sentinelhub
by SINERGISE

AUTOMATED AGRICULTURAL FIELD DELINEATION TOOL

EO Research Team at Sinergise

Agenda

NIVA
NEW IACS VISION IN ACTION

- 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

NIVA
NEW IACS VISION IN ACTION

What?

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

Input data?

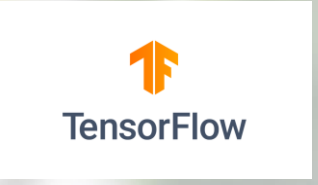
- Sentinel-2 10m (B-G-R-NIR) bands.
- GSAA vectors.

How?

- Using supervised deep learning - ResUnet-a.

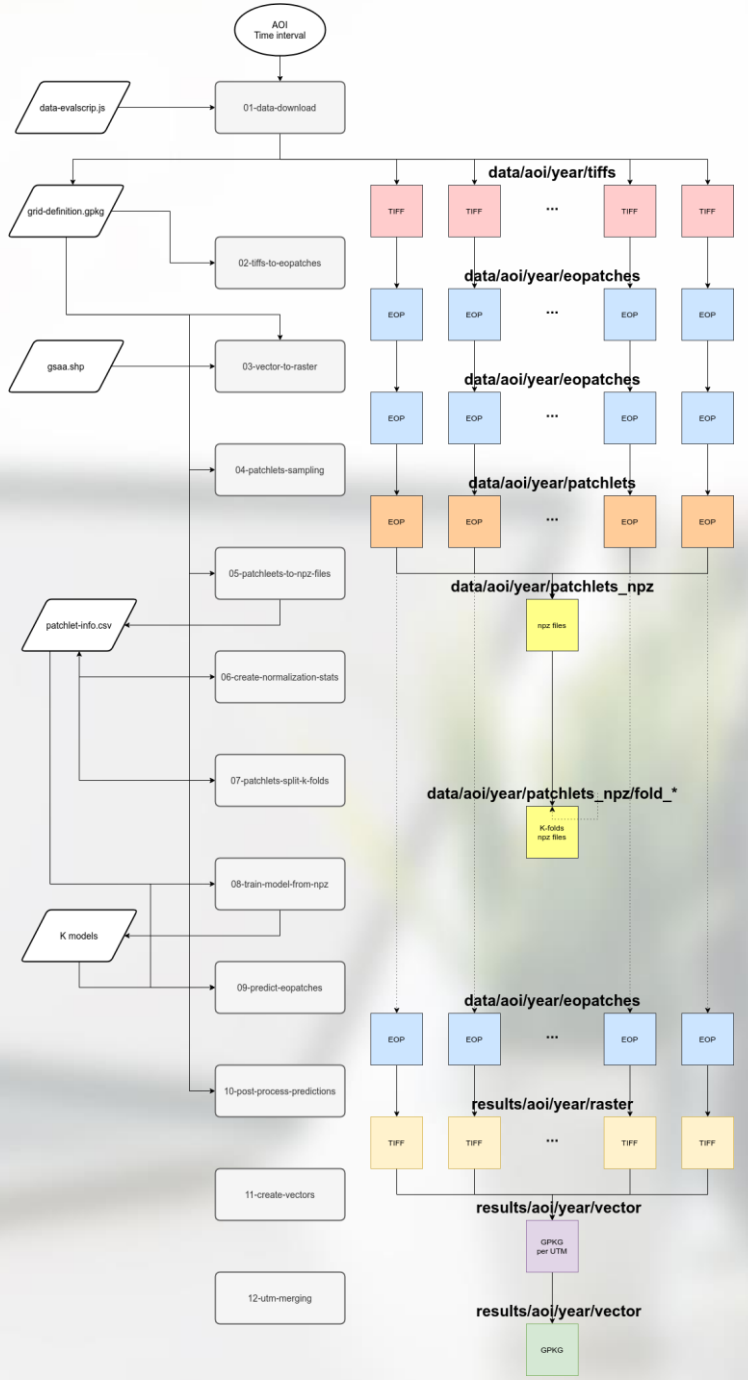
Main tools utilized

- 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.



