



# AUTOMATED AGRICULTURAL FIELD DELINEATION TOOL

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# Agenda



- What is the delineation tool and what it can be used for
- Overview of the technical components.
- Discussion on open sourcing and knowledge sharing



# Introduction



## What?

- A tool for automatic delineation of agricultural parcels based on Sentinel-2 images.
- Source code with instructions available on [GitHub](#).

## Input data?

- Sentinel-2 10m (B-G-R-NIR) bands.
- GSAA vectors.

## How?

- Using supervised deep learning - ResUnet-a.



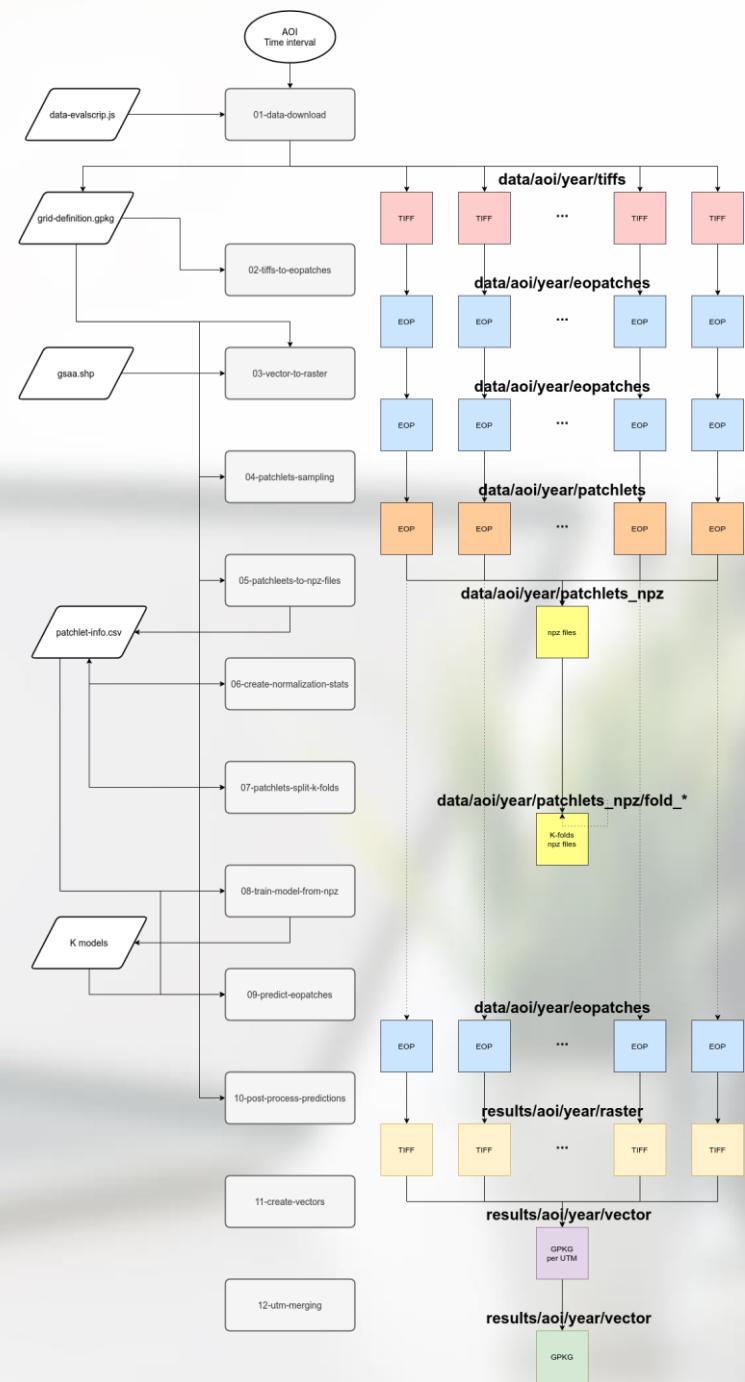
# Main tools utilized

- Sentinel Hub large-scale batch processing API for download.
- AWS S3 for storage.
- eo-learn and eo-flow open-source frameworks.
- Tensorflow for training & inference.
- In addition, the field delineation workflow uses the following:
  - Docker containers;
  - psql PostgreSQL database;
  - gdal geospatial processing library, version >2.4.0.



