

Inland Water Mapping in the PLOTO project



DISC 23, Budapest, 05 – 06 Dec. 2023

Thodoris Betsas

PhD (c), Laboratory of Photogrammetry SRSGE NTUA
betsasth@mail.ntua.gr

Horizon Innovation Actions | Project no.
101069941



Co-funded by
the European Union



PLOTO Project in a Nutshell



Co-funded by
the European Union

About PLOTO



- **Project name:**

- Deployment and Assessment of Predictive modelling, environmentally sustainable and emerging digital technologies and tools for improving the resilience of IWW against Climate change and other extremes

- **Topic:**

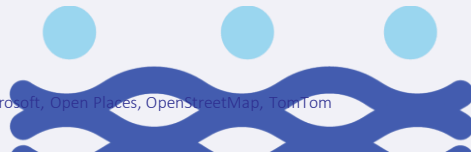
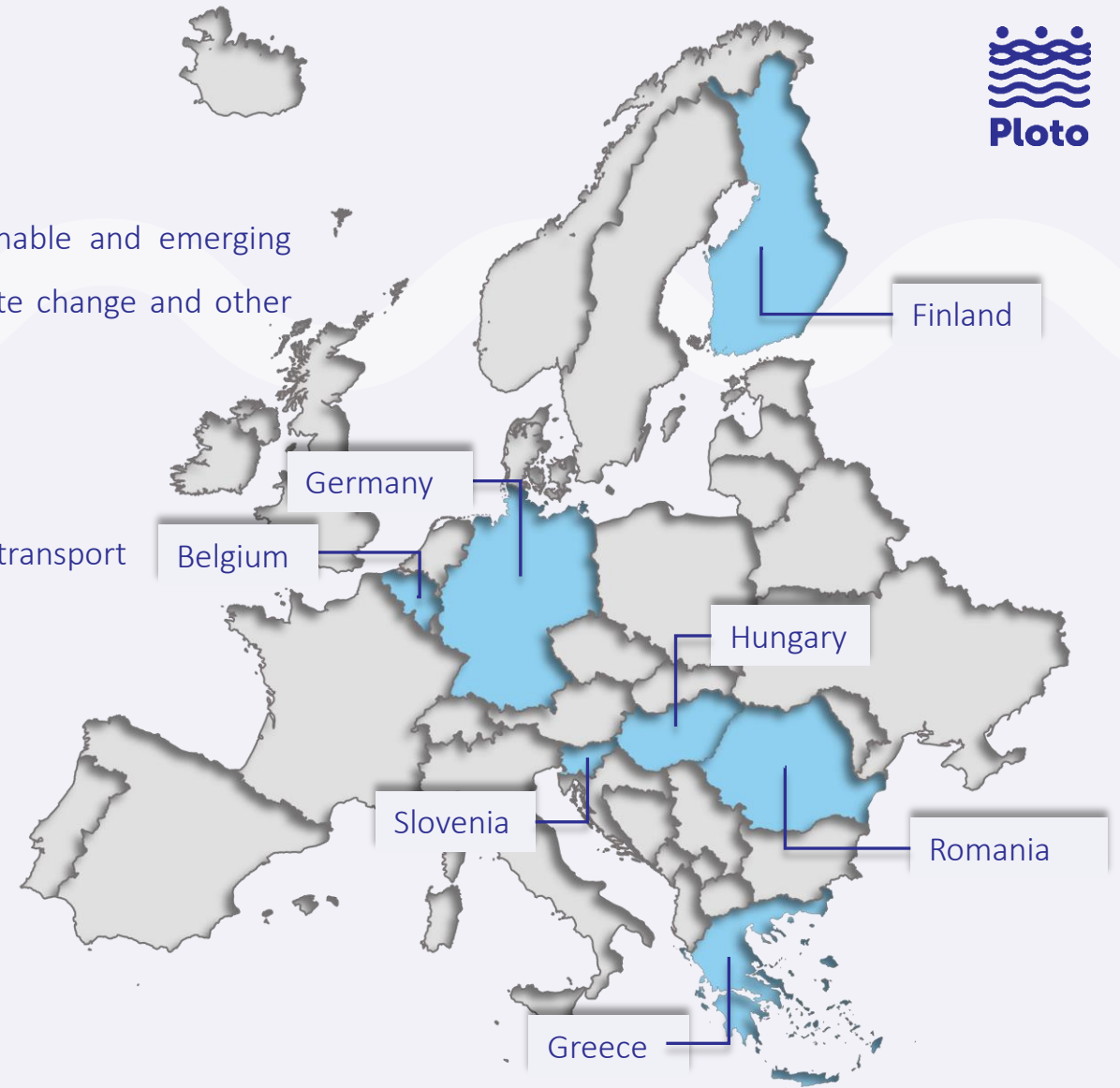
- HORIZON-CL5-2021-D6-01-09 - Climate resilient and environmentally sustainable transport infrastructure, with a focus on inland waterways