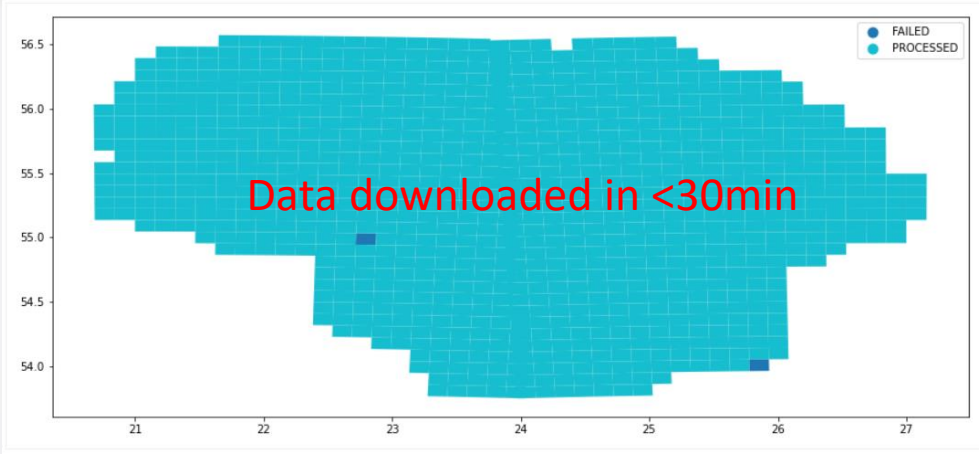
Main steps

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.

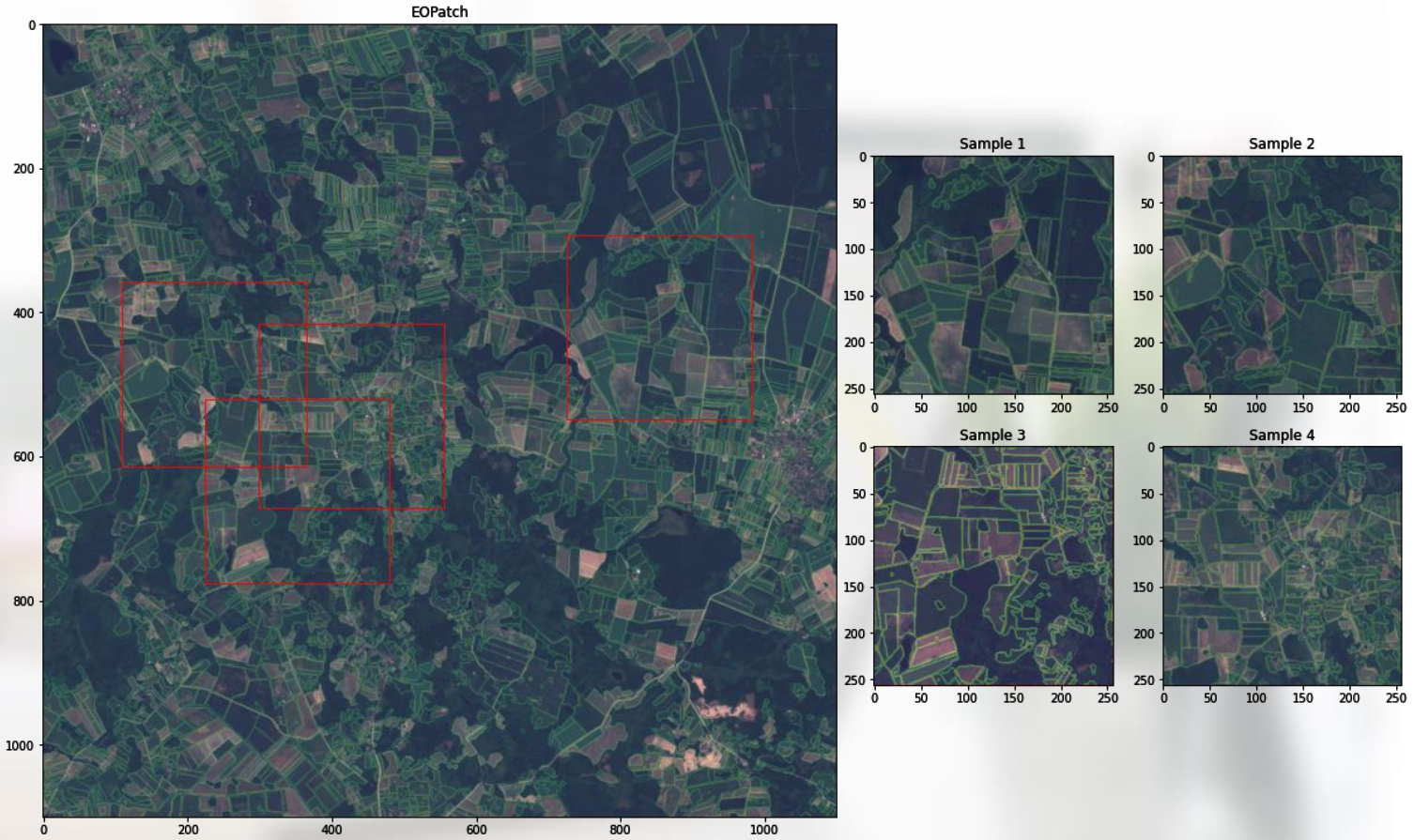
Extent, boundary and distance masks are computed and stored.

