Developing a parcel-level based monitoring and reporting system for Carbon Farming in Europe

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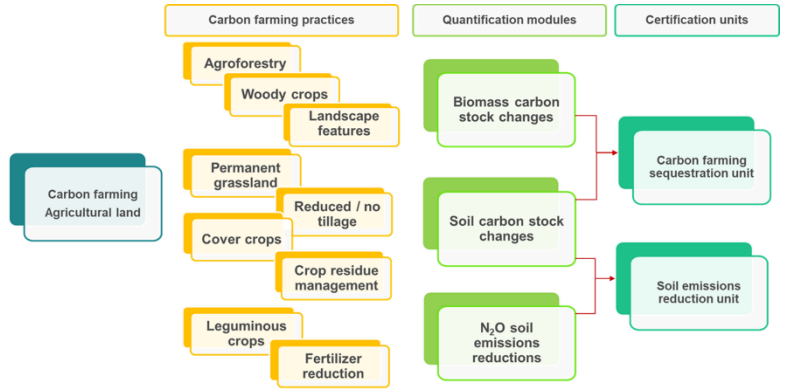
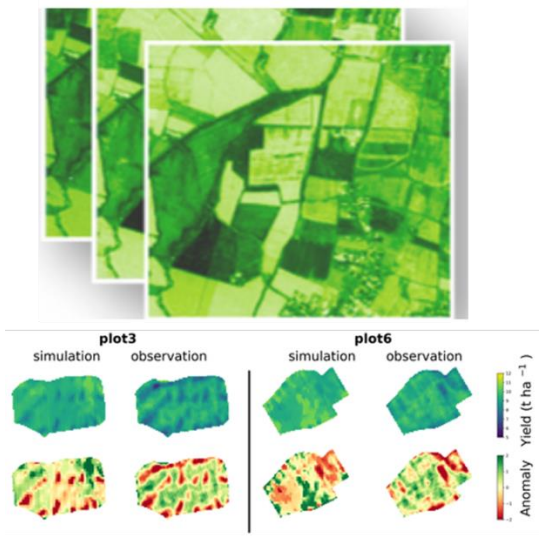
Rationale

- Currently limited uptake of carbon farming (low carbon price, high administrative burden, high uncertainties in quantification and lack of trust in carbon markets)
- CRCF regulation and upcoming certification methodologies
- Farmers have to provide similar data for multiple purposes (scope 3 reporting (CSRD), CAP payments, voluntary carbon market, biofuels)
- National LULUCF inventories have to improve and use Tier 3 approaches
- Opportunities for earth observation and new (open) data sets





Wijmer et al. (2024)

CAFAMORE – CArbon FArming MOnitoring and REgistry

- Objective: To develop an EU-wide parcel-based Monitoring, Verification and Reporting system for Carbon Farming, which comprises quantification and baseline approaches, a spatially explicit registry and marketplace.
- Increase attractiveness of carbon farming, reducing administrative burden for land managers, and multiple uses of the system (voluntary C market, CSRD reporting, LULUCF and CAP reporting).
- Focus: agricultural land on mineral soils including agroforestry and some N_2O
- 4-year project (started 1 July 2025)
- 11.5 M€ EC contribution