- **Start date:** 01/09/2022

- **End date:** 28/02/2026

- **Number of partners:** 20

- **Number of countries:** 7



PLOTO Aim, Challenges and Goals



Terrestrial Sensors

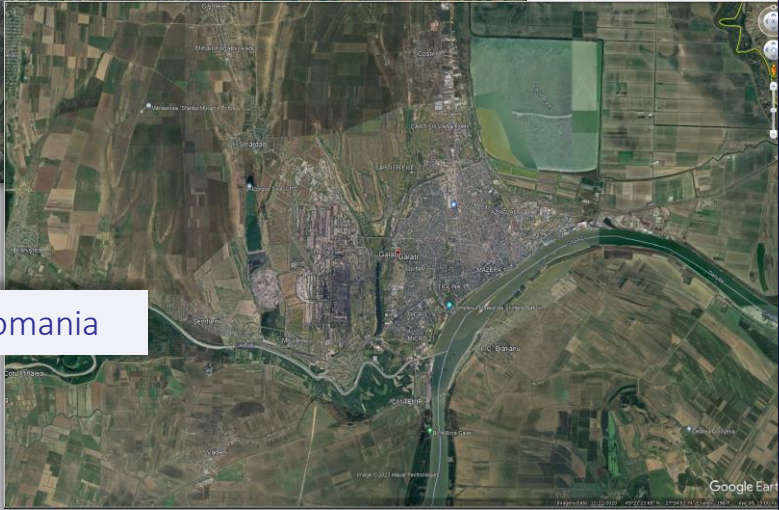
Pilot Cases



Wallonia, Liege Belgium



Budapest, Hungary



Galati, Romania



Powered by Bing
© GeoNames, Microsoft, Open Places, OpenStreetMap, TomTom



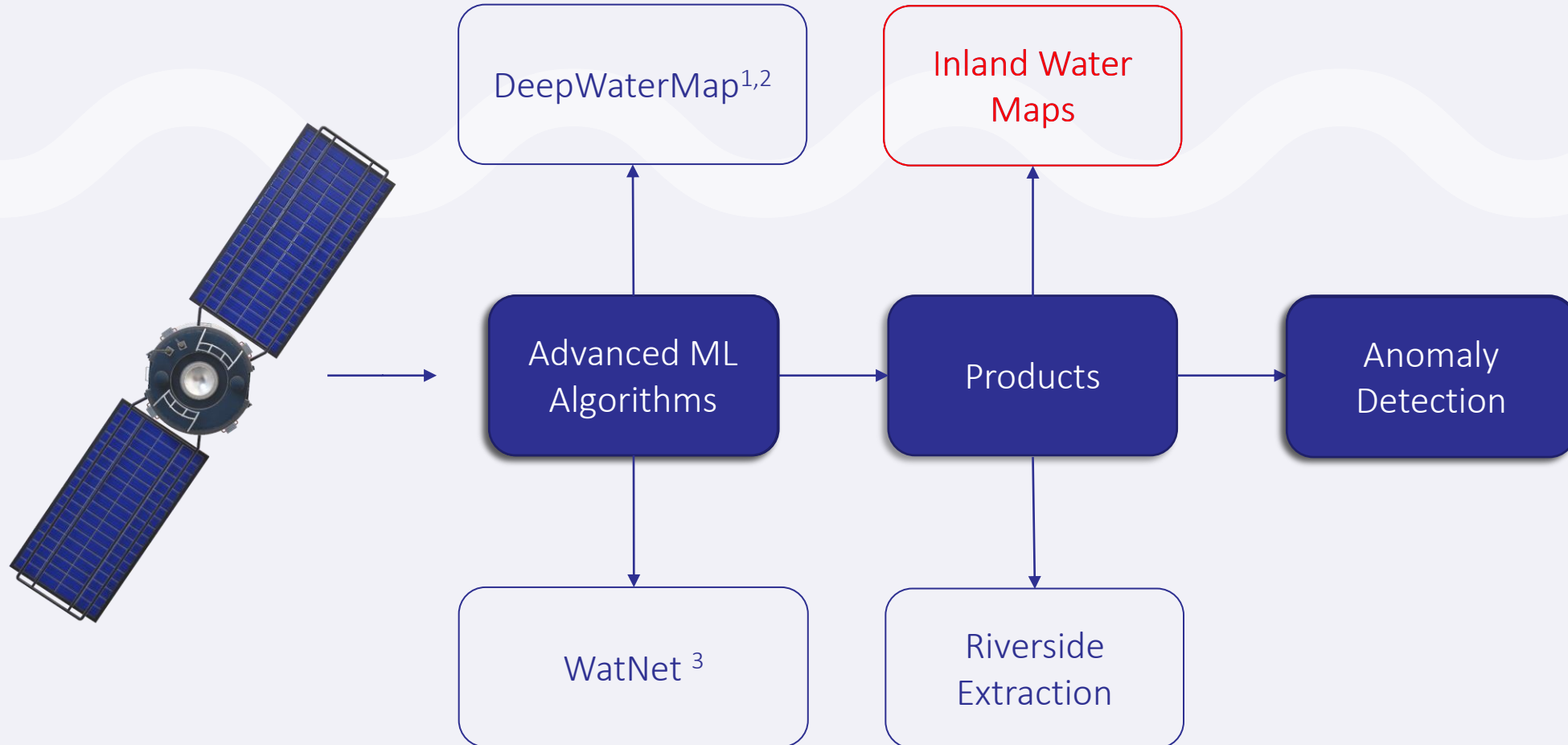


Inland Water Mapping



Co-funded by
the European Union

Inland Water Mapping using Sentinel 2 images

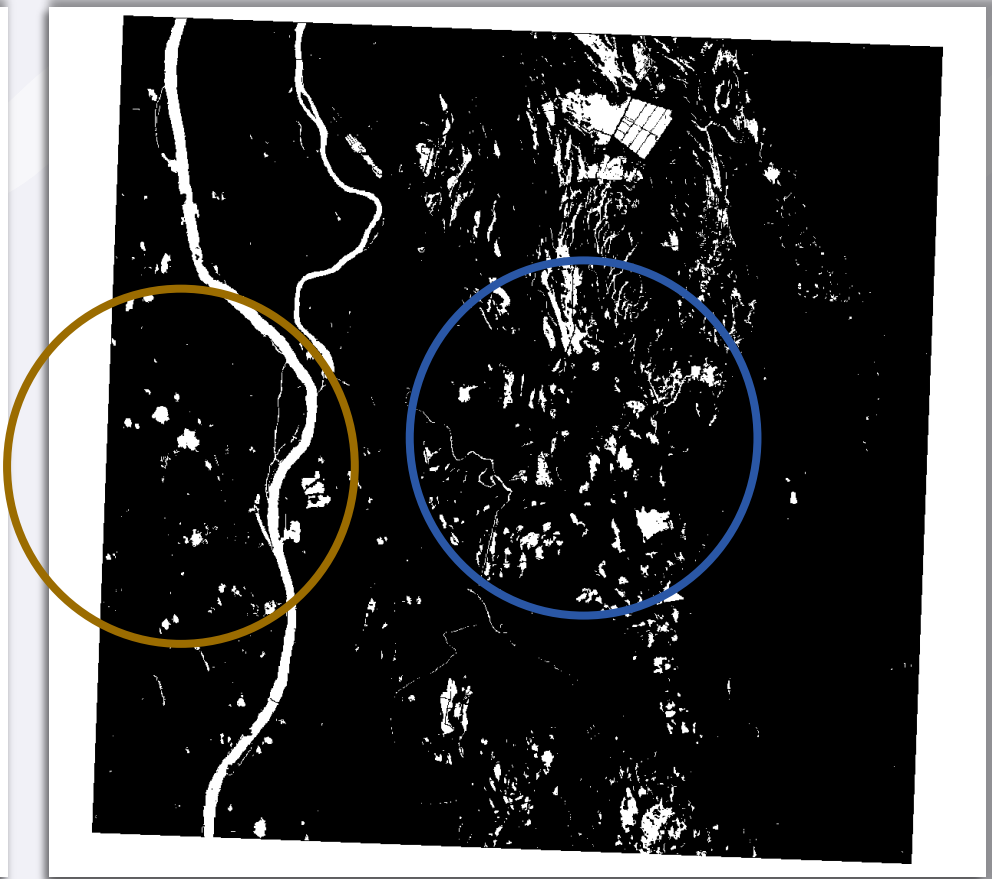


1. L. F. Isikdogan, A.C. Bovik, and P. Passalacqua, "Seeing Through the Clouds with DeepWaterMap," *IEEE Geoscience and Remote Sensing Letters*, 2019. [\[Read at IEEExplore\]](#), [\[PDF\]](#)

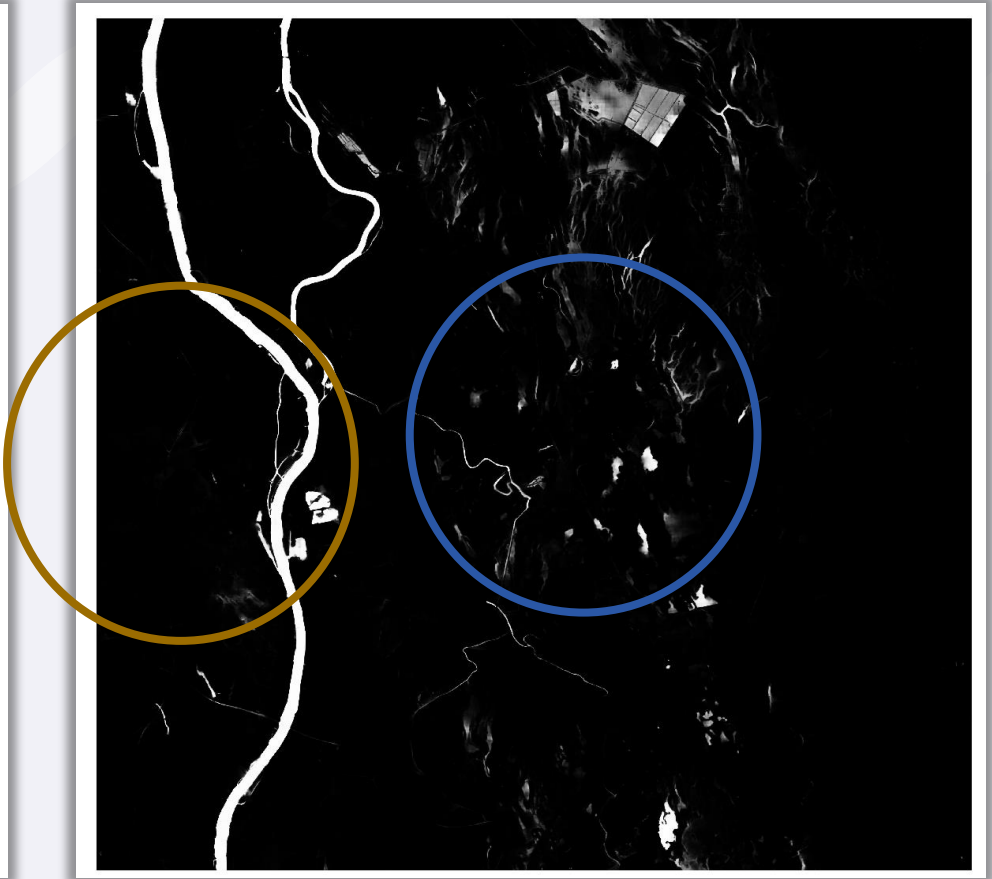
2. Isikdogan, A.C. Bovik, and P. Passalacqua, "Surface Water Mapping by Deep Learning," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 2017. [\[Read at IEEExplore\]](#), [\[PDF\]](#)

3. Xin Luo, Xiaohua Tong, Zhongwen Hu. An applicable and automatic method for earth surface water mapping based on multispectral images. *International Journal of Applied Earth Observation and Geoinformation*, 2021, 103, 102472. [\[Link\]](#)

