Eyes from Space: Satellite Intelligence for Monitoring Organic Farming and Sustainability

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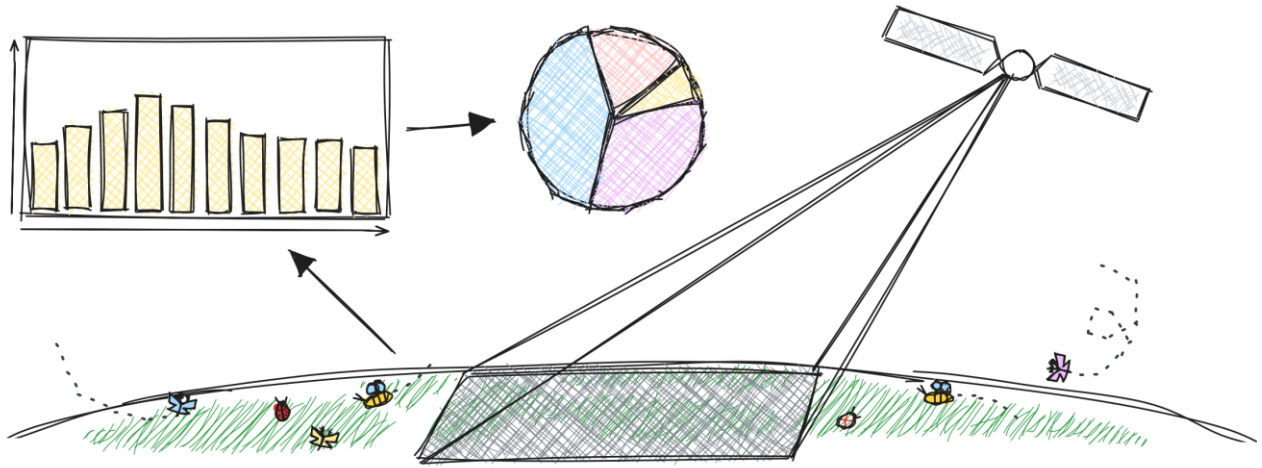
SINERGISE

THEROS

Motivation

- Monitoring large amounts of fields for organic compliance is
  - Time consuming
  - Expensive

Satellite imagery can be used to replace part of the checks or as a signal for targeted inspections.



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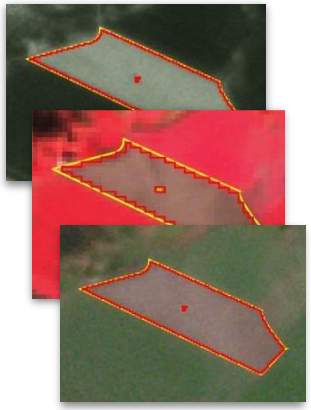
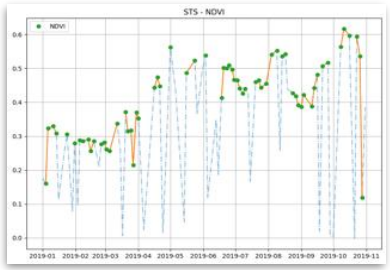
Deriving insights from satellite imagery

Raster Data → Signals → Markers → Decisions



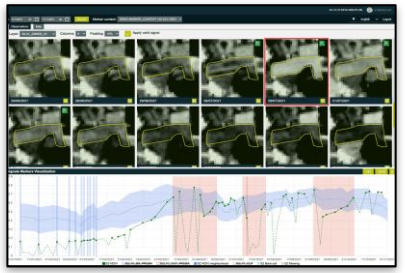
Fusion, ARPS, Sentinel-2, Sentinel-1, PVs



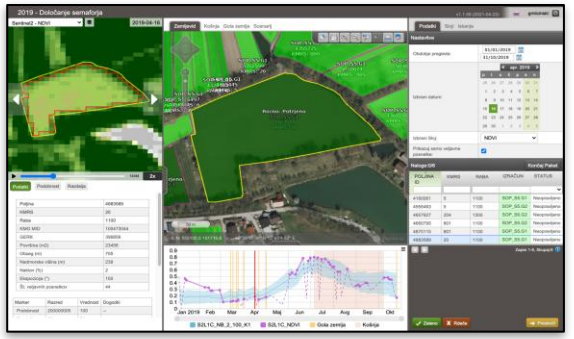
Time Series

Statistics

Markers



Events: greening, harvest, Crop type, organic status



Business rules

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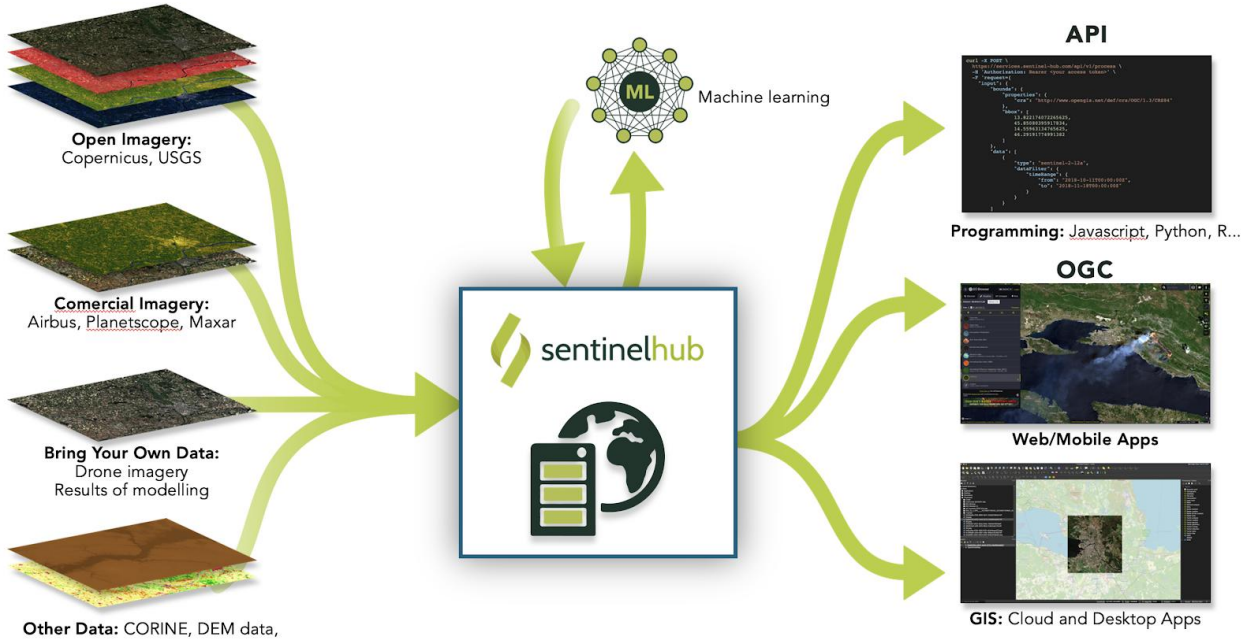
Satellite imagery timeseries

