# DEEP LEARNING AND FIELD BOUNDARIES DELINEATION

## Challenge 6: Using AI algorithms for defining boundaries of agriculture fields based on Sentinel 2 images

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# MOTIVATION

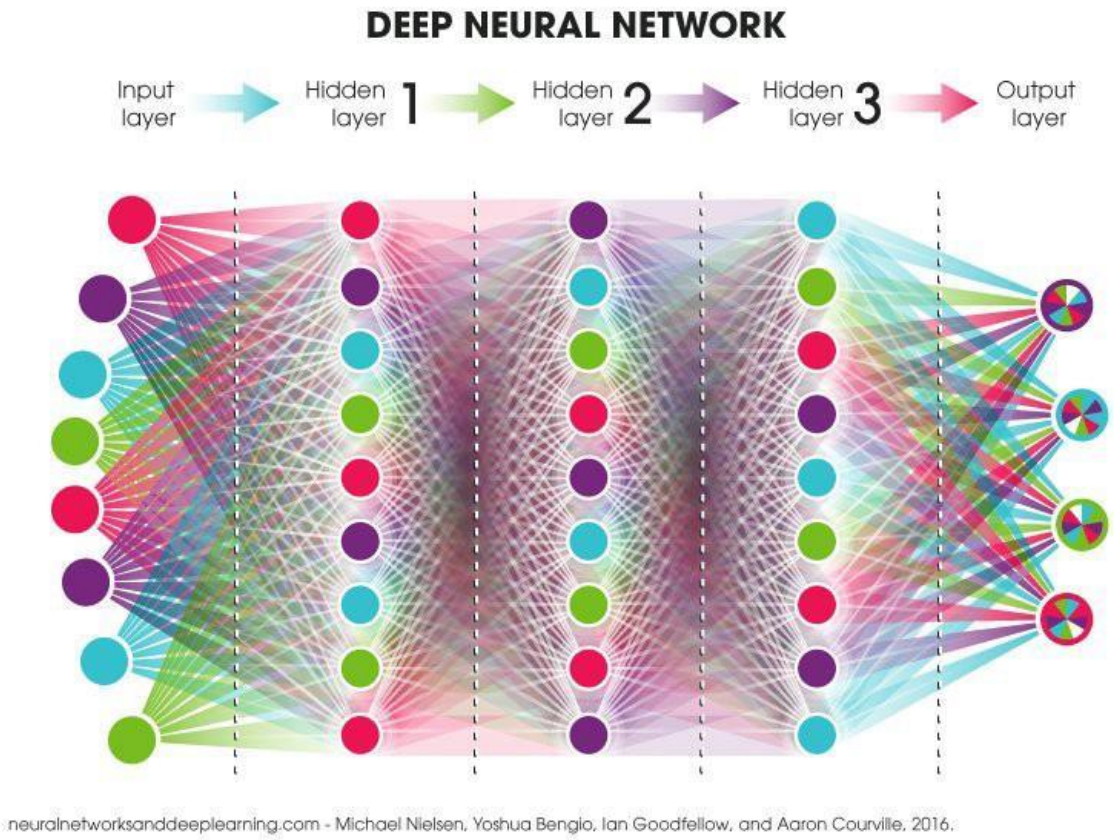
Accurate information on field boundaries = valuable input for agricultural applications:

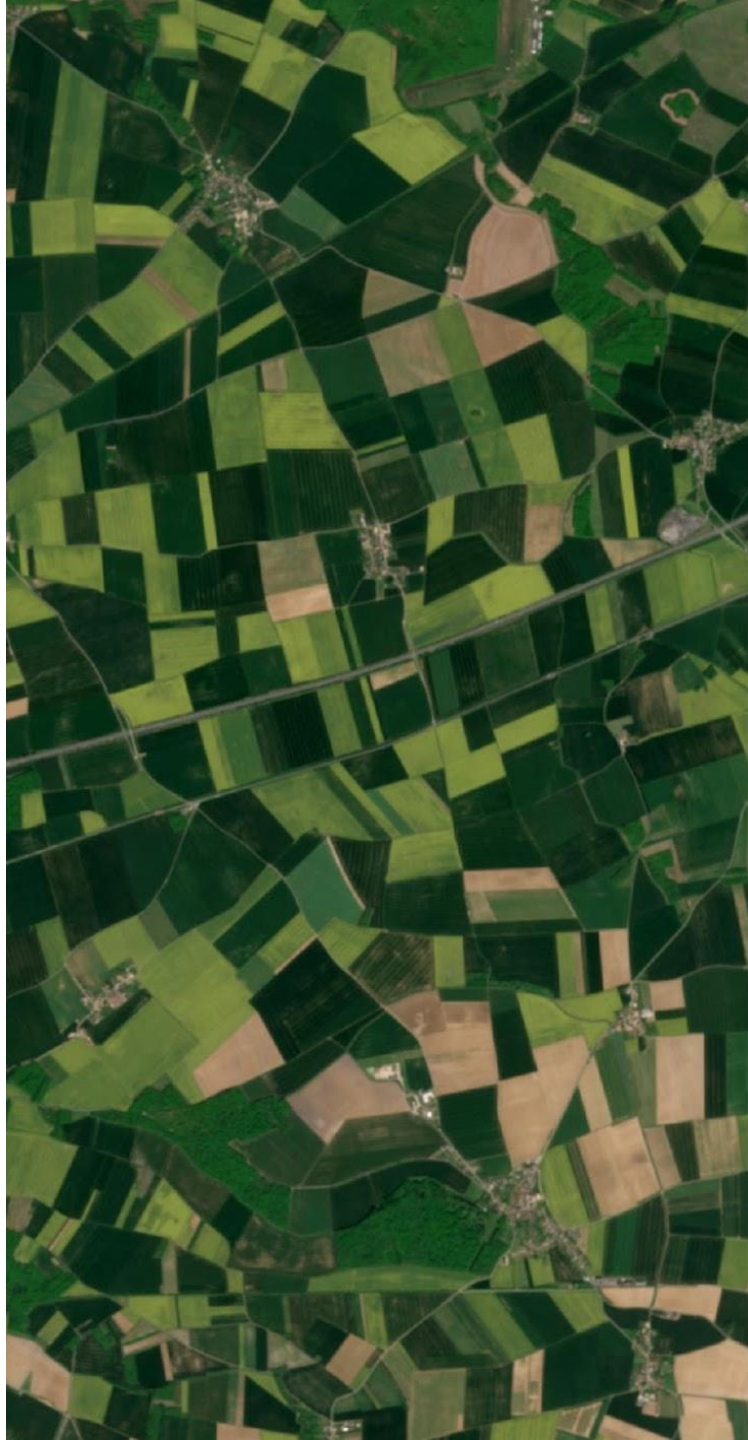
- Crop monitoring
- Crop management – irrigation, fertilizer application, pesticide application..
- Yield predictions

Land use and land cover classification

# DEEP NEURAL NETWORKS

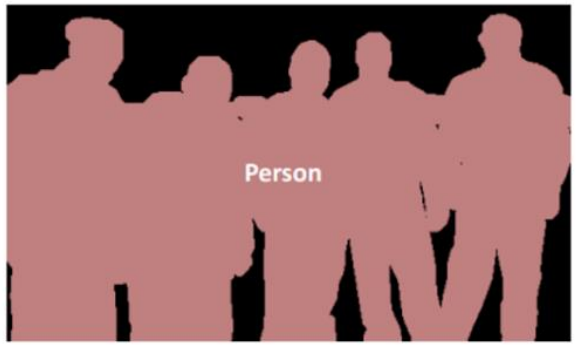
- Convolutional neural networks
- Recurrent neural networks
- Generative adversarial networks