WatNet Budapest Experiment



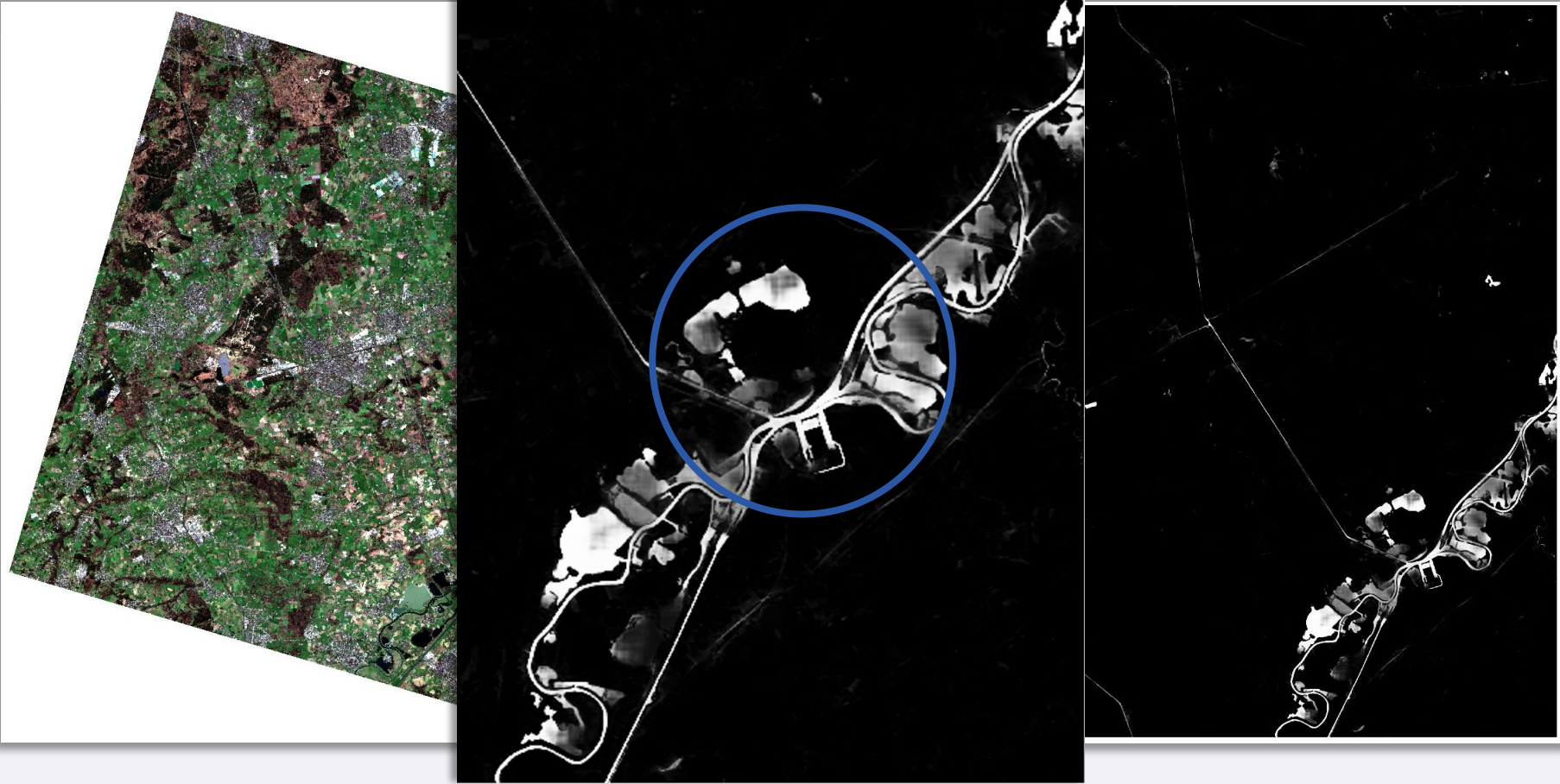
DeepWaterMap Budapest Experiment



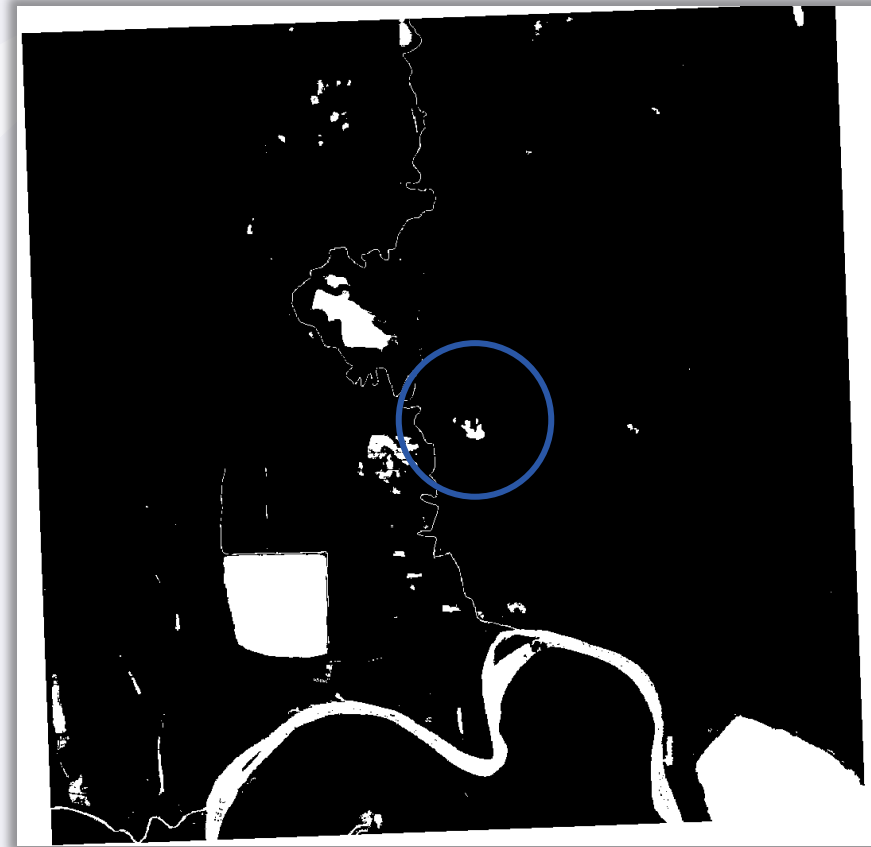
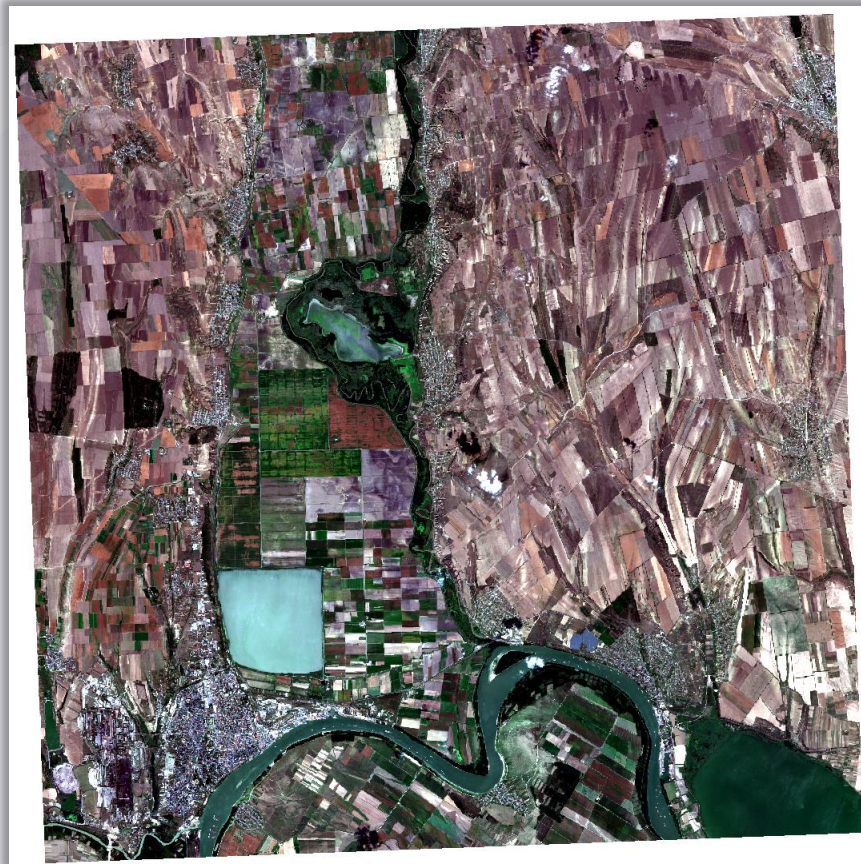
WatNet Wallonia Experiment (Liege)



