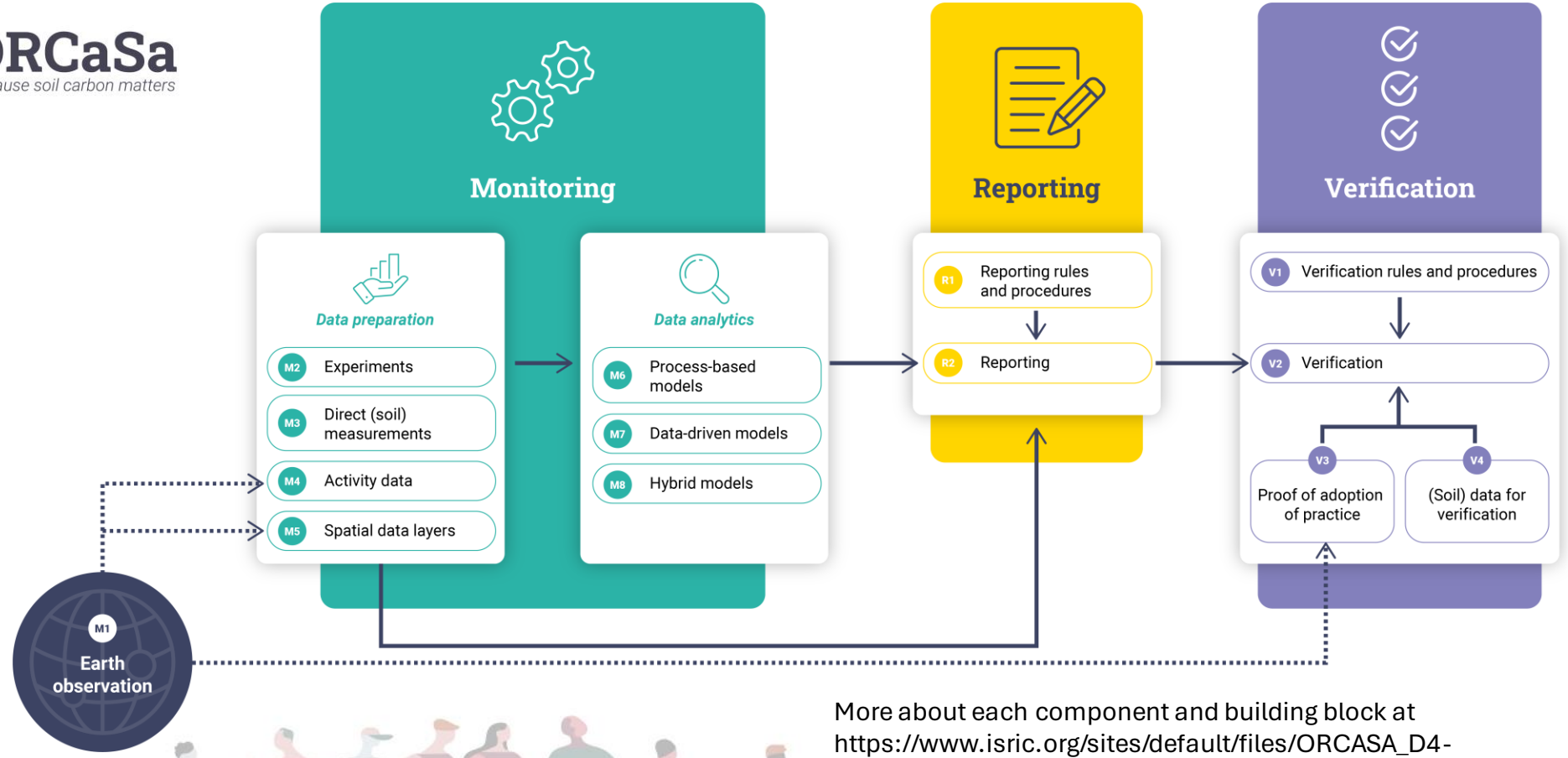
- National inventories = Nationally Determined Contributions (NDCs) under the Paris agreement (COP21)
- Carbon offset programs (offsetting/Voluntary Carbon Market) mainly for forest up to now but developing fast for cropland,
- Compensation of GHG emissions inside the supply chain (insetting) ➔ e.g. agri-food companies engaged in SBTI FLAG objectives (to report their environmental progress) ➔ credits used for scope 3 reporting cannot be sold as offset credits,



- Common Agricultural Policy in Europe ? ➔ currently lack of political will, of access to plot/farm activity data in most EU countries and of operational methods for monitoring

The components of a MRV scheme

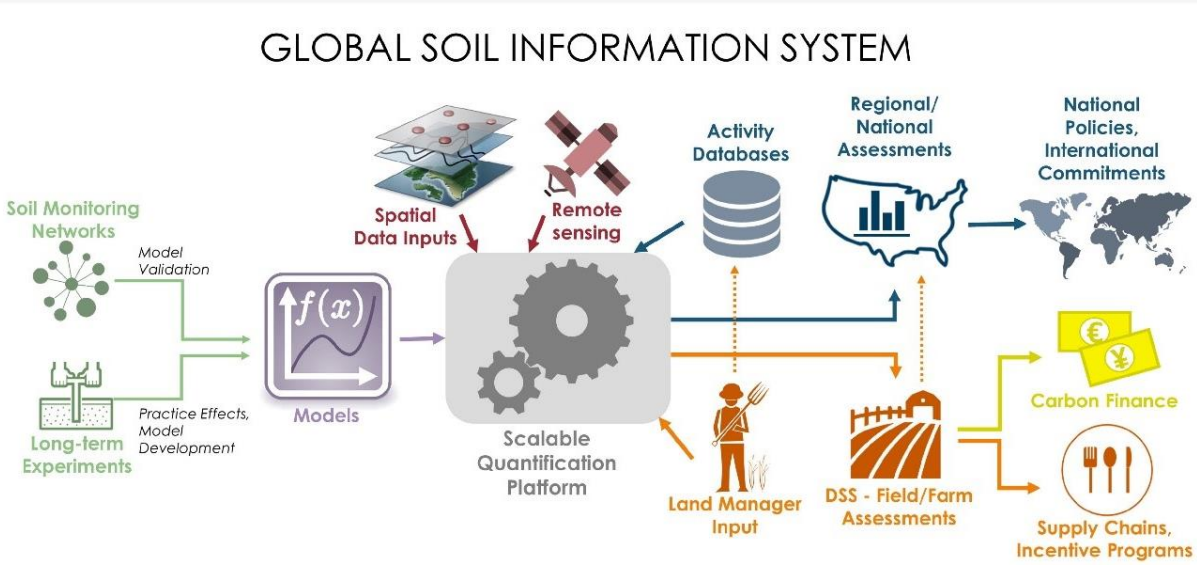
Schematic representation of the components/building blocks and information flow for a generic MRV framework