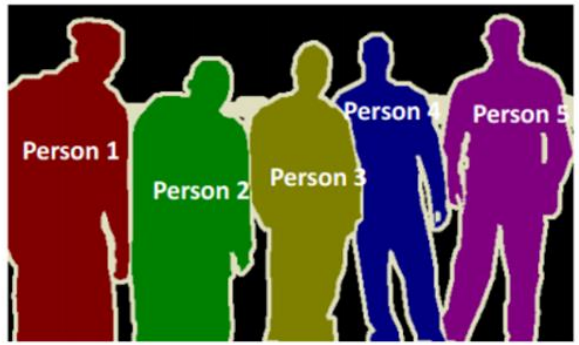



# OBJECT DETECTION X SEMANTIC SEGMENTATION X INSTANCE SEGMENTATION

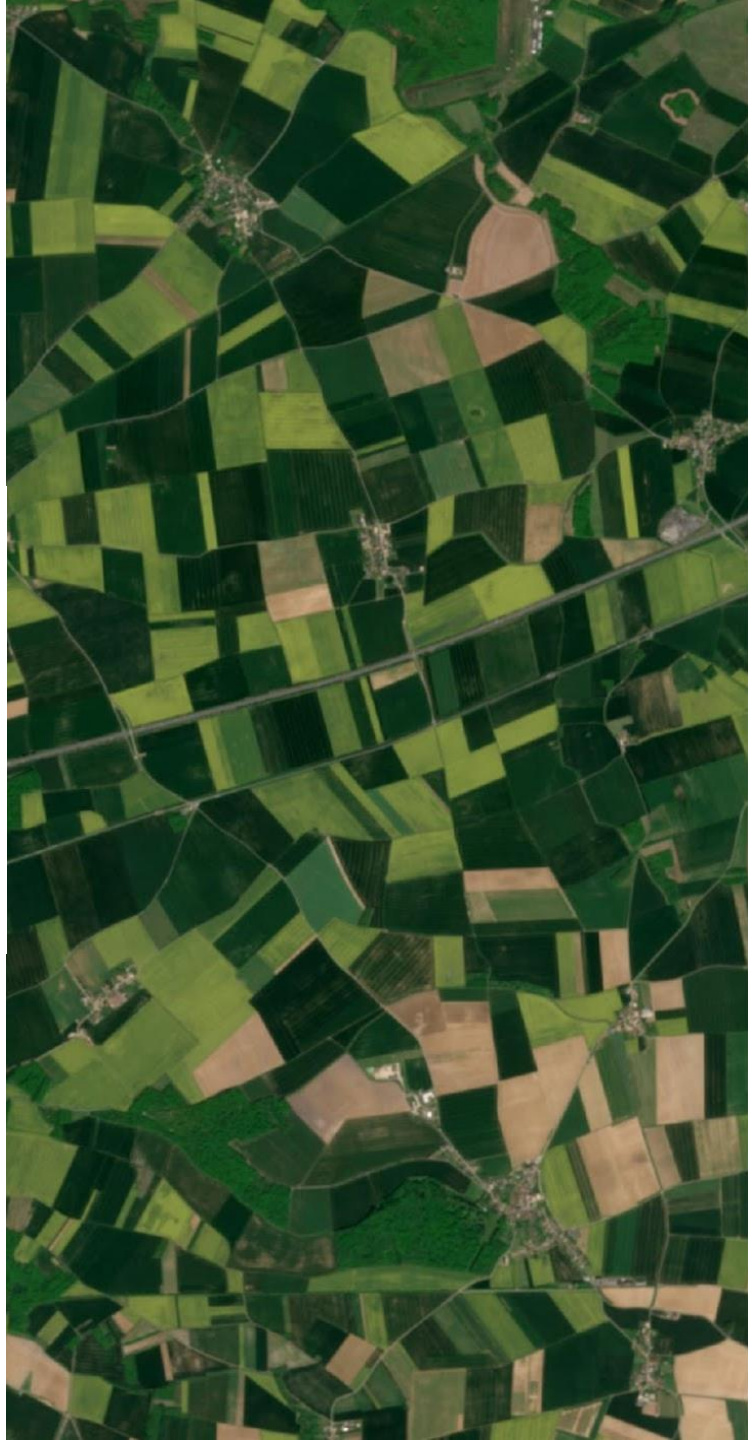
Object Detection



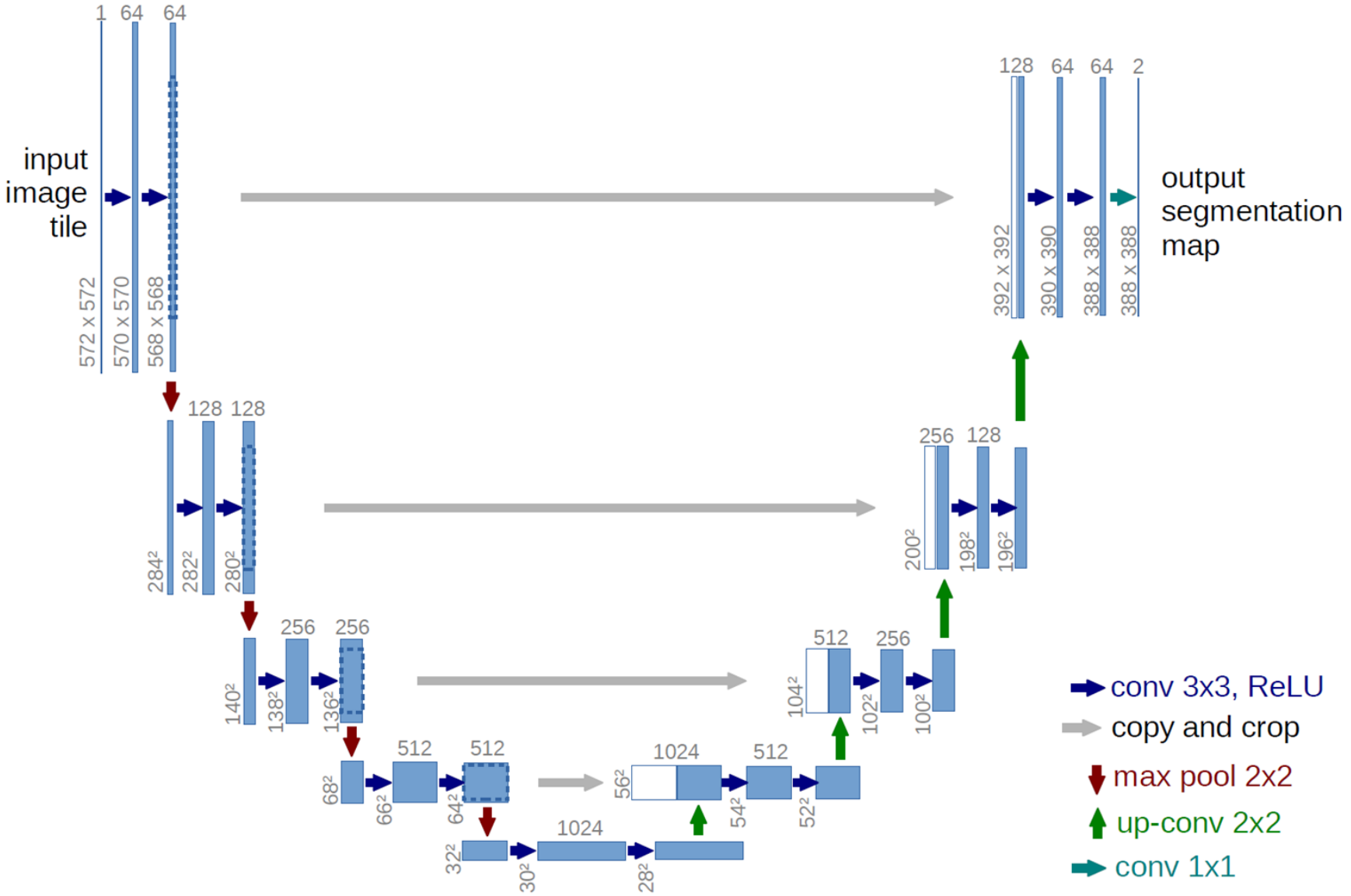

Semantic Segmentation

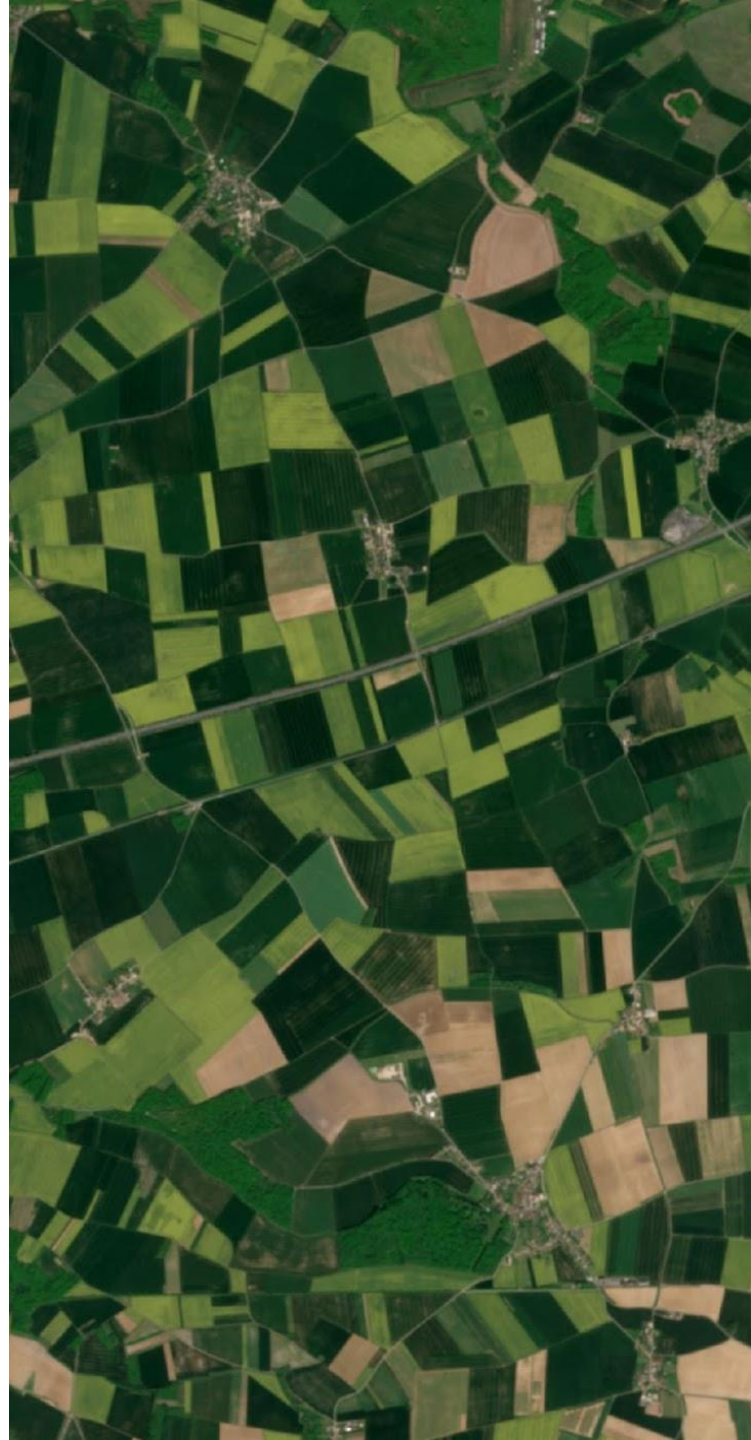



**Instance Segmentation**



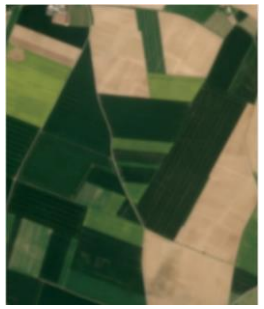
