Deep Learning for Water Bodies Segmentation from SAR Images

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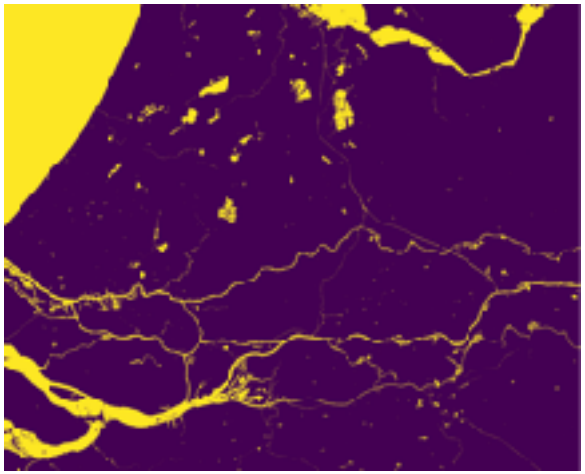
Datasets

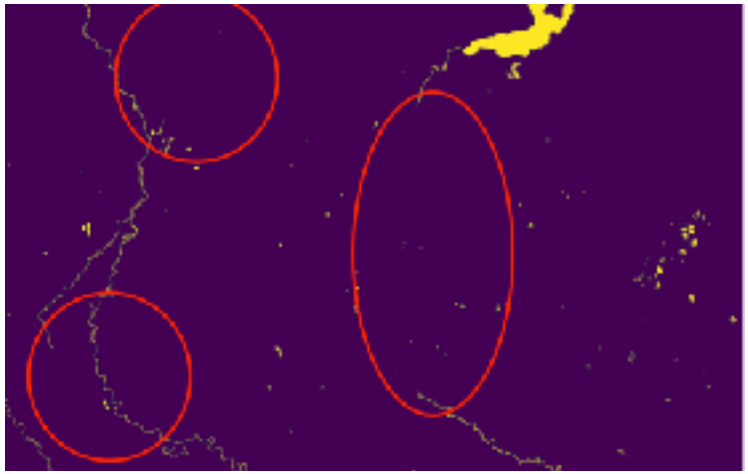
- Sentinel-1A - Interferometric Wide Swath (IW) mode
- Copernicus Land Monitoring Service Labels (High-Resolution Layer Water and Wetness)
- VV-VH dual-pol SAR images

Training Set: Netherland Area

***Validation/Test Set*:** North Italy Area

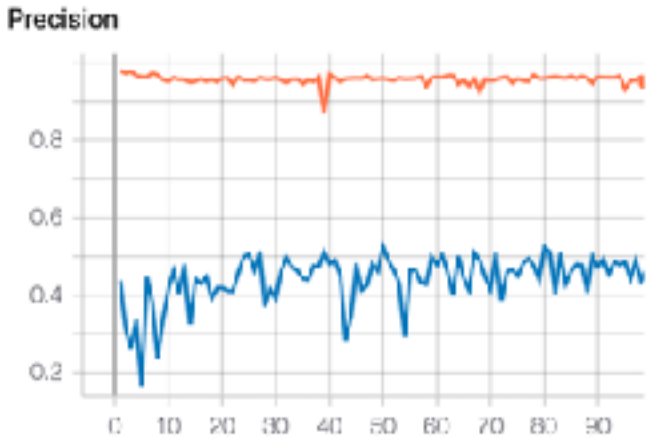
- Sampling algorithm - patches 128x128 pixels large.
- Patches are divided based on the percentage of water pixels

