Earth Observation services in support of agriculture and Common Agricultural Policy
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EO-based large scale topsoil Organic Carbon Services

Dr. P. Ilias, EV ILVO

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 869366.

ABOUT ME:

- GeoAI Engineer: Enjoy to design and develop IT solutions by applying Business Analysis best practices .
- Experience in various domains including AgriFood.
- Support current ILVO digitalization activities like the DjustConnect Data Sharing Platform or the Development of EU Food Waste Data Space.
- Responsible for the development of EO based services that can support the Topsoil Organic Carbon Estimation within the ENVISION and EJP-Soil Stereopes projects.

ABOUT ILVO:

- Flanders Research Institute for Agriculture, Fisheries and Food.
- Research Institute linked to the Flemish government**.**
- Created 85 years ago, 630 employees.
- One of ILVO mission is to support Flemish AgriFood community to its digitalization activities.
  - Data Sharing / API economy.
  - Digital Sovereignty.
  - Precision - Smart Farming.

ILVO

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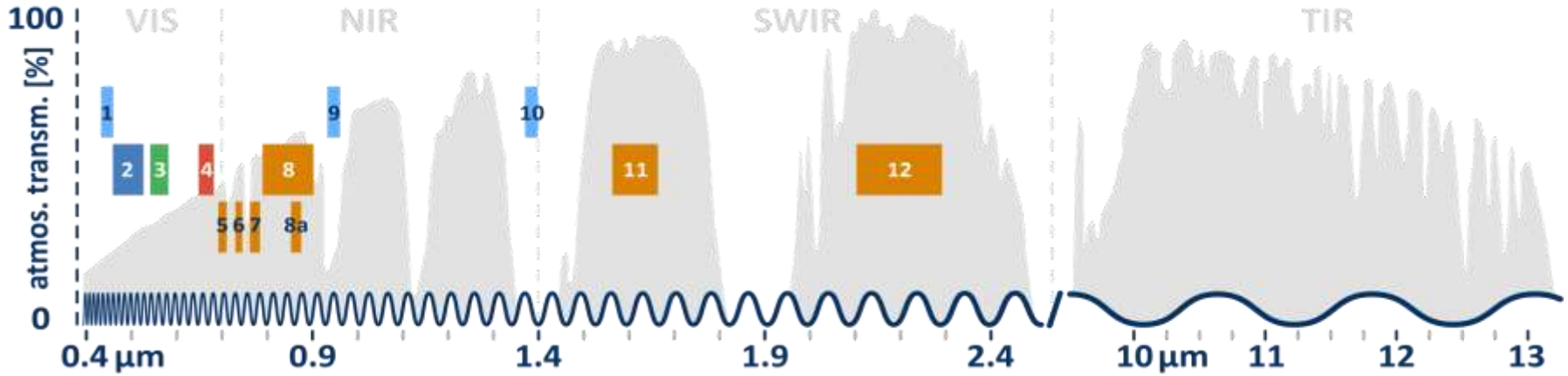
Our goal (in short) within ENVISION?

A service that delivers top-soil qualitative Soil Organic Carbon estimations at a parcel level, governing the CAP needs for soil organic carbon monitoring. The Service should provide estimations for the whole Flemish region (large scale).

How?

By using Sentinel 2 data (time-series), together with SOC lab measurements of collected soil samples (soil campaign). Using indicators for the assessment of bare soil.



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Significant Methodological Phases

Phase 2: Modeling

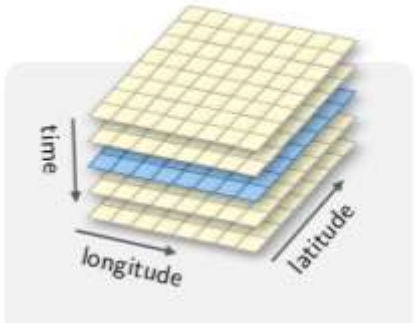
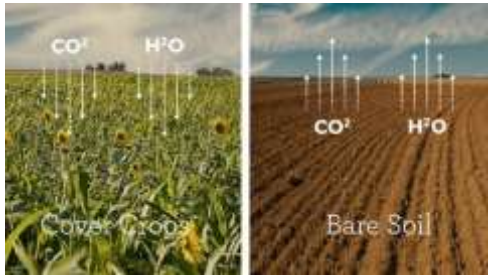
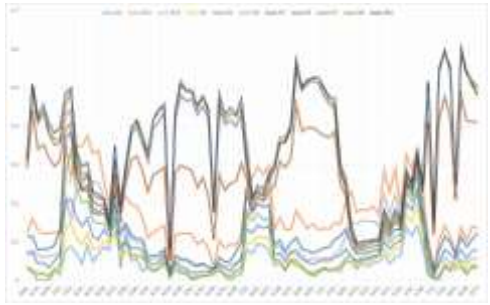
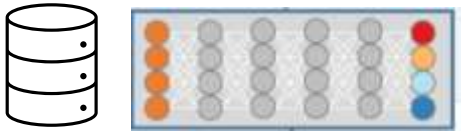


Image collection

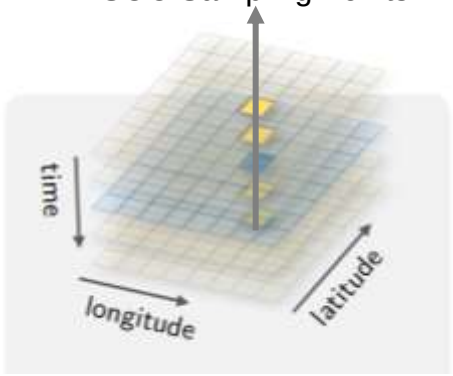
Identify Bare Soil Pixels







SOC Sampling Points



Cloudless Bare Soil Collection
(yellow pixels=bare soil)

Parcel Level

Regional Mapping

Parcel Level

SOC Maps (West Flanders)

Phase 3: Model Deployment

Phase 1: Bare Soil (Crop Land)

Phase 5: Improvements

Phase 4: Validation

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Flemish Use case

Enhance and simplify the SOC monitoring process:

- ✓ Provide a continuous overview of the state of soils.
- ✓ Avoiding the on-the-spot checks.
- ✓ Evaluating the SOC level over the whole parcel or farm and no more based on-the-spot inspections.
- ✓ Reduce effort, time, and resources.
- ✓ Reduce the administration burden for farmers and for LV.
- ✓ Reliable information on the declared parcels.