- We are using information from the **Sentinel-2 satellite**
- We extract the reflectance values from the imagery pixels that are within the boundaries of the parcel
- We are using the Sentinel Hub service for processing the data



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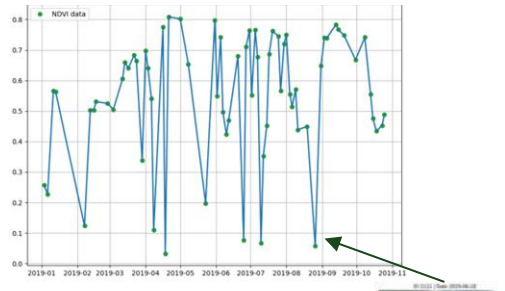
Signals Processing

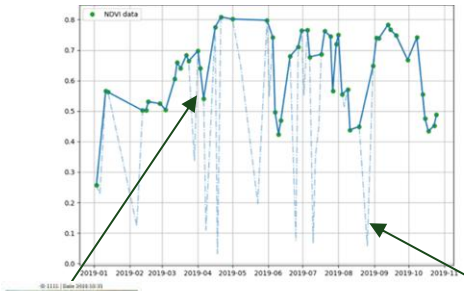
s2cloudless
- machine-learning (ML) approach
- applicable over all land types
- available on Sentinel Hub (and open-source)

Sentinel-2 L2A SC

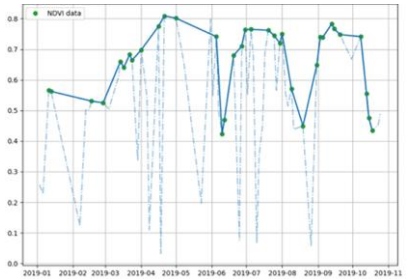
observation outlier detector
- ML approach (simplistic model)
- based on a small set of labels (~1k parcels)
- not meant for all land-types (unless supported by labelled data)
- focus on artefacts: missed clouds, cloud shadows, haze, ...



NDVI without clean-up



NDVI without clouds



without clouds or outliers

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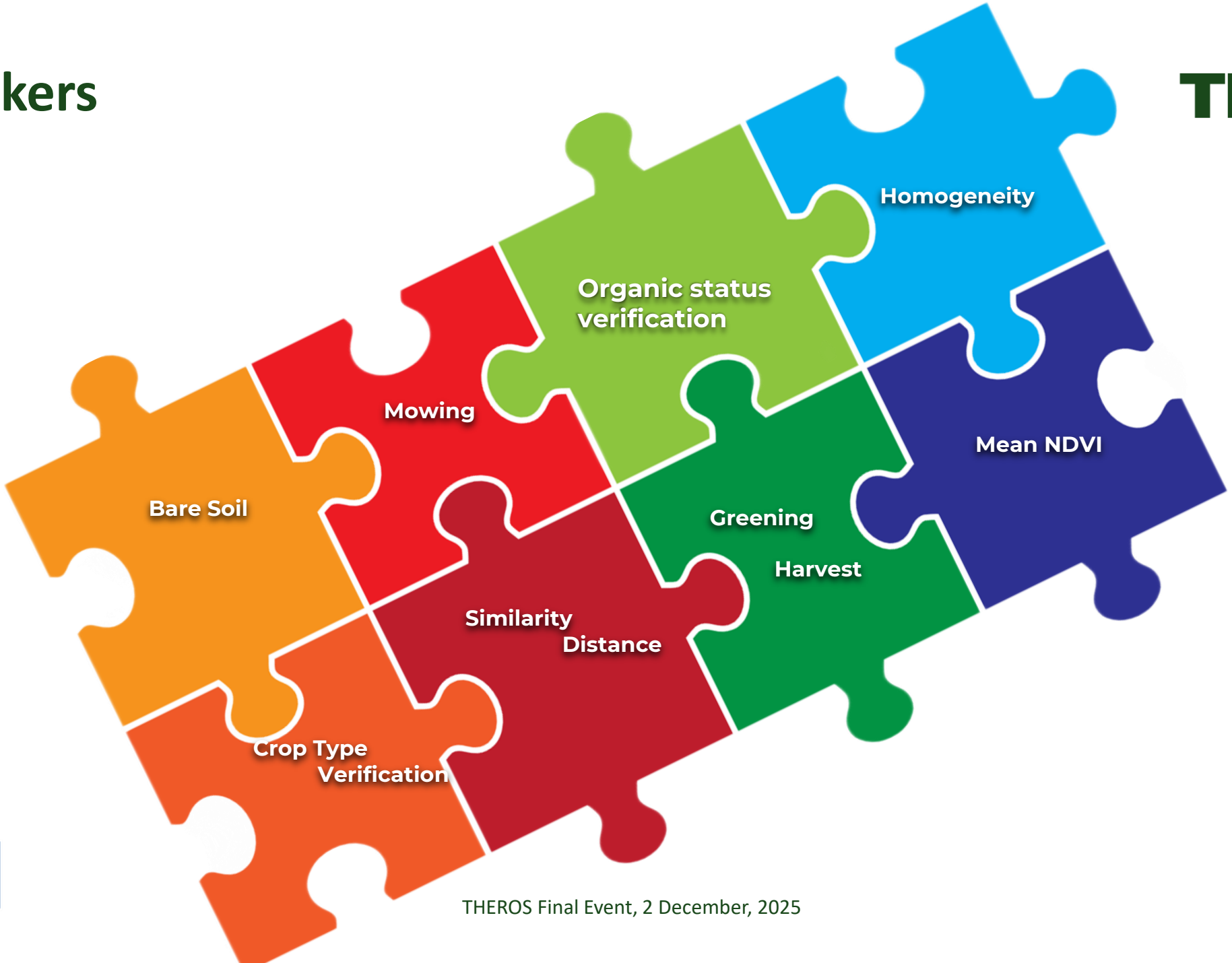
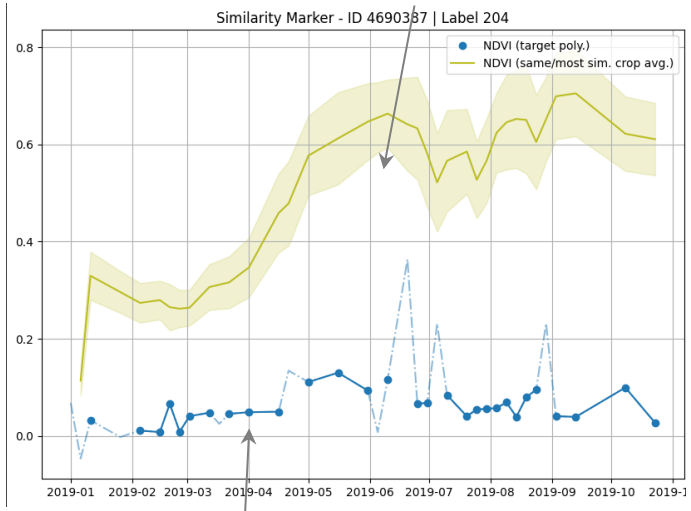
Markers


