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Assessment on Chl-*a* concentrations & eutrophication dynamics

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PONTOS Joint Open Workshop

Odessa, Ukraine

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AUA ACOPIAN CENTER *for the* ENVIRONMENT

CERTH CENTRE FOR RESEARCH & TECHNOLOGY HELLAS

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GREEN ALTERNATIVE

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D.T1.2.5 Objectives

- **The PONTOS platform will** acquire data from land and marine databases (e.g. Copernicus, MODnet, Géoservices Sextant and BLACKSEASCENE) and **process space-borne images to assess the dynamics of chlorophyll concentration as an indicator of water eutrophication to operatively monitor nutrient pollution** within the pilots for the period 2009-2021.

- *In-situ* historical and PONTOS field data (e.g. TN, DON, NO_3^-, NH_4^+ & TP, $PO4_3^-$) will be used for establishing correlations.

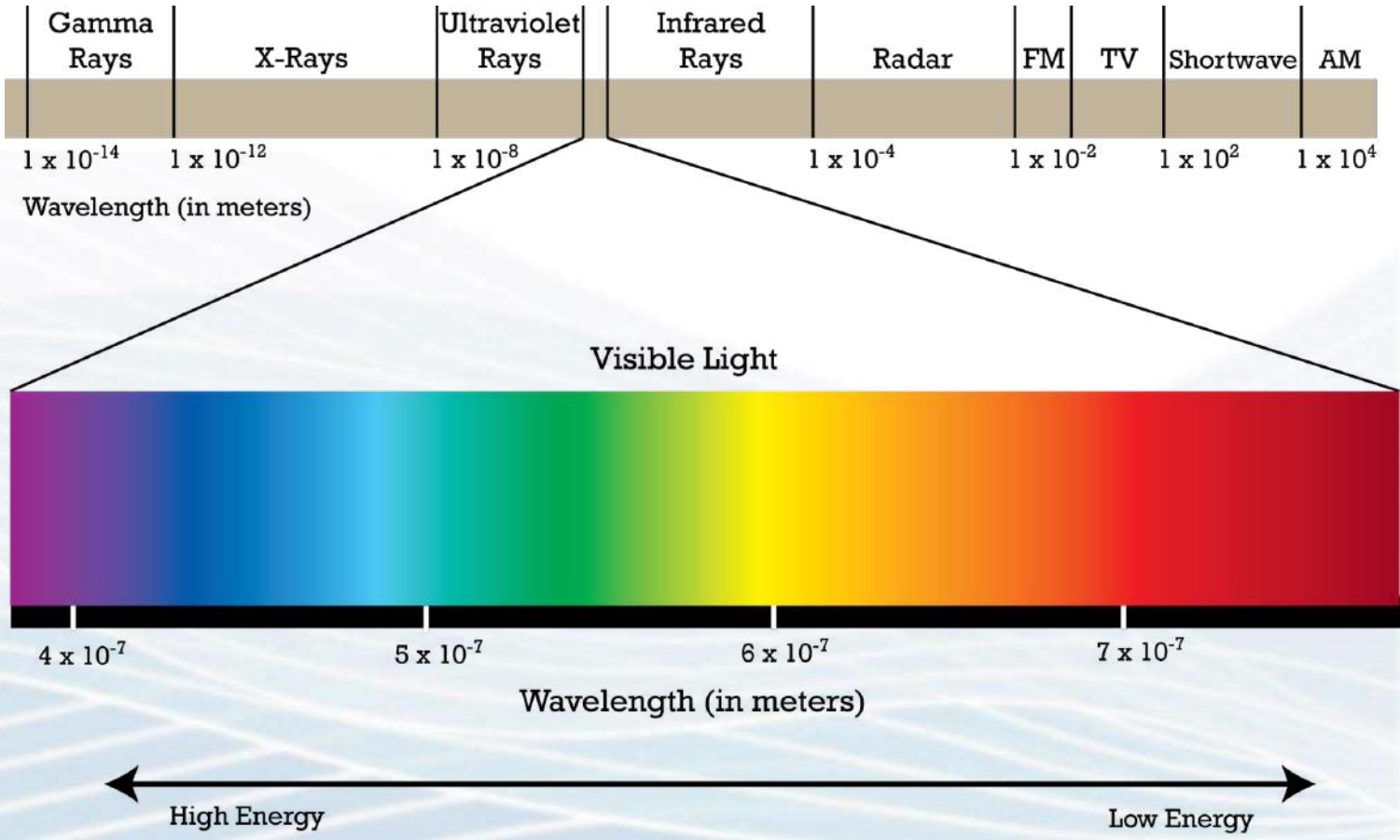
Why study eutrophication?

