



Common borders. Common solutions.

Assessment on changes in wetland and floating vegetation cover

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Tbilisi, 20 May 2022





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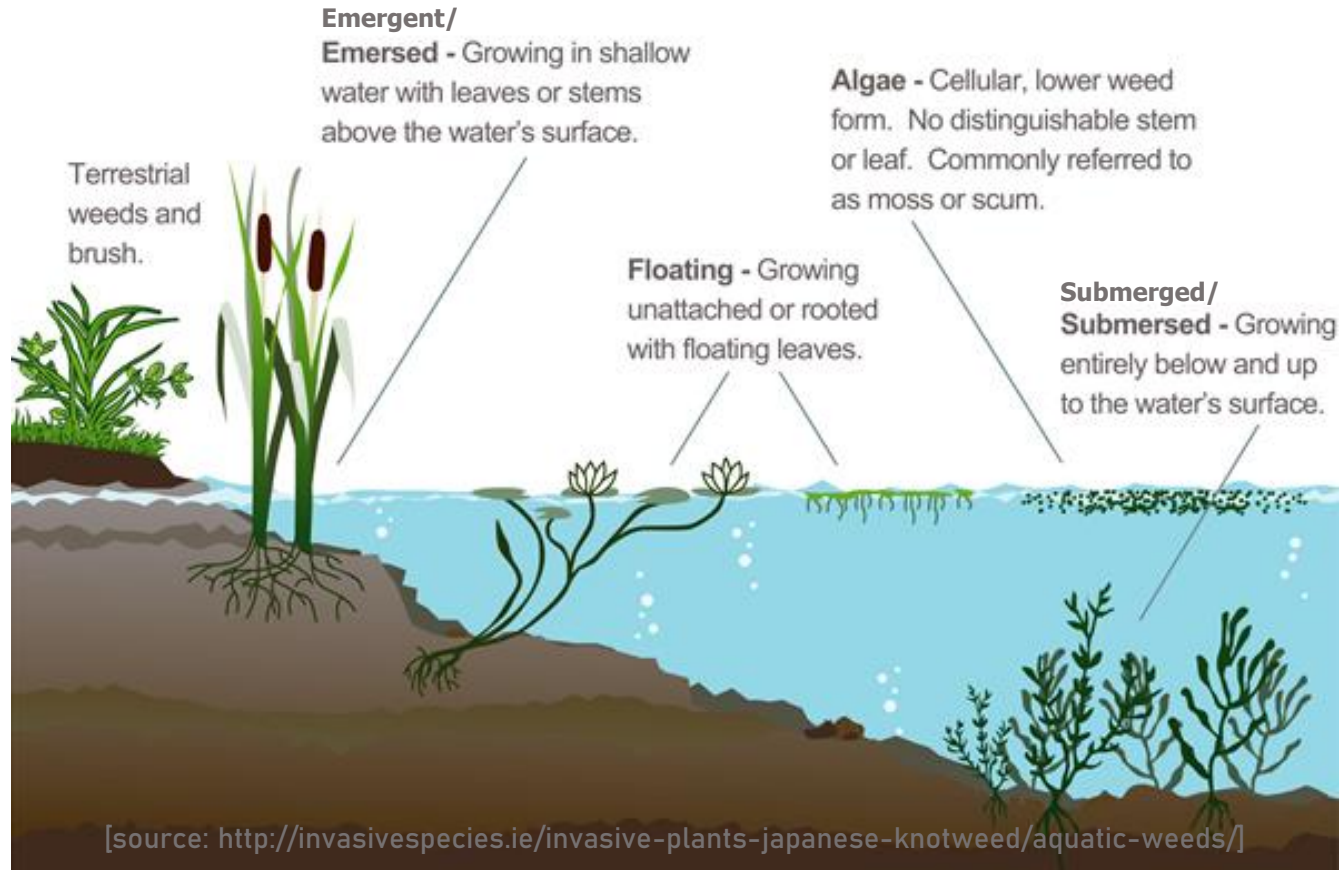
Common borders. Common solutions.