Homogeneity
Organic status verification
Mowing
Bare Soil
Mean NDVI
Greening
Harvest
Similarity
Distance
Crop Type Verification

Mean NDVI

Example claimed to be permanent meadows



NDVI profile of this FOI

Digital Orthophoto

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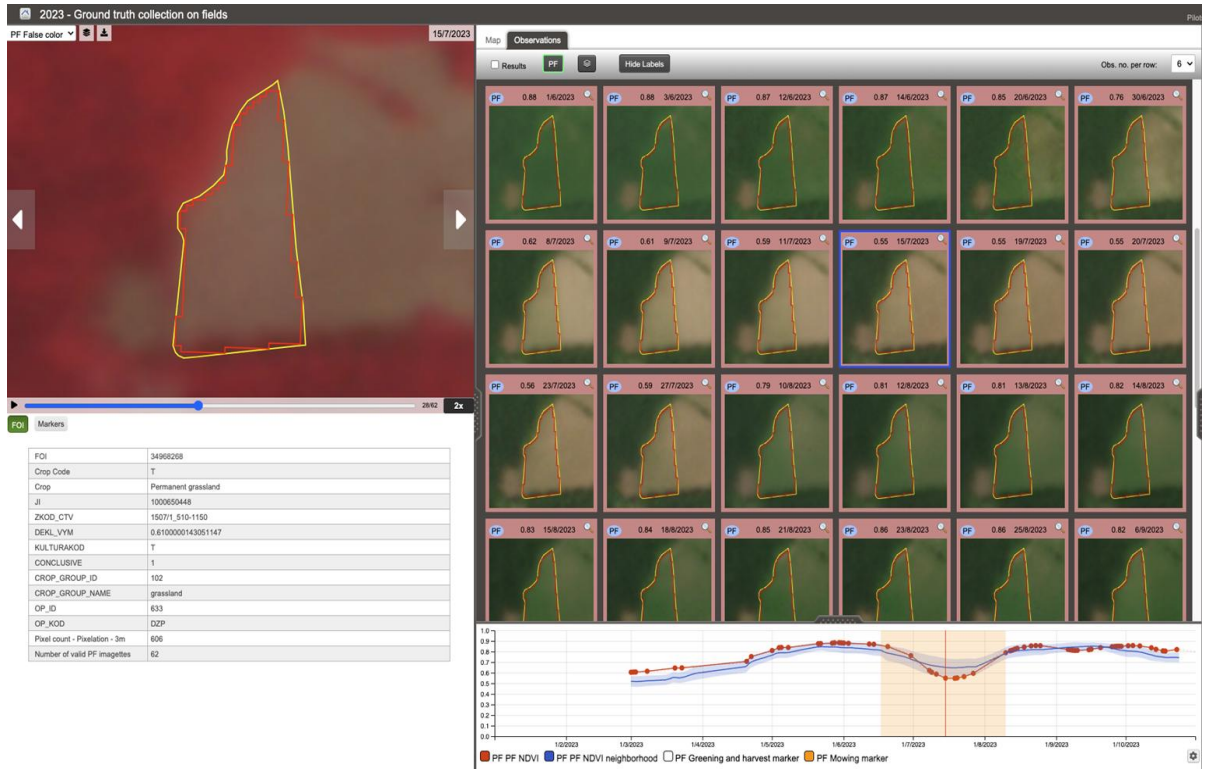
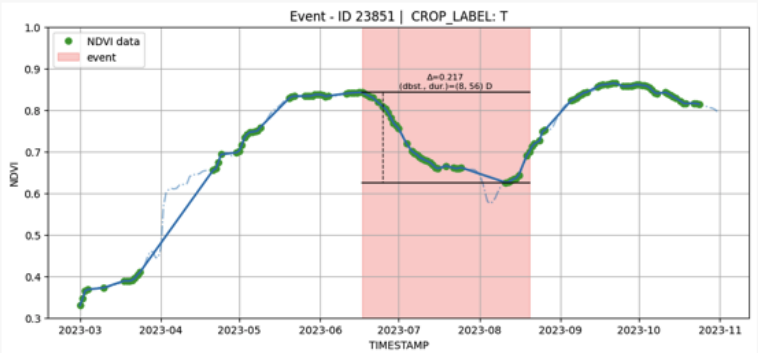
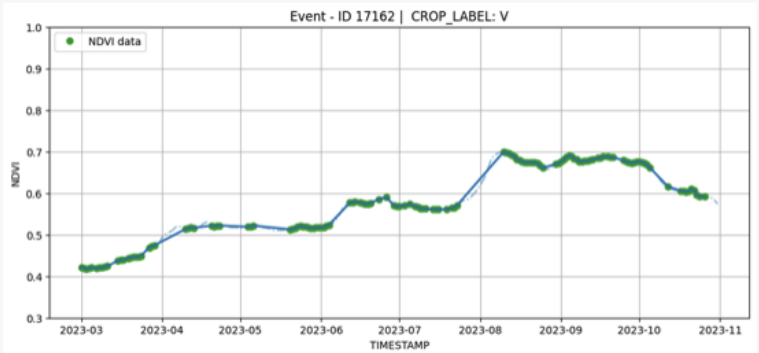
Mowing marker