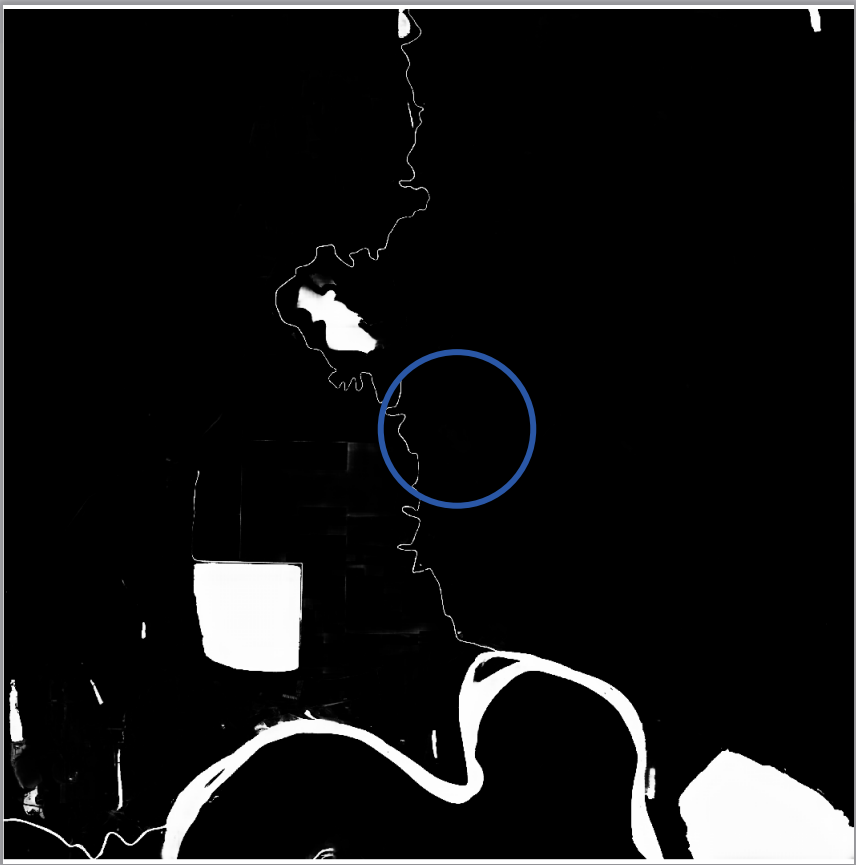
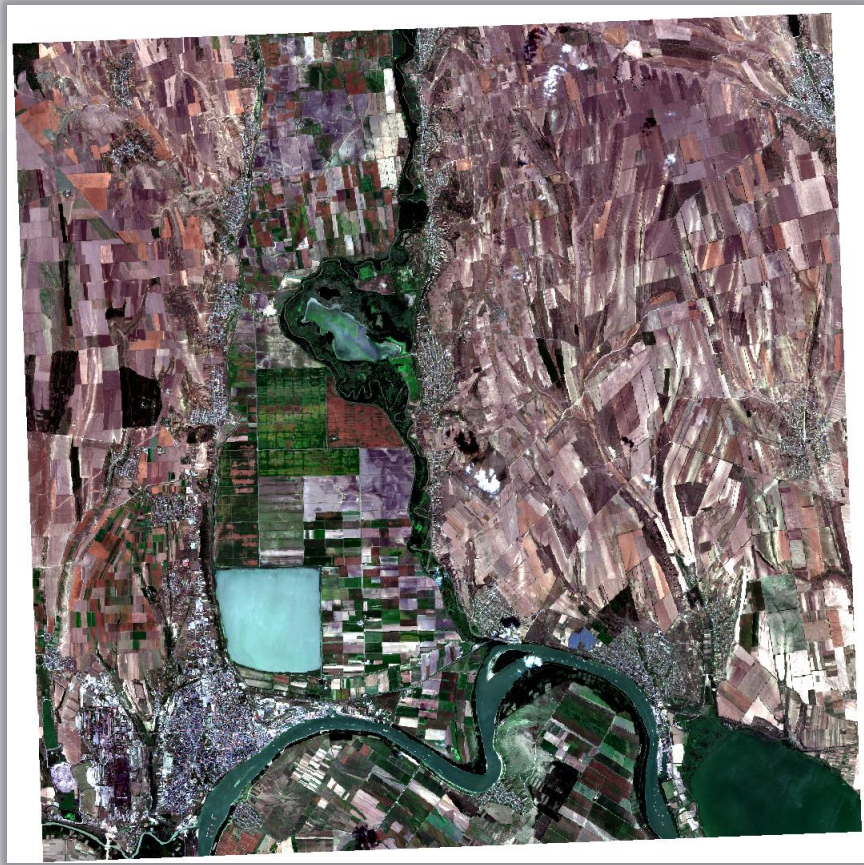
DeepWaterMap Wallonia Experiment (Liege)



WatNet Galati Experiment (Romania)



DeepWaterMap Galati Experiment (Romania)



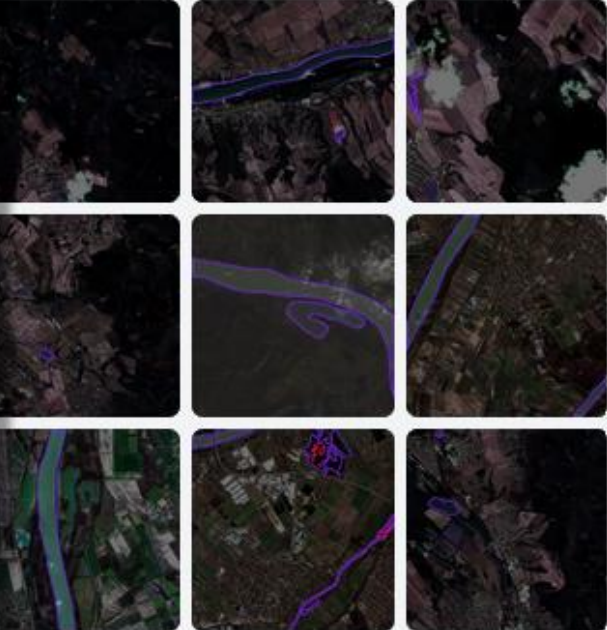
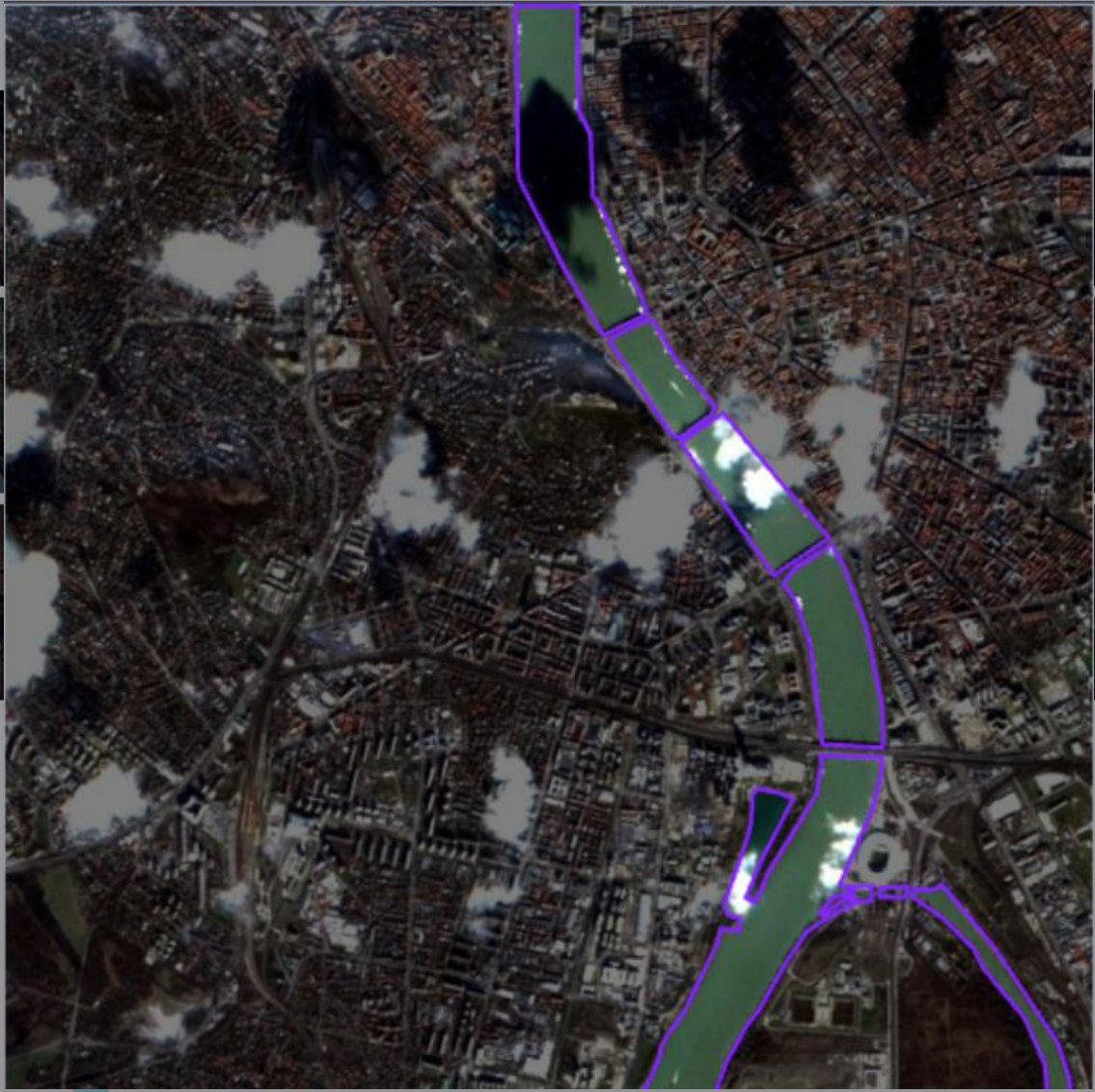