Background

- Complications of navigation of small vessels
- Complications of (commercial) fishing
- Excessive shading of the water body
- Excessive consumption of water-soluble oxygen
- Increased rates of siltation / sedimentation
- Substrate for filamentous algae
- Decreased surface water quality
- Decreased/ increased attractiveness for eco-tourists

Terminology:

Definitions of various aquatic vegetation types





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Common borders. Common solutions.

Aims:

- To estimate (inter-annual) changes in the area of emergent and floating vegetation cover during 2009-2021 in the pilot areas with identification of the most "vulnerable"/ overgrown areas
- To estimate annual dynamics of changes in emergent and floating vegetation cover over 2021

Additionally (optionally):

- To identify aquatic vegetation species using VHR satellite images and UAV-mosaics (selected sub-sites) and use them for validation of Sentinel-2 images
- To quantify the growth of aquatic vegetation biomass in pilots (where possible)
- To identify (semi-)submersed vegetation (where applicable) and to assess their area/density using UAV and satellite VHR images (selected sub-sites)

Ukraine: a) Coastline with beaches and recreational areas from Odessa city to the Danube river delta;
b) Dniester River Delta area and adjacent estuary



Georgia: a) Entire coastline of Georgia;
b) Downstream part of Rioni river, incl. delta area and Kolkheti NP



Greece: Nestos River, its Delta and the coastal zone close to the Delta



Armenia: Sevan Lake and its catchment area



Data used

I. In-situ observations

- Field GPS tracking of aquatic vegetation boundaries by using a boat (historical data) [if available]
- Mapping of aquatic vegetation cover at selected sites by using UAVs (2021) [if applicable]
- Vegetation sampling at selected sites (2021) [optional]

II. Space-born observations

- VHR images (MAXAR) processing for selected sites at selected dates
- Satellite images (Sentinel-2 for 2015-2021; Landsat for 2009-2013) processing using CERTH algorithm



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Field data

Historical data for 2011-2020 (Ukrainian pilot case)

- Tracking of the boundaries of emergent and floating (+dense semi-submerged) vegetation with the boat-mounted GPS device of Eagle SeaCharter 640CDF GPS with horizontal accuracy of 3-5 meters (WAAS)
- Visual assessment of emergent and floating vegetation, its types and areas covered with a photo report
- Post-expeditionary processing of the results of field tracking with GIS software, production of vegetation maps, chronological analysis of changes