# Main steps

1. Data download
2. Preparing EOPatches
3. Sampling
4. Conversion to training-ready format
5. Normalization
6. Split into K-Folds.
7. Training
8. Prediction
9. Post processing
10. Vectorisation



# Data download

- Sentinel-2 imagery over the area of interest is downloaded using Sentinel Hub Batch API:
  - 10 meter bands (R, G, B, NIR).
  - Time interval of the downloaded data can be arbitrarily set - usually covers the growing period when fields are not bare.
  - The 10km (overlapping) UTM grid is used.
- Resulting GeoTiffs are stored to the AWS S3 bucket.



# Preparing EOPatches



GeoTiffs are converted into EOPatches.

If training a field delineation model, reference field boundaries are added to the EOPatches.

Extent, boundary and distance masks are computed and stored.

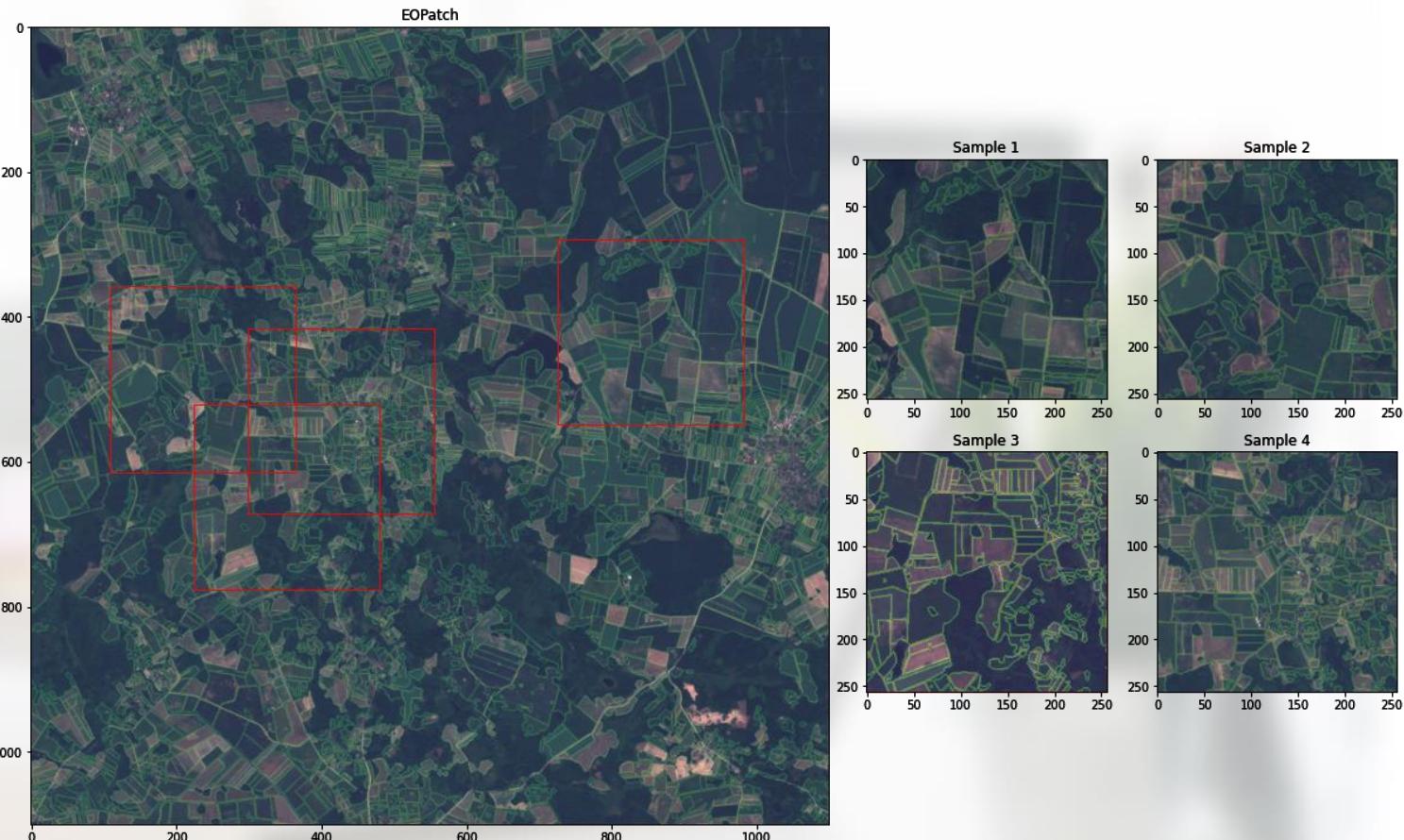


# Sampling

Smaller patchlets are sampled from the EO Patches.