- Indicator / outcome of anthropogenic impacts and water quality deterioration.
- Reporting of chl-*a* concentrations required measurements of the EU WFD.
- Impacts of eutrophication:
  - Increased BOD
  - Potential anoxia
  - Reduced biodiversity
  - Toxic cyanobacterial blooms
  - Increased undesirable emissions (CH_4, H_2S)
  - Loss of ecosystem services

Chl-*a* remote sensing

Higher reflectance in lower wavelengths (blue + green regions) at lower [chl-*a*]

=> Challenges in inland waters with higher chl-*a* + humic substances



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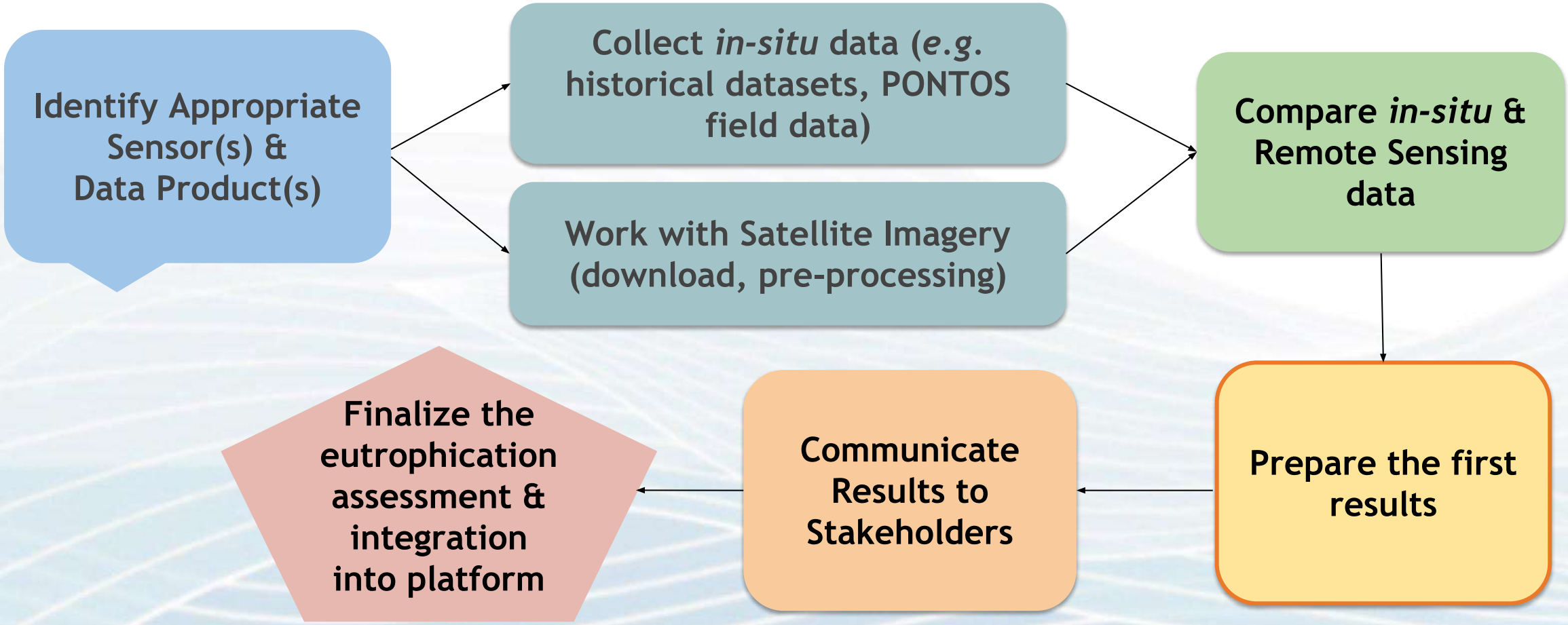