FOI	34968268
Crop Code	T
Crop	Permanent grassland
JI	1000650448
ZKOD_CTV	1507/1_510-1150
DEKL_VYM	0.6100000143051147
KULTURAKOD	T
CONCLUSIVE	1
CROP_GROUP_ID	102
CROP_GROUP_NAME	grassland
OP_ID	633
OP_KOD	DZP
Pixel count - Pixelation - 3m	606
Number of valid PF imagettes	62





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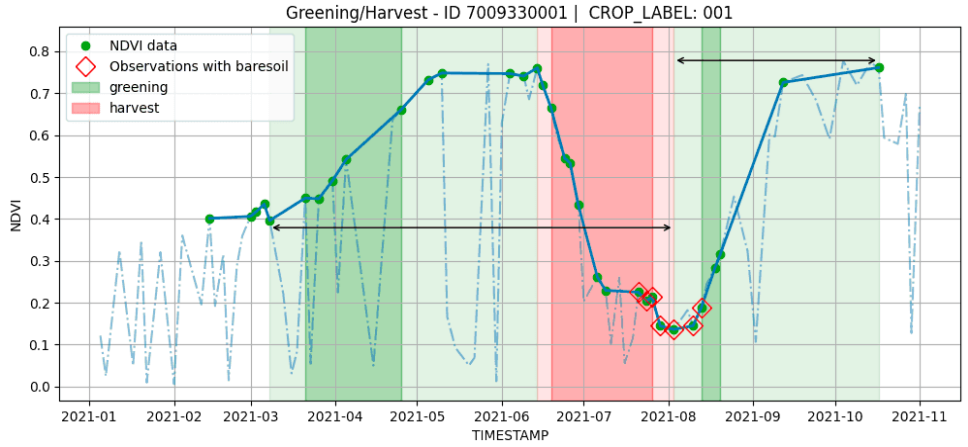
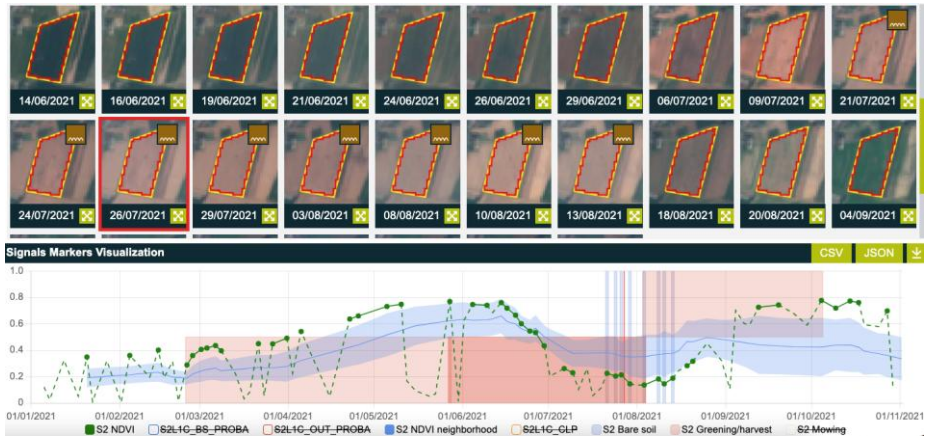
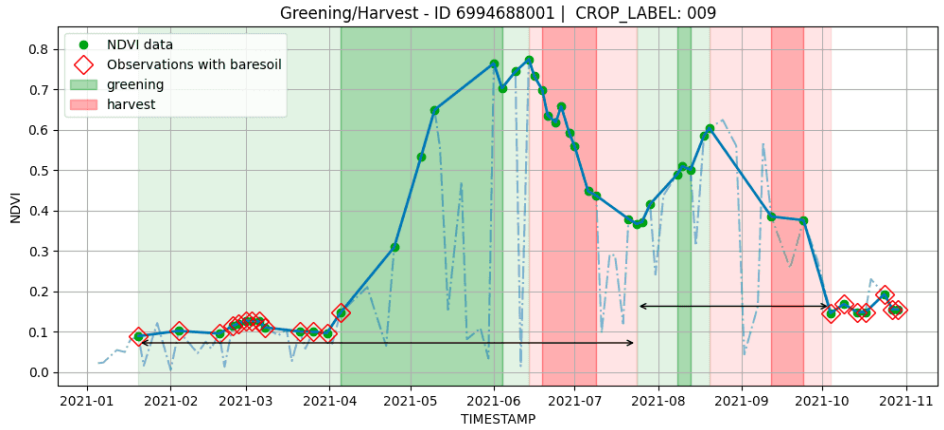
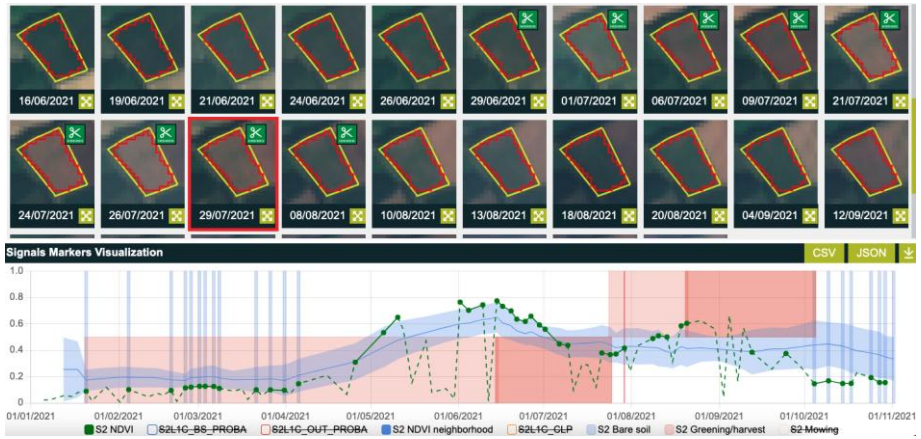
Greening / Harvest Marker