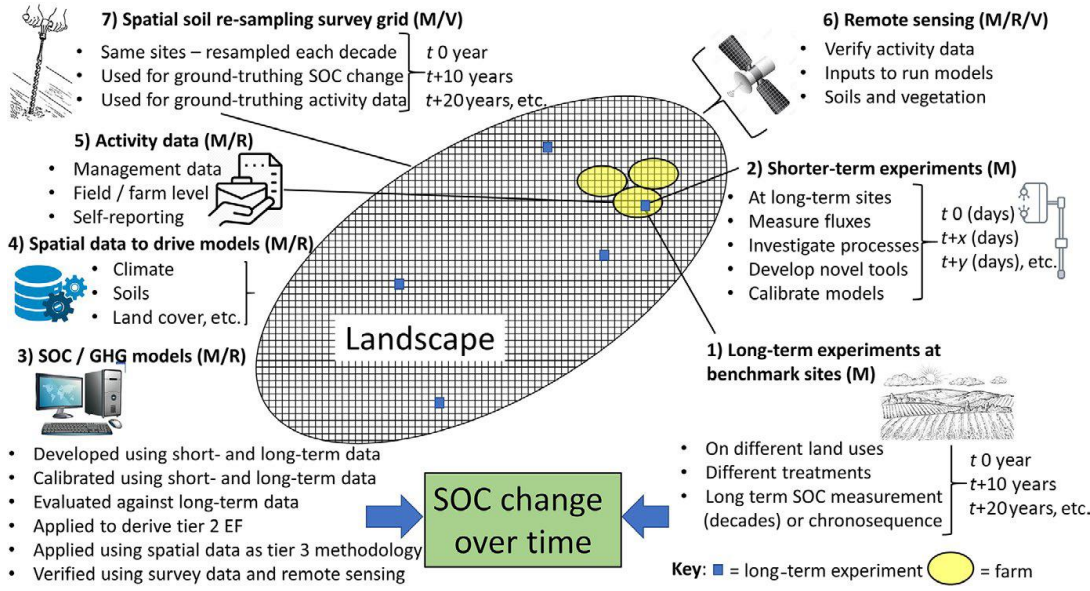
More about each component and building block at https://www.isric.org/sites/default/files/ORCASA_D4-1_FinalDeliverable_InReviewByEU_0.pdf

Conceptual MRV frameworks for cropland

Paustian et al. (2019): NDC, VCM, supply chain in the USA



Smith et al. (2020)



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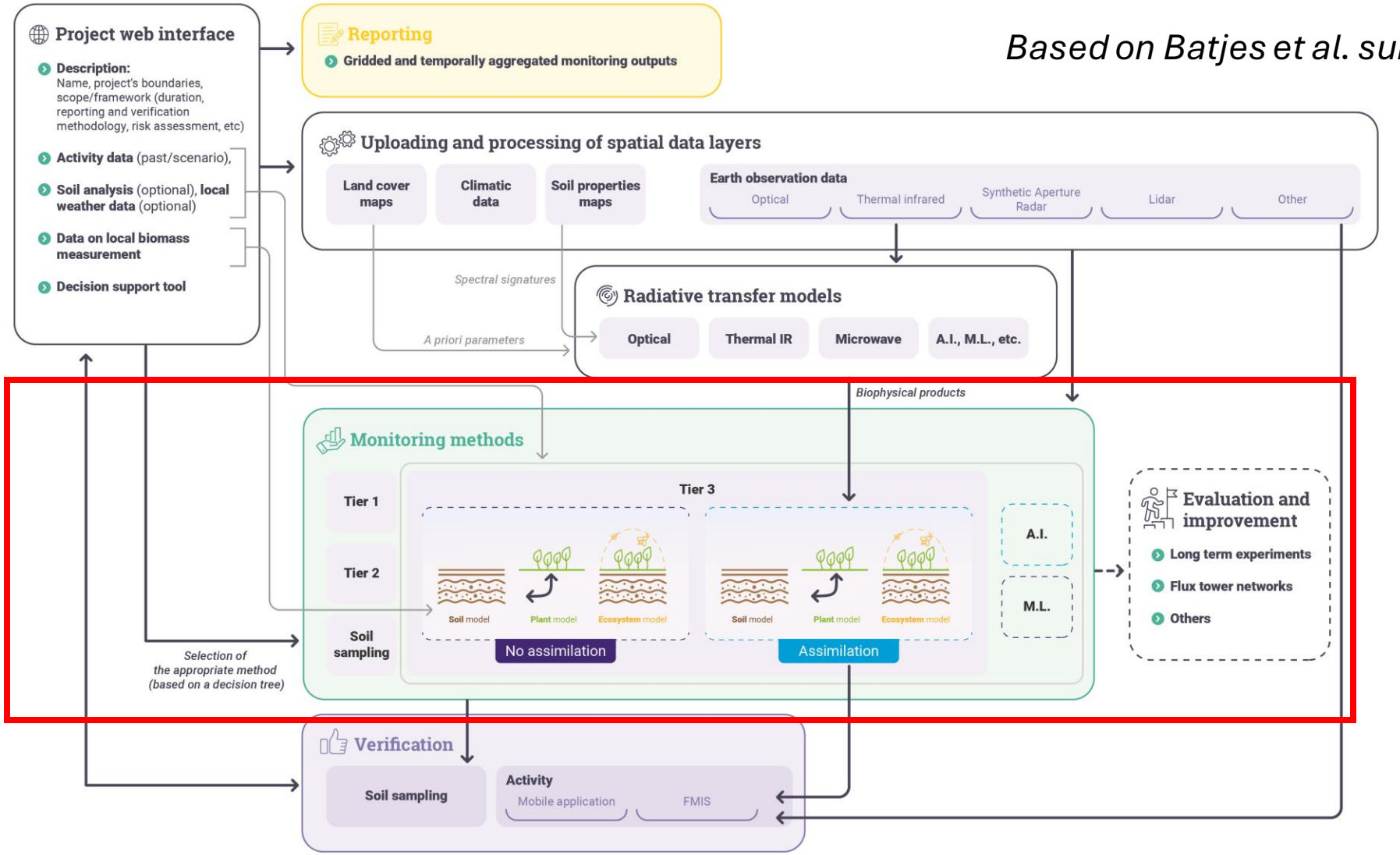
Propositions of MRV methodological framework

ORCaSa
Because soil carbon matters

Based on Batjes et al. submitted



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How to Monitor SOC stock changes ?