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Pilot sites

Satellites used in remote sensing

Landsat 4-5

2009-2011

Landsat 7 ETM+

2012

Landsat 8

2013-2015

Sentinel 2

2015-2019

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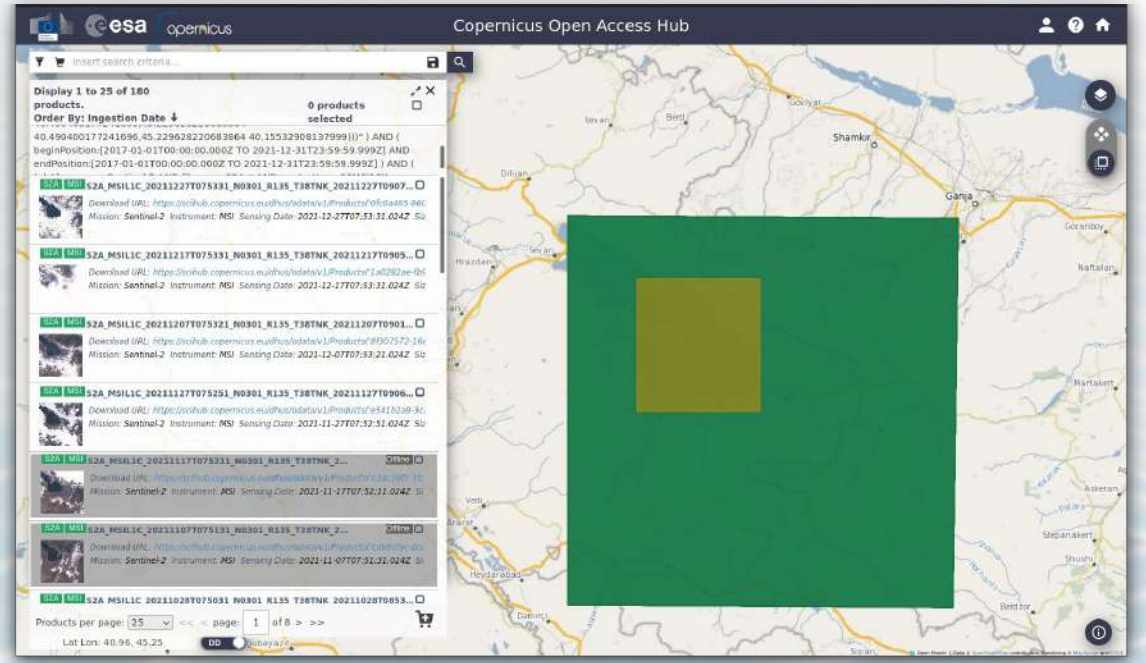
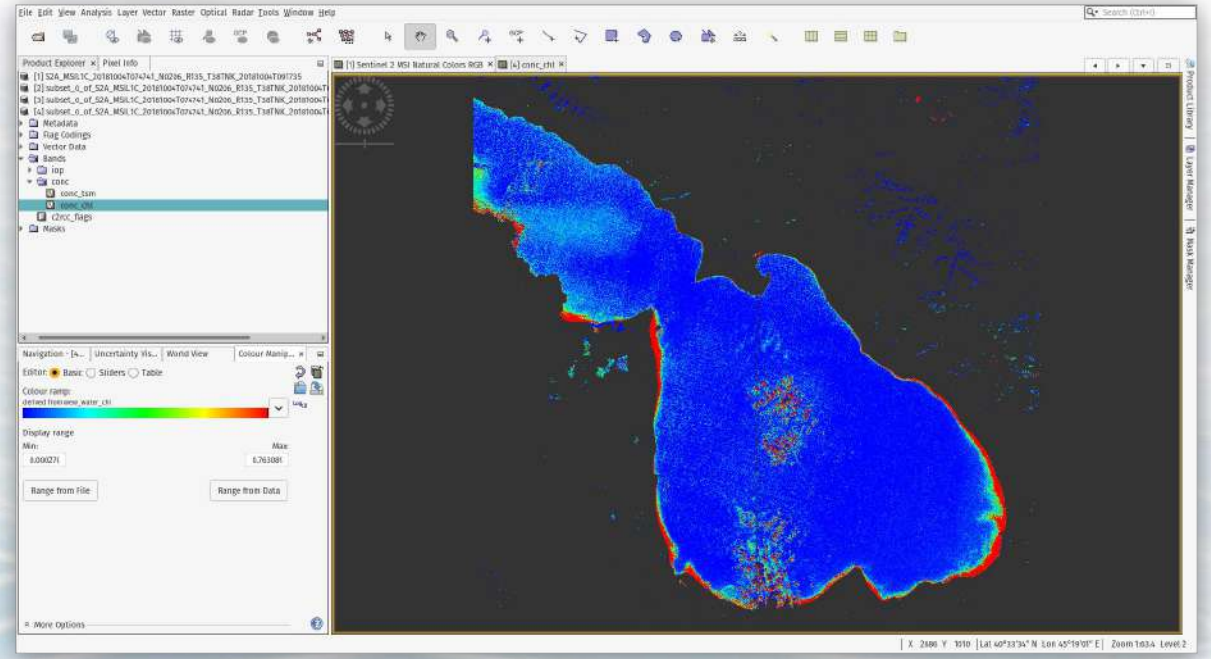
Method used