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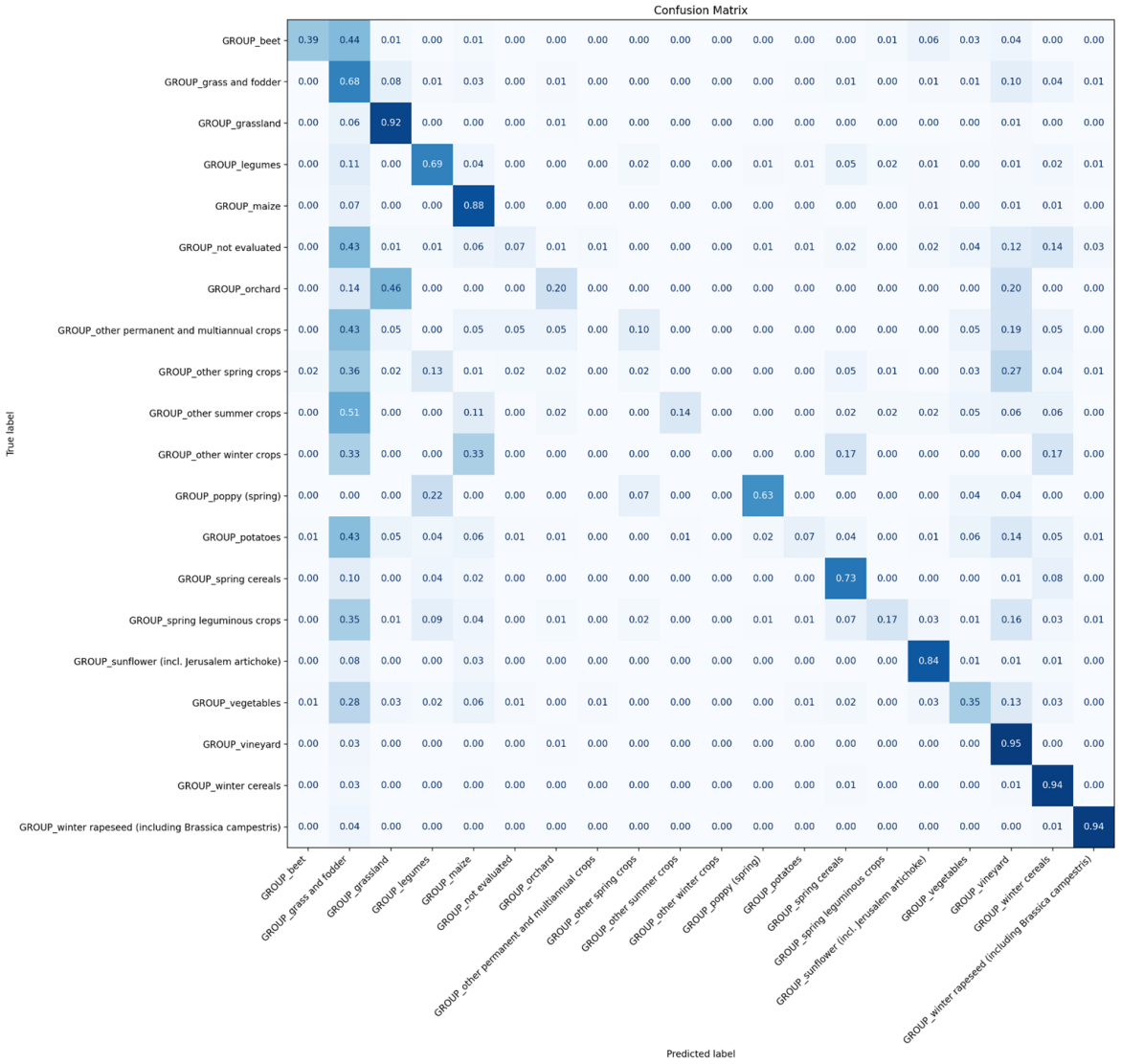
Crop Type Validation Marker