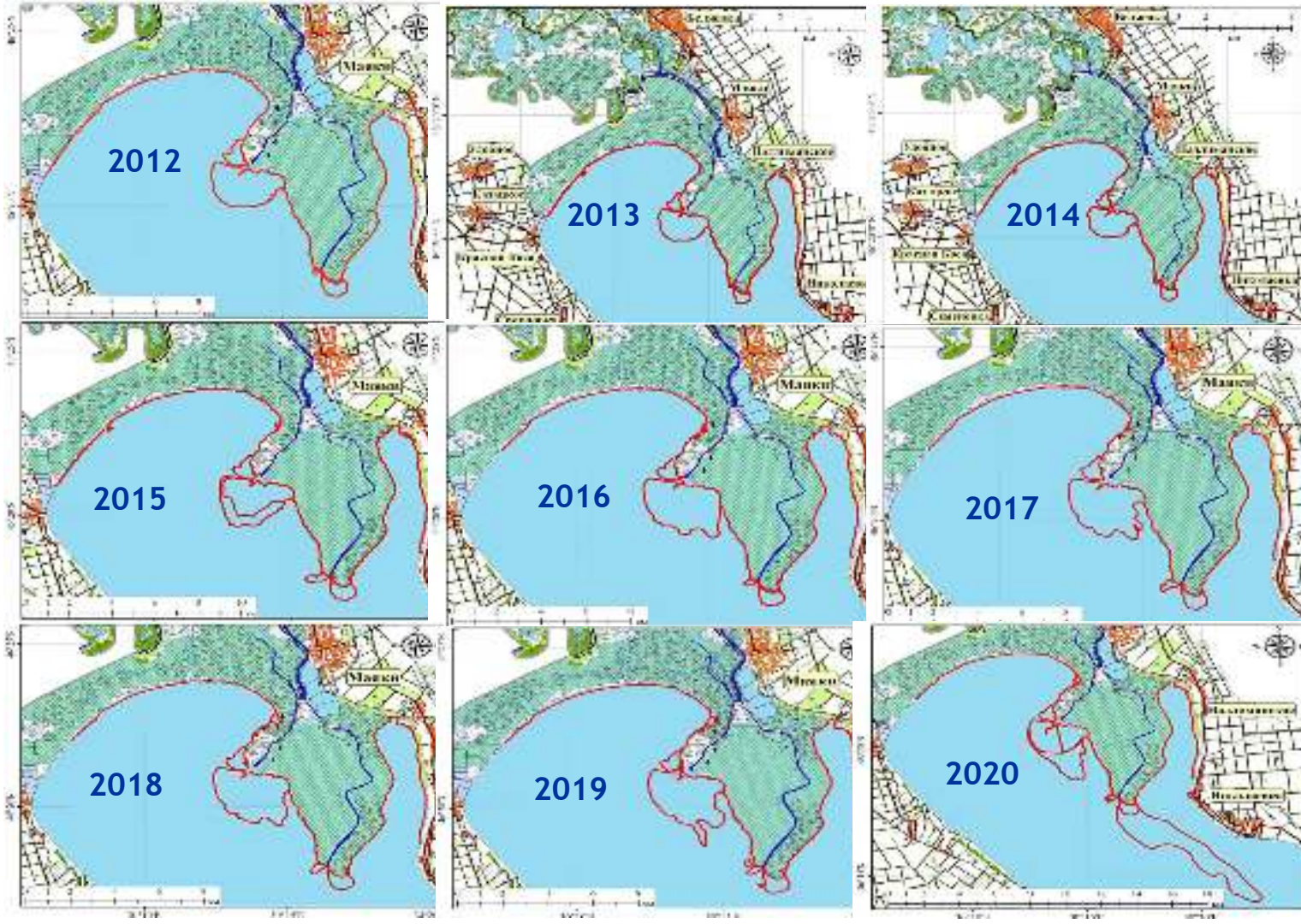




Field data

GPS-tracking

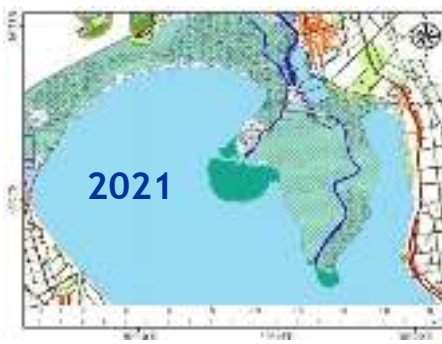
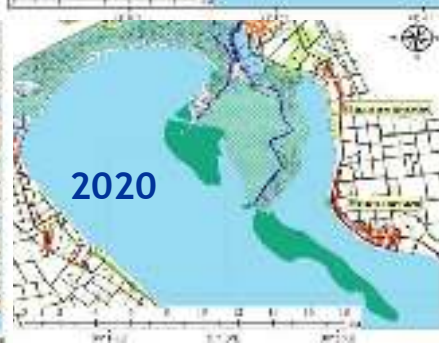
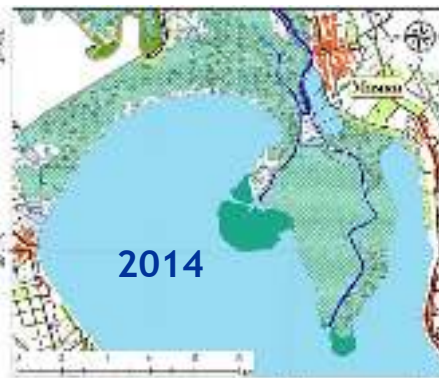
Borders of emergent and floating (+dense semi-submerged) vegetation in the Dniester estuary in summer period of 2012-2020