- Measurements of soil SOC content/bulk density ➔ representativity of spatial paterns ?
- Statistical models spatialising in situ soil data using related patterns (e.g. Szatmári et al. 2021) and digital soil mapping (e.g; Vaudour et al. 2020; Heuvelink et al., 2020),
- Management measures (TIER 1 & 2): estimated standard values for Specific Land Management measures (activity X leads to increase/decrease in SOC) ➔ only for NDCs,

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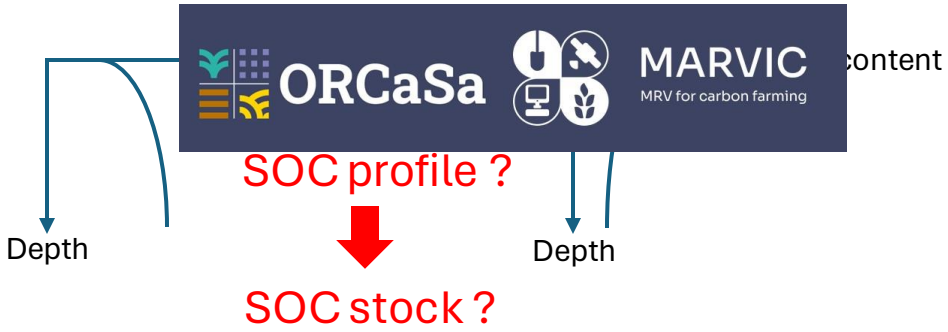
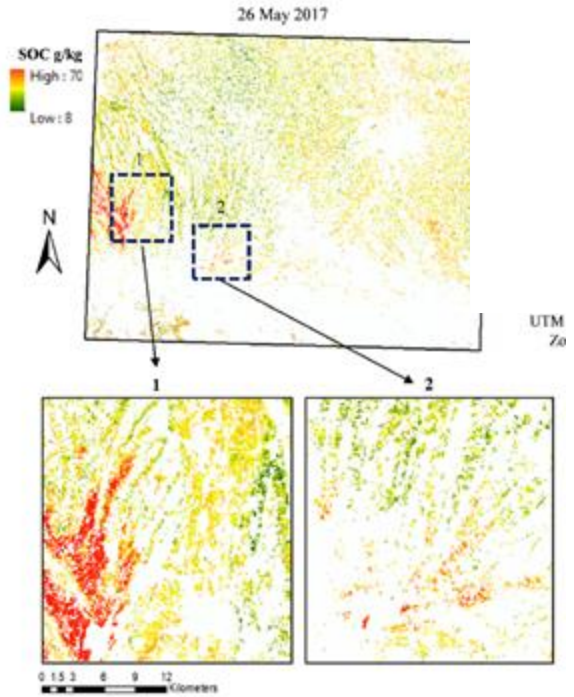
- ~~Monitoring of SOC stock directly from remote sensing ?~~





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- Process based models/operational processing chains (TIER 3) simulating plant/soil processes and their interactions and assimilating remote sensing data (e.g. FiON, AgriCarbon-EO, Remote-C, RETINA) or not (e.g. STICS, DNDC, CENTURY, RothC),
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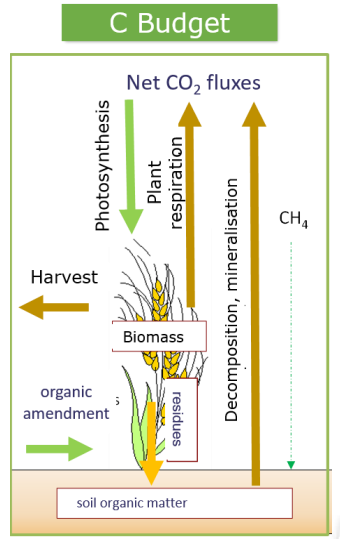
- Combination of the above methodologies ? The choice depends on the context of application, the availability of input data, models adapted to the local context, cost/benefits ratio…

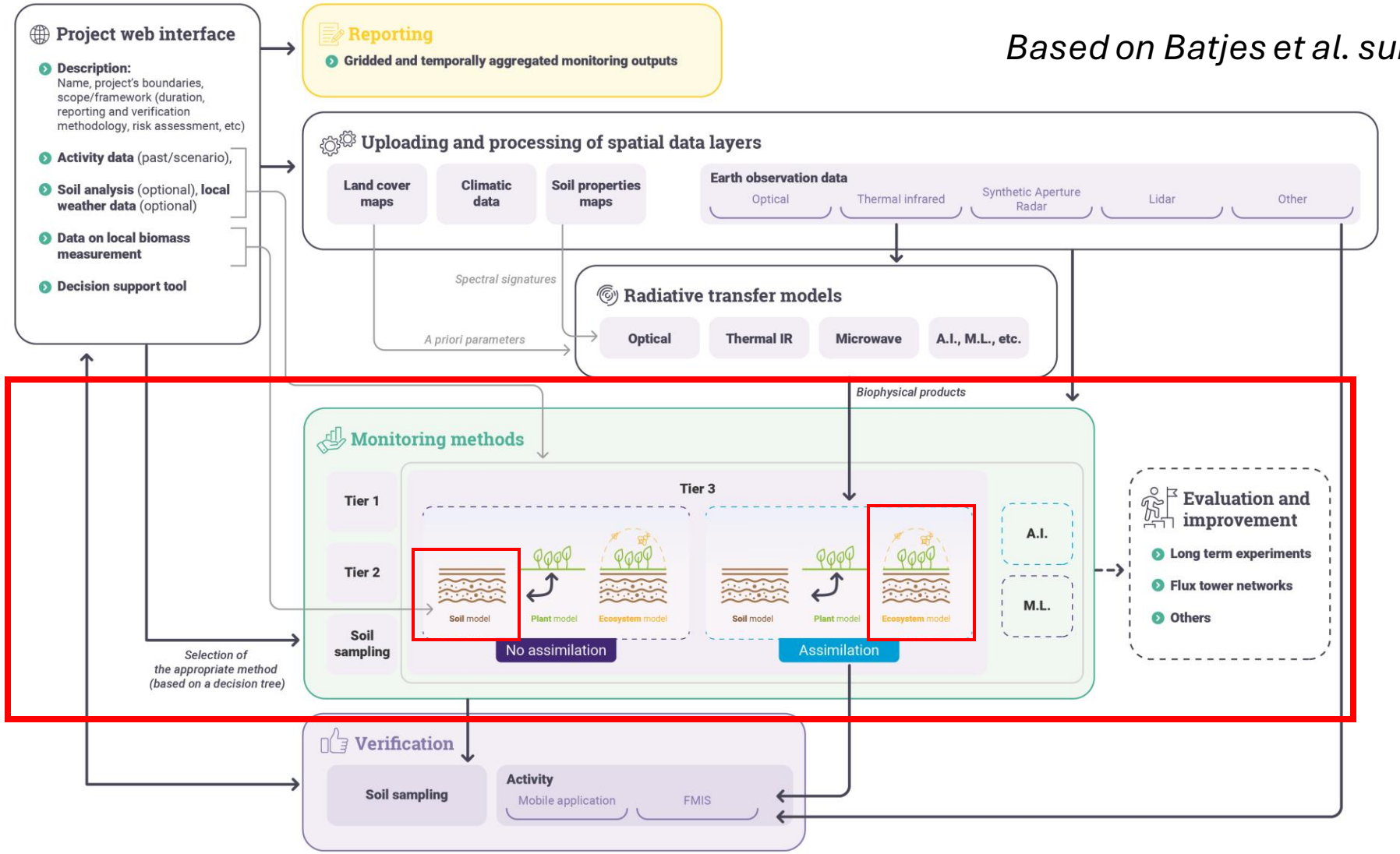


Monitoring of SOC is an ecosystem issue !!! A MRV method for SOC shall address other compartments than the soil (e.g. biomass) ➔ C budget approach !!!