# UNet Architecture

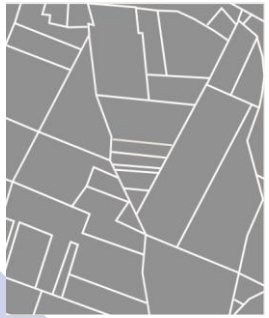


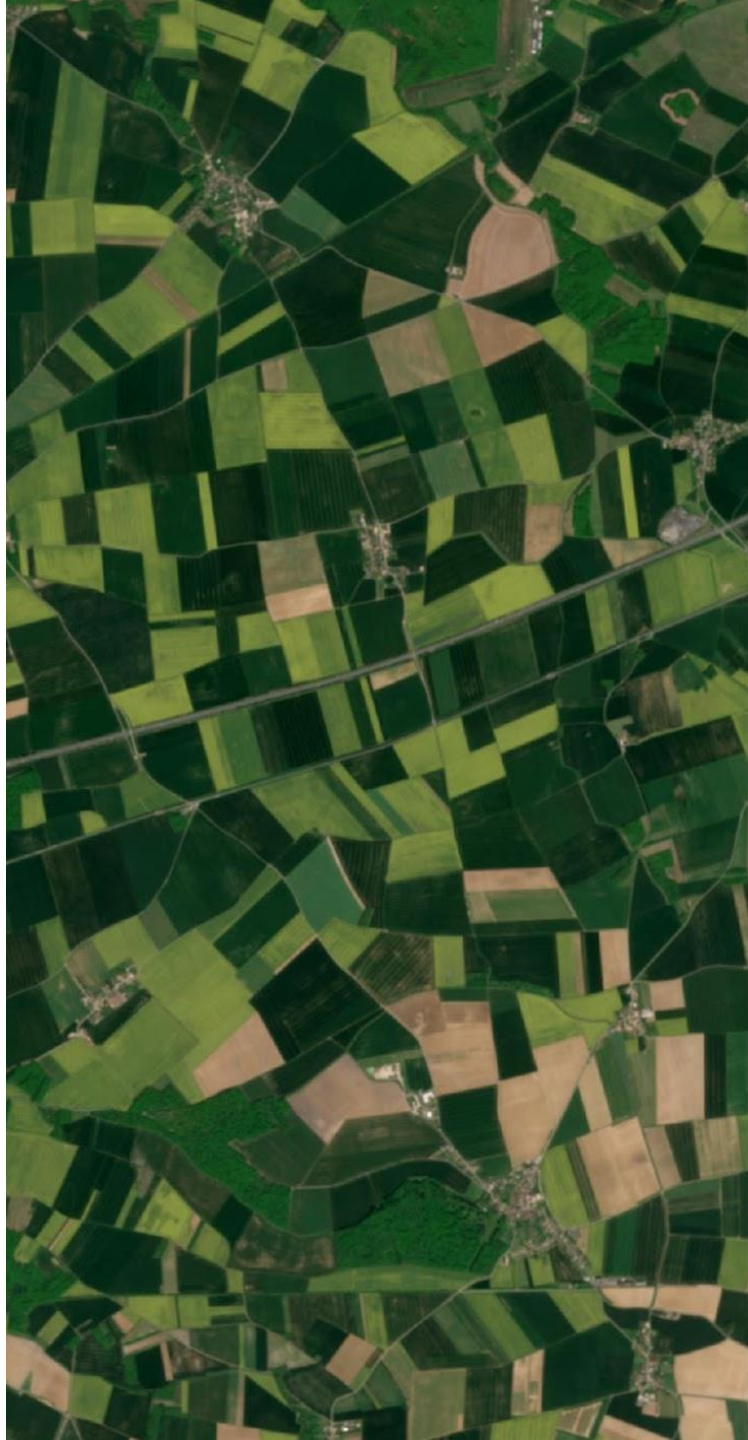
# METHODOLOGY

Training Image | Training Boundaries | Pretrained Model

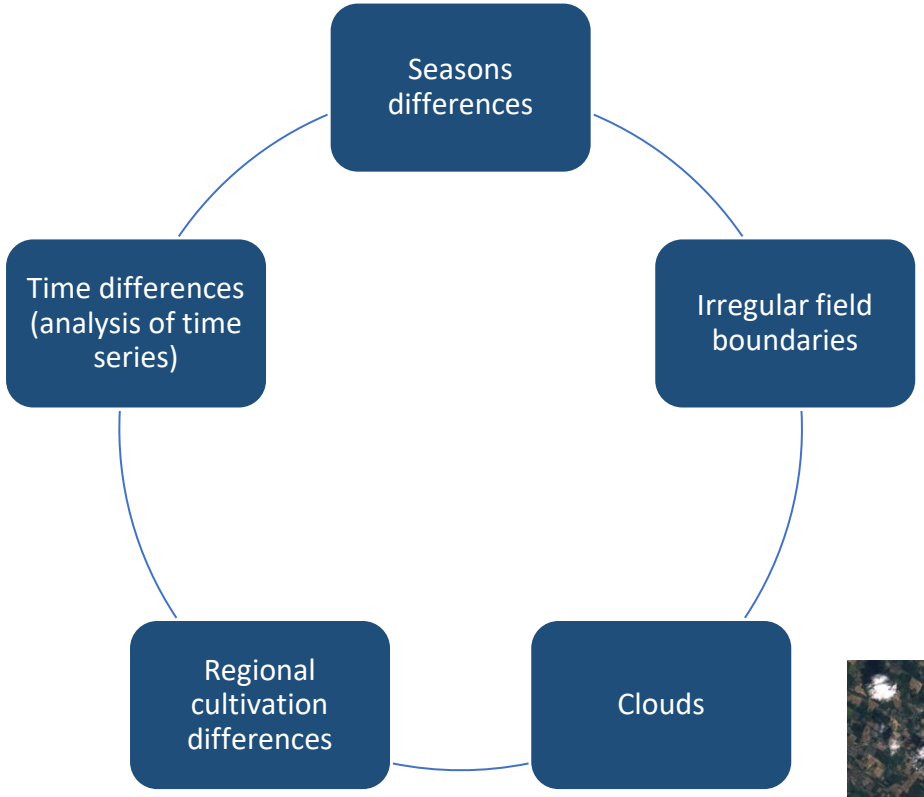


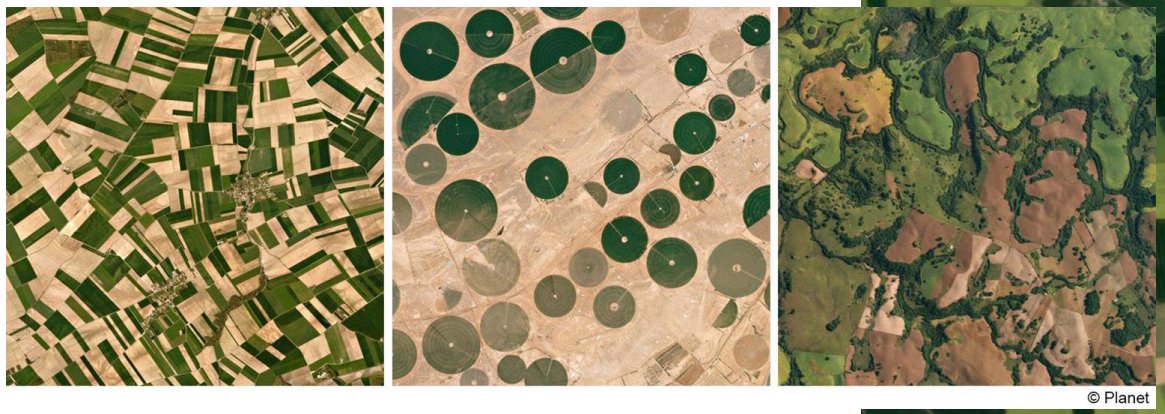


Input Image | Pretrained Model | Predicted Boundaries



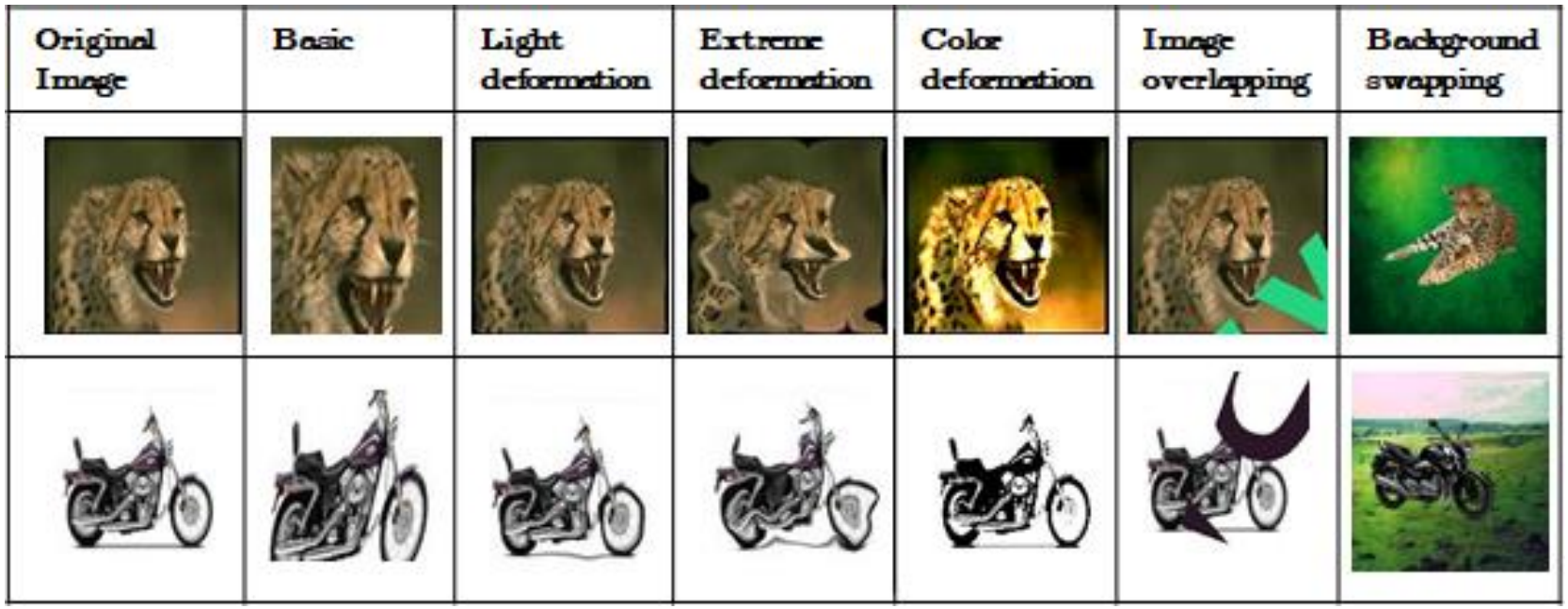