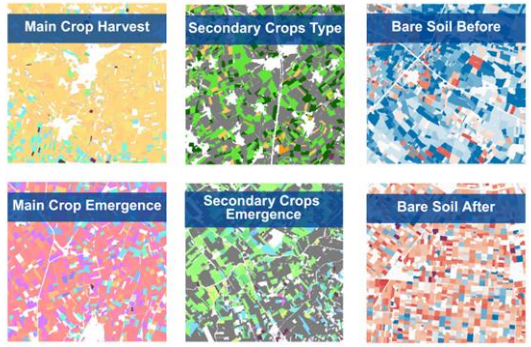
Consortium

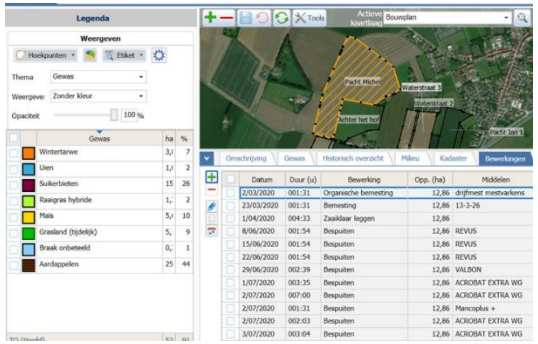
22 partners

Covering 10 countries

Pilots in 7 countries

MRV tool

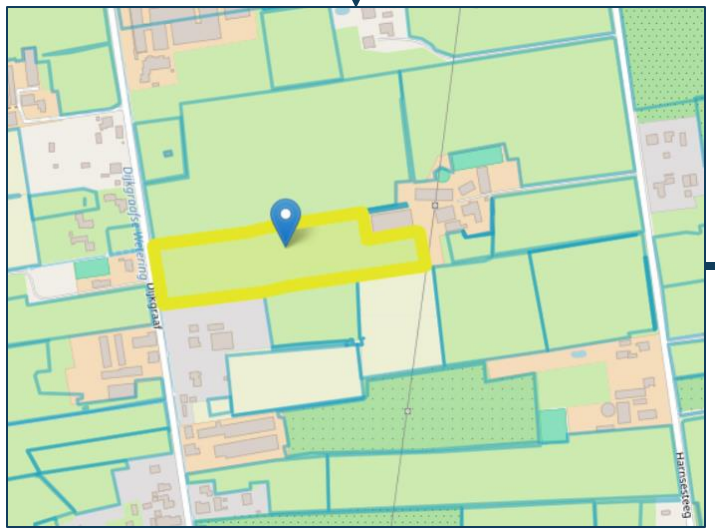




LPIS

EO data

FMIS



Quantification module

Multi-model platform

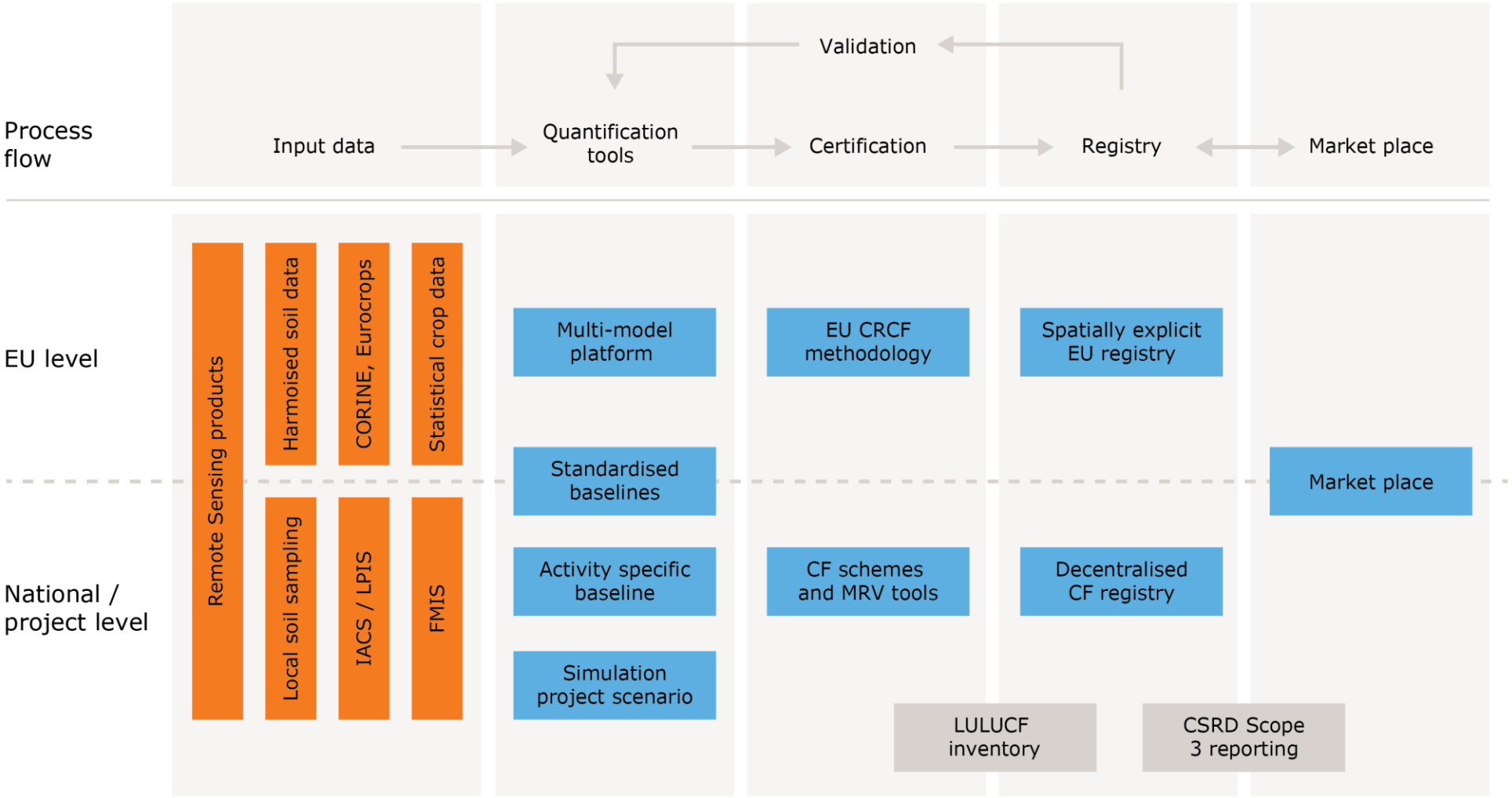
Certification

Registry