Propositions of MRV methodological framework

ORCaSa
Because soil carbon matters

Based on Batjes et al. submitted



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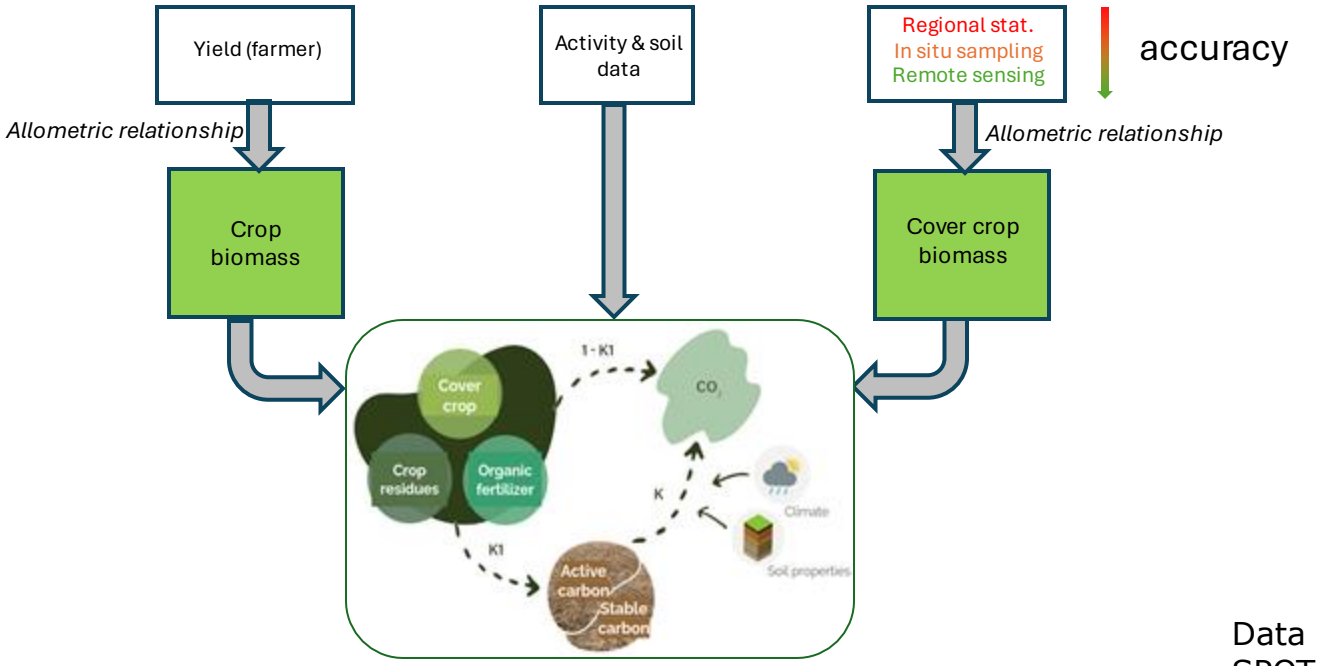
Examples of modeling approaches for SOC monitoring

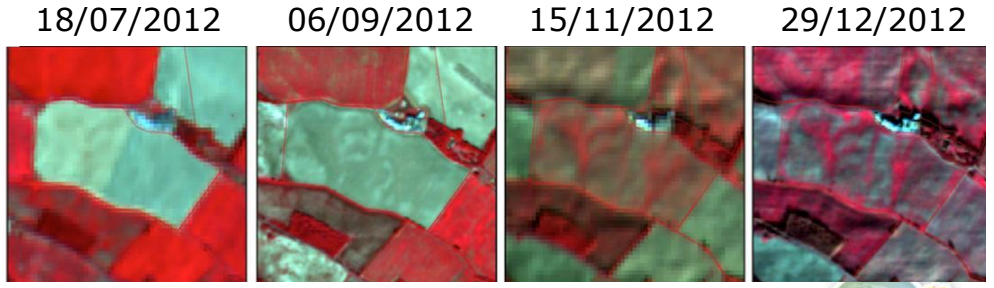
Soil Centered approach ➔ LABEL BAS CARBONE



AMG soil model (Clivot et al 2019)

- **Most crops & carbon farming practices**
- **Cropping systems of the farm (not plot level)**
- **Cost (mostly acivity data collection)**
- **Uncertainty assessment**
- **Scalability**
- **Accuracy**

Data SPOT4/5



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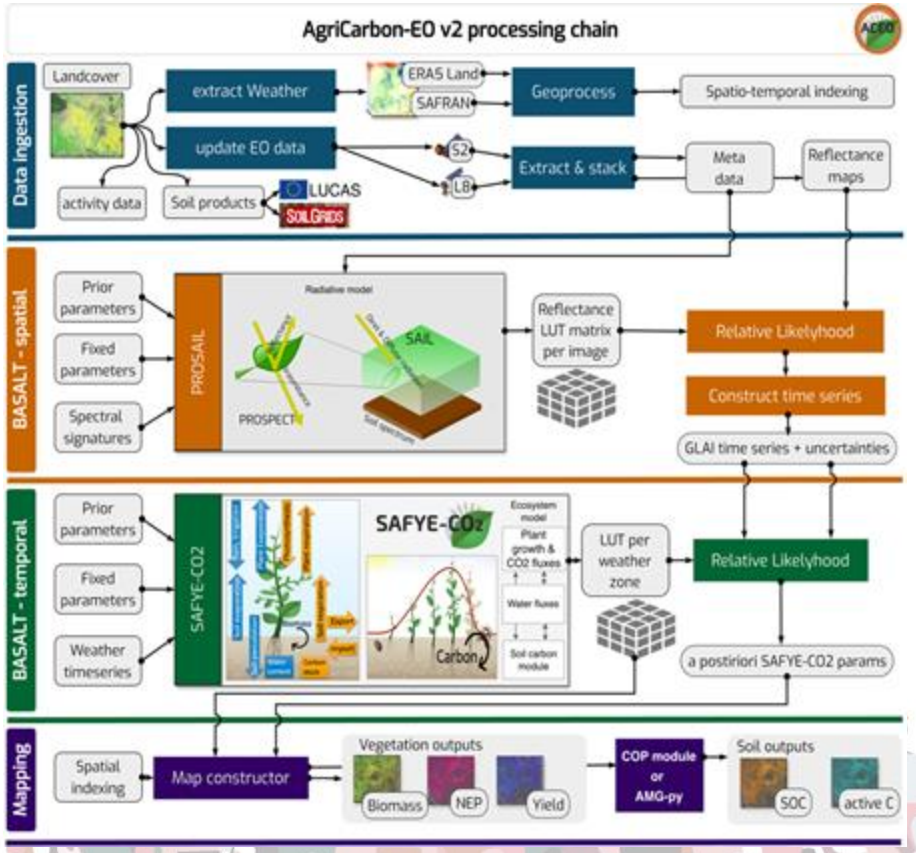
Examples of modeling approaches for SOC monitoring