# Big Training Dataset Importance



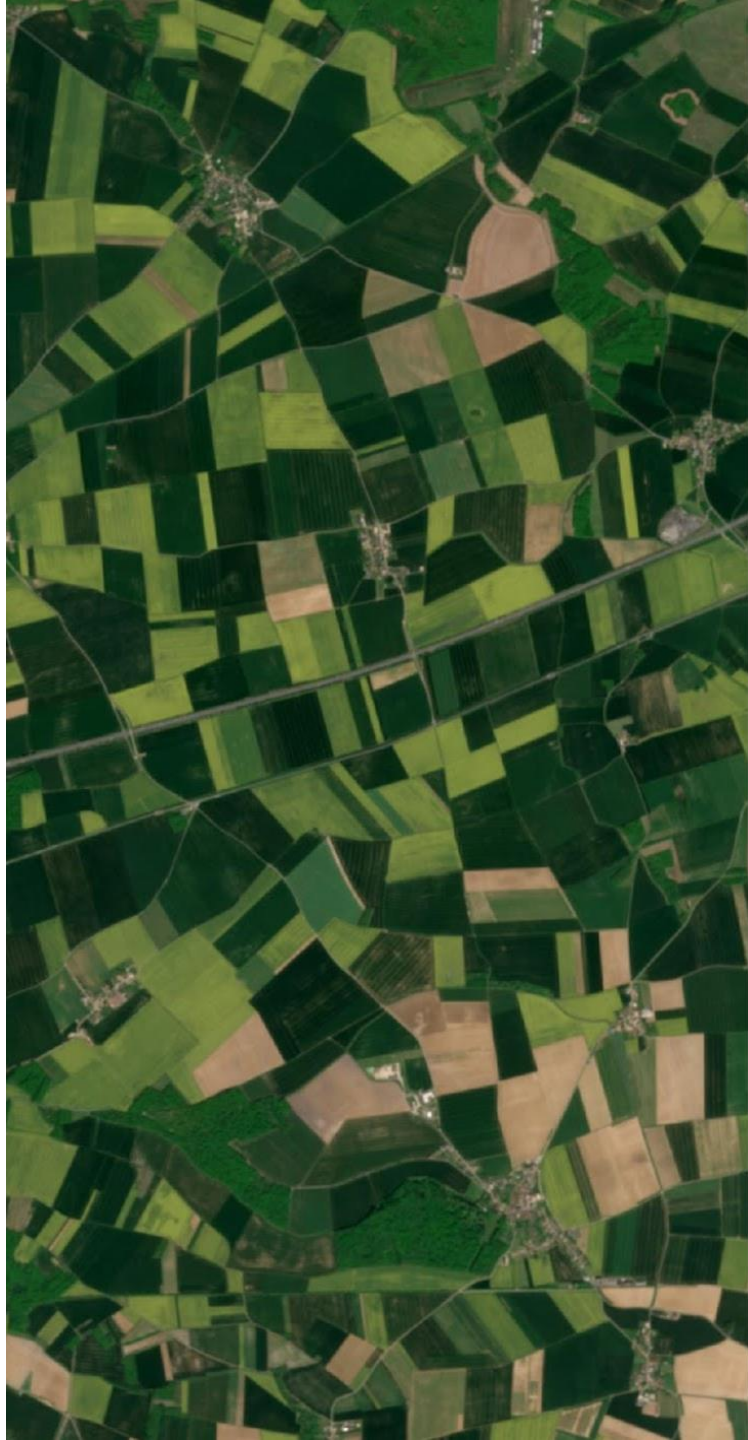




# Not enough data? Let's augument!

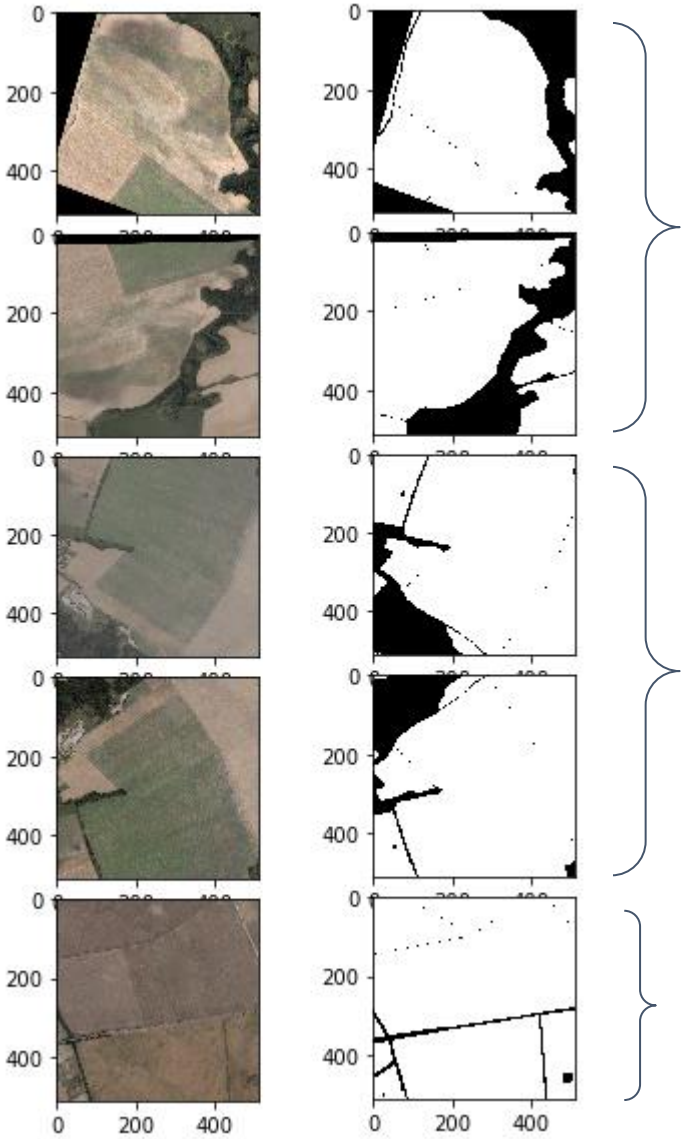
- Method of dataset extension by modification of existing data using transformation, deformation, shift of color spectrum etc.




https://medium.com/@mcr222/data-augmentation-benchmark-for-deep-learning-2db712c6eb3e