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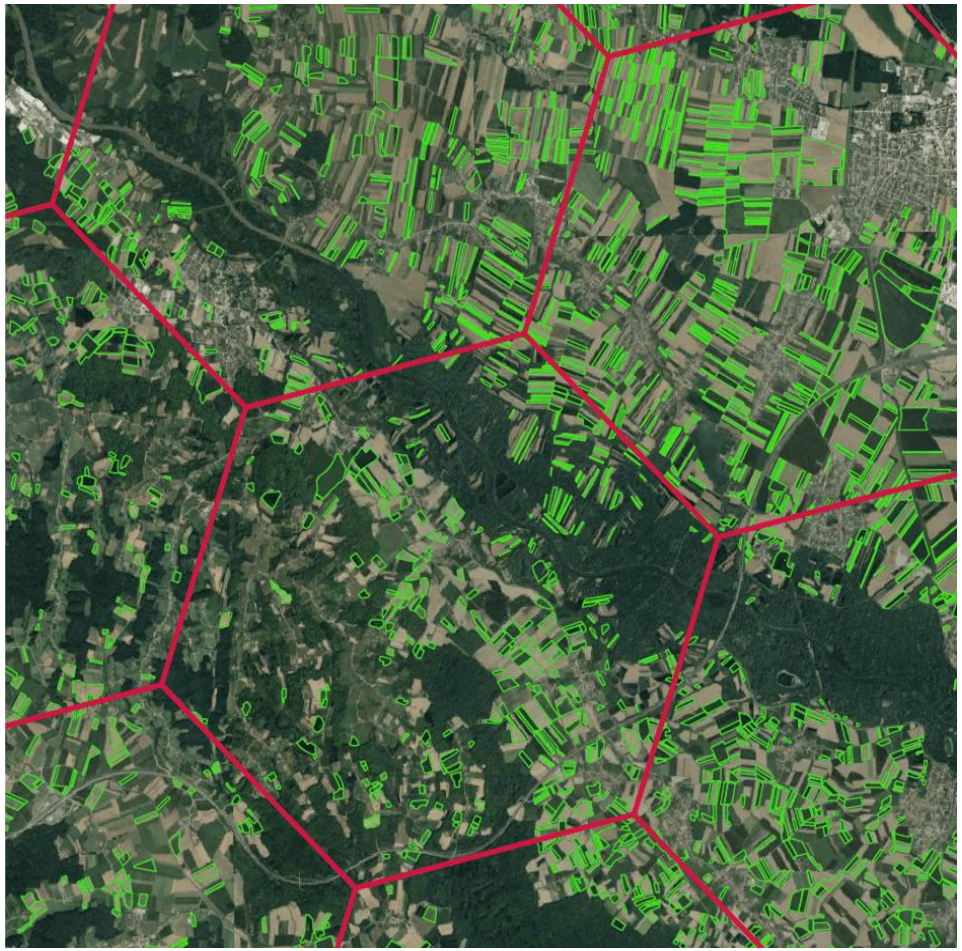
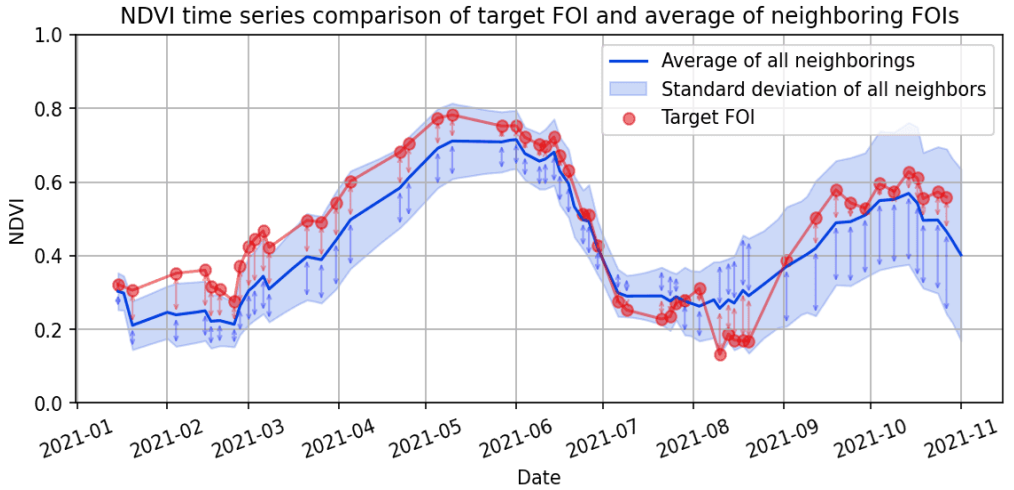
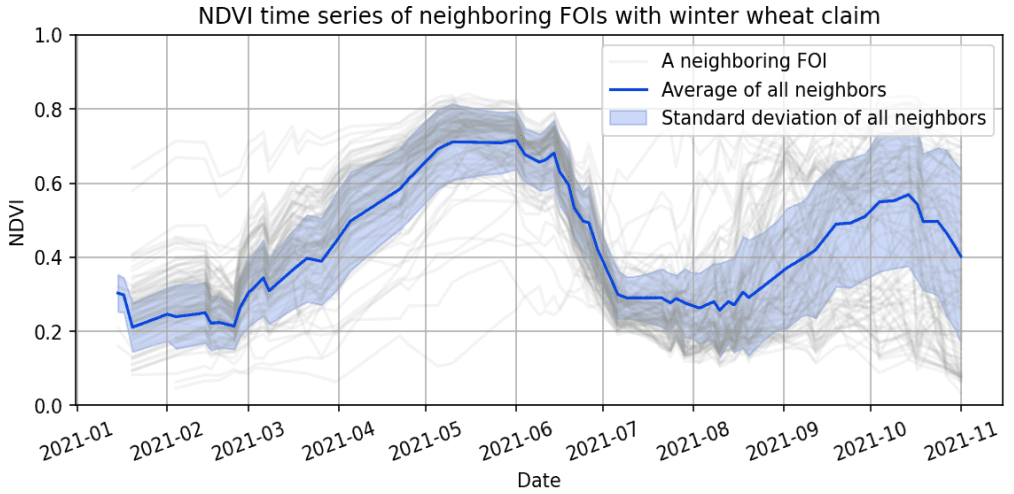
Similarity / Distance Marker