- Images downloaded from Copernicus Open Access Hub & USGS Earth Explorer
- Images then processed in SNAP with C2RCC
- Chl-a and TSM images downloaded
- Validation with *in-situ* measurements





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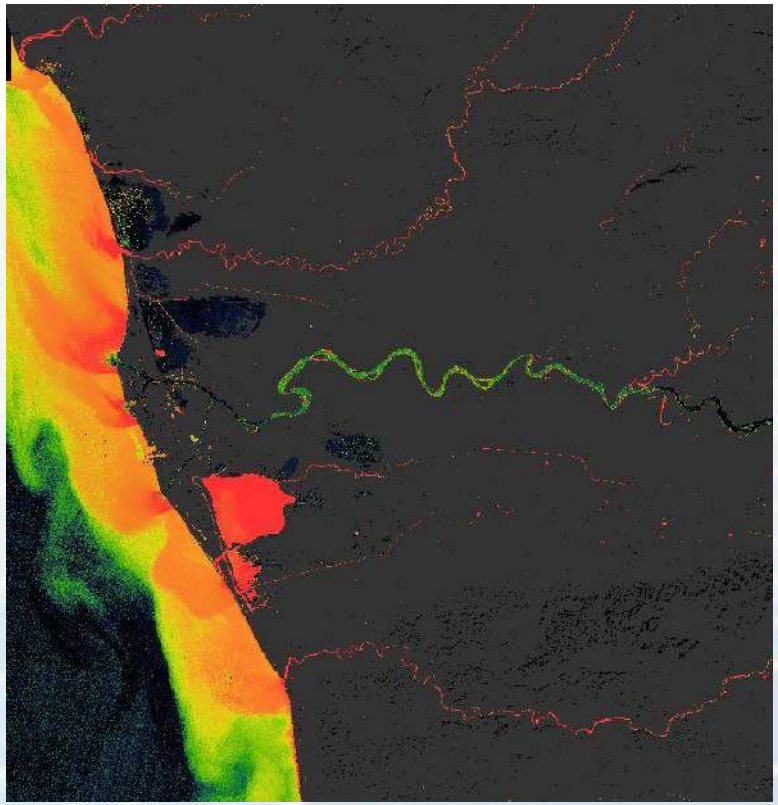
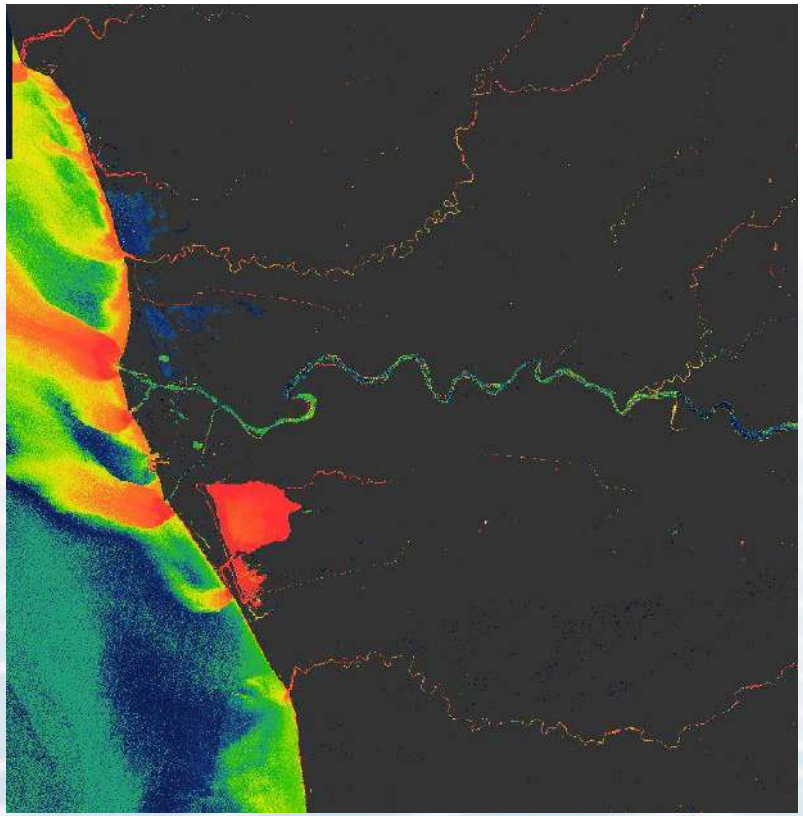
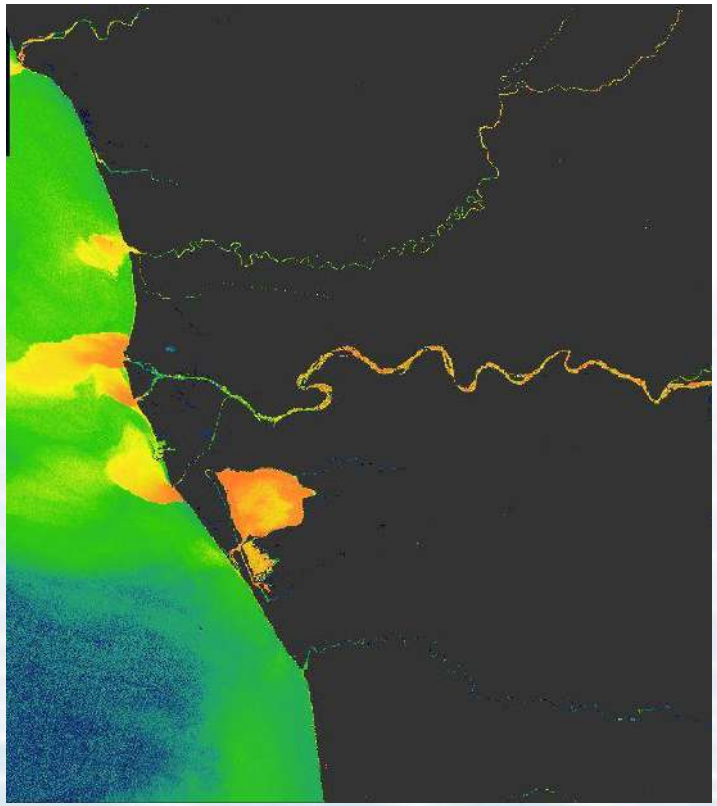
Eutrophication dynamics (Kolkheti lowland, Georgia, Spring 2020)