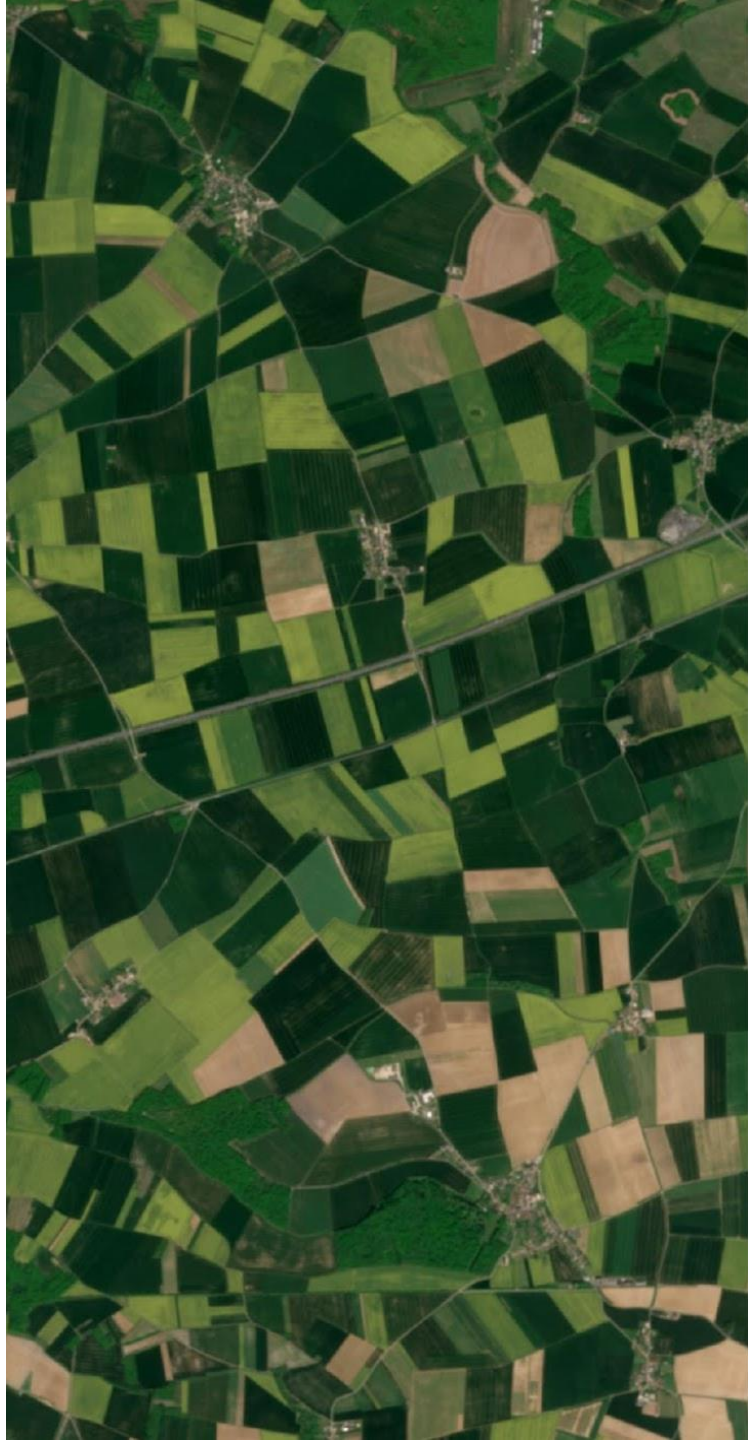
# Practical Use: imgaug library




horizontally inverted, shifted, added noise

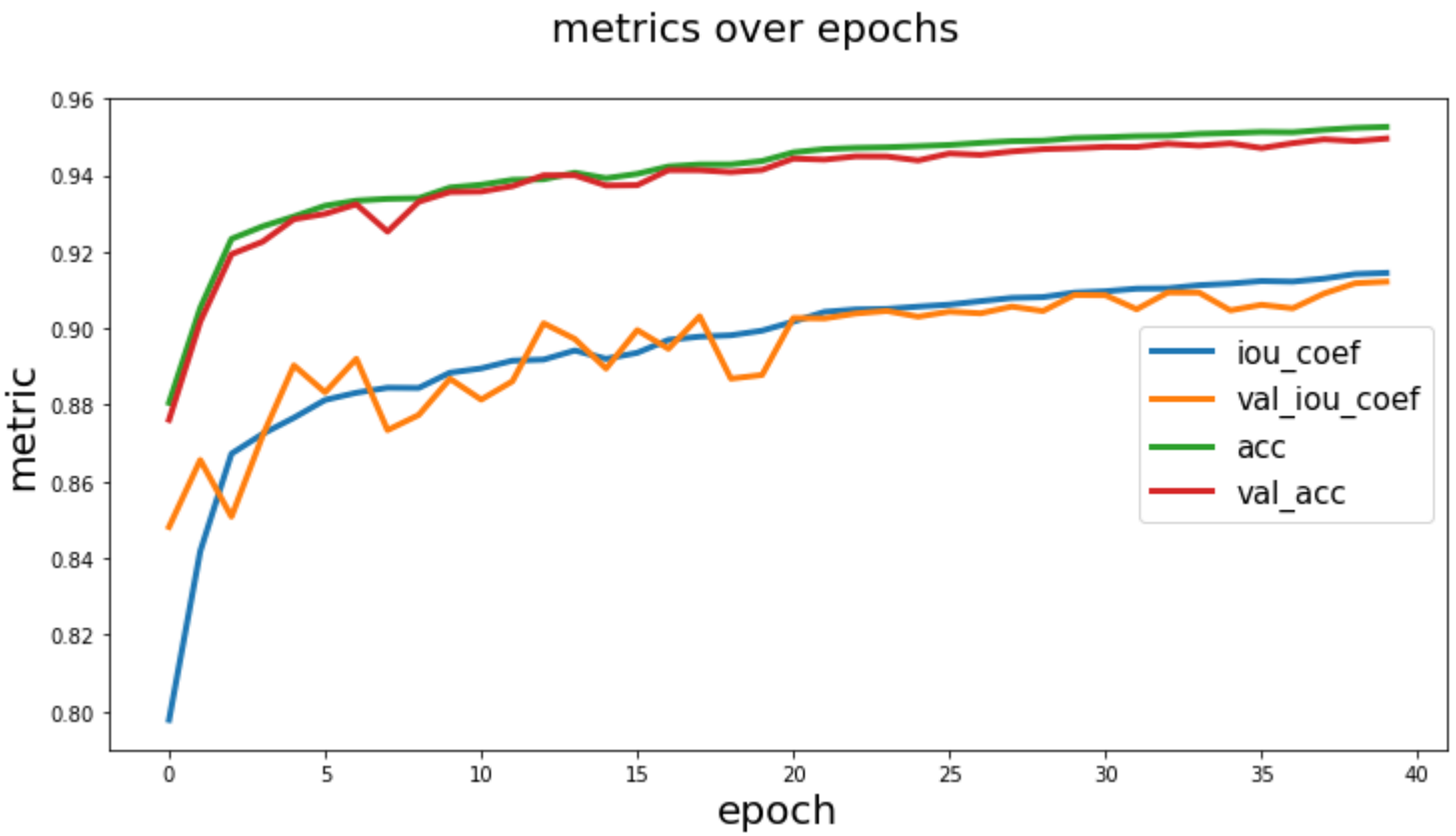
horizontally inverted, contrast changed

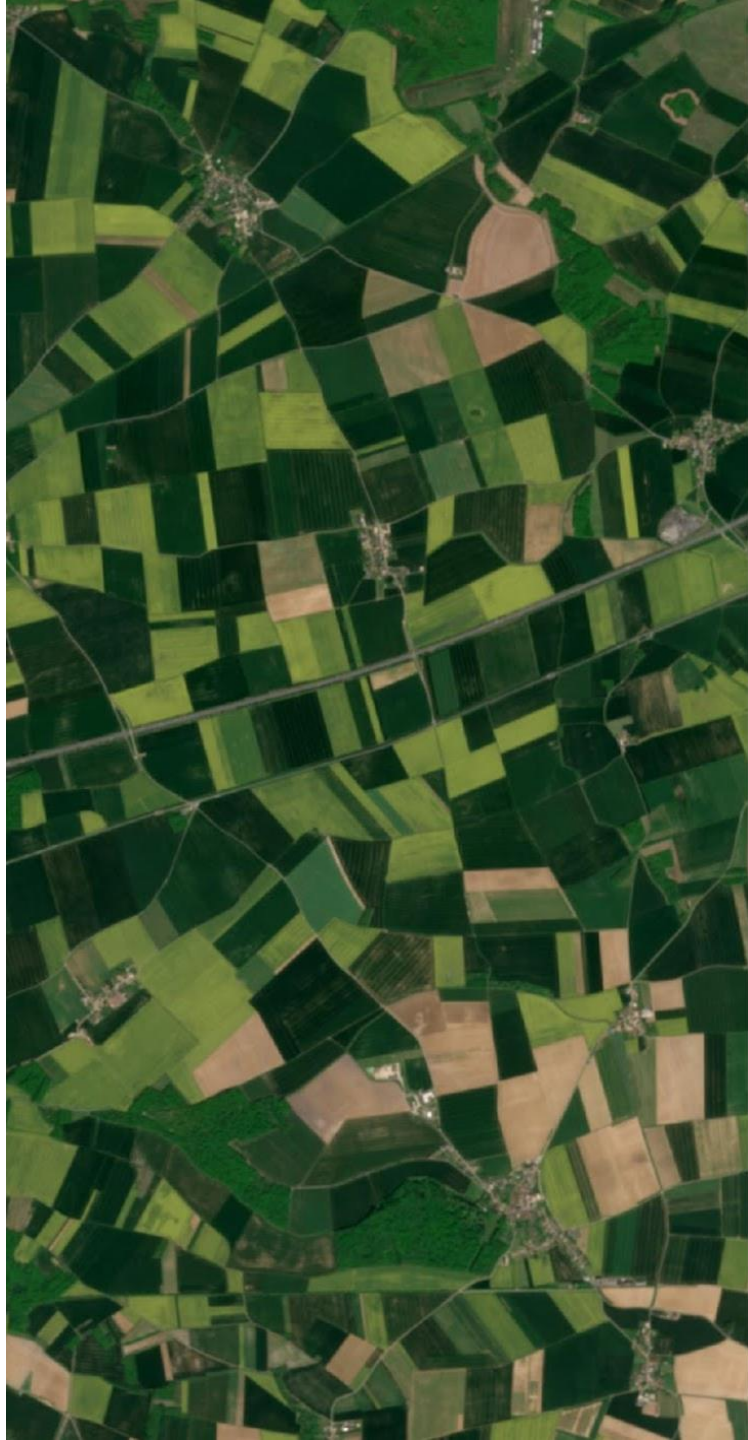
…



# Model Training

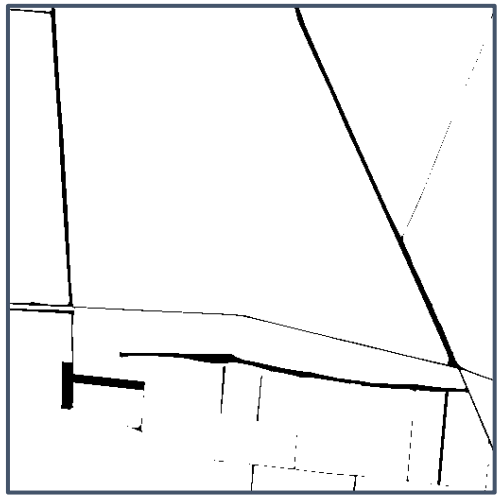
- 40 epochs (~ 1 one hour training on GPU)
- 3600 training tiles (with augumentation)
- Choosing the best model with **IoU koeficientu** (Intersection over Union)