Field data

Results

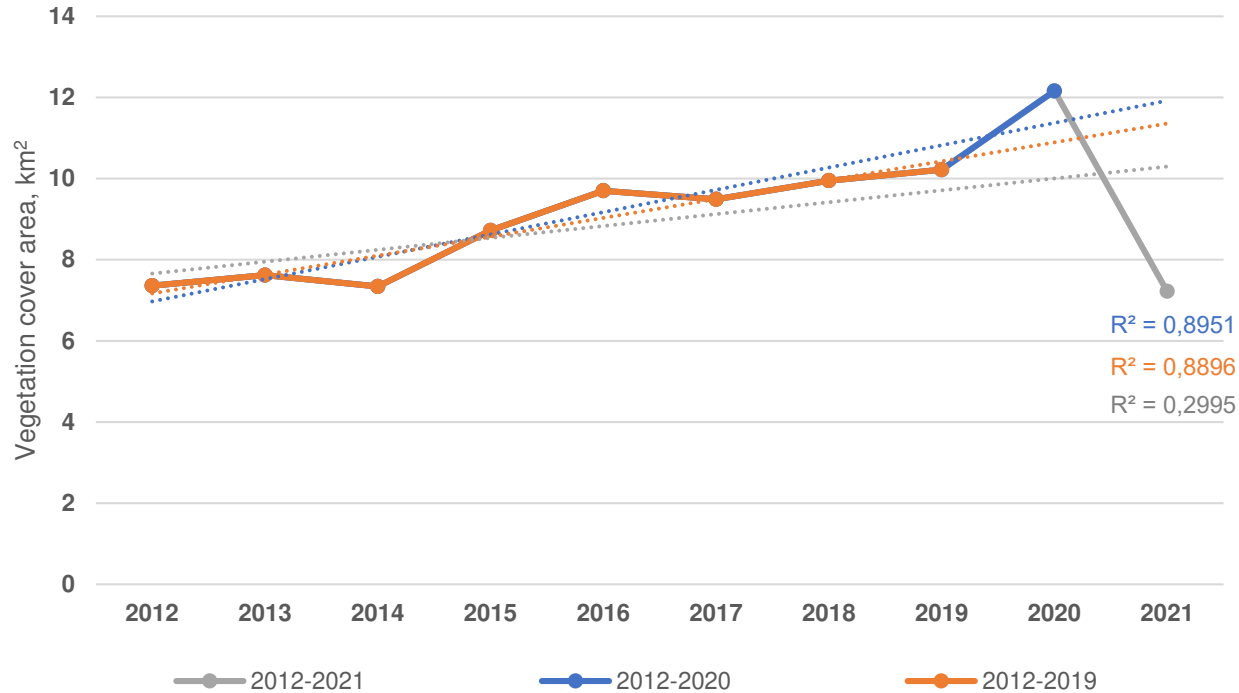
Areas of floating (+semi-submerged) vegetation in the Dniester estuary in summer period of 2012-2021





Field data

Results



Inter-annual changes floating (+ dense semi-submerged) vegetation cover (km²) in the Dniester estuary in summer periods of 2012-2021