Soil data / soil samples

Climate data

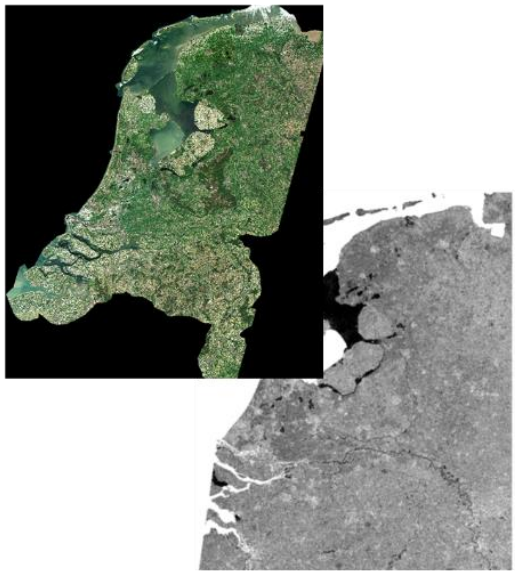
Conceptual Framework



Parcel level SOC quantification for Netherlands

ESA funded project (EO4CSM), RothC application

Sentinel-2 **images** (10m NDVI, reflectances)
2018 - 2024



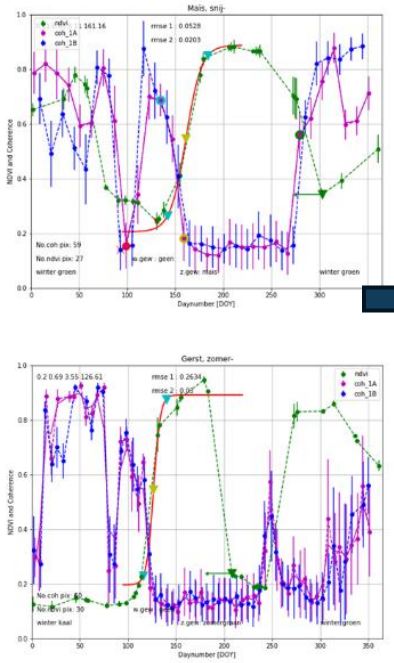
Sentinel-1 **images** (20m coherence)
2018 - 2024