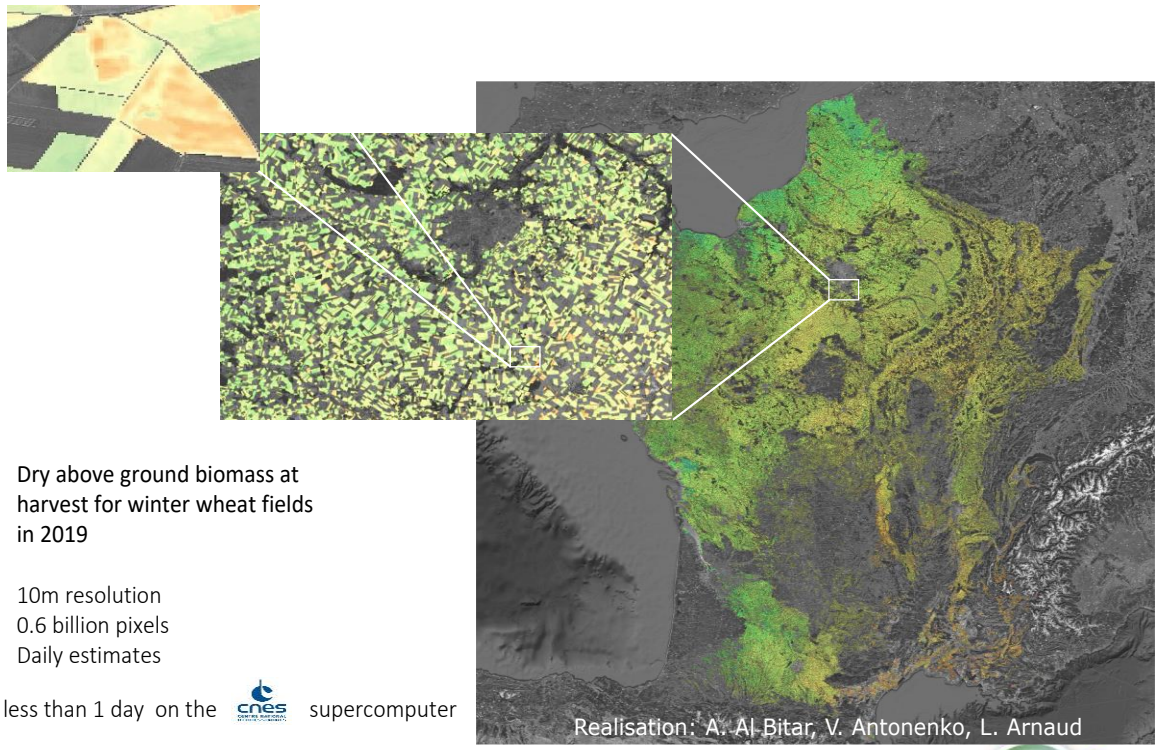
Hybrid approach (combining modeling, remote sensing for biomass, in-situ data)➔ AgriCarbo dedicated to upsaclling the C budget components and their uncertainties

See Wijmer et al. 2024 (V1)

https://gmd.copernicus.org/articles/17/997/2024/



Straw cereals aboveground biomass in France in 2019



Dry above ground biomass at harvest for winter wheat fields in 2019

10m resolution
0.6 billion pixels
Daily estimates

In less than 1 day on the cnes supercomputer

Realisation: A. Al Bitar, V. Antonenko, L. Arnaud

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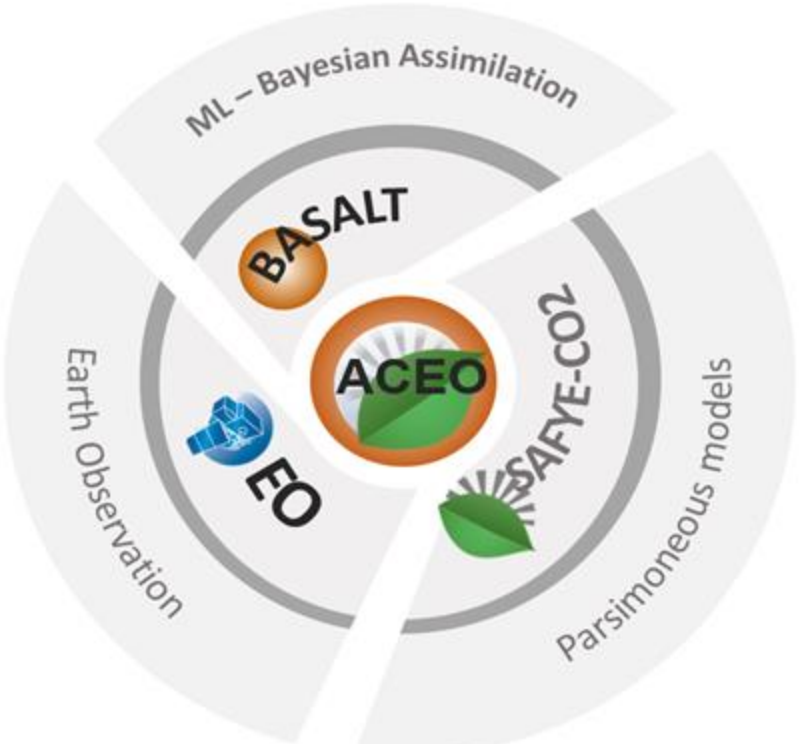