Sampling

Smaller patchlets are sampled from the EOPatches.

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.

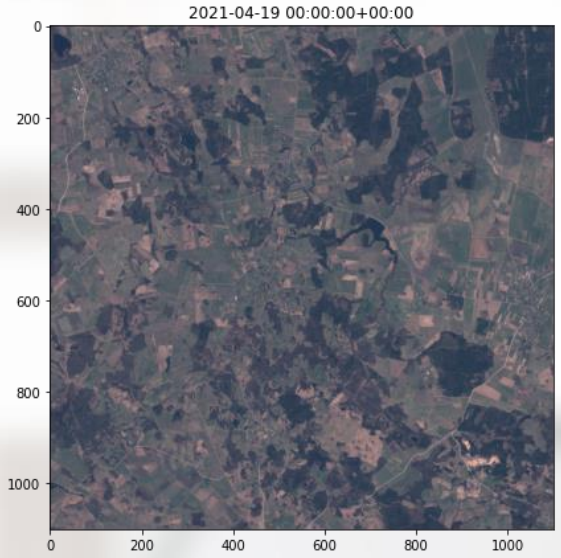
Having the data in such a format allows us to efficiently load the data directly from S3 storage during training.

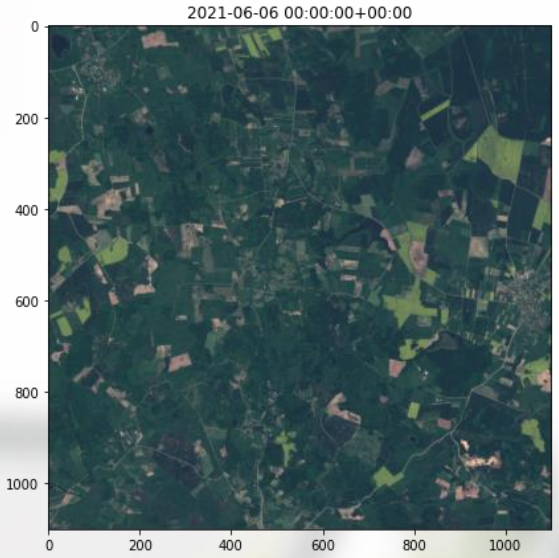
Normalization

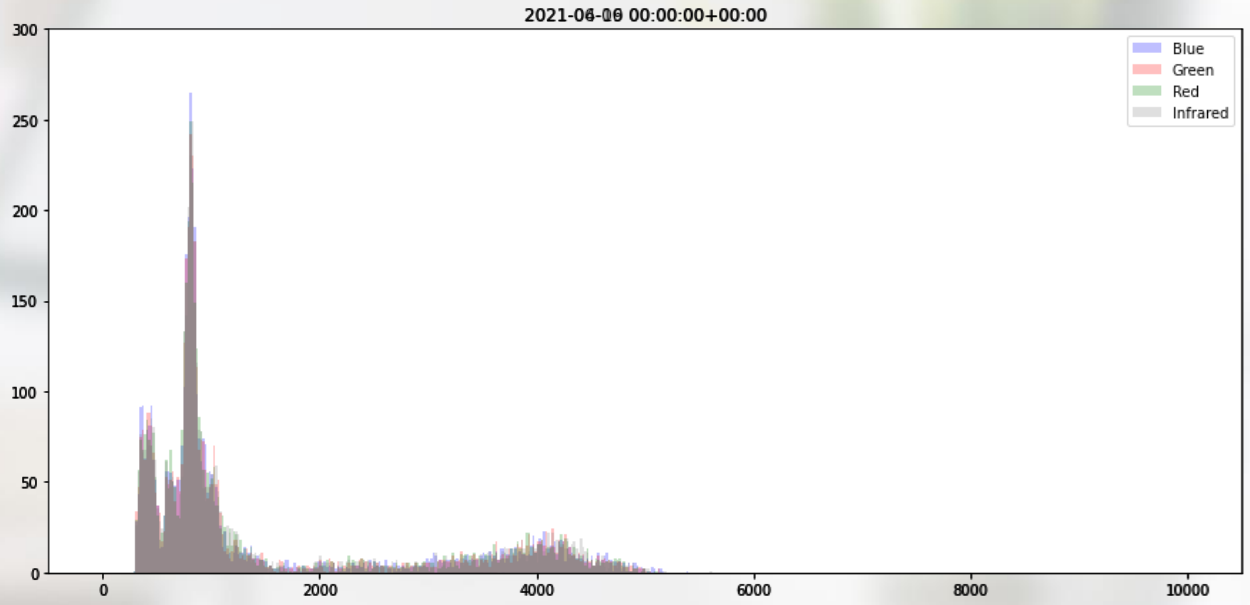