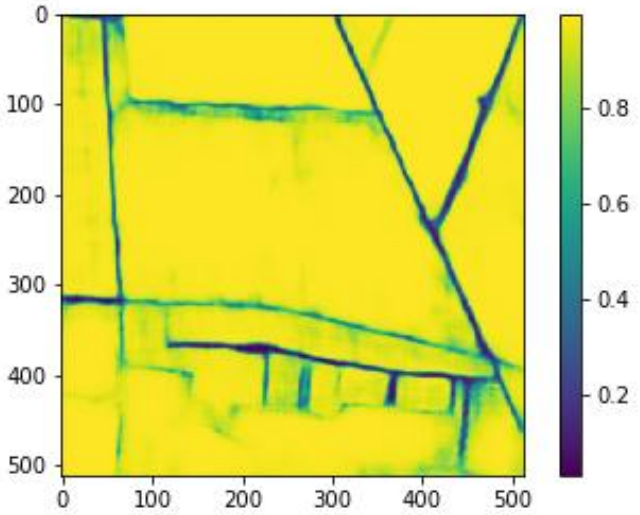



# Prediction

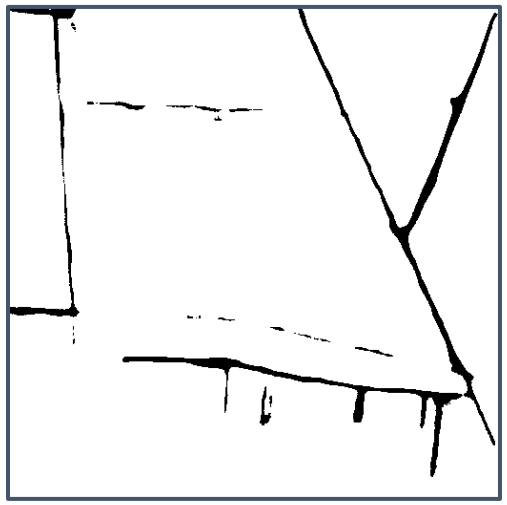
1) input tile



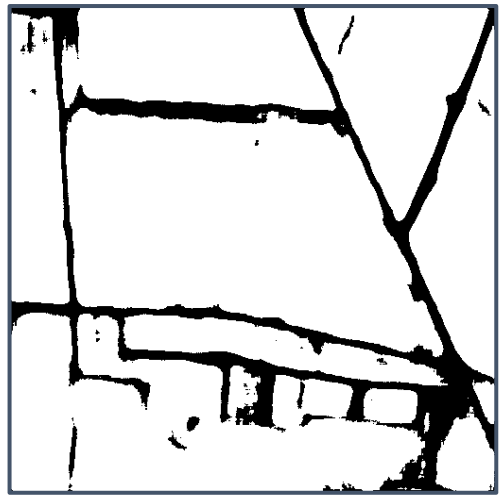
2) ground truth