DEPARTEMENT LANDBOUW & VISSERIJ

ILVO
Flanders research institute for agriculture, fisheries and food

Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Phase 1 • Bare Soil • Soil Campaign	Phase 2 • Modeling	Phase 3 • Deployment	Phase 4 • Validation	Phase 5 • Improvements

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Feedback and lessons learned

Major Improvements per phase:

- **Phase 1: Base Soil Assessment in Agricultural (Crop) land.**
  - More focus/work to understand the story of data sets. Deal as a time series analysis problem. The use of median values without criteria is not suggested. Clean/Filter remove the noise.
  - Use of Crop-Soil-Water Indices together with data describing Farm Practices at parcel level. Those data deliver critical markers.
  - First, the development of a Bare Soil Collection and then the design of the Soil Campaign.

Feedback and lessons learned

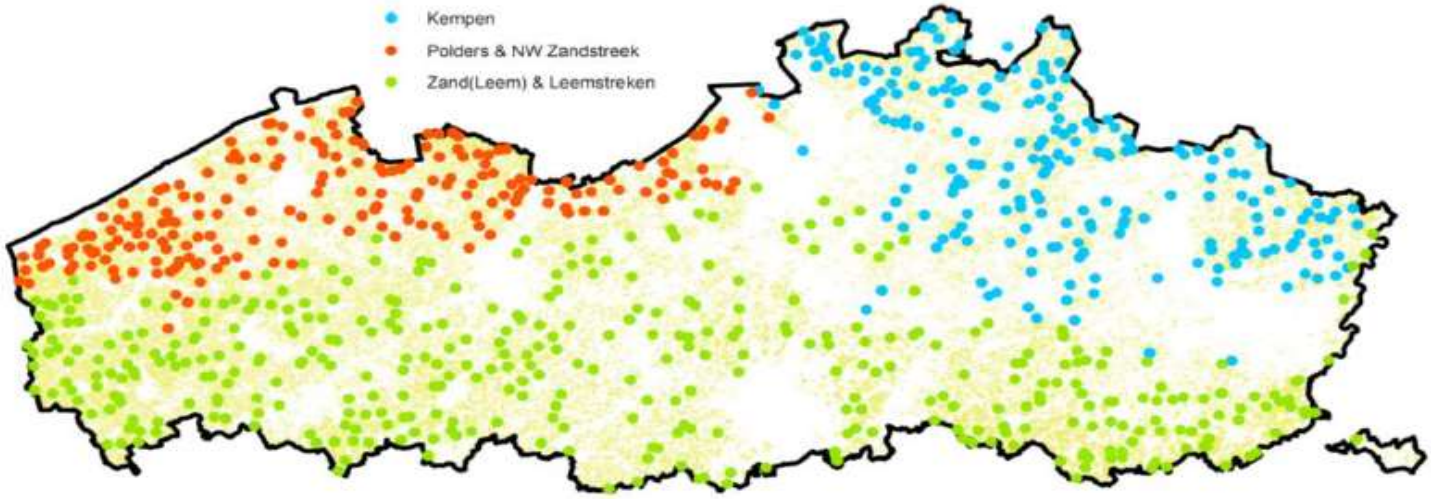
Major Improvements per phase:

- **Phase 2: Modeling.**
  - The number of needed sampling data increases with the coverage area. How? Is it possible to enrich our training set with other training sets? How can we support SSL data sharing?
  - Use Phase 1 products (Bare Soil Collection) and other auxiliary data to optimize the sitting process.
  - Apply “Smart Ways” to link sampling data with the Bare Soil Collection. Its not a one-to-one mapping because one sampling point may have many reflectance signatures.

Feedback and lessons learned

Major Improvements per phase:

- **Phase 3: Model Deployment (+Service Business Logic)**
  - Comparing with Smart Farming, at CAP the annual SOC monitoring, at parcel level, requires higher accuracy. How to inherit the accuracy of the model to the map products? It's a challenge.
  - Use of SOC Classes instant of actual SOC model predictions?
  - How to deal with ML black boxes? As humans we want to understand how it works. Develop and Provide a CAP service logic.



Flemish C-Monitoring network

Next Steps:

- **Phase 1:** Use of Hyperspectral imagery (EnMAP, not within ENVISION).
- **Phase 1**: Work more on development of Bare Soil Collection, however this approach have limitations.
- **Phase 2:** Use as markers data describing Farm management practices. With the support of DjustConnect (within ENVISION).
- **Phase 2:** Use of Model Sharing practices to overcome Data Sharing barriers (DjustConnect Data Space + Federated AI).
- **Phase 2 & 4:** Use C-Monitoring data (try within ENVISION).
- **Phase 3:** Identify within ENVISION together with LV and LC, compatible ways to the CAP needs, to deliver the modeling results.

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Thank you for your attention!

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