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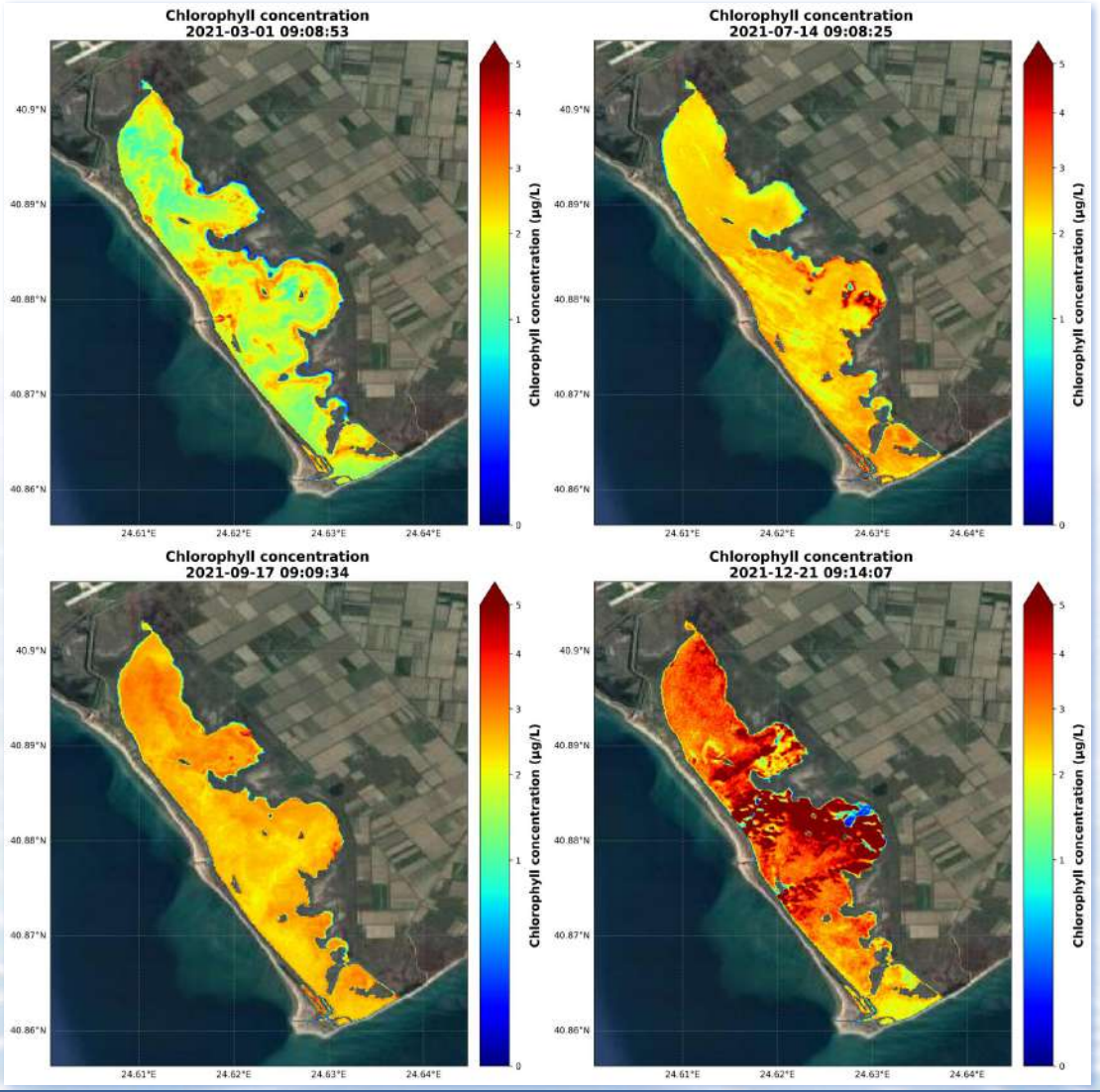
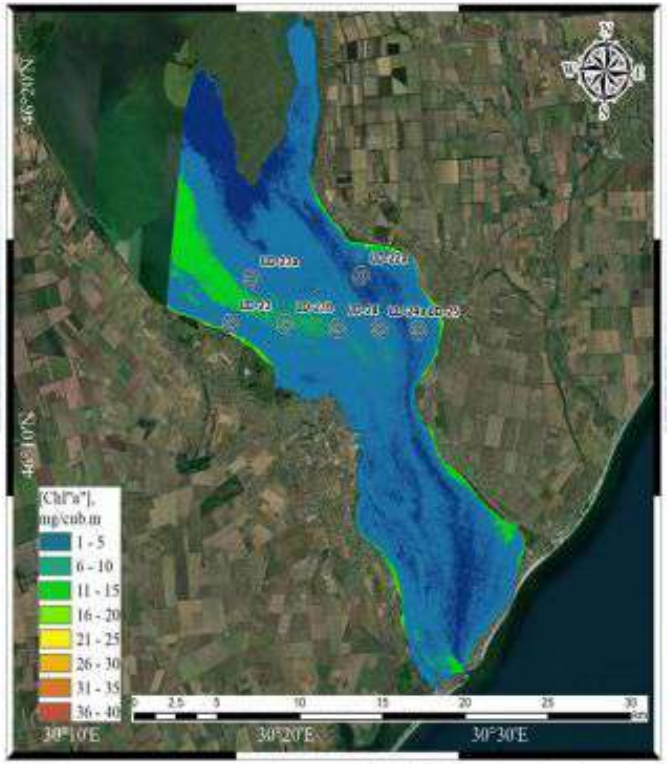
Eutrophication dynamics (Greece)