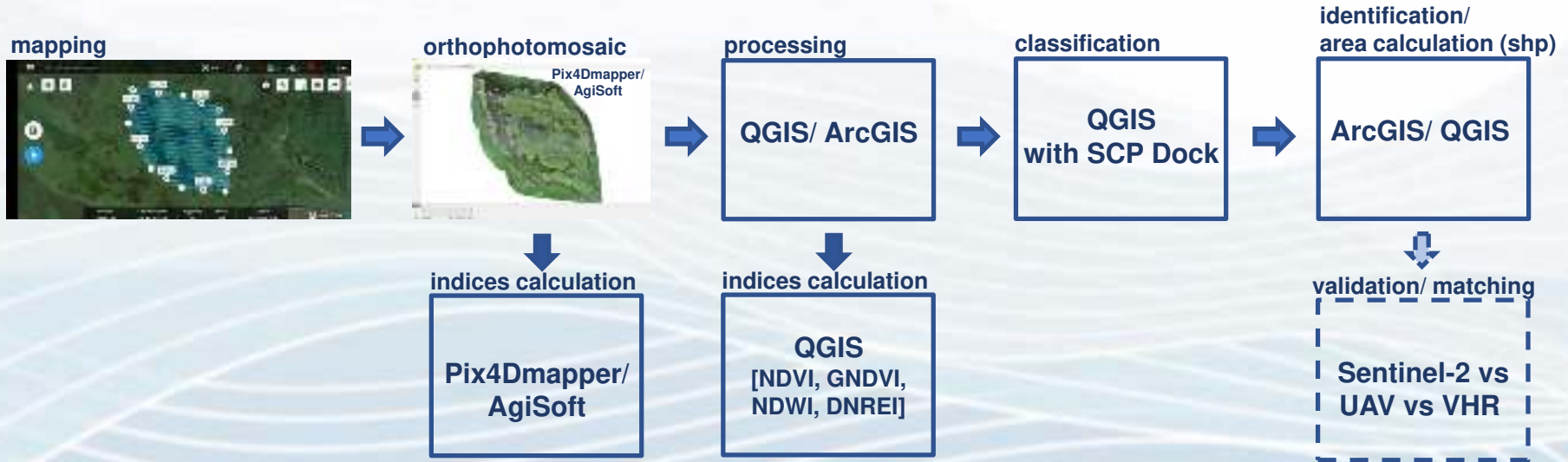
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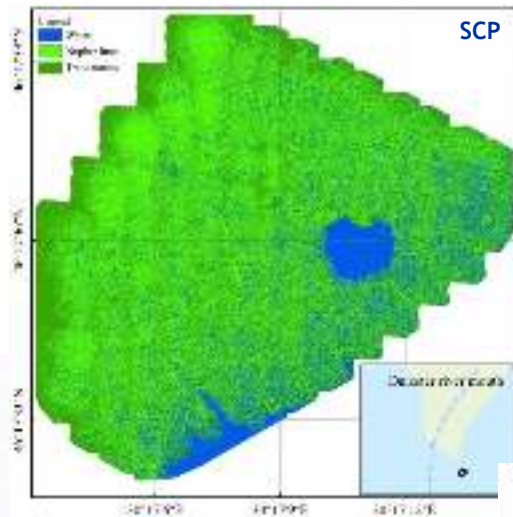
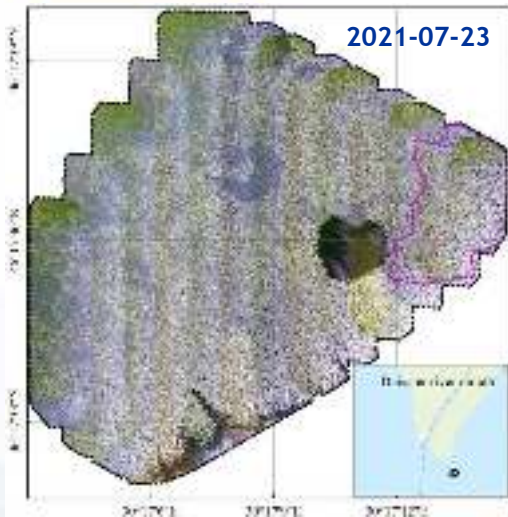


Field data

Mapping using Unmanned Aerial Vehicles (UAVs)

- Use of aerial images for detailed mapping ($3\text{-}6\text{ cm pixel}^{-1}$) of aquatic vegetation