Constraints can be imposed on the underlying reference of the sampled patchlets.

Supports sampling of positive and negative samples.

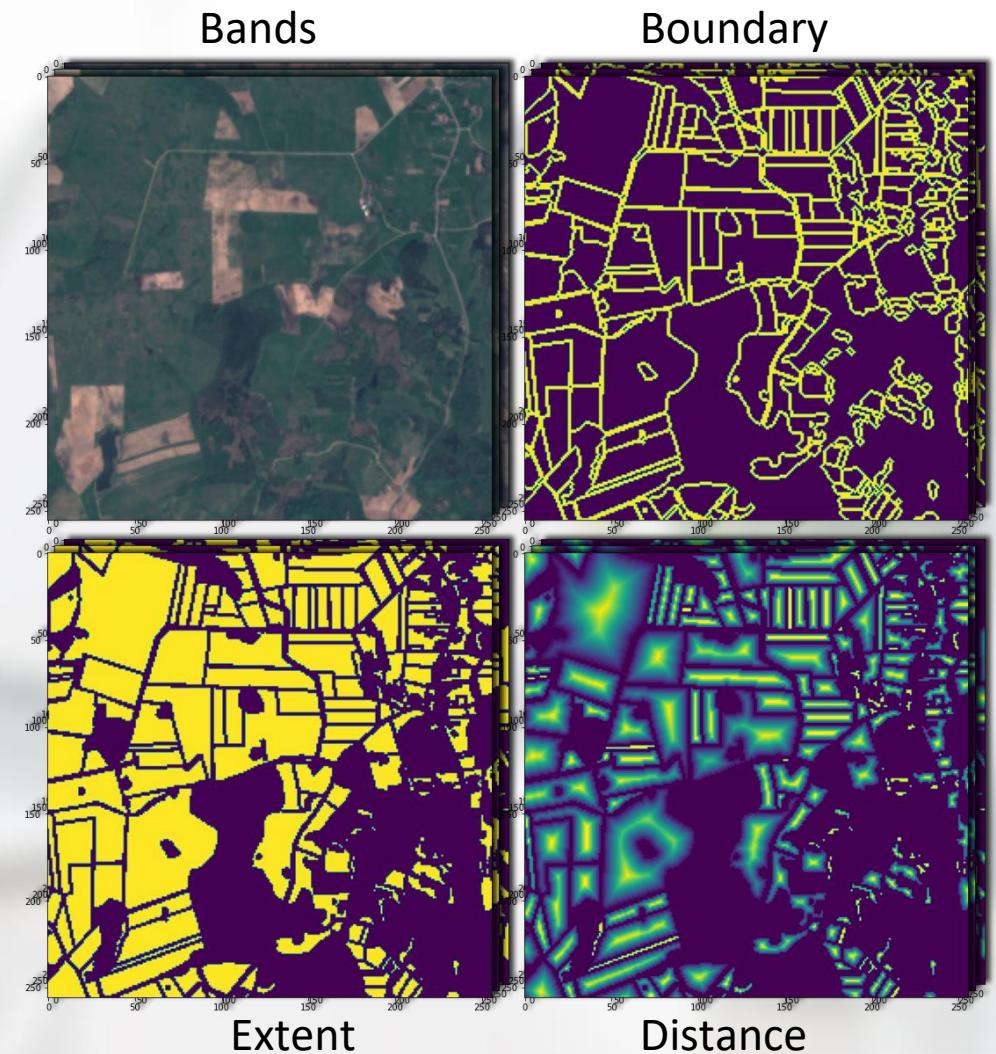


# Conversion to training-ready format

The sampled patchlets are chunked and stored into multiple .npz files, allowing to efficiently access the data during training.

The NPZ files store the features and the targets.

Having the data in such a format allows us to efficiently load the data directly from S3 storage during training.