- 6 lagoons, 3 in the Nestos complex
- Surrounded by cultivated areas and important for fish production
- Used a Takagi-Sugeno neuro-fuzzy model
- 122 *in-situ* measurements (2015 to 2021) for training the model and validation

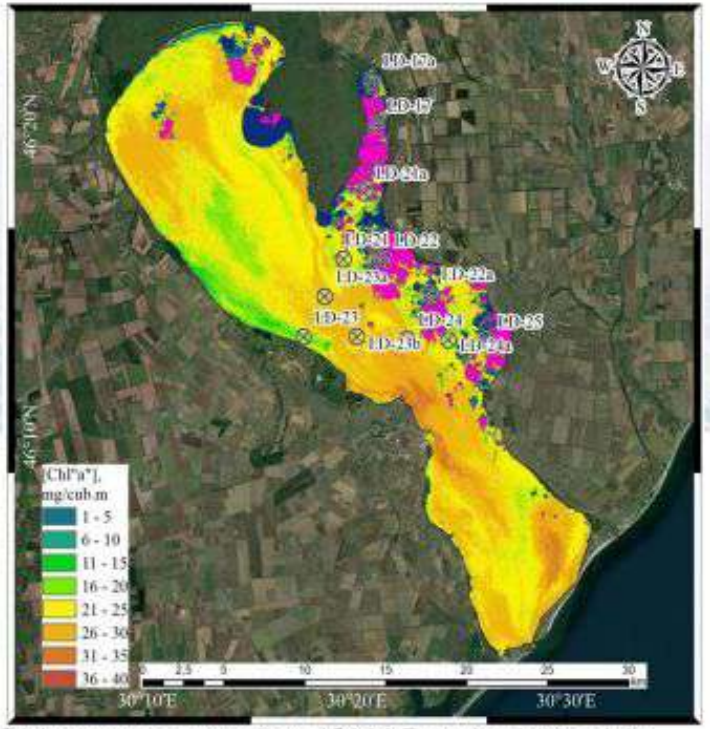


Eutrophication dynamics (Dniester estuary, Ukraine)