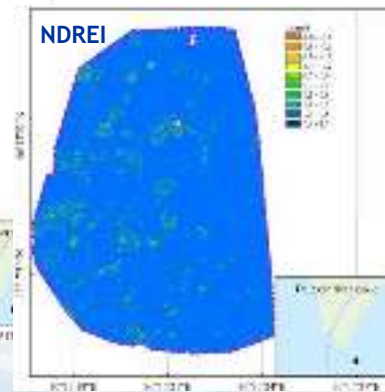
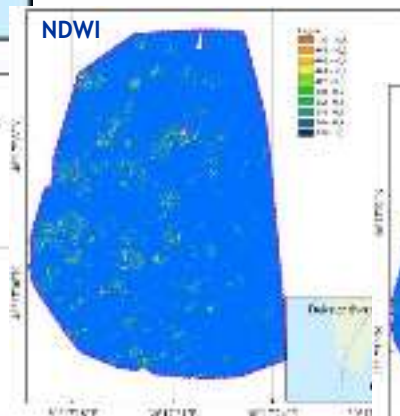
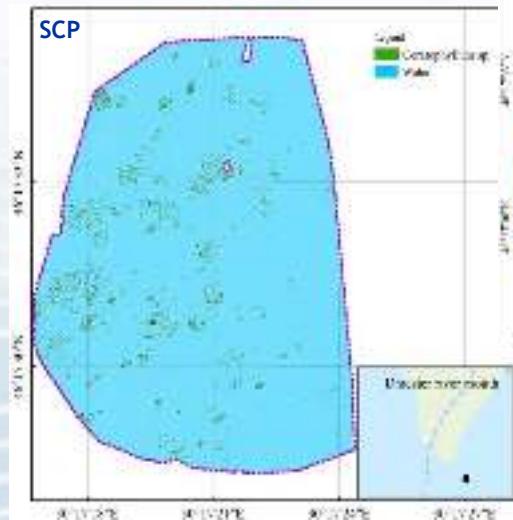
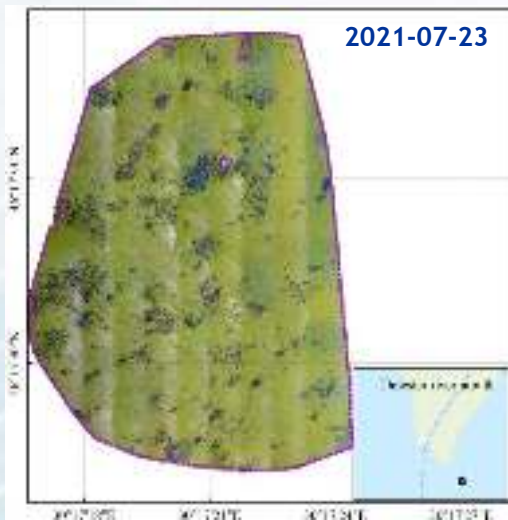


Field data

UAV mapping: PONTOS-UA



Water covered area: 18.8%
Nuphar lutea cover: 45.0%
Trapa natans cover: 36.2%



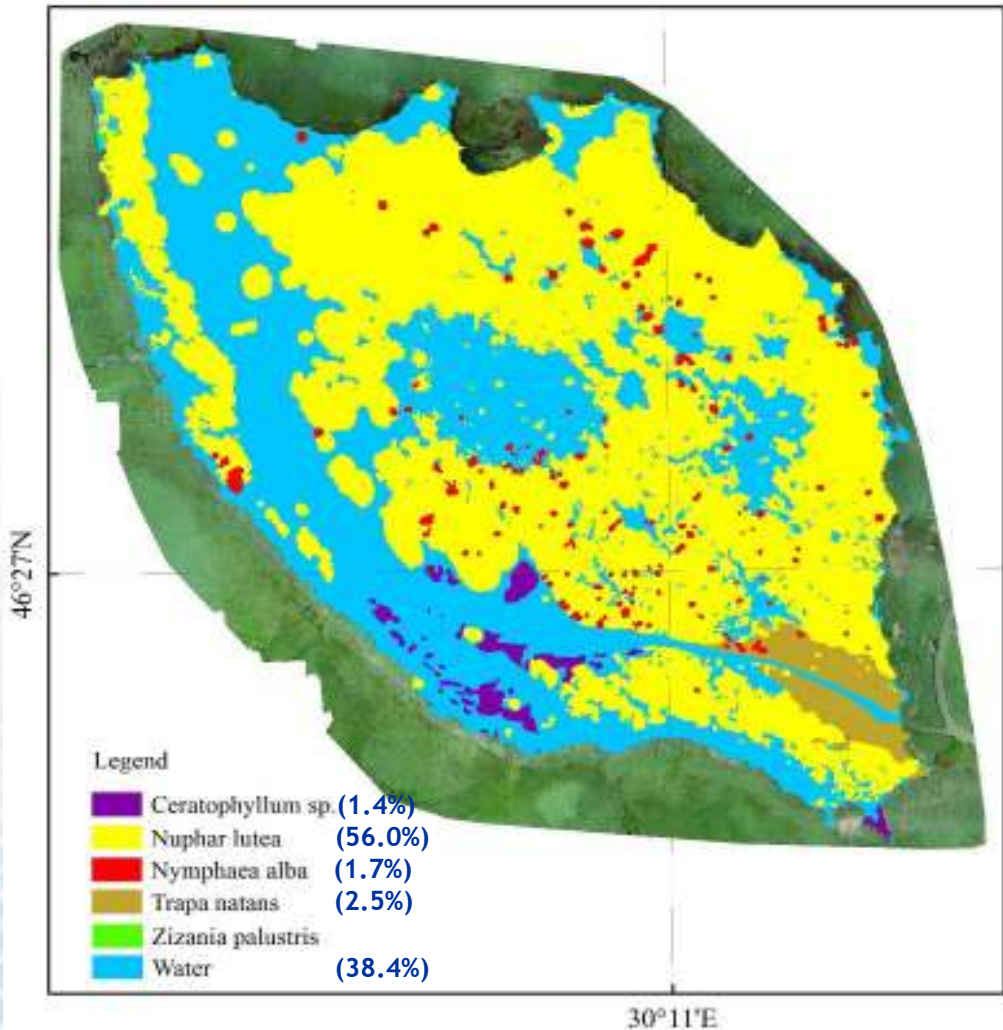
Water covered area: 97.0%
Ceratophyllum sp. cover: 3.0%