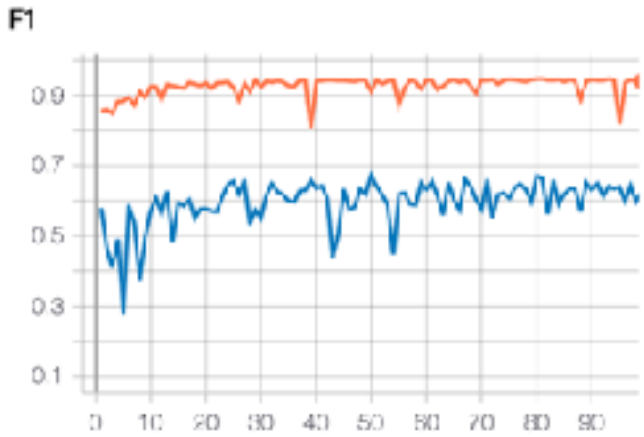




Datasets - Validation

- Patches with a percentage of water higher than 60% are not included

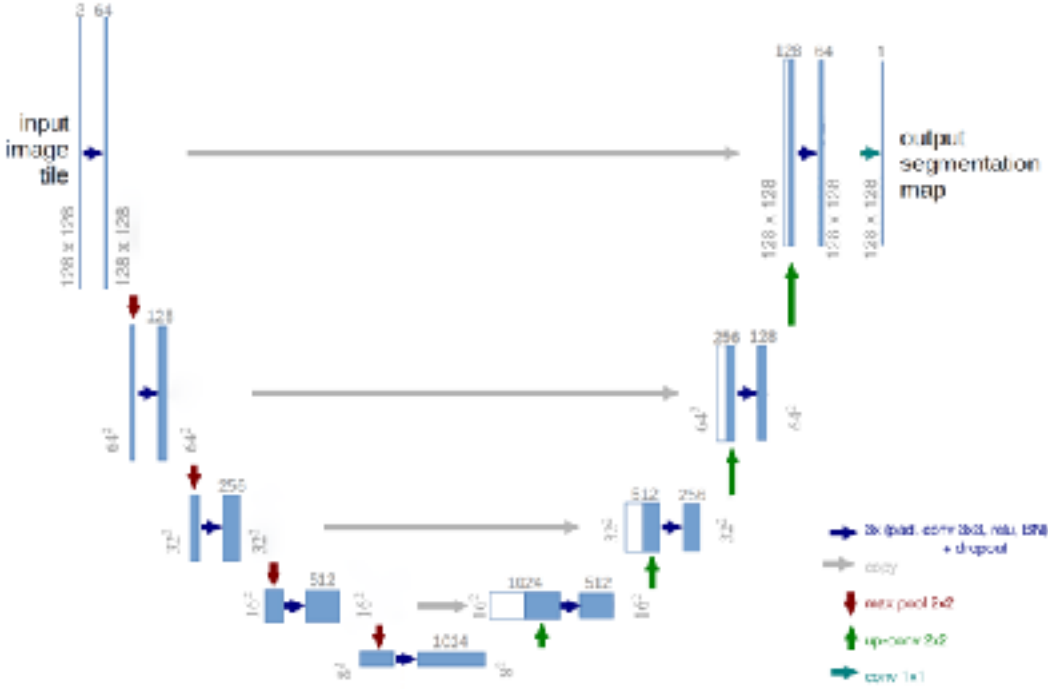




Supervised Learning (Baseline)

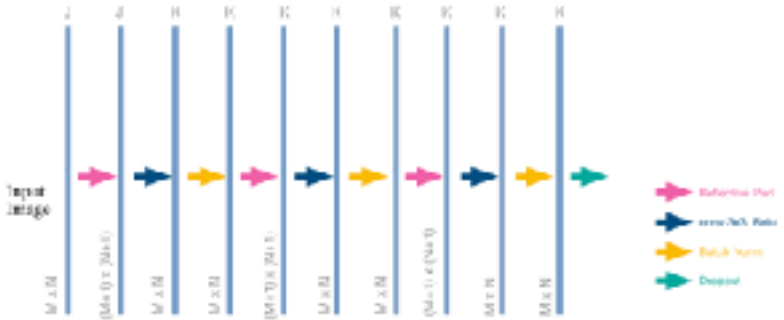
Network

- UNet
- Three convolutional layers for each block
- Reflective padding
- Batch Normalization
- Dropout