The model needs to perform well over timestamps taken over the whole year, but the distribution of the bands differ through time.

Normalization statistics computed on a monthly basis.

Multiple statistics are computed.





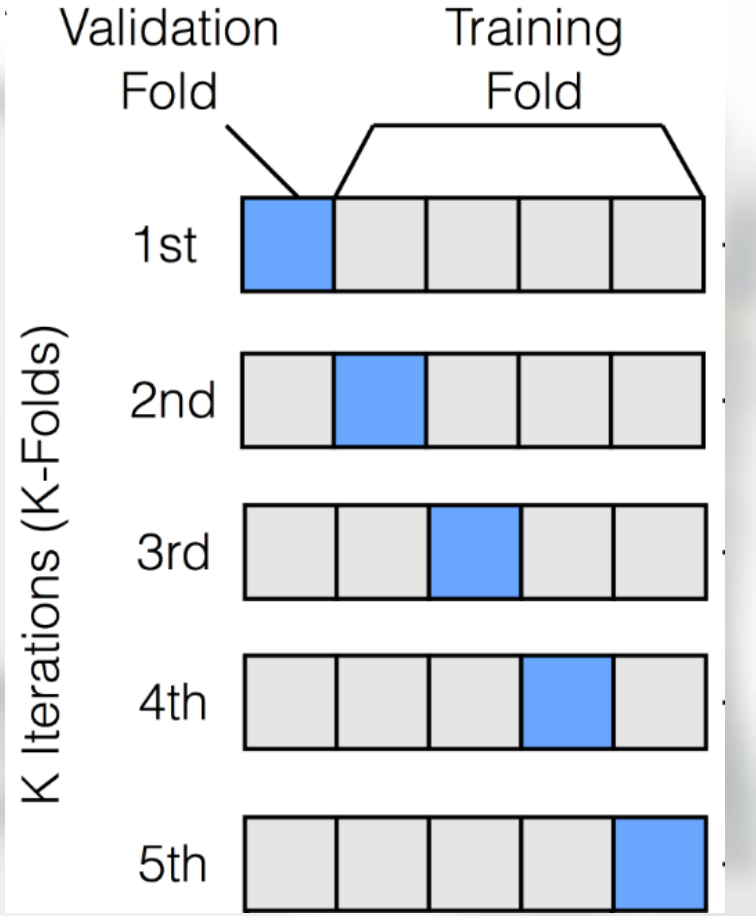


Split into K-Folds

Since small patchlets can be sampled from the same EOPatches and can overlap, split of the data has to be performed at the EOPatch 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.[1]).