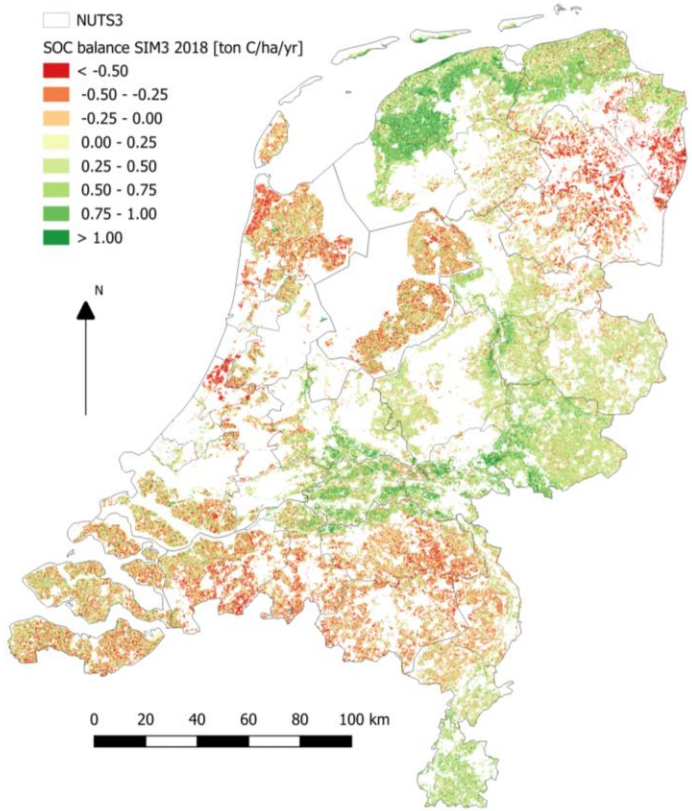
Parcels (LPIS)
2018 - 2024

Time series:

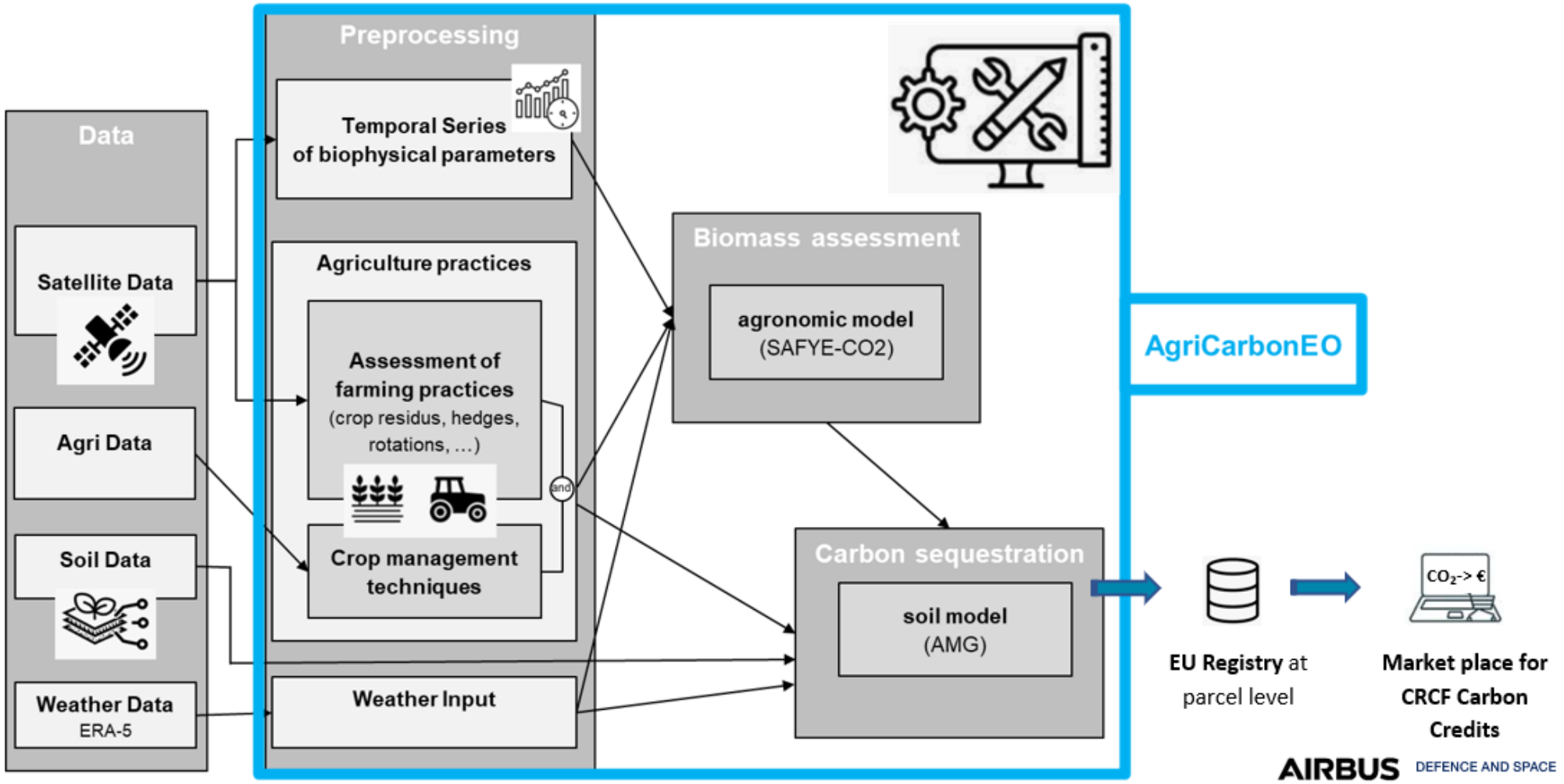
- NDVI (mean + std)
- Reflectances (mean + std)
- Coherence (mean + std)