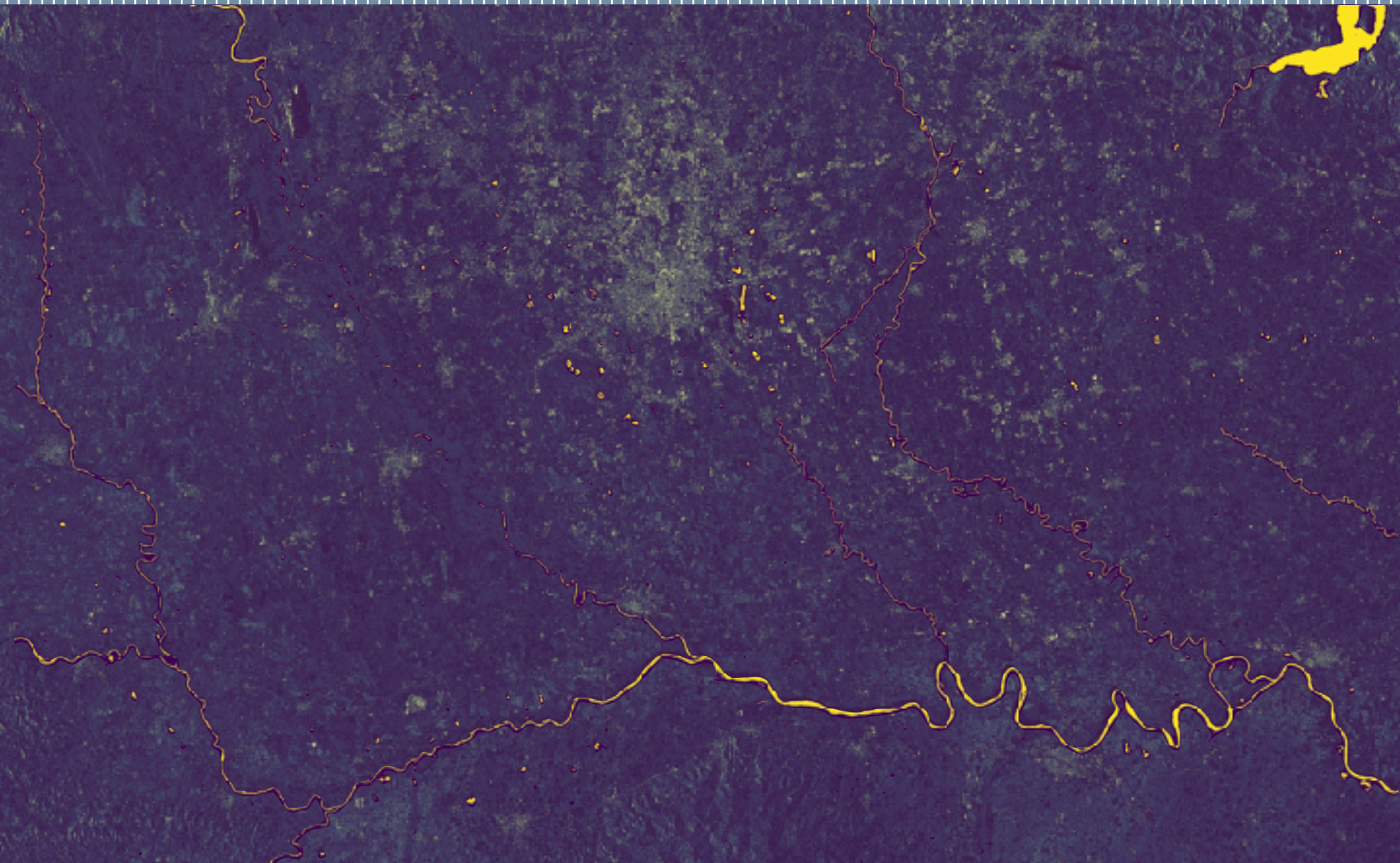


Training

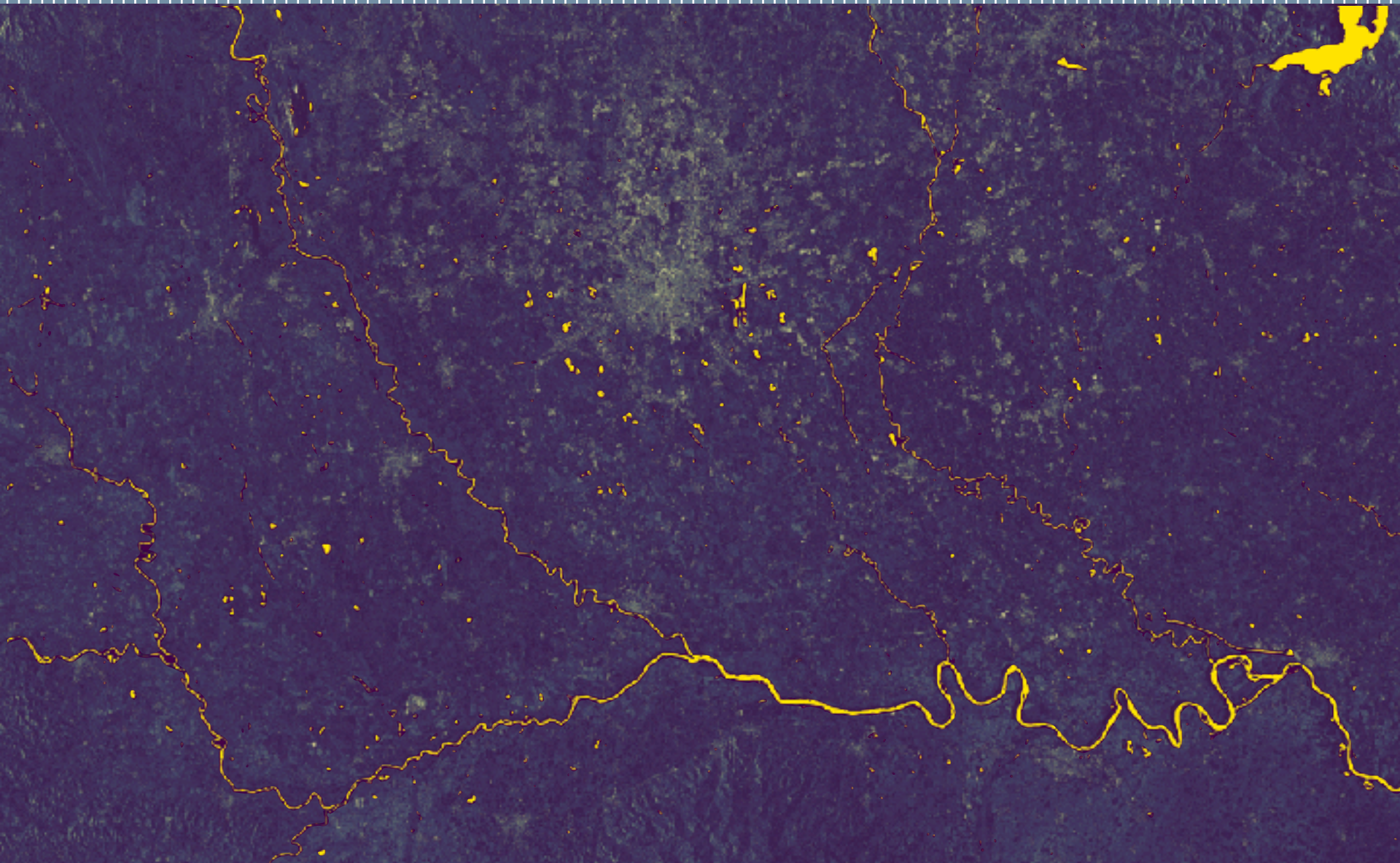
- Loss function: Weighted Binary Cross Entropy
- Optimizer: ADAM algorithm
- Learning rate of 0.0003 and a batch size equal to 32
- Data augmentation: Rotation and Flipping