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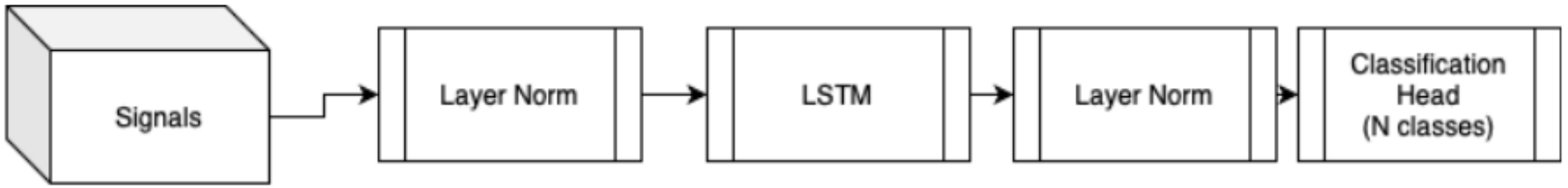
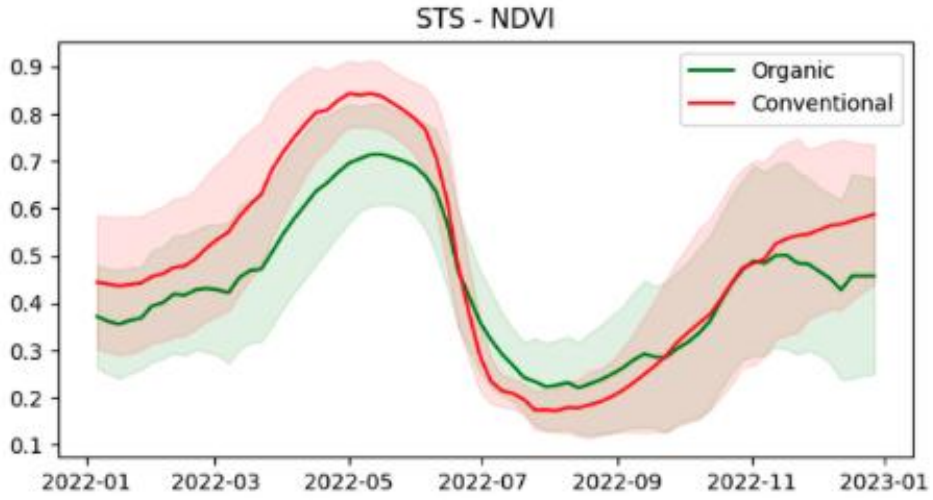
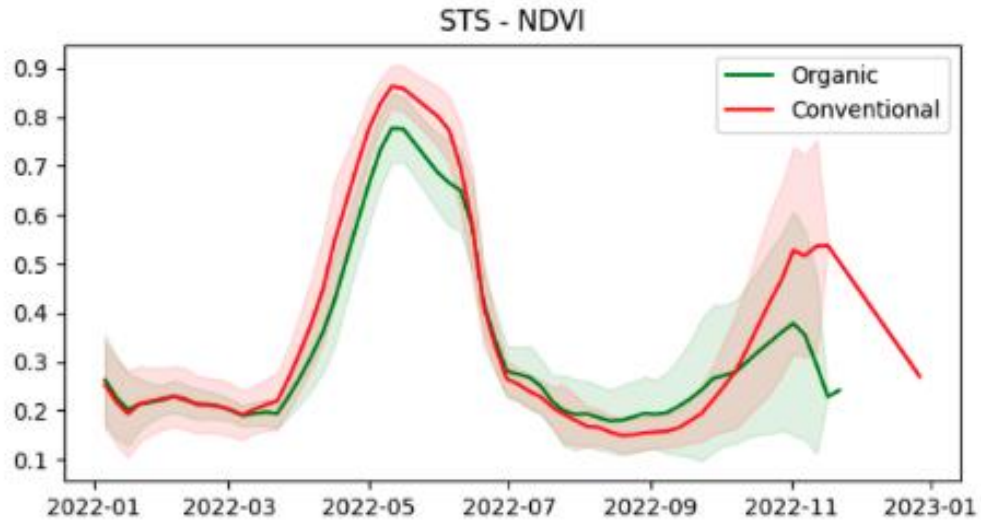
Organic / Conventional Marker





Soft wheat



Barley

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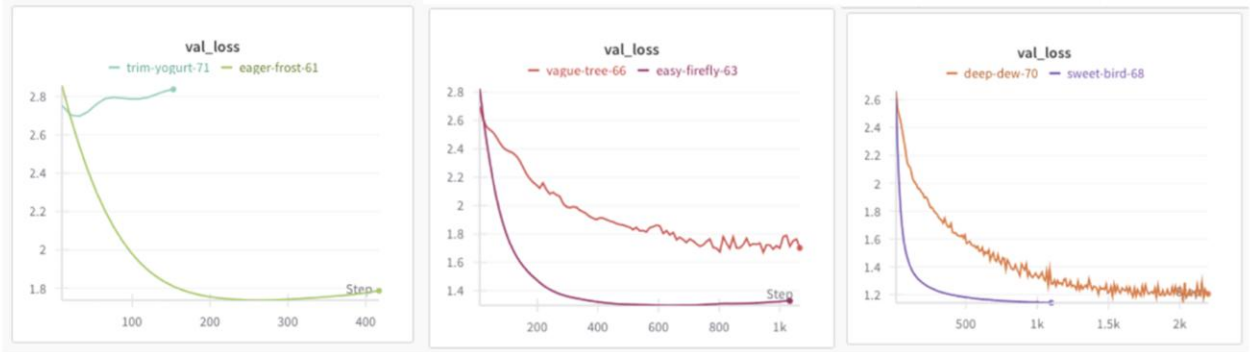
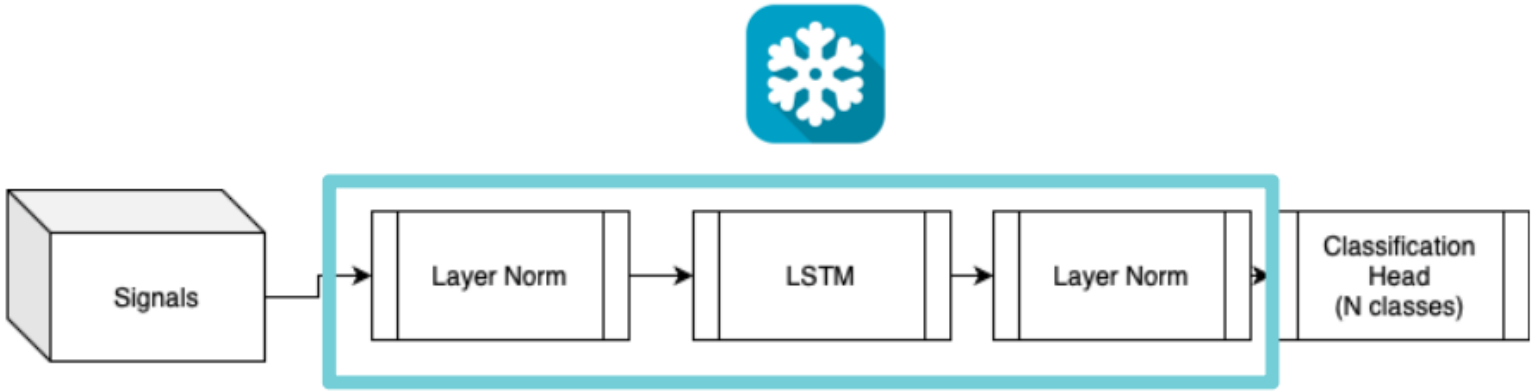
Generalization of the models