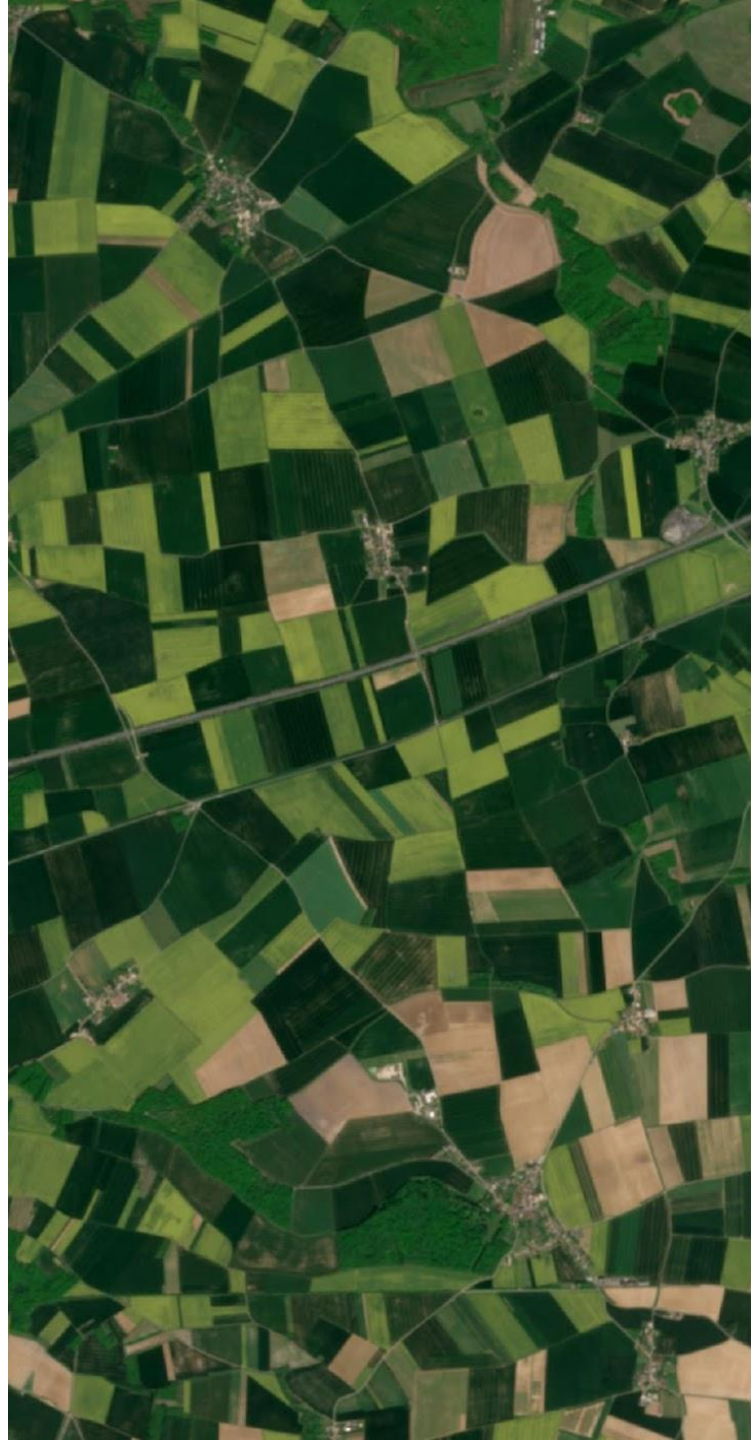

3) prediction heatmap



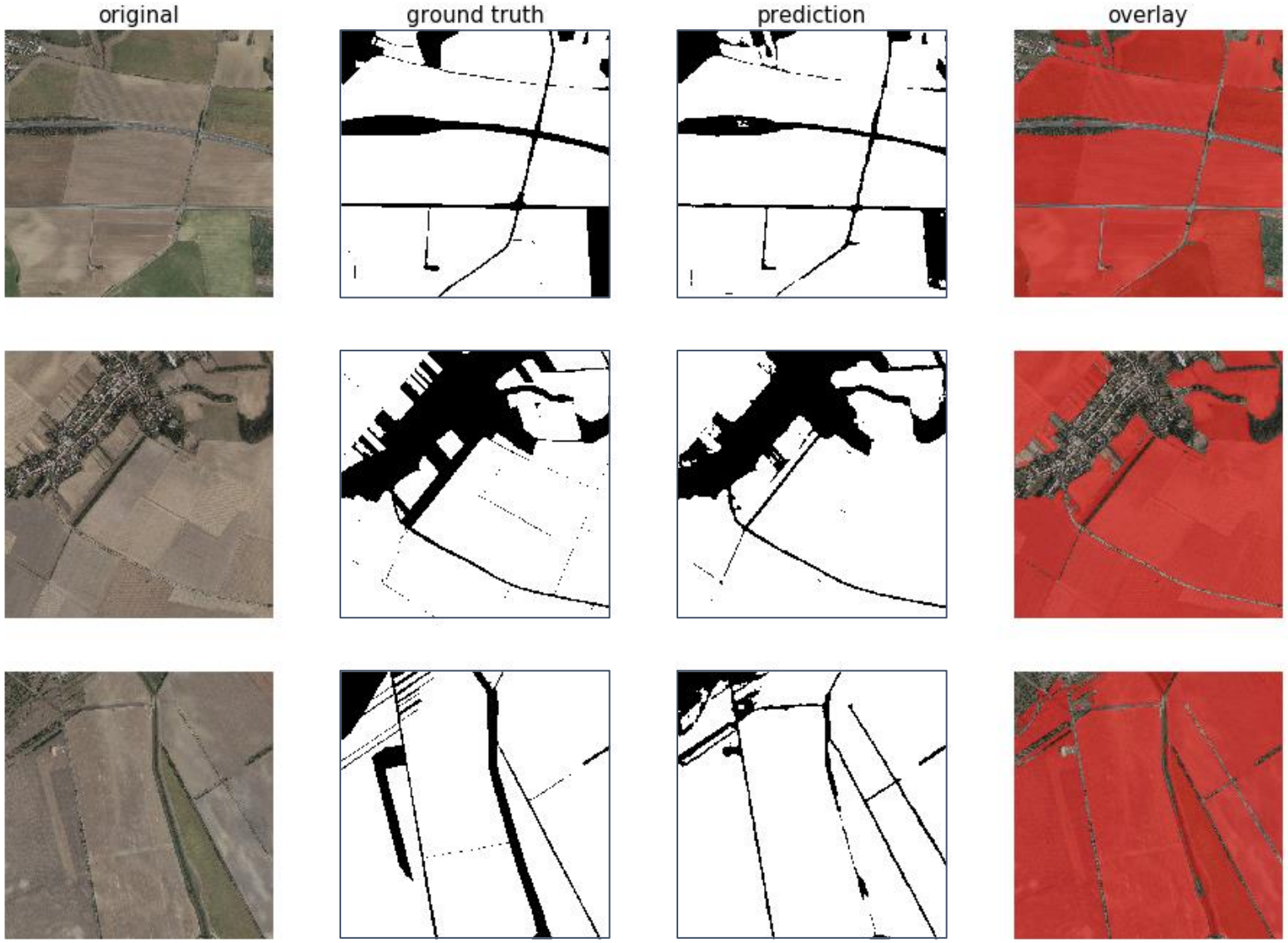
4) binary mask (thresh 0.5)

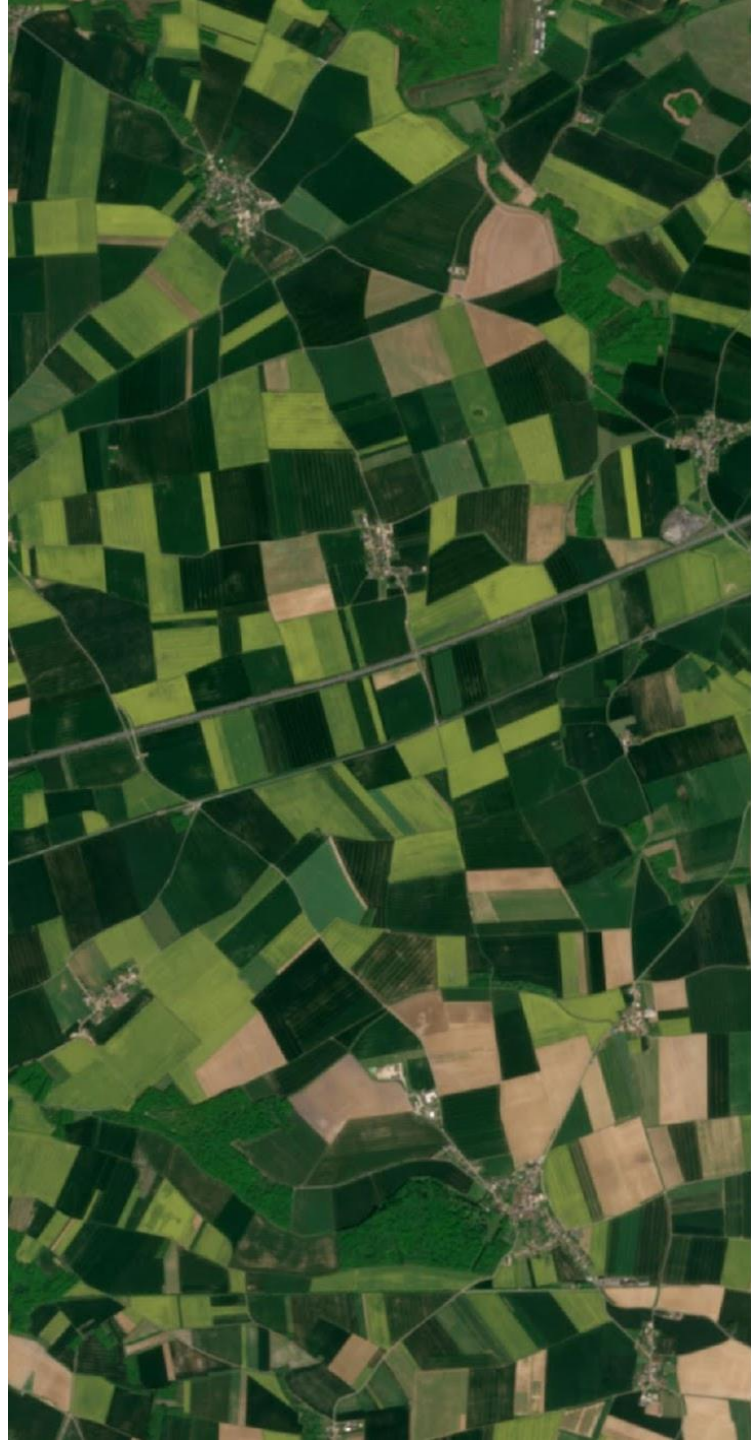


5) binary mask (thresh 0.9)