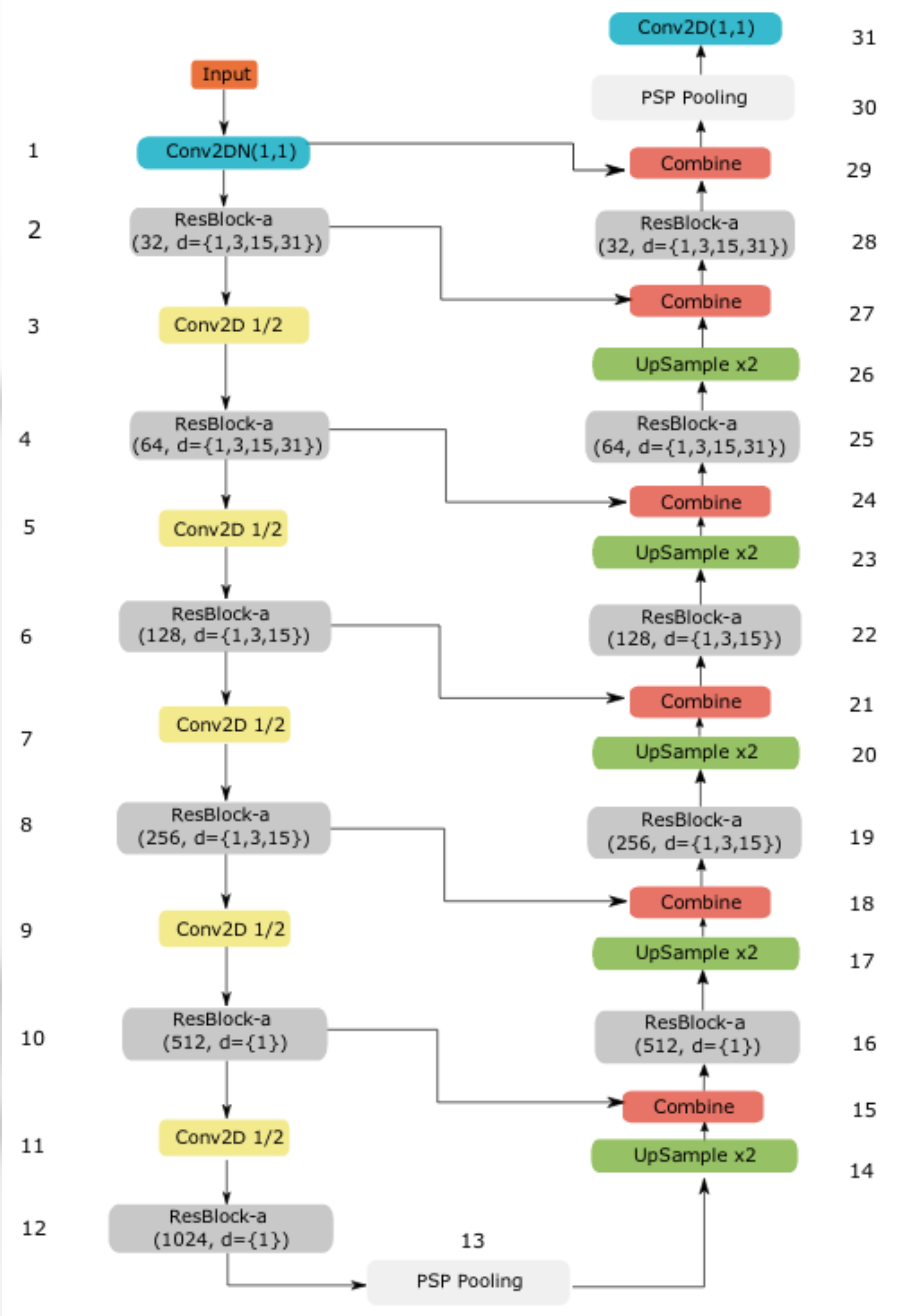
Implemented using eo-flow.

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.