for all LPIS parcels





AgriCarbonEO approach for France



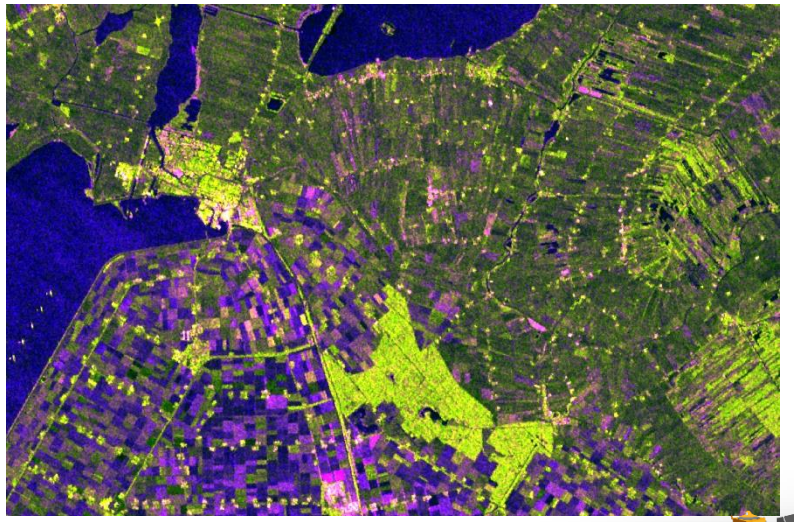
Key results

- Catalogue of harmonised soil, crop and crop management data sets at EU scale
- **Catalogue of remote sensing products for CF quantification**
- Multi-model quantification platform
- Spatially explicit registry for CF certificates
- Prototype CF marketplace and trading mechanisms
- EU wide and national standardised baselines
- Operating and validated local/national MRV modules
- European crop and cover crop biomass database
- **Biomass crop maps**
- **EO based woody biomass monitoring**
- Monitoring tool to evaluate biogeochemical stability of SOC (permanency index)
- Analysis of current and future CF market and opportunities
- Business strategies for increased uptake of CF