# Results

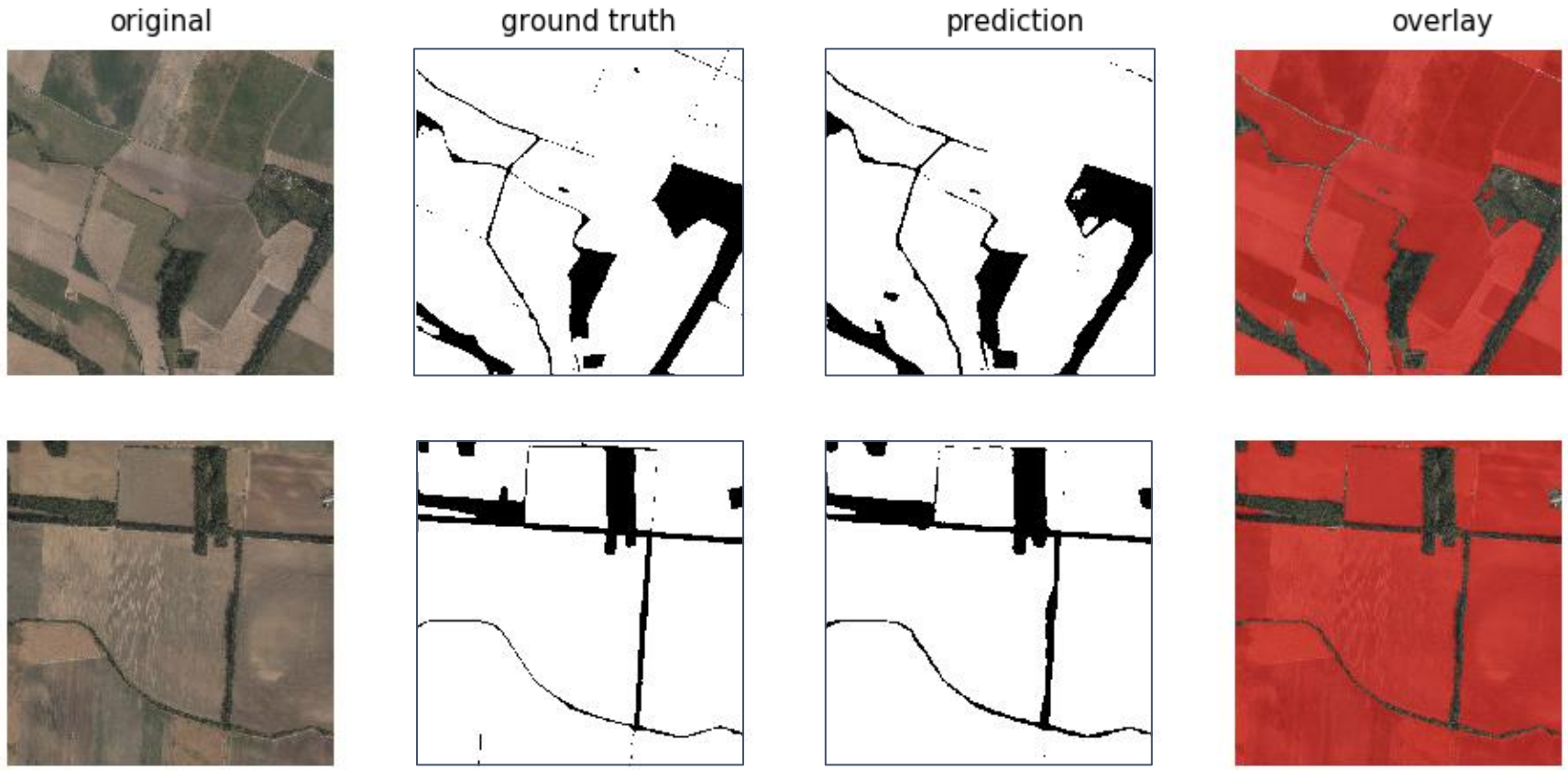


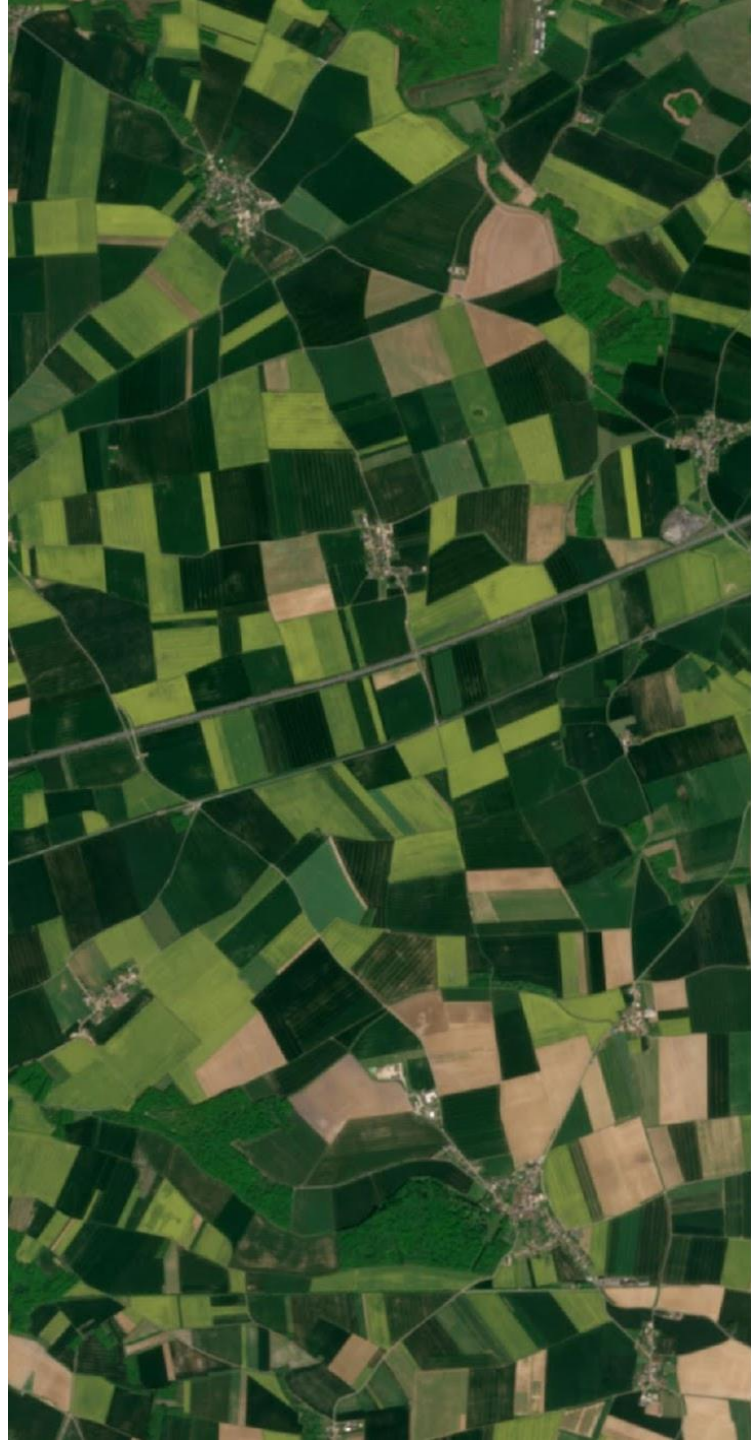



# Results

Evaluation of 52 test tiles that were excluded from the training dataset:

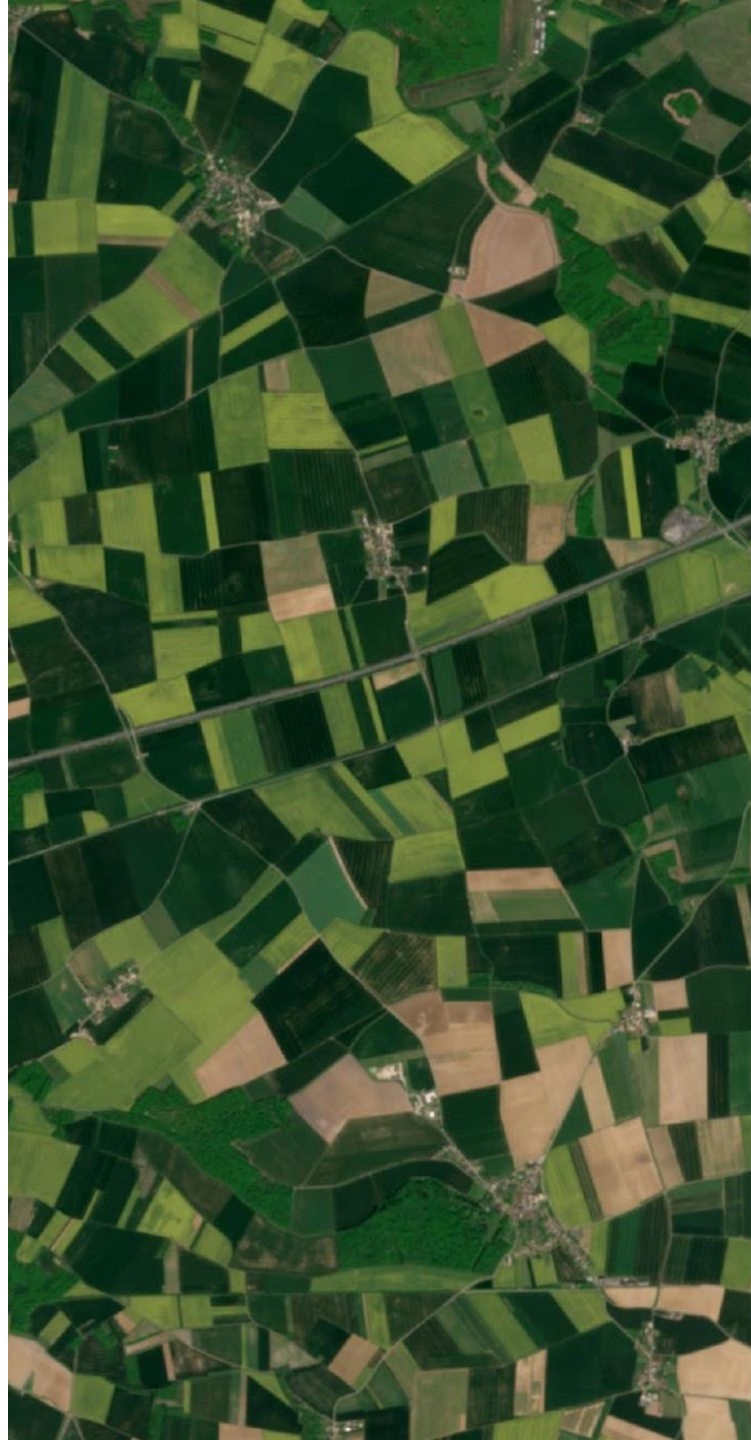
- IoU coefficient: **0.923**
- Accuracy: **0.956**



# Further Ideas / Improvements

- Different classes (water, crop, forests, …)
- Different resolution, multispectral images
- Instance segmentation (Mask R-CNN)



# Questions?

Thank you for your attention!