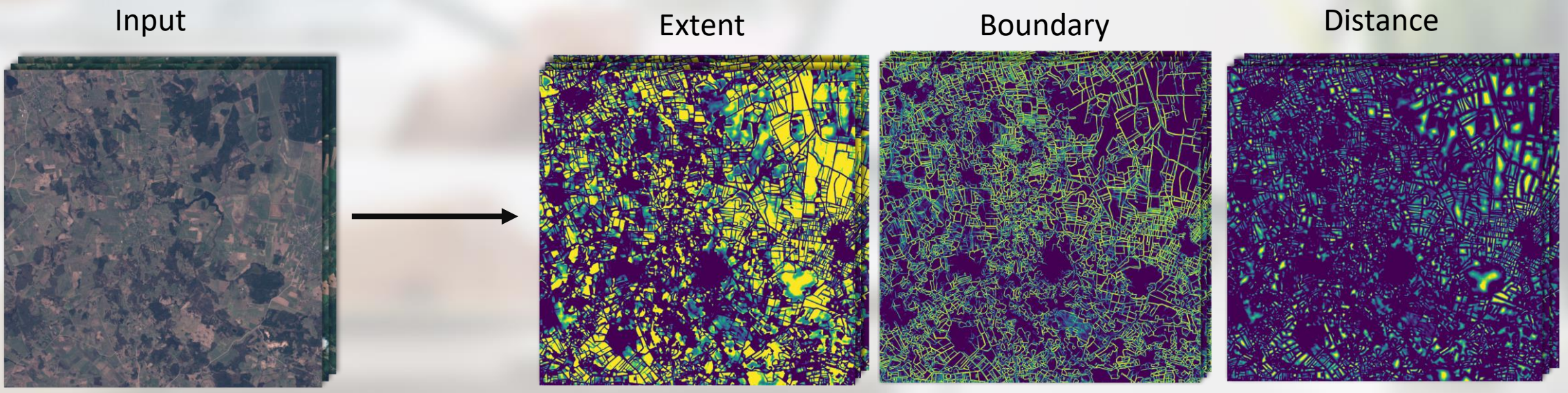
A single model is derived by averaging the weights of the k-fold models.