EO data inventory – current status

Open and free Copernicus Sentinel-1 and Sentinel-2

- 10-20m spatial resolution (parcel)
- Minimum 5 days revisit
- Spectral bands very suitable for agriculture (vis. red-edge, NIR, SWIR)

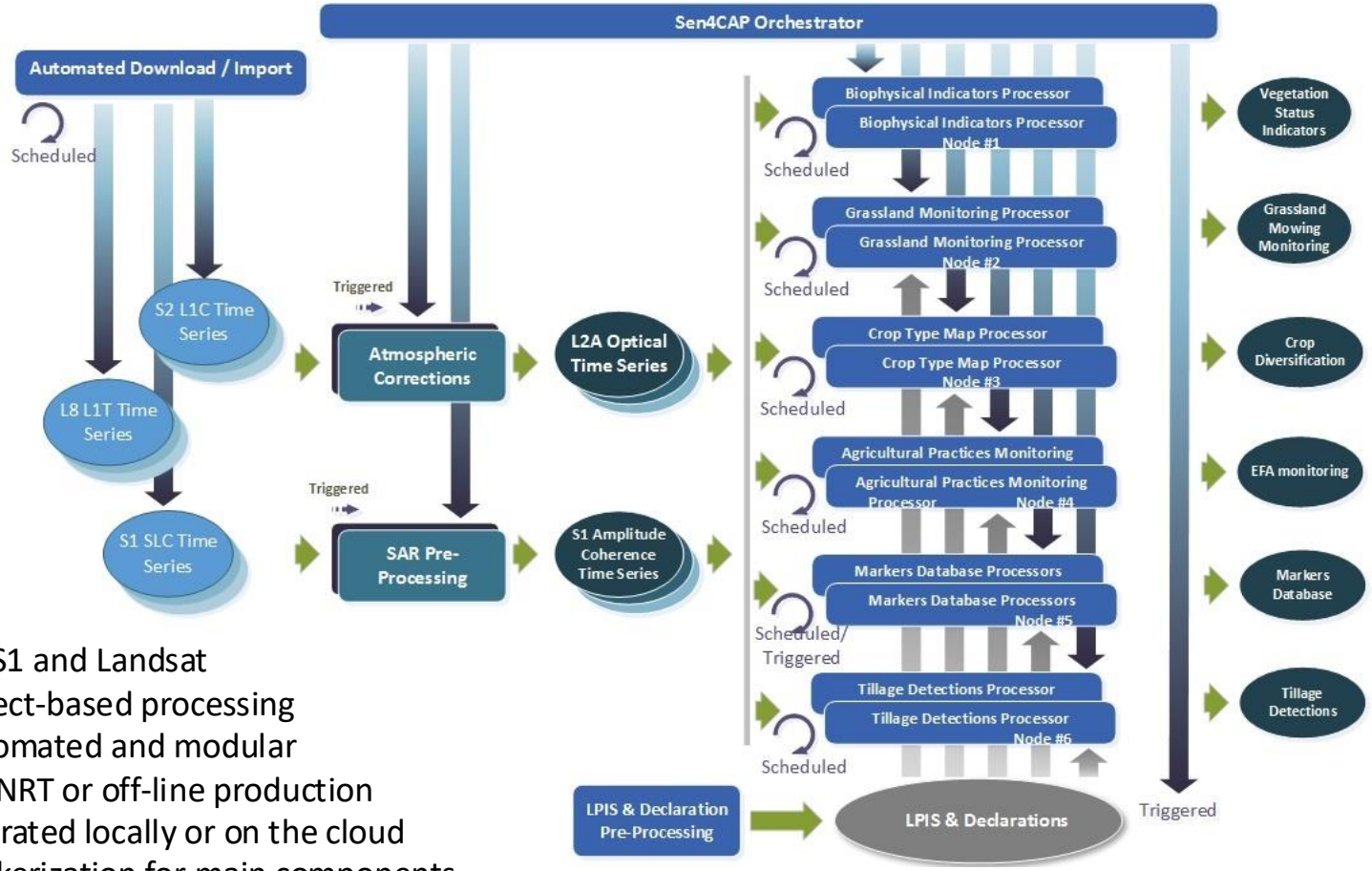


- 10m spatial resolution
- Minimum 6 days revisit
- Backscatter and coherence

Commercial Pléiades Neo

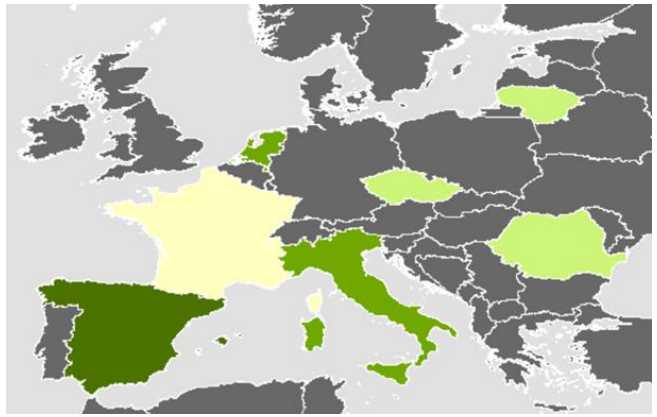
- 30cm spatial resolution
- 1 day revisit upon tasking request