Evaluation



Co-funded by
the European Union

Manual Annotations using Roboflow¹



1. Roboflow: <https://roboflow.com/> (accessed 01/17/2023)



Inland Water Mapping Evaluation

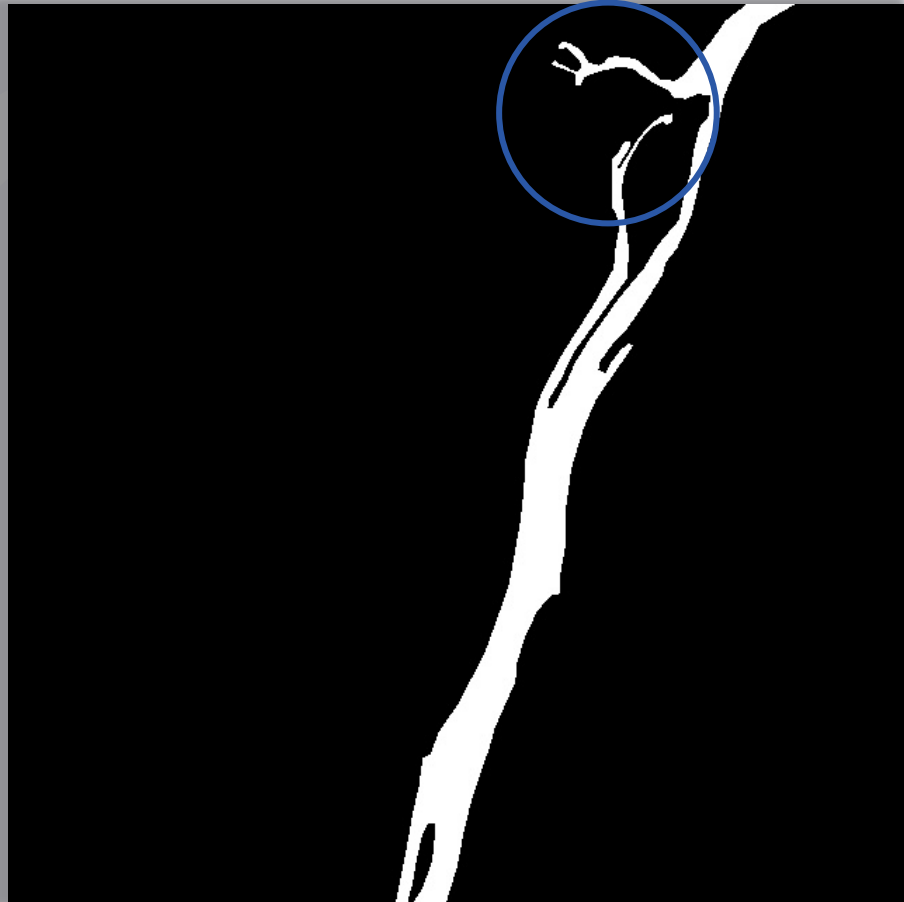


Algorithm	Precision (%)	Recall (%)	F1-score (%)	Overall Acc (%)	mIoU (%)
WatNet (Authors) ³	96.6	96.7	---	98.8	96.5
DeepWaterMap (Authors) ^{1,2} V1 and V2	88 (av. 1,3,5)	89(av. 1,3,5)	89(av. 1,3,5)	---	---
	97	90	93	---	---
WatNet (Pilot Sites)	85.9	89.2	87.4	98.2	83.5
DeepWaterMap (Pilot Sites)	89.5	92.8	91.03	98.5	85.2

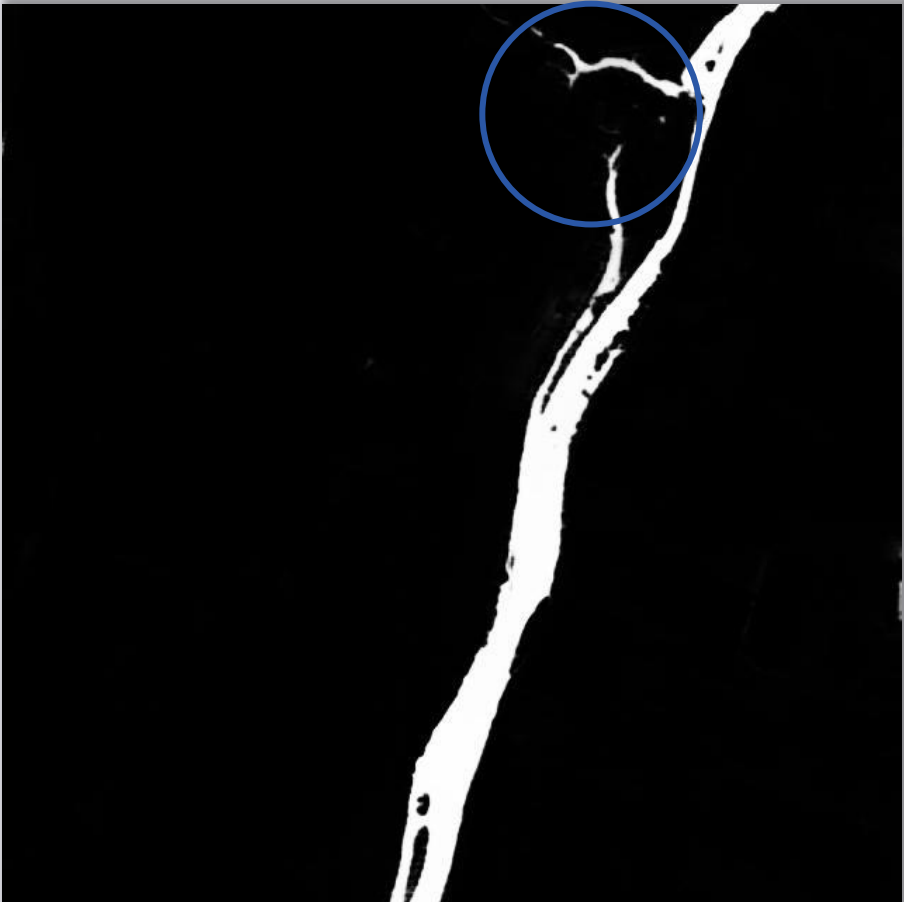
1. L. F. Isikdogan, A.C. Bovik, and P. Passalacqua, "Seeing Through the Clouds with DeepWaterMap," *IEEE Geoscience and Remote Sensing Letters*, 2019. [\[Read at IEEExplore\]](#), [\[PDF\]](#)
2. Isikdogan, A.C. Bovik, and P. Passalacqua, "Surface Water Mapping by Deep Learning," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, 2017. [\[Read at IEEExplore\]](#), [\[PDF\]](#)
3. Xin Luo, Xiaohua Tong, Zhongwen Hu. An applicable and automatic method for earth surface water mapping based on multispectral images. *International Journal of Applied Earth Observation and Geoinformation*, 2021, 103, 102472. [\[Link\]](#)