Results Comparison - Copernicus Labels

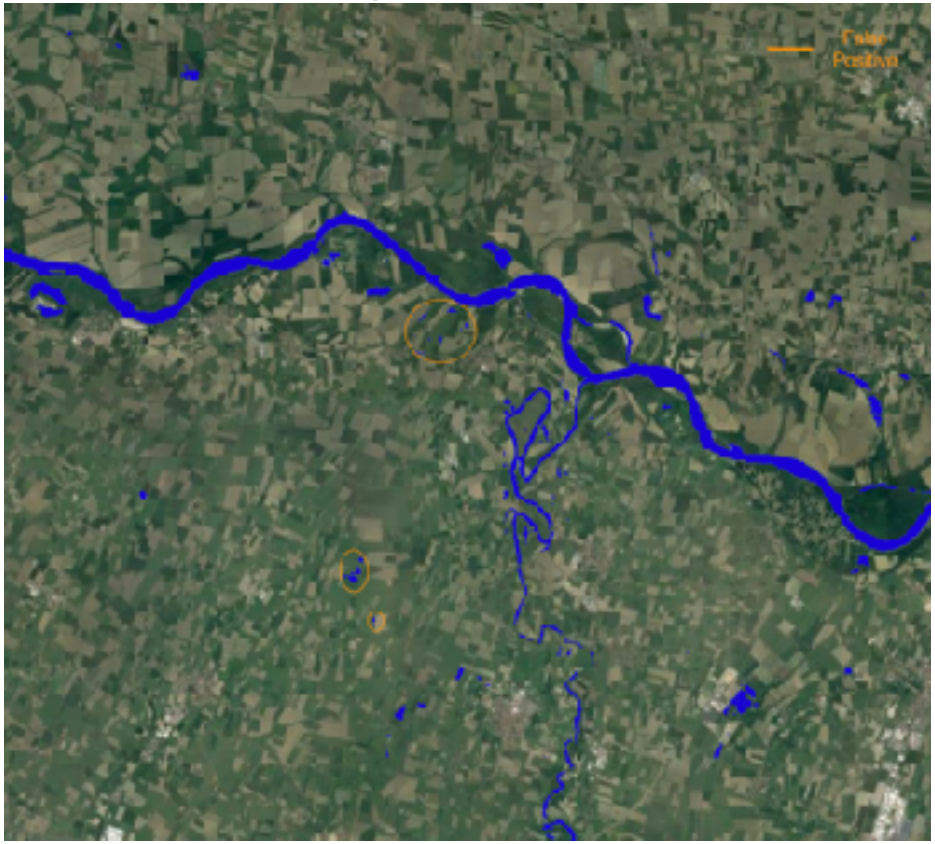


Results Comparison - Supervised Learning



Supervised Learning - False Positive

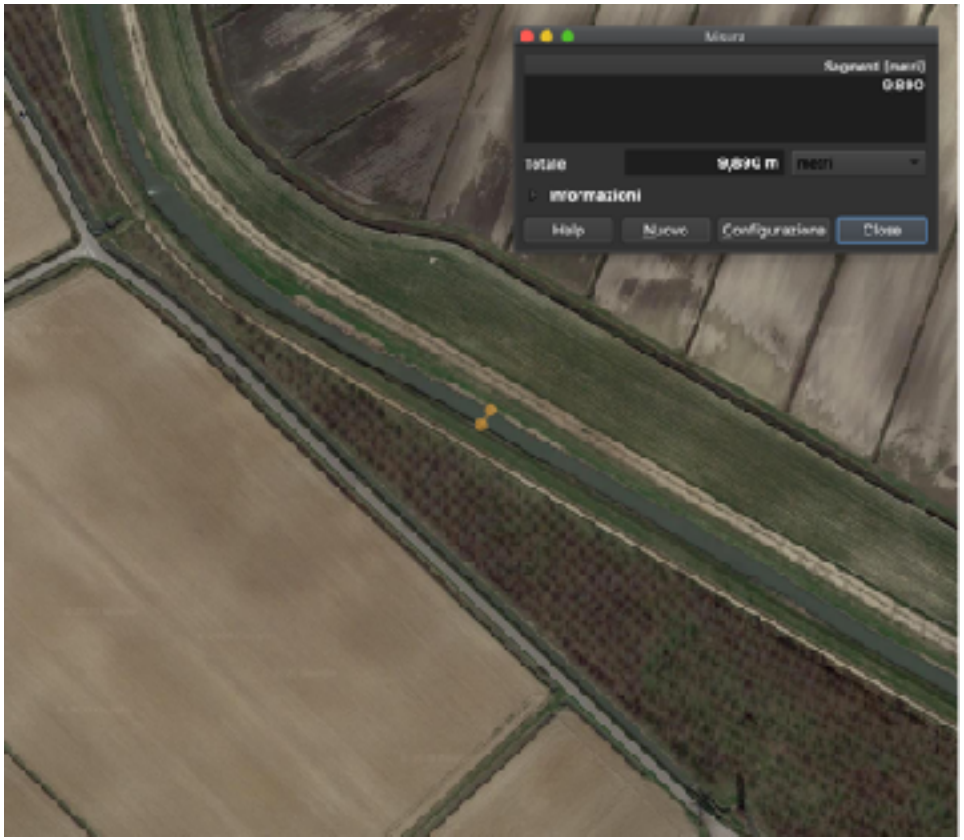
Agricultural fields



Radar shadows

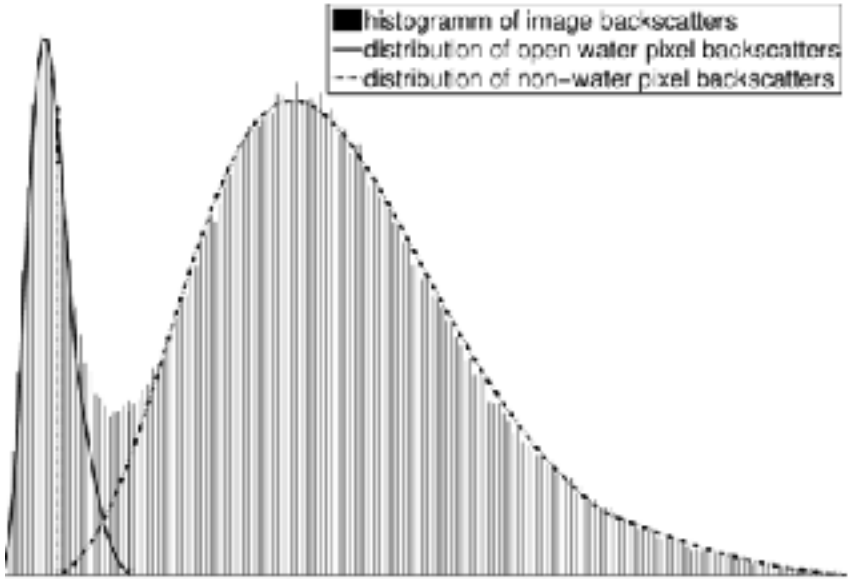
(to be removed using acquisition geometry information)