- Dniester estuary and Bile Lake
- Satellite image analysis complimented by field trips in 2021
- Tot. number of samples:
  - Chl - 105
  - Hydrology obs - 200
  - Nutrients - 200
  - Oxygen - 200
  - Phytoplankton - 70
  - Bacteria - 70



Chl-a concentration (SNAP calculation) in Dniester estuary for 24 April 2021



Chl-a concentration (SNAP calculation) in Dniester estuary for 20 August 2021 (purple – clouds area)

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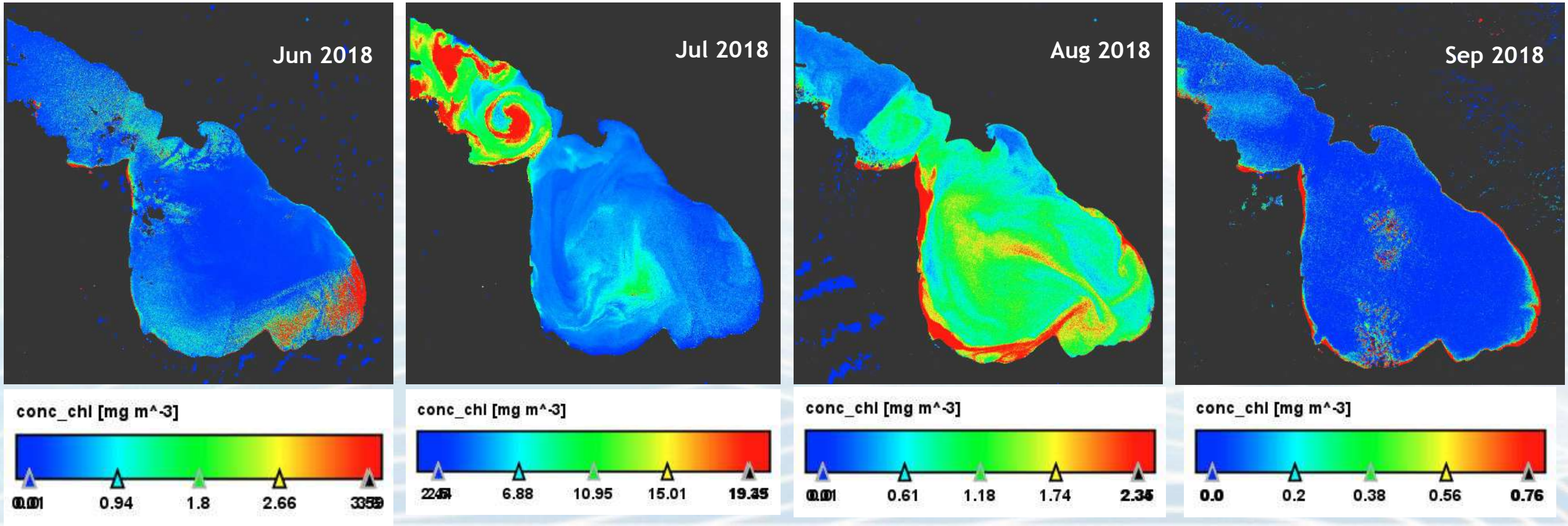
Eutrophication dynamics (Lake Sevan, Armenia)

Distinct dynamics within years (algal blooms generally appearing in July)



Assessing the method

- (+) Provides high frequency of measurements (temporal and spatial)
- (+) Relatively straightforward processing

- (-) Shallower areas could be problematic with reflectance from sediments interfering
- (-) Difficult in distinguishing between chl-a from phytoplankton and filamentous algae
- (-) Might need to be calibrated per location or at least water body type

Upcoming steps

- Publish reports on the eutrophication analyses
- Analyze the results from the other analyses (forest cover changes, wetlands, and agricultural water balance) to investigate their impacts on water quality
- 2nd set of trainings to stakeholders
- Prepare an online module for training to be available on the PONTOS platform

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