Example of IoU 83%



Ground Truth



Prediction



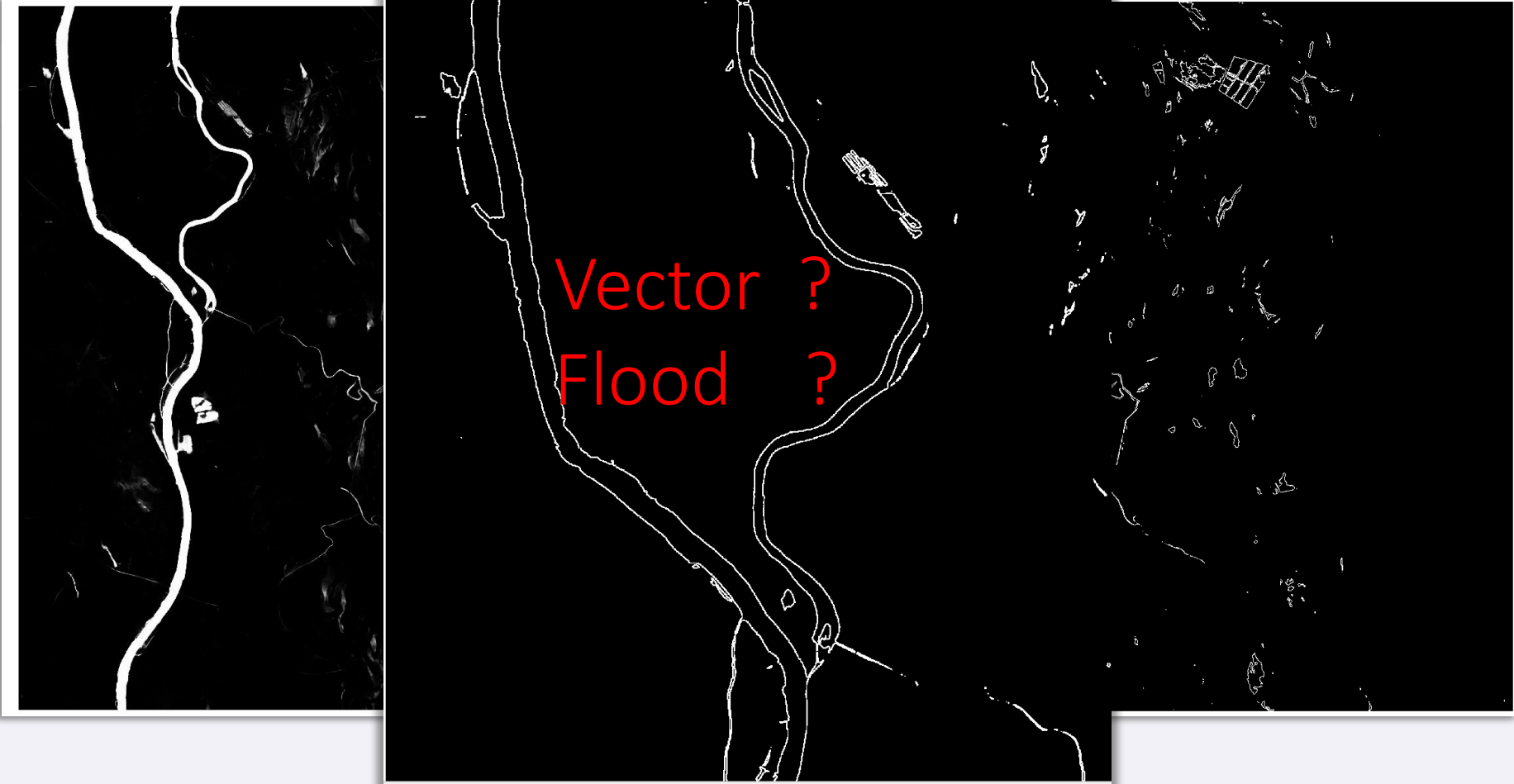


Using the Water Maps. On Going and Future Work



Co-funded by
the European Union

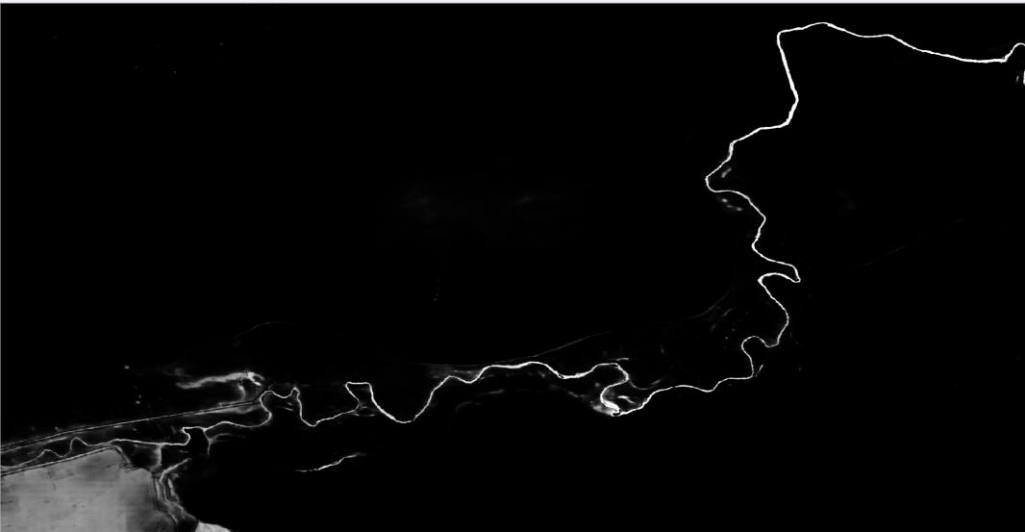
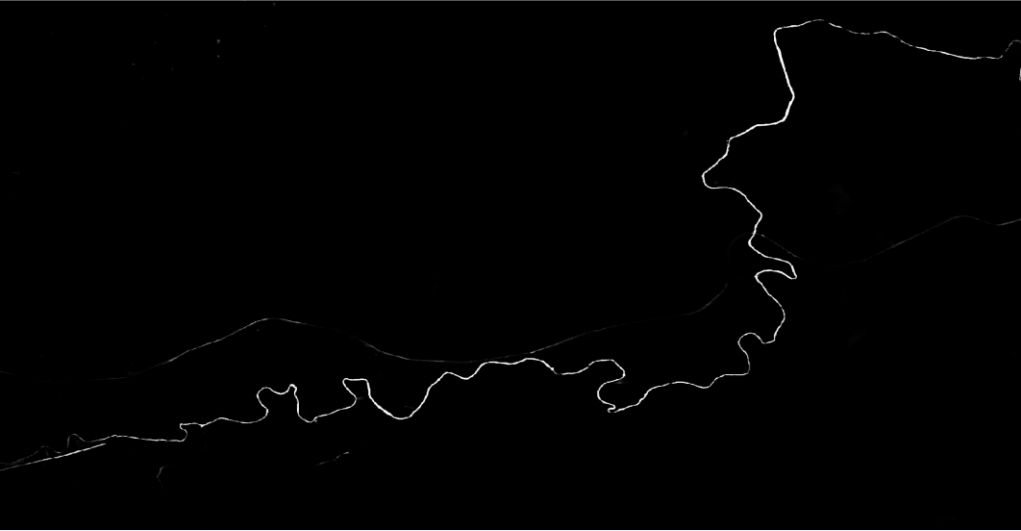
DeepWaterMap Budapest River Banks Extraction as a Georeferenced Raster



Thessaly Greece, Flood 09 September 2023



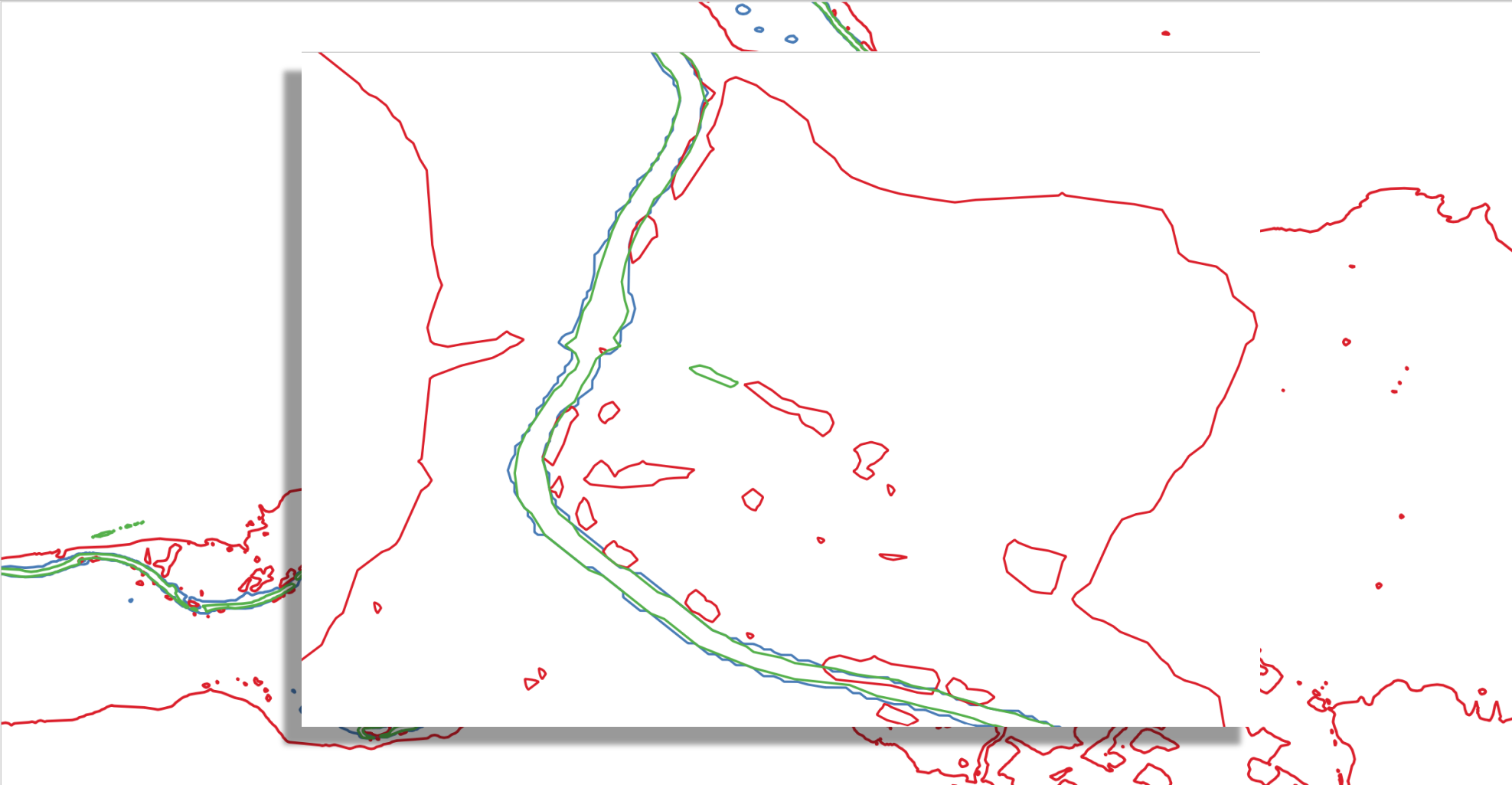
Riverside Extraction in Vector (1/3)