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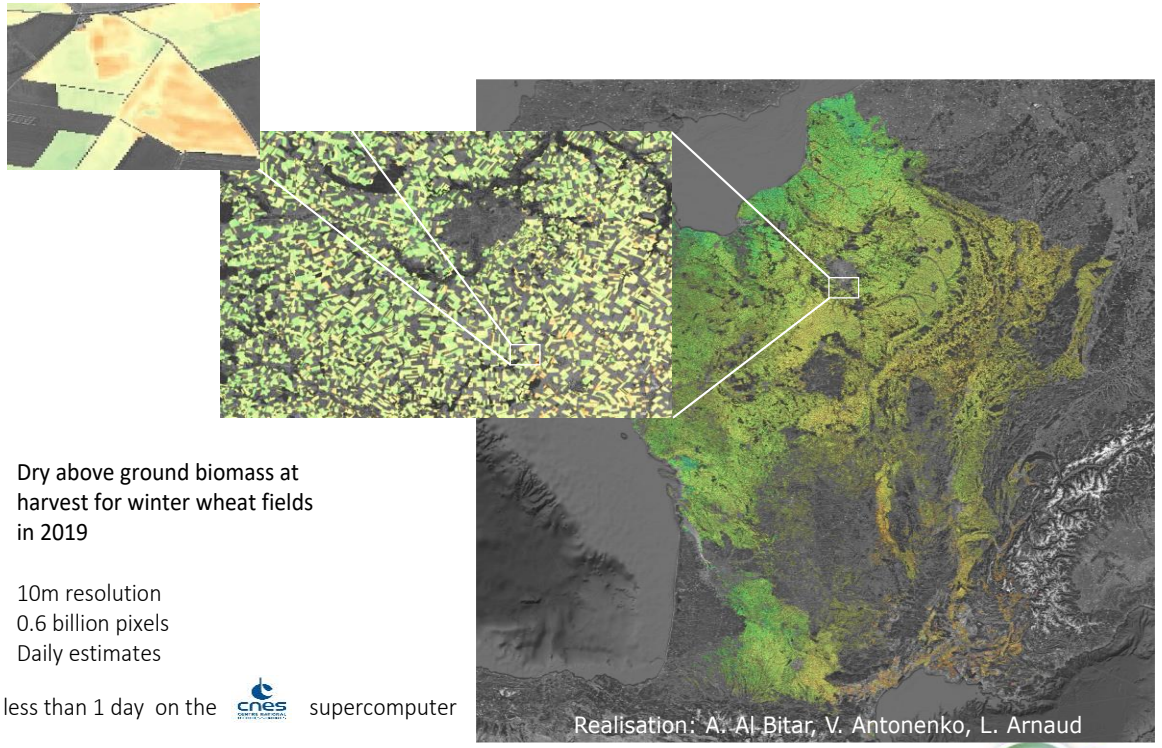

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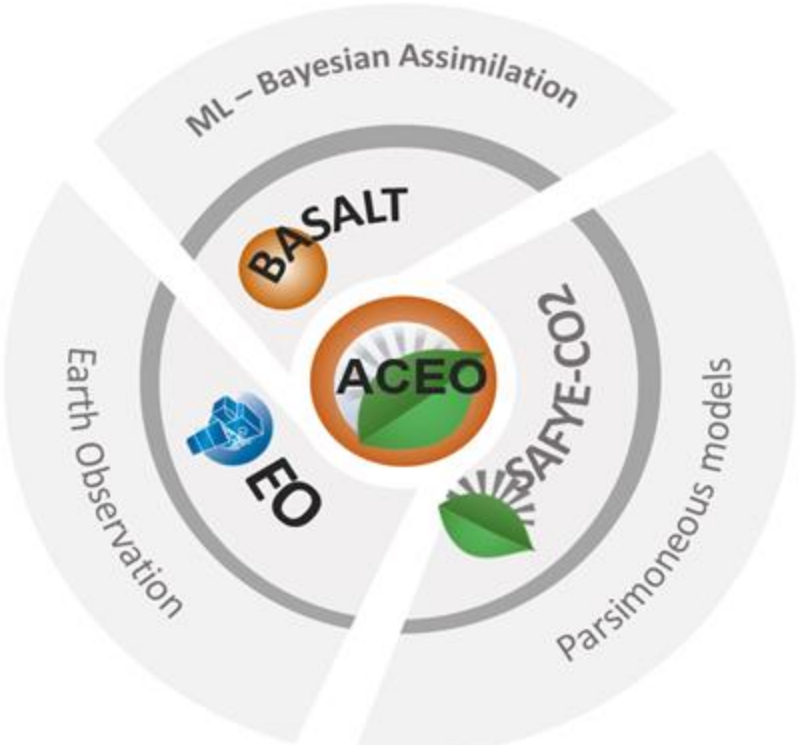

- ☹ **Main crops & not all C farming practices**
- ☺ **Plot level (even pixel ➔ best for validation)**
- ☺ **Cost (mostly acivity data collection)**
- ☺ **Scalability**
- ☺ **Uncertainty assessment**
- 😐 **Accuracy (depends on access or not to local soil and activity data)**

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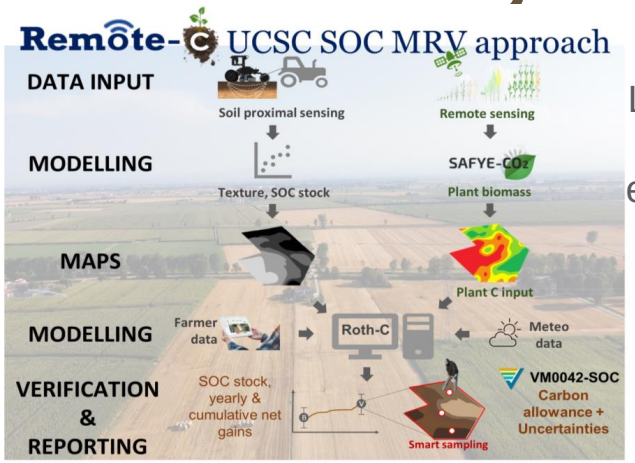
Many other MRV tools based on modeling



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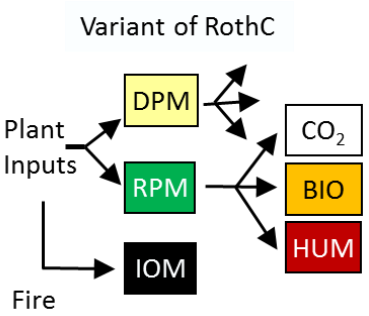
Light use efficiency approach for estimating biomass input to the RothC soil model

Australia (NDC)