Supervised Learning - Final Results

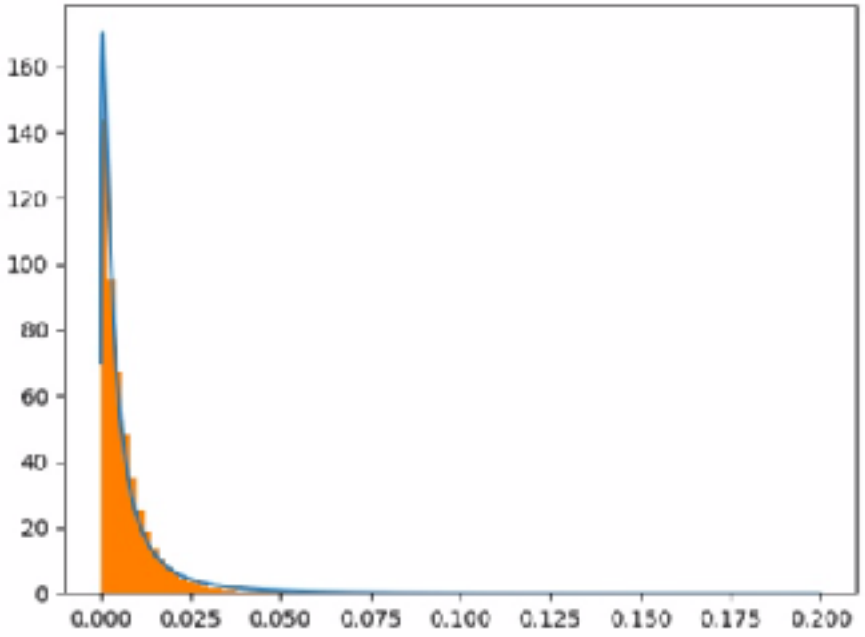


Active Learning

- The active learning methodology is used to automatically select and update pixels belonging to our labels based on a prior knowledge available about the distribution of water in the SAR image
- When illuminated, water surfaces reflect the signal resulting in low amplitude areas in the SAR image