- Spectral bands very suitable for agriculture (vis. red-edge, NIR)

Sen4CAP open source system for CAP monitoring demonstrated at national scale across EU



- S2, S1 and Landsat
- Object-based processing
- Automated and modular
- For NRT or off-line production
- Operated locally or on the cloud
- Dockerization for main components

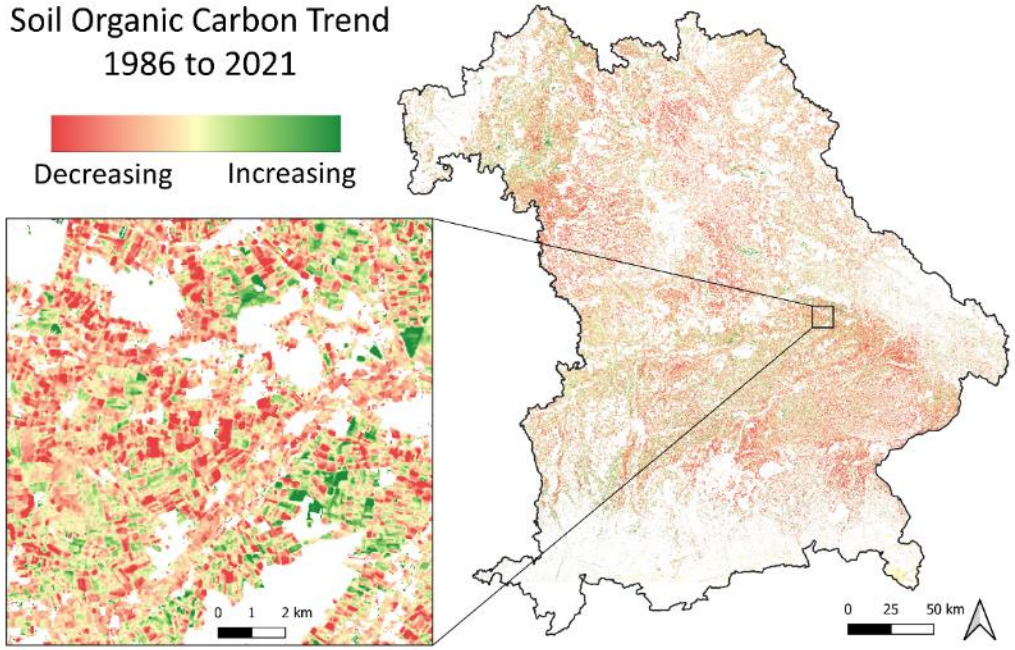
Sen4CAP pilot countries



EU Cloud offering Sen4CAP as a service
Current project on the Sen4CAP cloudification