[1] https://arxiv.org/pdf/1910.12023.pdf

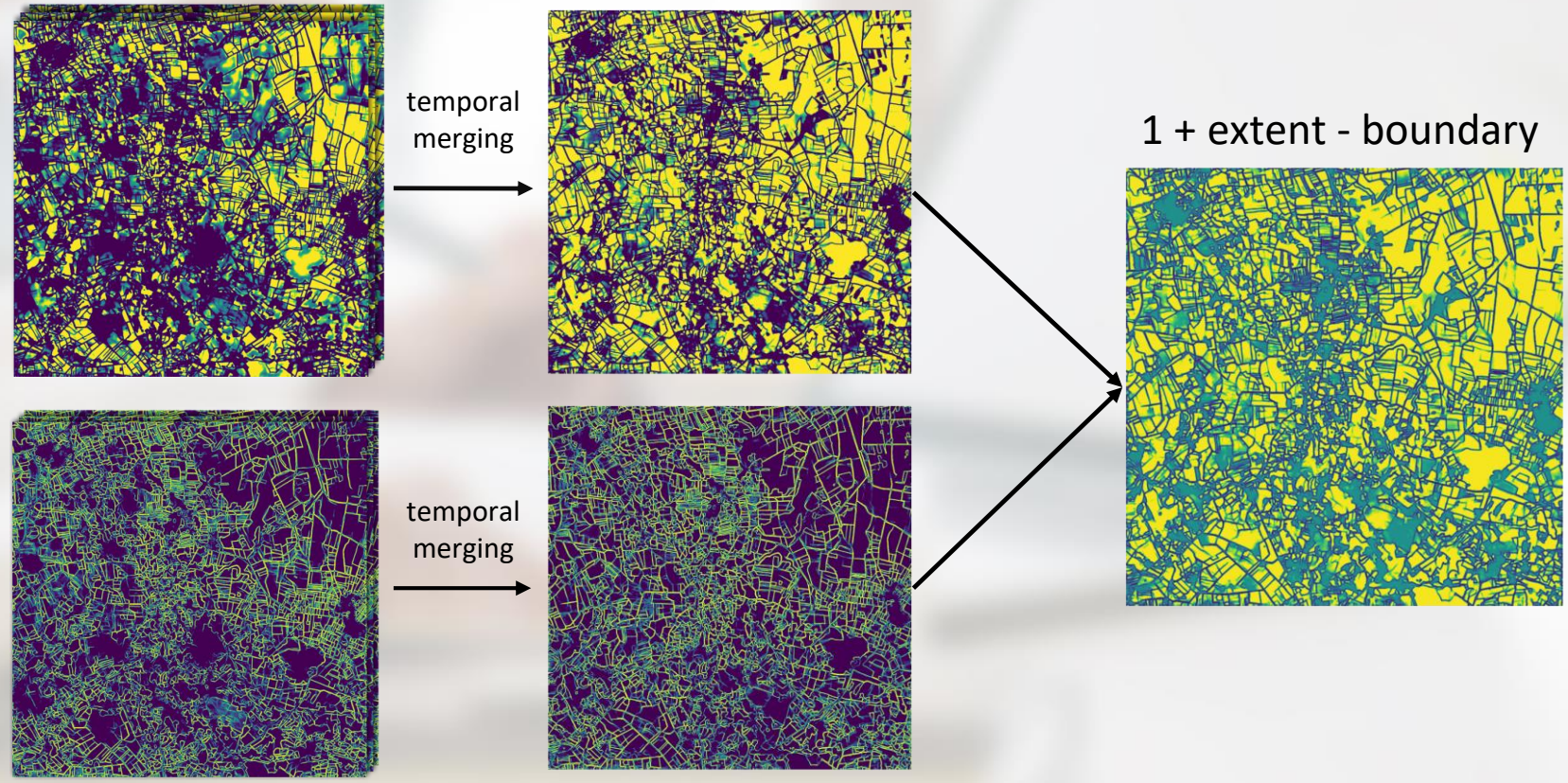
Prediction

- Prediction is performed over EOPatches 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 probabilties are combined.



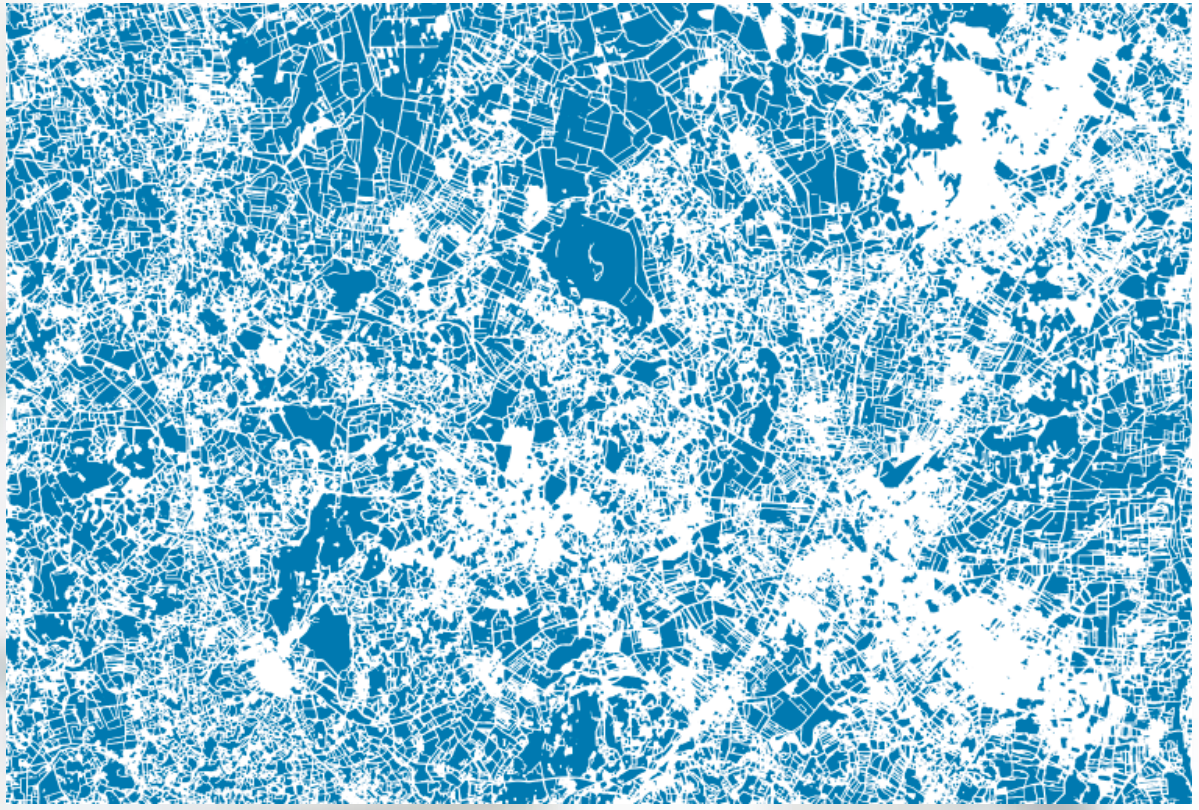
Vectorisation

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.