Active Learning - Training

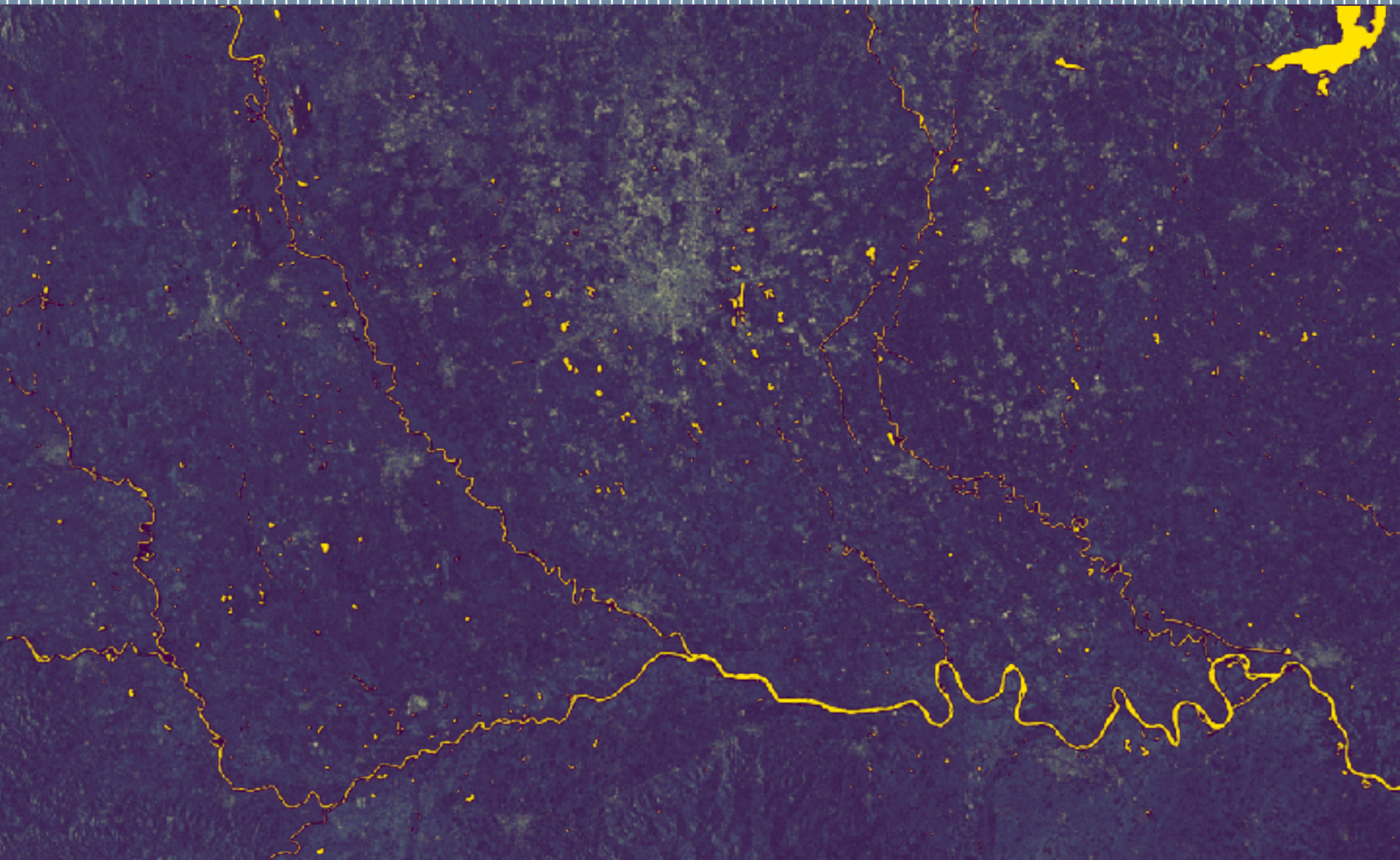


Original patch

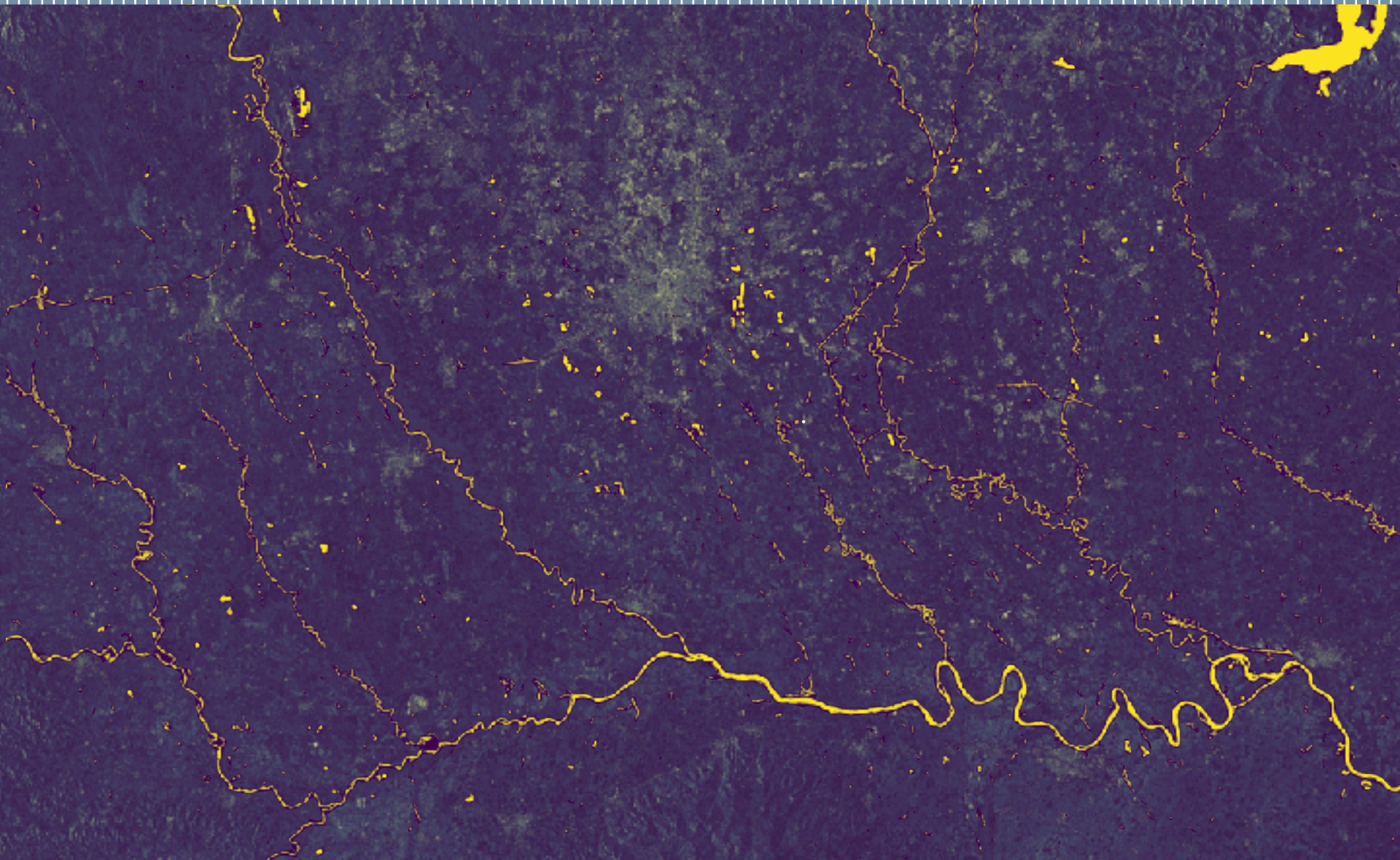
Updated pixels

Updated patch

Results Comparison - Supervised Learning



Results Comparison - Active Learning



Results Comparison

Supervised Learning