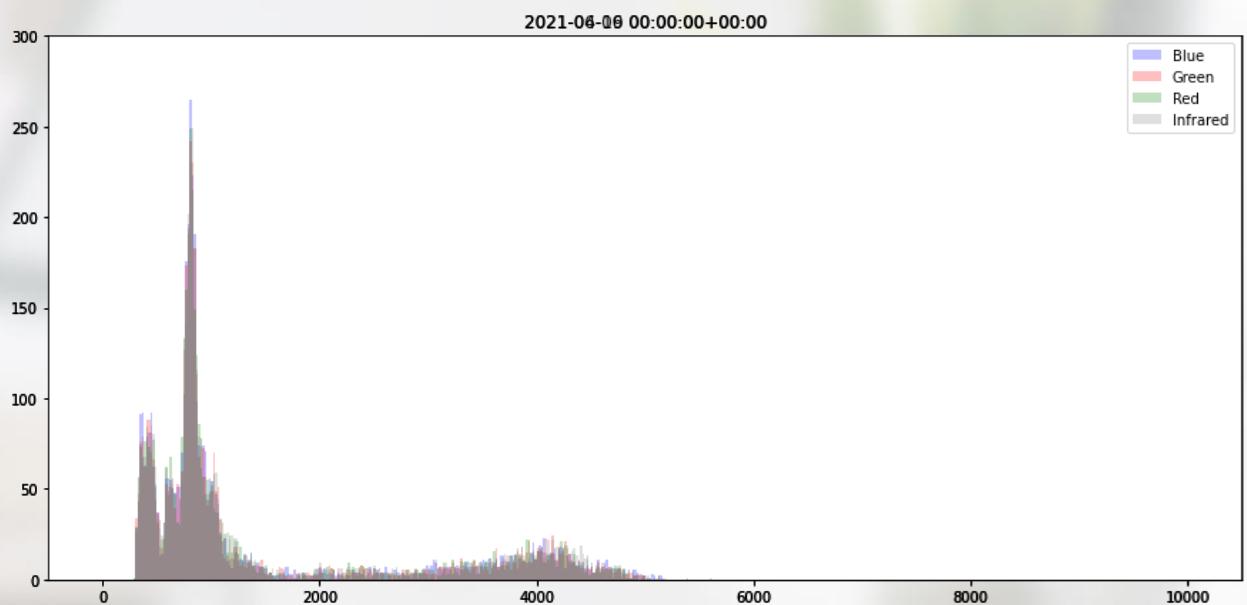
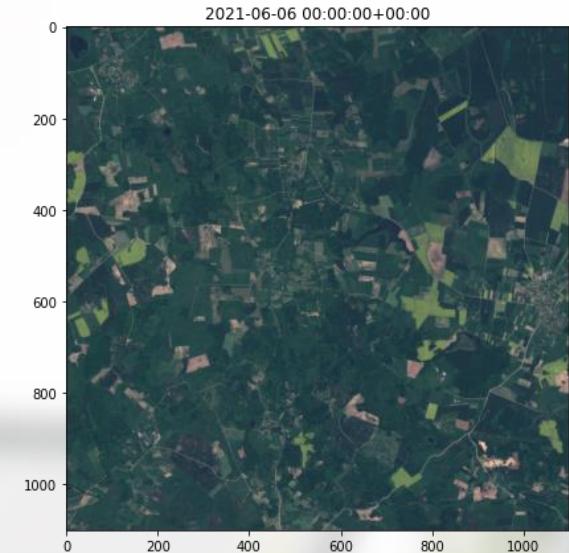
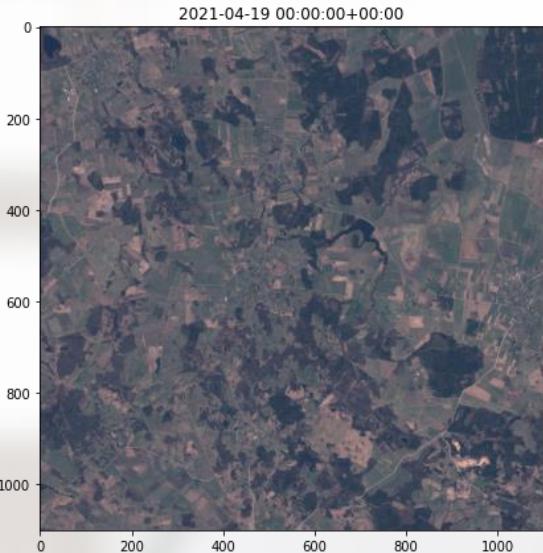


# Normalization

The model needs to perform well over timestamps taken over the whole year, but the distribution of the bands differ through time.

Normalization statistics computed on a monthly basis.