2021-07-26



RGB mosaic; 5 cm/pixel



Field data

UAV mapping: PONTOS-UA





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Field data

Phragmites australis

Vegetation sampling (e.g. Ukrainian pilot case)

Trapa natans



Nuphar lutea



Ceratophyllum demersum





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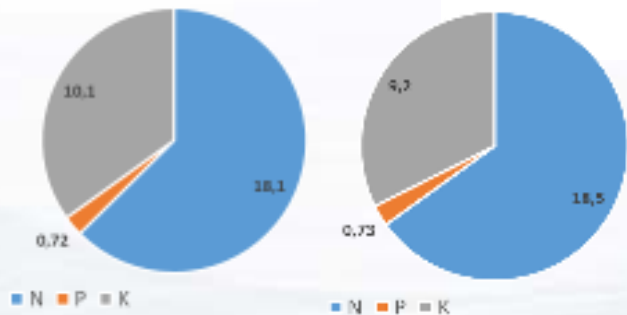
Field data



Nutrient content (mg N/P/K kg⁻¹ dry matter) in vegetation species sampled in the Bile lake and Dniester estuary

(July 2021)

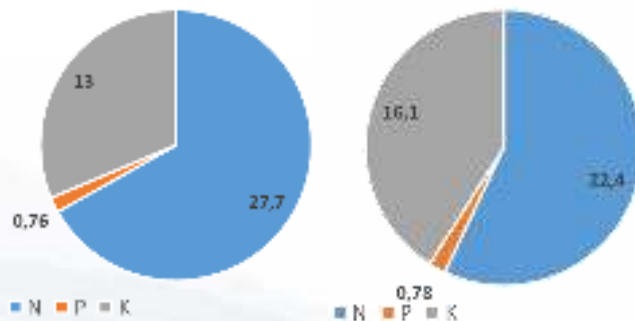
Phragmites australis



Bile lake

Dniester est.