- One of the goals of the THEROS project is to ensure that Markers can be applied across larger areas
- Take a pretrained crop classification model that was trained on a large geographically diverse dataset (based on Eurocrops dataset) and fine tune it
- **Improves the classification performance, especially if number of samples is low**





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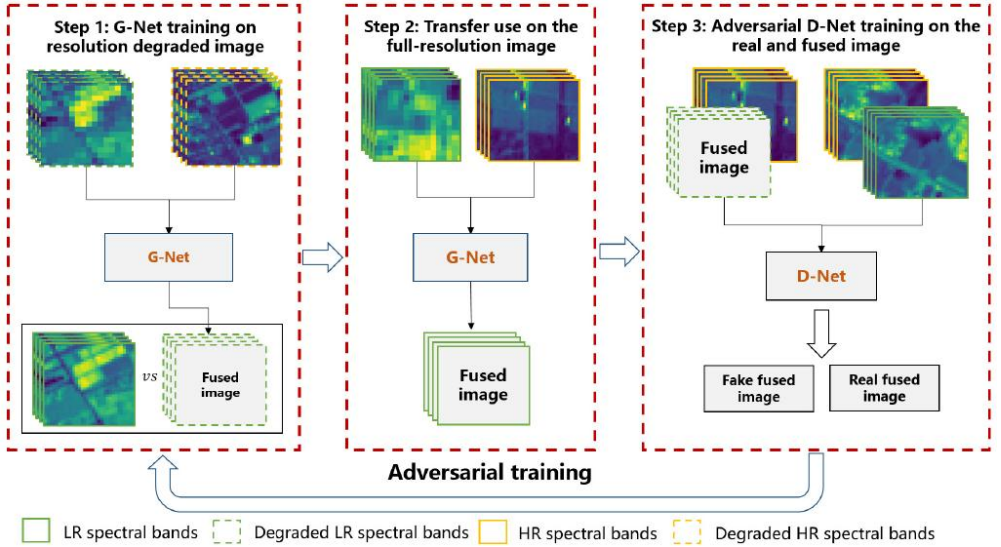
Super Resolving lower resolution Sentinel-2 bands

- Red, Green, Blue, Near-Infrared bands at 10m resolution, other bands are at 20m or 60m resolution
- **For agricultural monitoring the 10-meter bands can be sufficient, there is still information in the other bands that can aid the models in analyzing the field.**
- To offset this issue, **we want to enhance the lower resolution (LR) bands from their native 20 m and 60 m spatial resolutions to the resolution of the HR bands**, i.e. 10 m/pix,



The FusGAN approach proposed in Luo et al. (2020).

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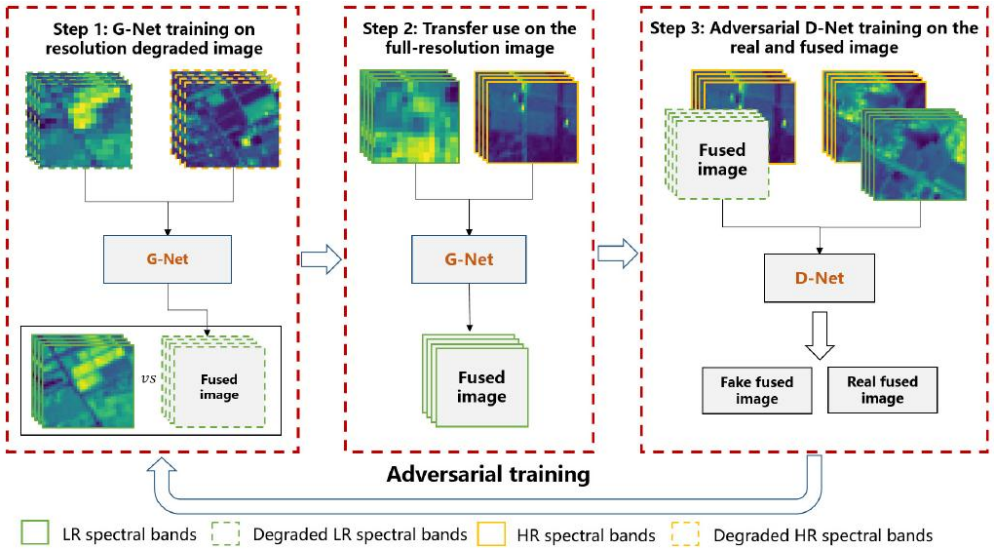
Markers on Super Resolved imagery

- We apply SR model over all Sentinel-2 observations that cover the AoI
- We compute markers both using signals derived from Super Resolved imagery and from the original imagery.
- Improvement observed for small (or narrow) parcels



The FusGAN approach proposed in Luo et al. (2020).

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Thank you for your attention!

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