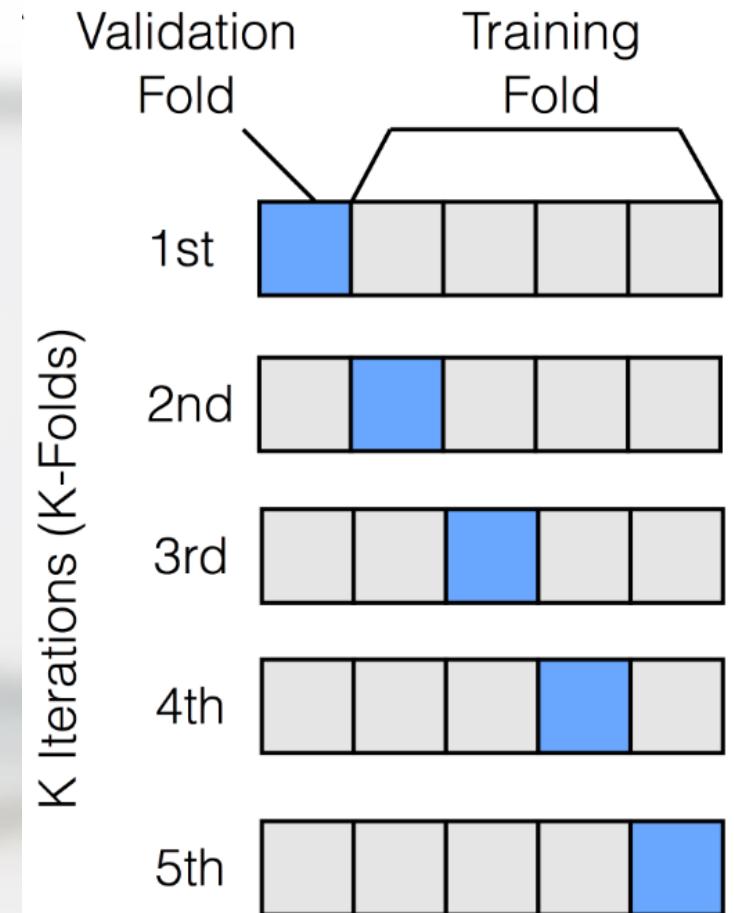
Multiple statistics are computed.



# Split into K-Folds

Since small patchlets can be sampled from the same EOPatches and can overlap, split of the data has to be performed at the EO Patch level. Additionally, all timestamps of a patchlet need to belong to the same split.

Data is split into N folds, where N is user defined.



# Model & training

Based on ResUnet-a (Waldner et al.<sup>1</sup>).

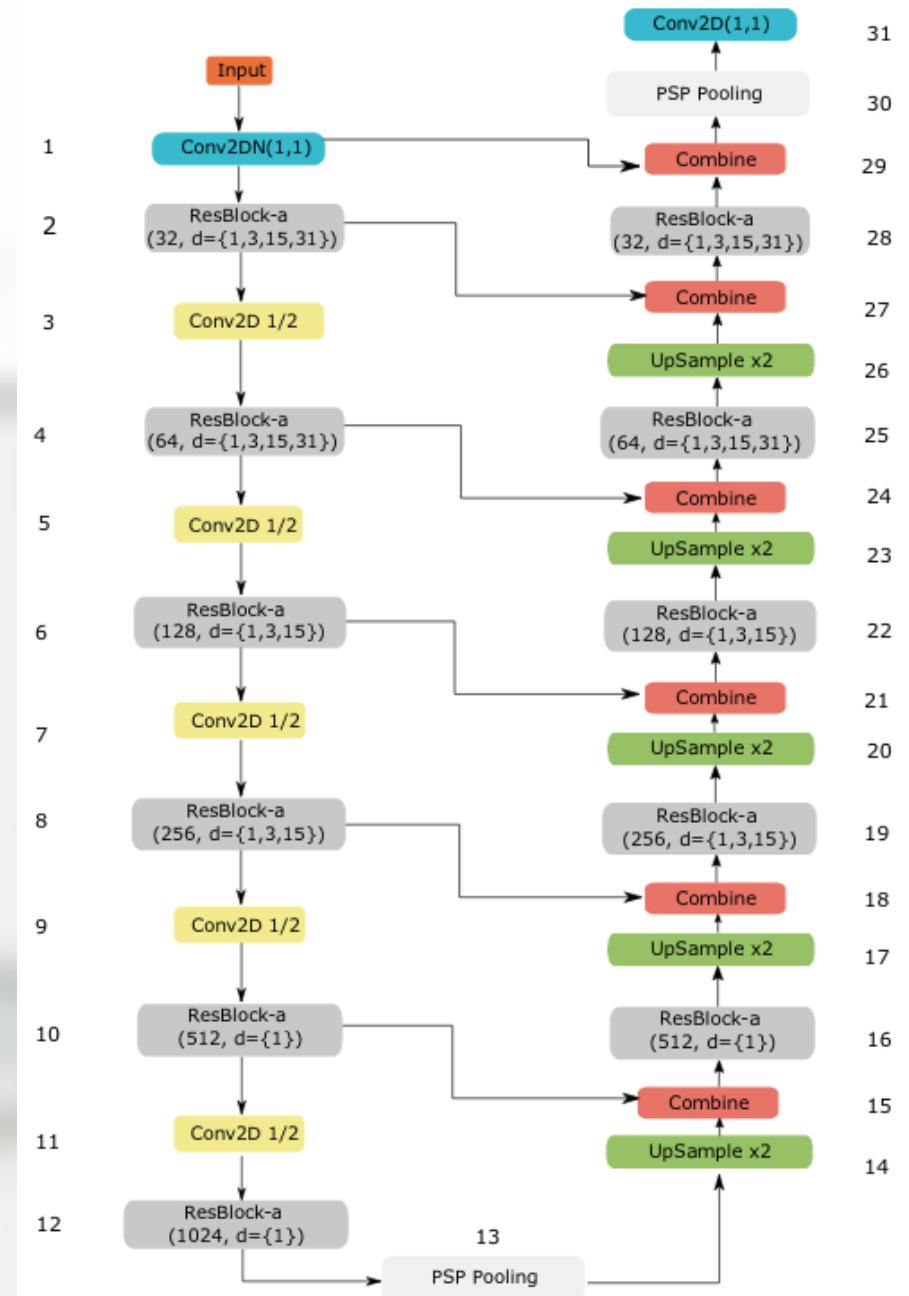
Implemented using eo-flow.