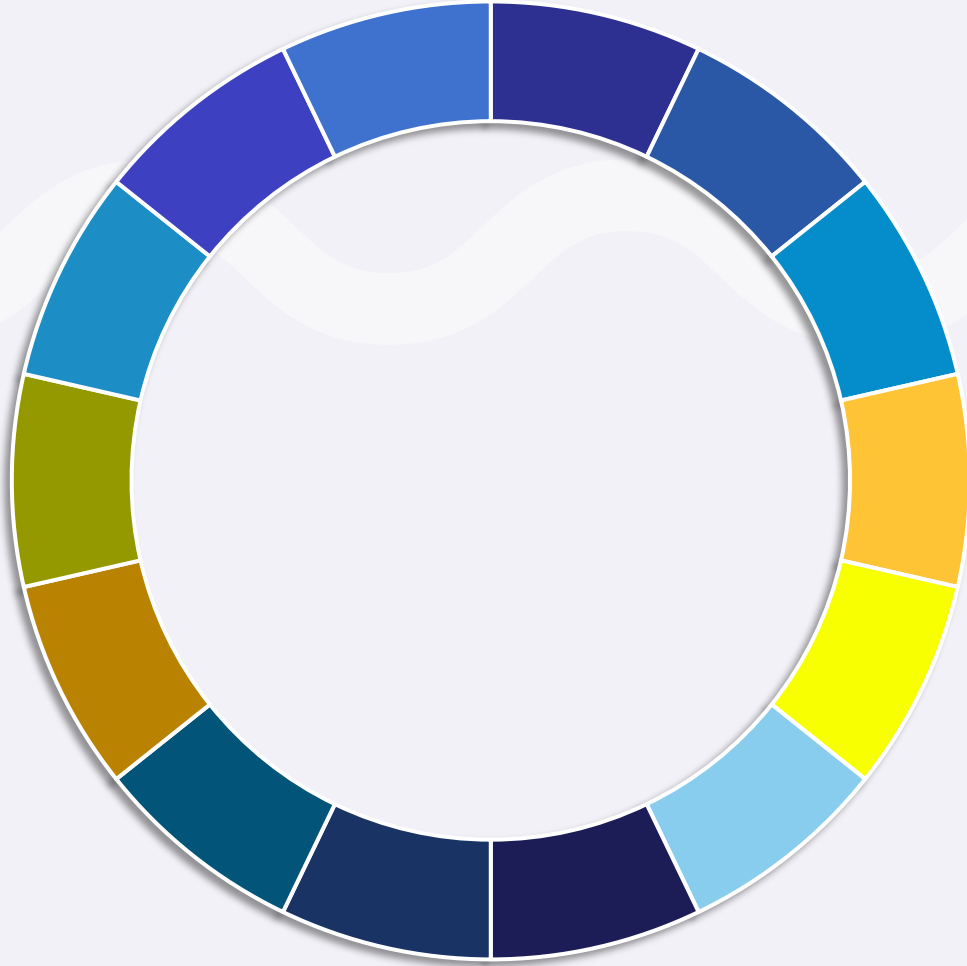
Riverside Extraction in Vector (2/3)



Riverside Extraction in Vector (3/3)



Char Detection / Alert



- Sep 2022
- Oct 2022
- Noe 2022
- Dec 2022
- Jan 2023
- Feb 2023
- Mar 2023
- Apr 2023
- May 2023
- Jun 2023
- Jul 2023
- Aug 2023
- Sep 2023
- Oct 2023