Active Learning

Blue over green

Green over blue

Results Comparison

Supervised Learning

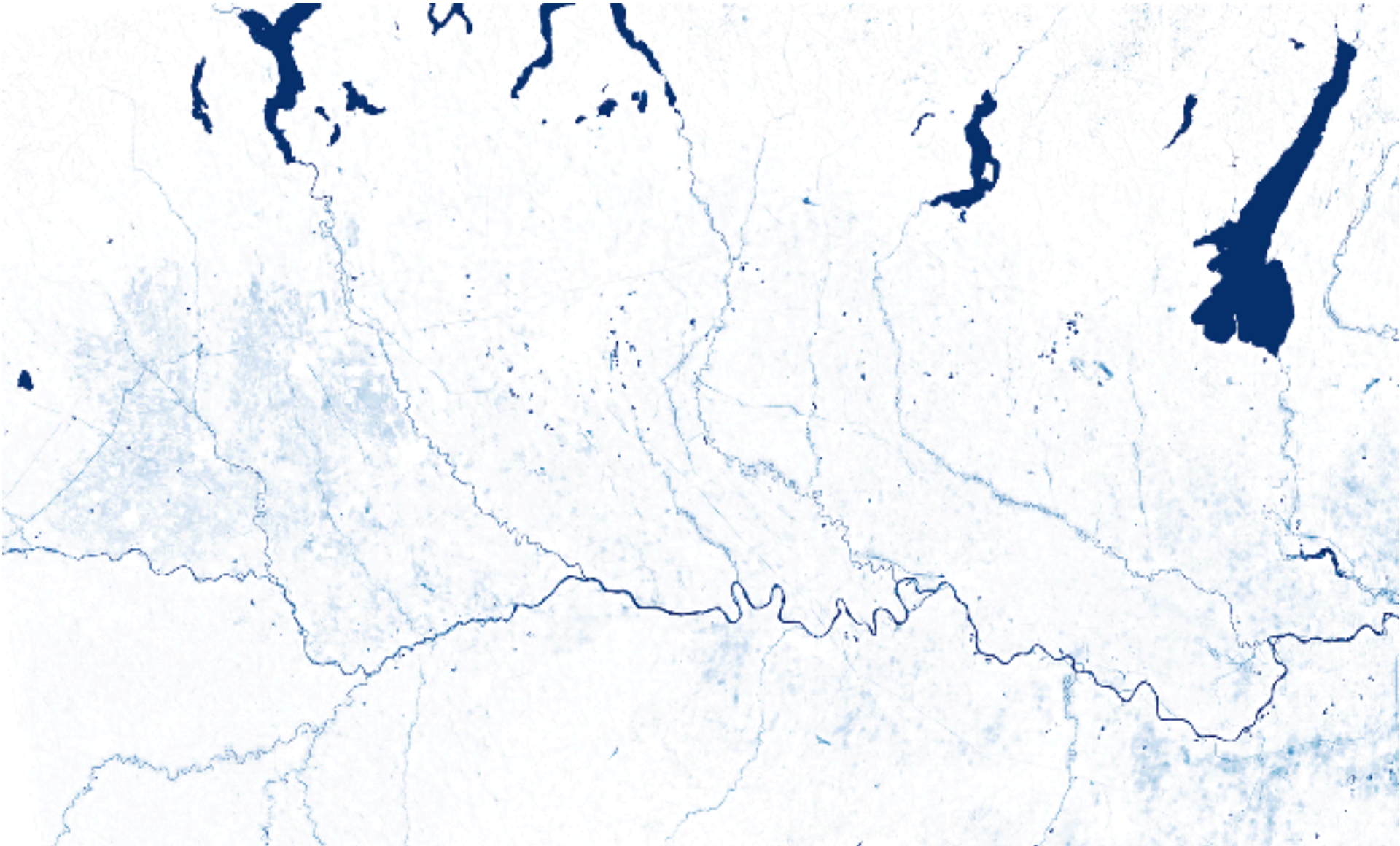
Active Learning

Blue over green

Green over blue

Flood Frequency

19 Images - Period: 11/2017 - 07/2018



Thank you for your attention