COMET-Farm: C market

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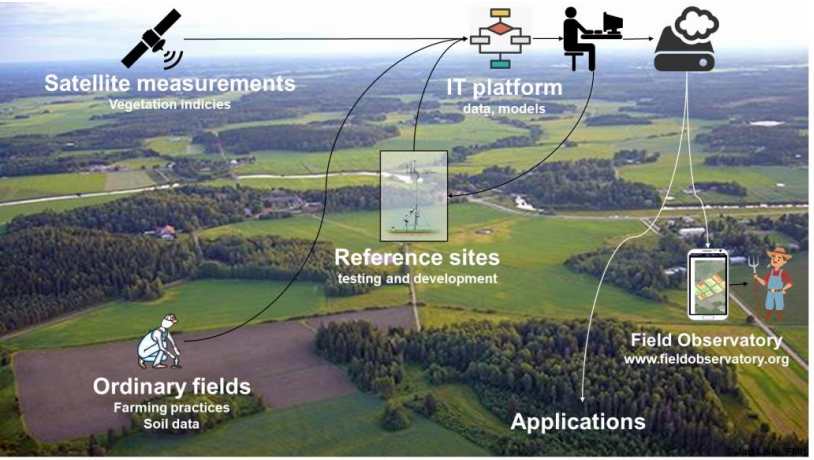
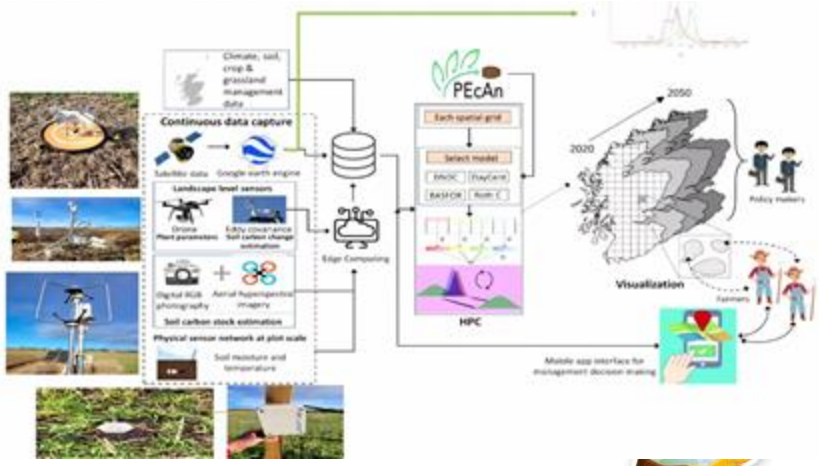
Field observatory network



Constraining existing crop/grassland models (e.g. STICS) with satellite observations

RETINA Project (UK): C market



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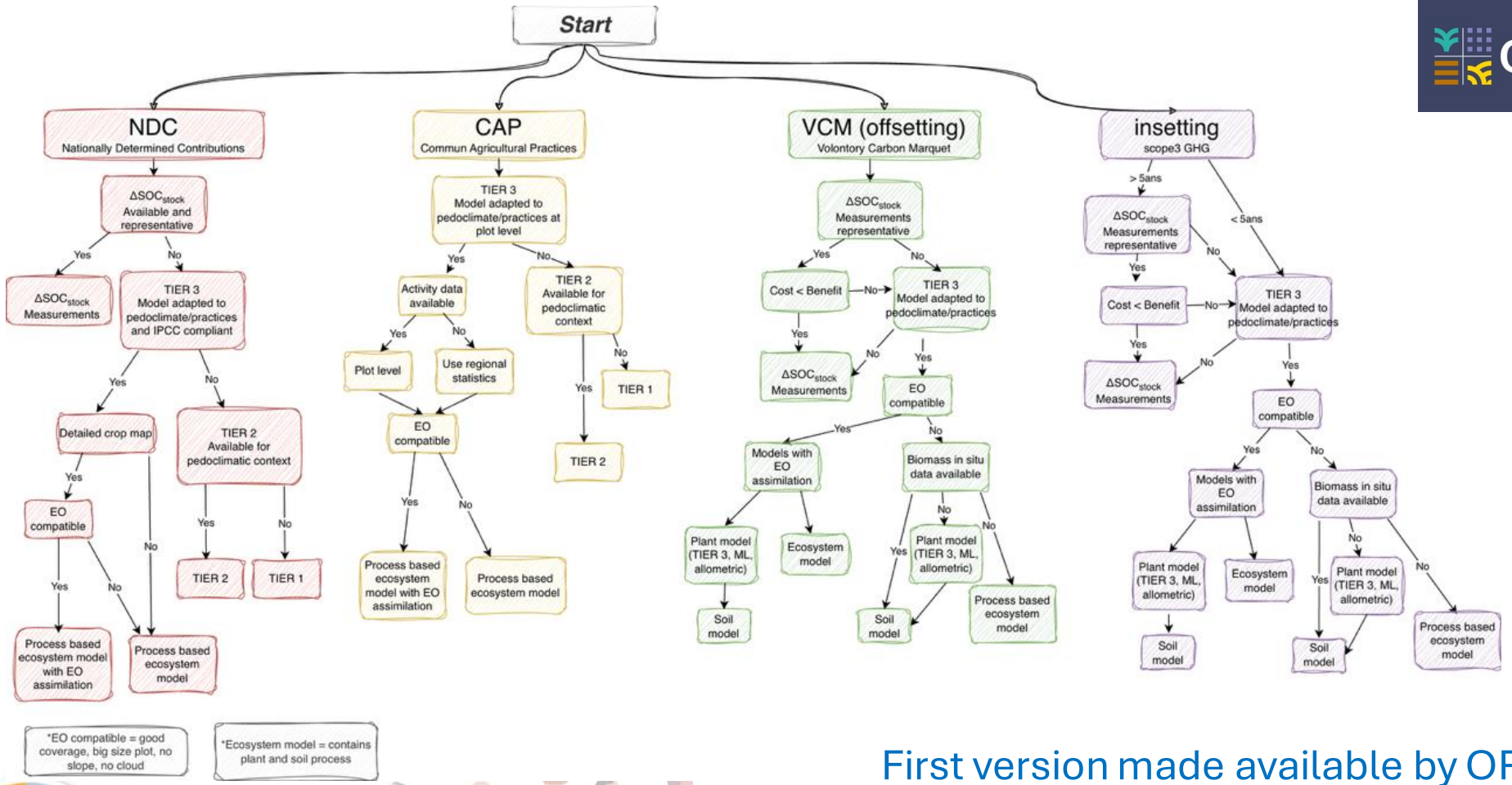
Decision tree to choose the Monitoring approach tailored to the local context



ORCaSa MARVIC MRV for carbon farming

First version made available by ORCASA at the end of the yea

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Key message

One of the main challenge for promoting SOC storage and to assess the impacts of management practices on the agricultural soils concerns Monitoring (MRV) ➔ need for scalable, multi-context (NDC, C market…), automatized, cheep, reliable, transparent methods for monitoring the effect of management on SOC stock changes in agricultural soils,

Following as much as possible CIRCASA's recommendations :