Char Detection - Alert 2/3



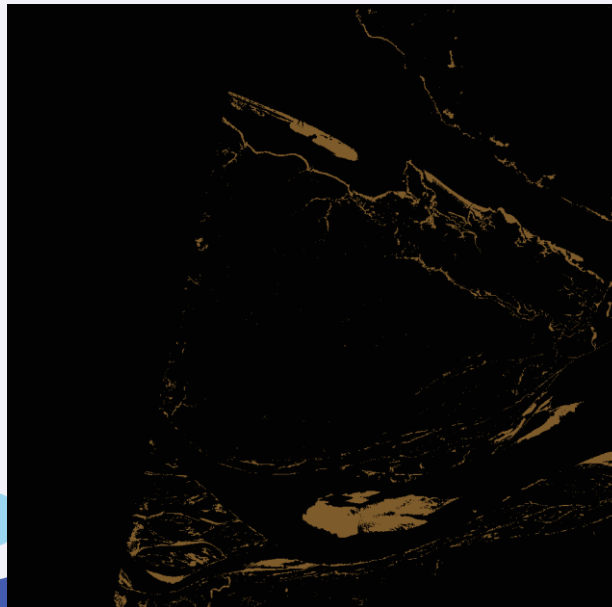
April 2023



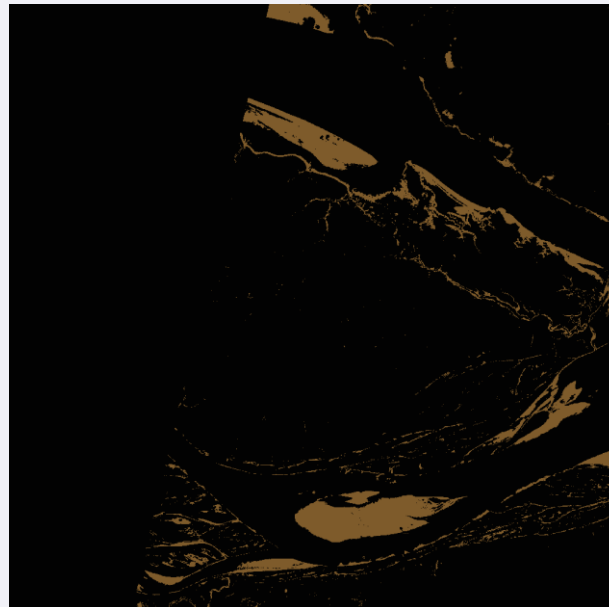
May 2023



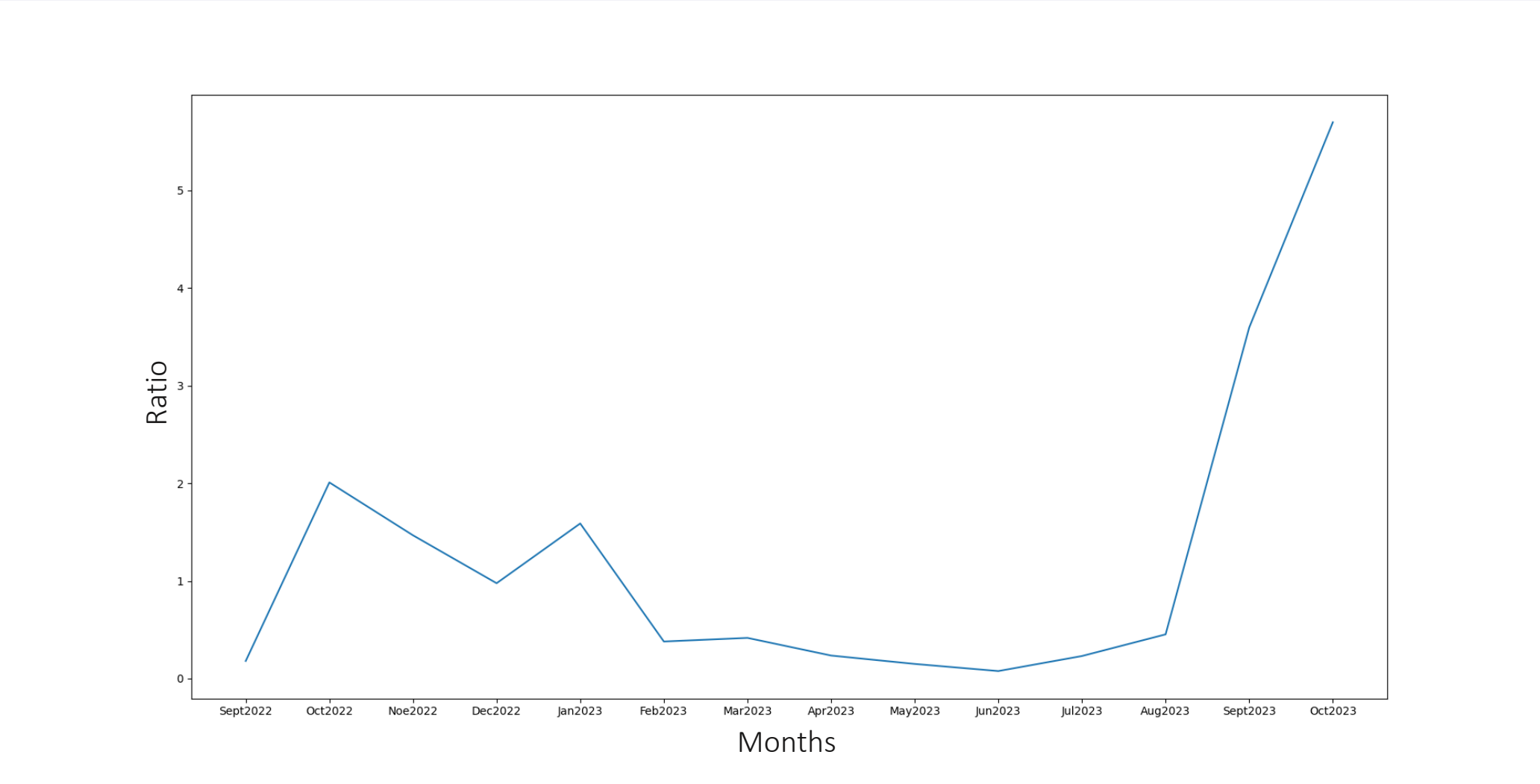
September
2023



October
2023



Char Detection / Alert



THANK YOU!



Horizon Innovation Actions | Project No. 101069941

ploto-project.eu

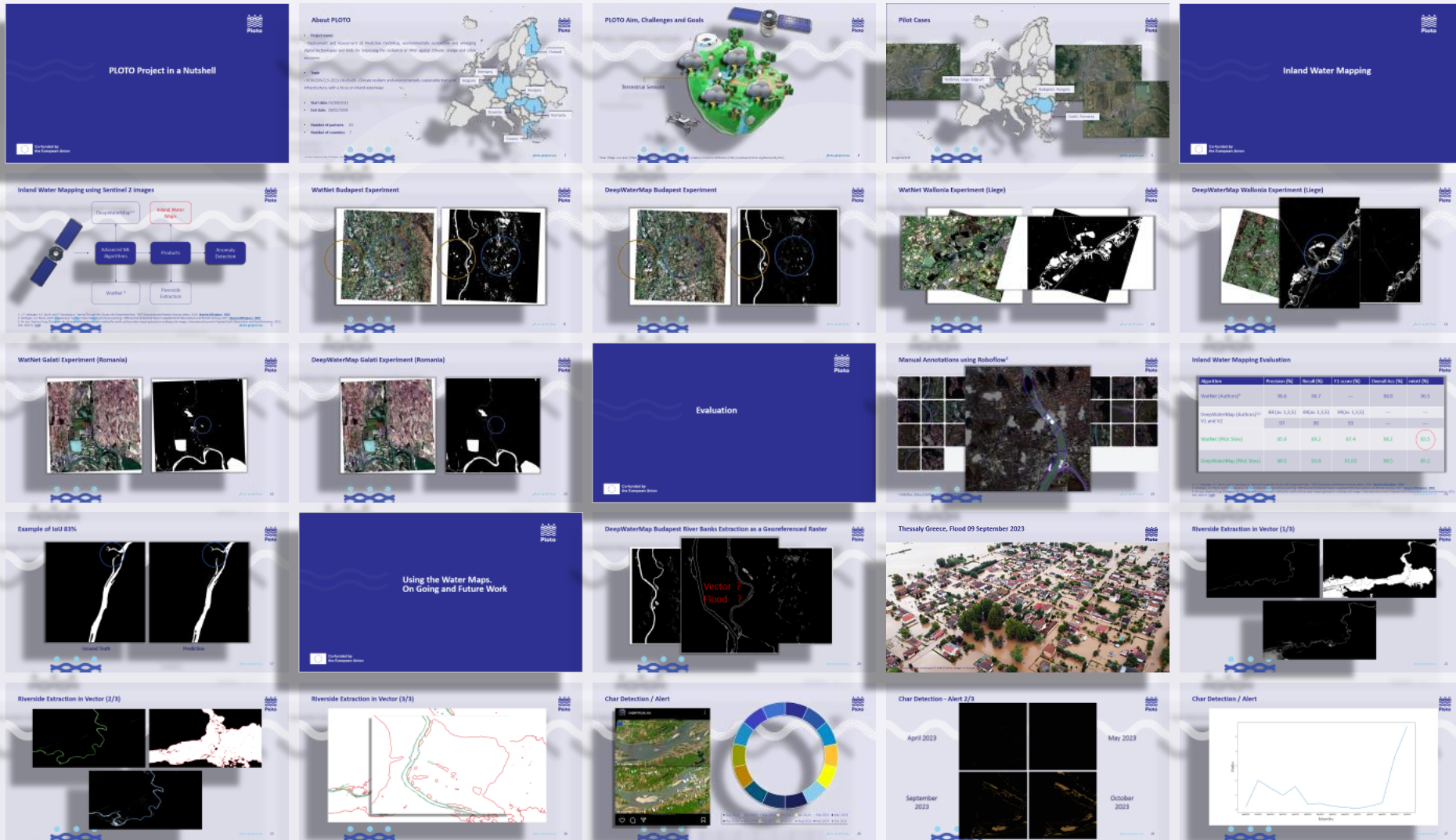
[Thodoris Betsas](#)

Laboratory of Photogrammetry SRSGE NTUA
betsasth@mail.ntua.gr



**Co-funded by
the European Union**

Questions ??



PLOTO Project in a Nutshell

About PLOTO

- **Objectives:** Deployment and assessment of machine learning, semi-supervised, statistical and ensemble deep-learning methods to support the extraction of water bodies from satellite imagery.
- **Year:** 2020/2021-2023/2024/25 - Climate resilience and environmental sustainability through interventions with a focus on inland waterways.
- **Start Date:** 01/07/2020
- **End Date:** 30/06/2025
- **Number of partners:** 10
- **Number of countries:** 7

PLOTO Aim, Challenges and Goals

Pilot Cases

Inland Water Mapping

Inland Water Mapping using Sentinel 2 Images

WatNet Budapest Experiment

DeepWaterMap Budapest Experiment

WatNet Wallonia Experiment (Liège)

DeepWaterMap Wallonia Experiment (Liège)

WatNet Galati Experiment (Romania)

DeepWaterMap Galati Experiment (Romania)

Evaluation

Algorithm	Precision (%)	Recall (%)	F1 score (%)	Overall Acc (%)	IoU (%)
WaterNet (Lutbang) ¹	96.6	96.7	—	96.6	96.5
DeepWaterMap (Lutbang) ¹ V1 and V2	88.0a, 83.5b	89.0a, 83.5b	—	—	—
WaterNet (Bial Szei)	85.8	88.2	87.4	88.2	88.8
DeepWaterMap (Bial Szei)	85.5	82.8	84.0	84.5	85.2

Manual Annotations using Roboflow¹

Inland Water Mapping Evaluation

Example of IoU 83%

Using the Water Maps. On Going and Future Work

DeepWaterMap Budapest River Banks Extraction as a Georeferenced Raster

Thessaly Greece, Flood 09 September 2023

Riverside Extraction in Vector (1/3)

Riverside Extraction in Vector (2/3)

Riverside Extraction in Vector (3/3)

Char Detection / Alert

Char Detection - Alert 2/3

Char Detection / Alert