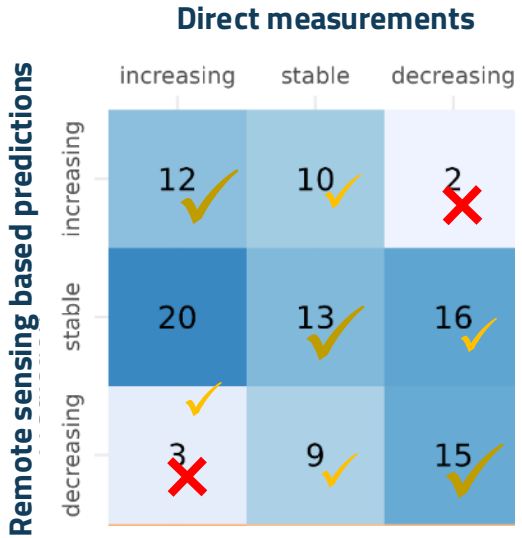
Remote soil C change detection for Bavaria

- Model applied to predict SOC every 5 years (1986 to 2021)
- Trends in SOC (g/kg/year) derived for every pixel
- Small-scale (field level) trends are visible!



Soil samples (direct measurements):

- 100 monitoring sites (croplands)
- Resampled 7 times: 1986 to 2022

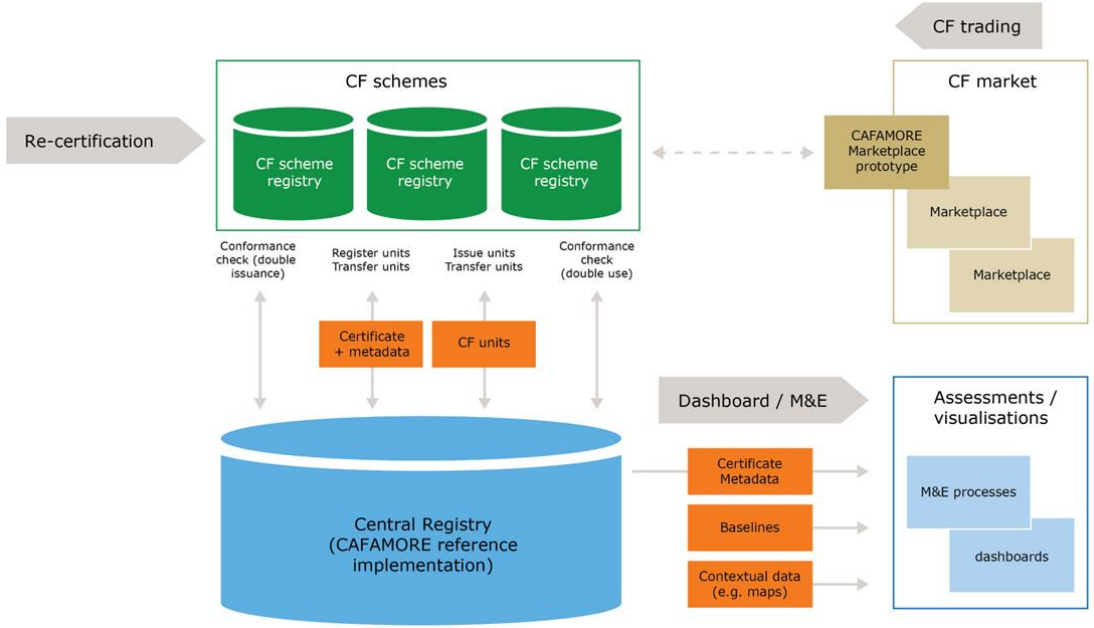


- Only 5% sites were completely off

Broeg et al. 2024, Global Change Biology

Challenges

- Definition of parcels
  - Which parcel delineation?
  - How to handle yearly changing sub-parcels?
  - Within field variation needed?
- Uncertainty quantification
- Get sufficient ground truth data
- Setup of the registry, serving multiple purposes
- ….



Suggestions / questions:

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Carbon Farming Monitoring & Registry

www.cafamore.eu

Funded by the European Union

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