- Modular & transparent approach with uncertainty assessment on SOC stocks,
- Several soil models instead of one ➔ allowing ensemble modeling approach,
- Assessment of the different components of the C budget in the development/verification process,
- Relying on strong data infrastructures following the FAIR principles: e.g. Copernicus, Fluxnet sites…
- High resolution, relying on remote sensing (e.g. Sentinel 2) to quantify biomass production & restitution to the soil,
- …

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ORCaSa MARVIC MRV for carbon farming

will provide guidelines, recommendations, methodological frameworks and tools for using/developpingmulti-ecosystem and multi context MRV tools

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THANK YOU

Visit our websites:

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https://www.project-marvic.eu/

https://www.cesbio.cnrs.fr/agricarboneo/agricarbon-eo/

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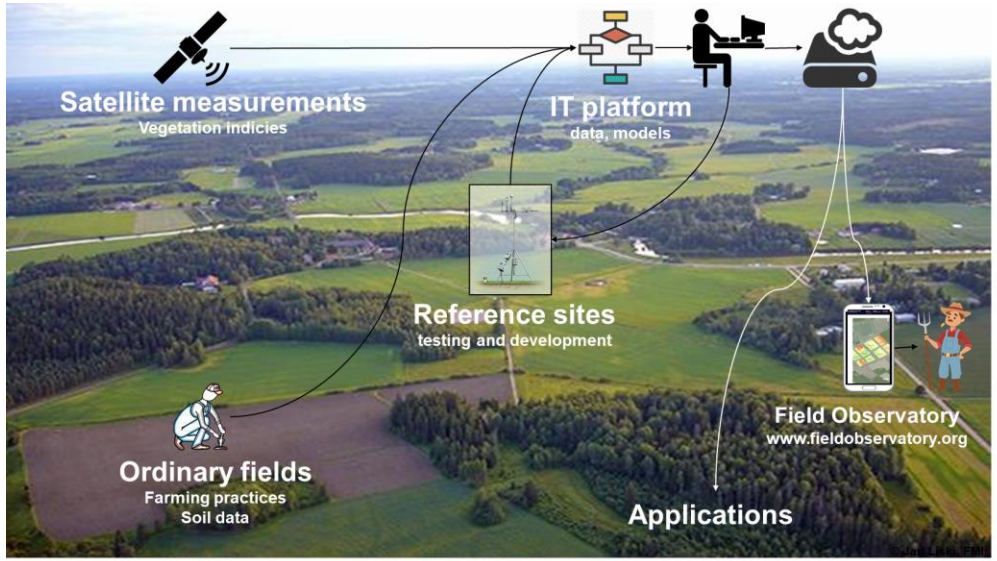
Operational processing chains for arable land

Examples



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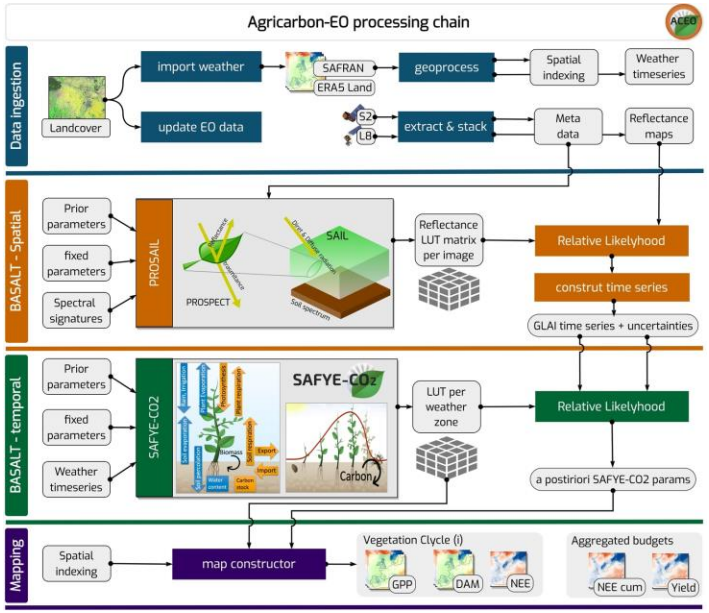
Our model catalogue

Model	Time-step	N_2O	Soils	Pros	Cons
SVM	hourly/ daily	N	Mineral	In house development	Development not complete yet PEcAn coupling has not begun
Basgra-Yasso	daily	Y	Mineral	Can turn features on/off Advanced PEcAn coupling	Grassland only
Basgra-BGC	daily	N	Organic	Includes specific adaptations for cultivated peatlands	Grassland only
STICS	daily	Y	Mineral, Organic(?)	Wide applicability	Heavily parameterized
L-DNDC	flexible	Y	Mineral, Organic	Wide applicability	Heavily parameterized

Constraining with EO data existing crop/grassland models (e.g. STICS) and soil model (e.g. YASSO)



Parcimonious crop model dedicated to upscalling assimilating EO data coupled to AMG soil model

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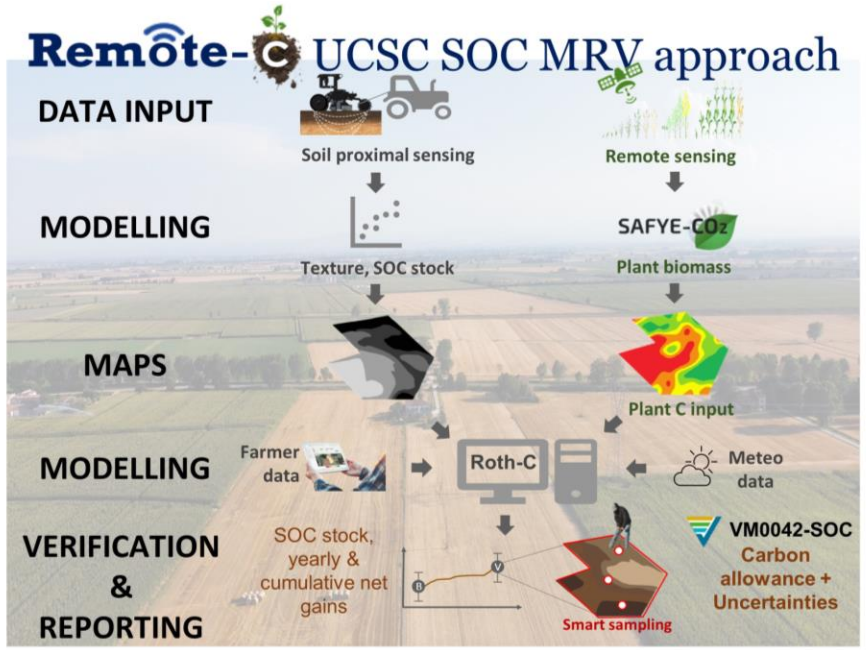

Light use efficiency approach for estimating crop/cover crop biomass input to the RothC soil model

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