Learns to predict extent as well as boundaries and distance.

Prediction is done for each available acquisition (single-temporal).

Train k models, one for each left out fold.

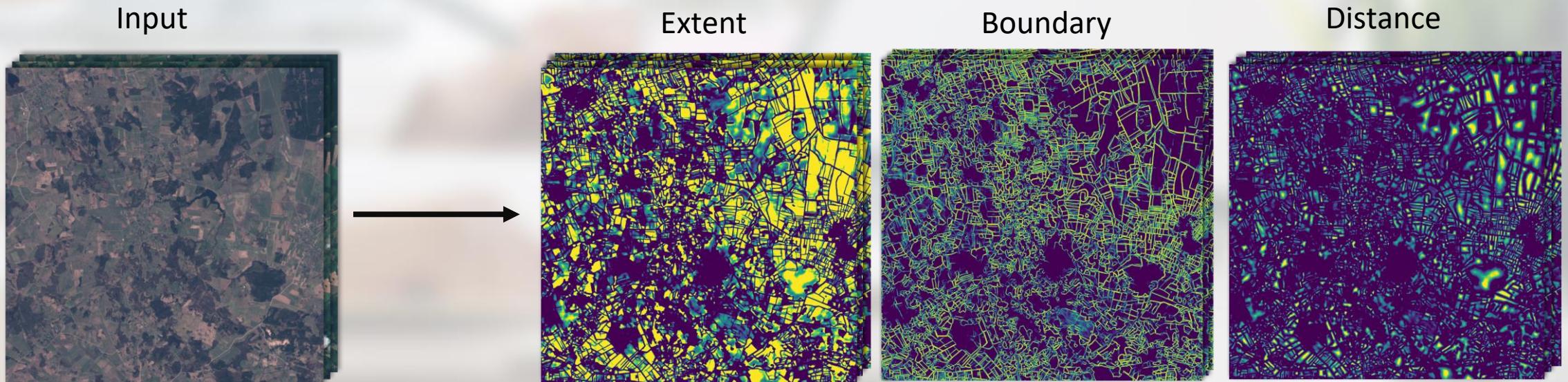
A single model is derived by averaging the weights of the k-fold models.