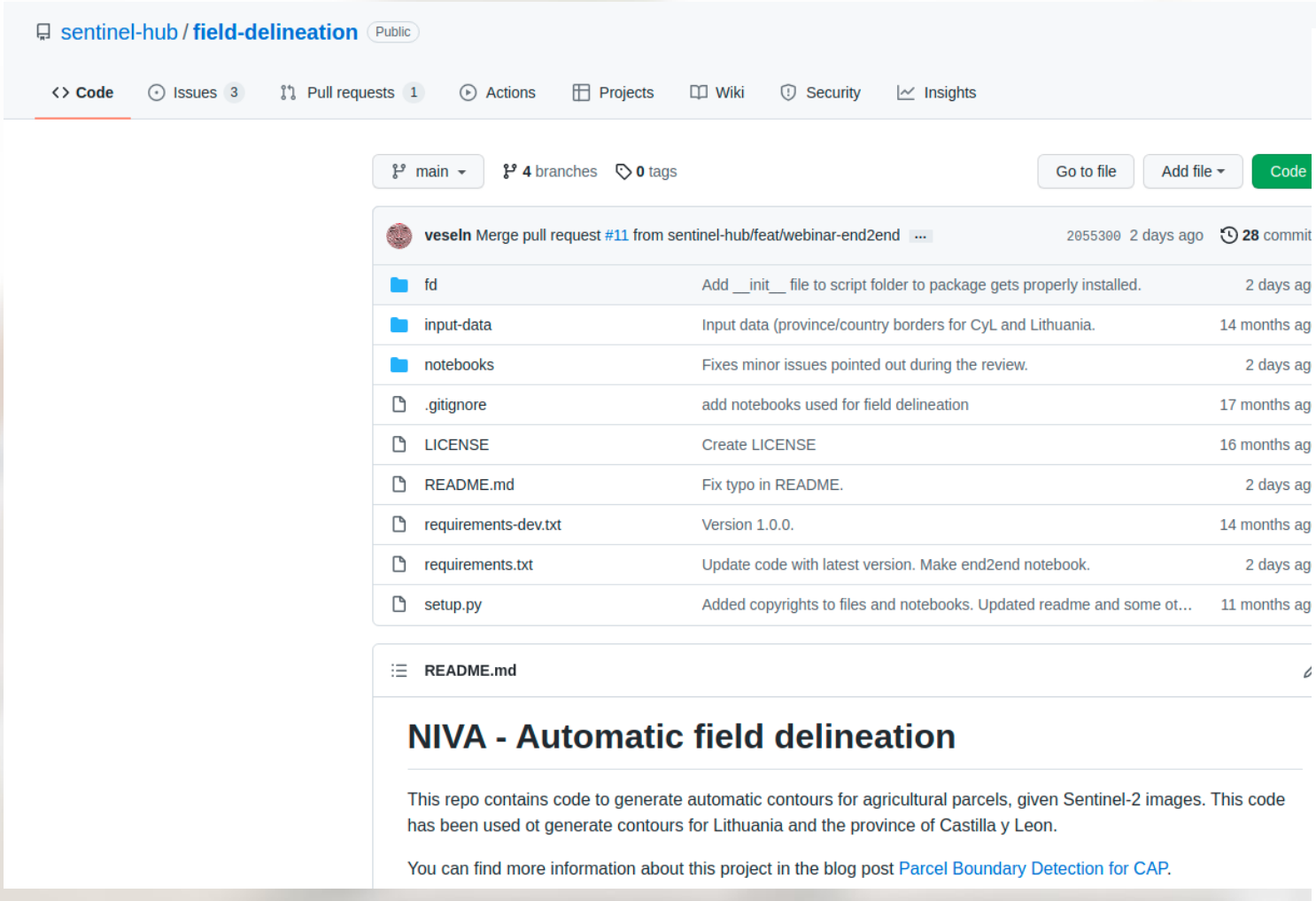
UTM merging for large AOIs



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



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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

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!