<sup>1</sup> <https://arxiv.org/pdf/1910.12023.pdf>

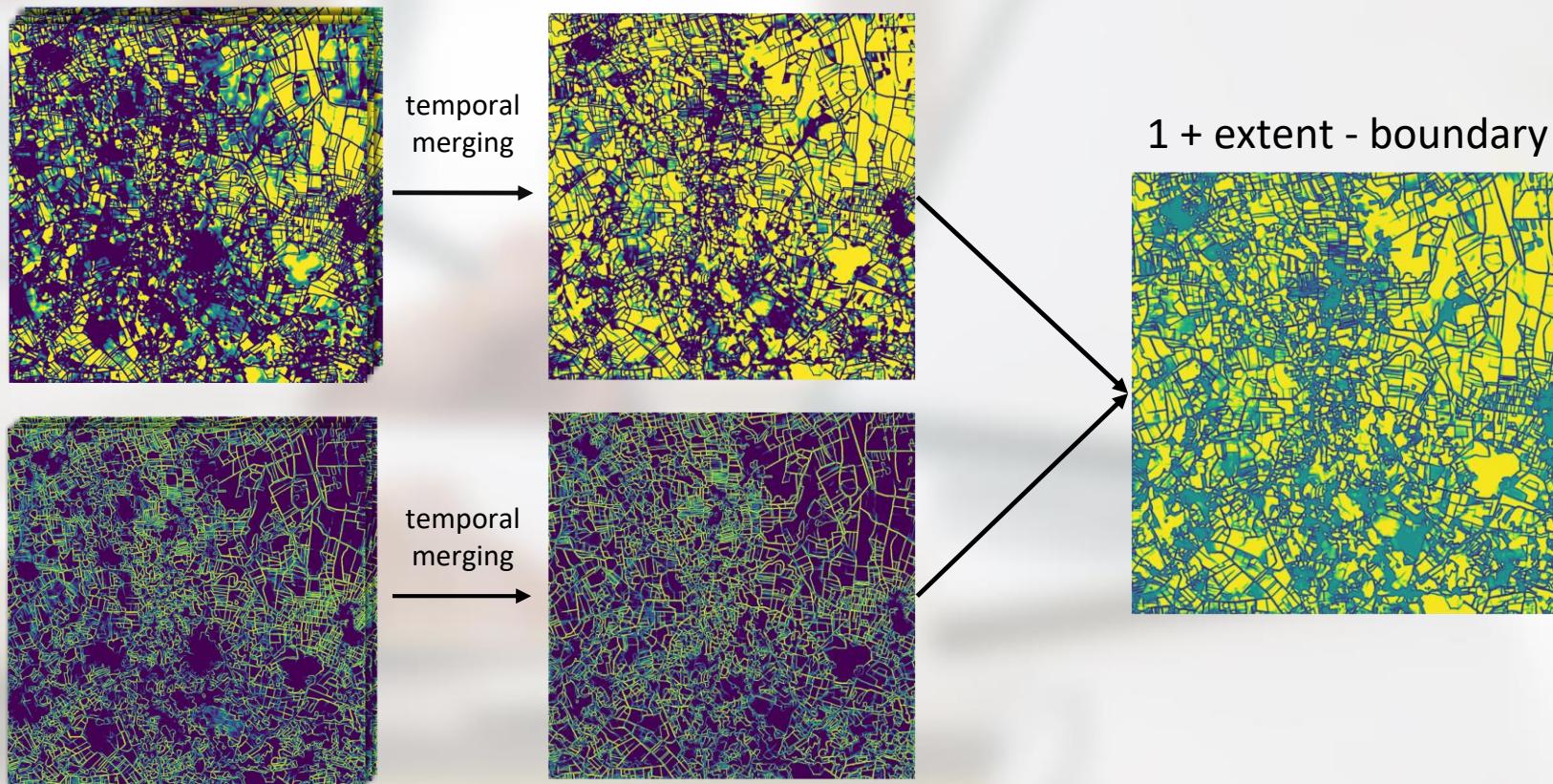
# Prediction

- Prediction is performed over EO Patches using the averaged model.
- Predict only on cloudless timestamps.
- Single-temporal prediction.



# Post processing

- Predictions are temporally merged over a specified time interval.
- The predicted extent and boundary probabilities are combined.



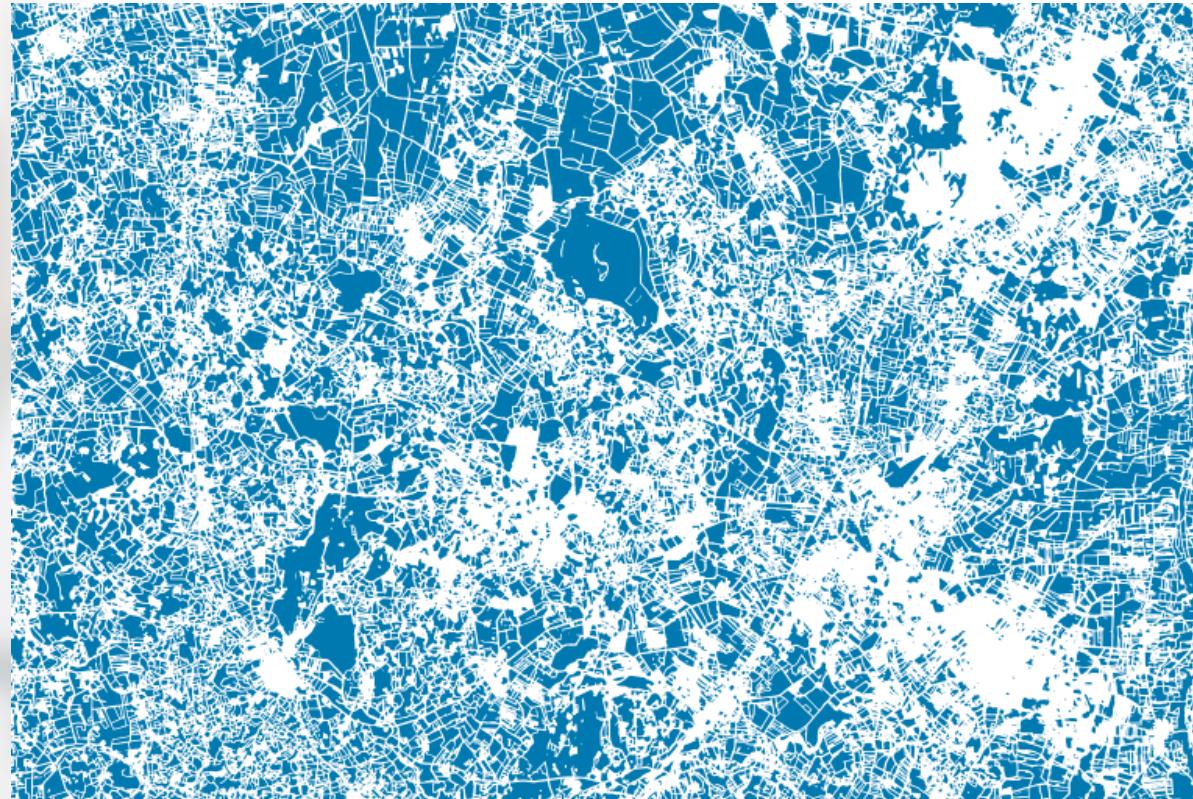
# Vectorisation

The raster predictions are combined into a virtual raster.

To obtain contours from the raster image, the GDAL contour utility is used and run over smaller overlapping areas.

To obtain a single vector layer the overlapping geometries are merged with a geometrical union.

UTM merging for large AOIs





# Open sourcing & outreach

- Open sourcing needs to go together with promotion / outreach
  - Medium blogpost, webinar, newsletter etc.
- No free lunch:
  - Requires effort to maintain and keep up to date
  - Support to users takes time, especially if you want to help everybody
- Interest exceeded all expectations (helped us with offering the tool also commercially)

# Run it yourself

[sentinel-hub / field-delineation](#) Public

[Code](#) Issues 3 Pull requests 1 Actions Projects Wiki Security Insights

main 4 branches 0 tags Go to file Add file Code

veseln Merge pull request #11 from sentinel-hub/feat/webinar-end2end ... 2055300 2 days ago 28 commit

fd	Add __init__ file to script folder to package gets properly installed.	2 days ago
input-data	Input data (province/country borders for CyL and Lithuania).	14 months ago
notebooks	Fixes minor issues pointed out during the review.	2 days ago
.gitignore	add notebooks used for field delineation	17 months ago
LICENSE	Create LICENSE	16 months ago
README.md	Fix typo in README.	2 days ago
requirements-dev.txt	Version 1.0.0.	14 months ago
requirements.txt	Update code with latest version. Make end2end notebook.	2 days ago
setup.py	Added copyrights to files and notebooks. Updated readme and some ot...	11 months ago

README.md

## NIVA - Automatic field delineation

This repo contains code to generate automatic contours for agricultural parcels, given Sentinel-2 images. This code has been used to generate contours for Lithuania and the province of Castilla y Leon.

You can find more information about this project in the blog post [Parcel Boundary Detection for CAP](#).



## **Automatic Field Delineation Tool**

<https://github.com/sentinel-hub/field-delineation>

## **eo-learn**

<https://github.com/sentinel-hub/eo-learn>

## **eo-flow**

<https://github.com/sentinel-hub/eo-flow>

## **Sentinel Hub Trial Account**

[https://www.sentinel-hub.com/create\\_account](https://www.sentinel-hub.com/create_account)

## **ESA Sponsored Accounts**

<https://www.sentinel-hub.com/Network-of-Resources/>



# Contact us

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**GitHub Issues**

<https://github.com/sentinel-hub/field-delineation/issues>

**Forum**

<https://forum.sentinel-hub.com/>

# Thank you!