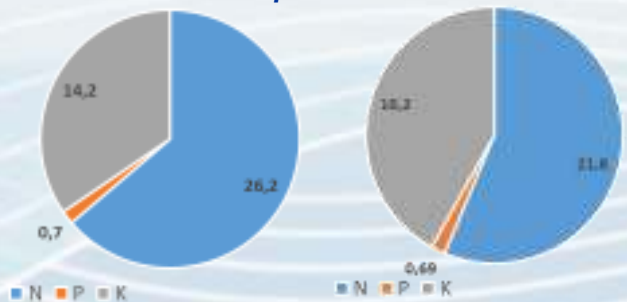
Trapa natans



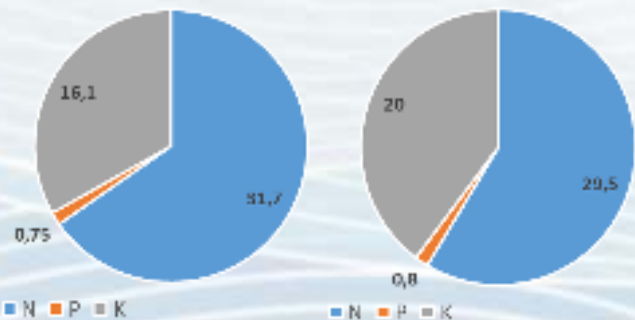
Bile lake

Dniester est.

Nuphar lutea



Ceratophyllum demersum





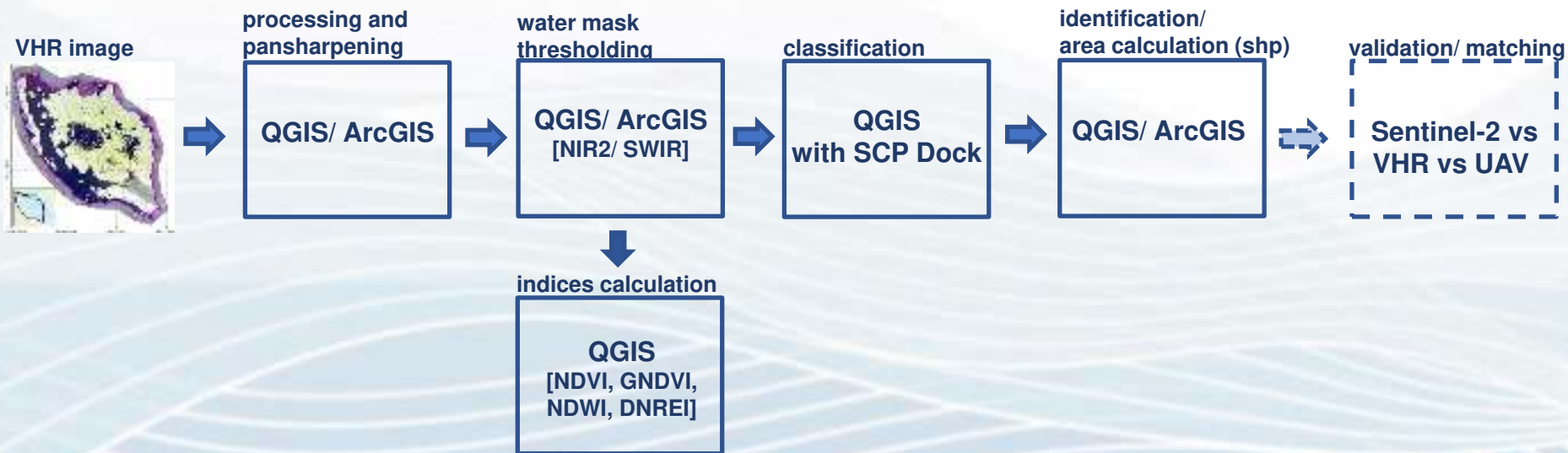
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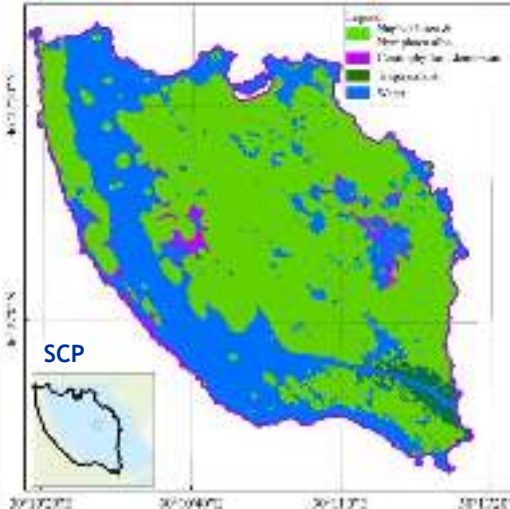
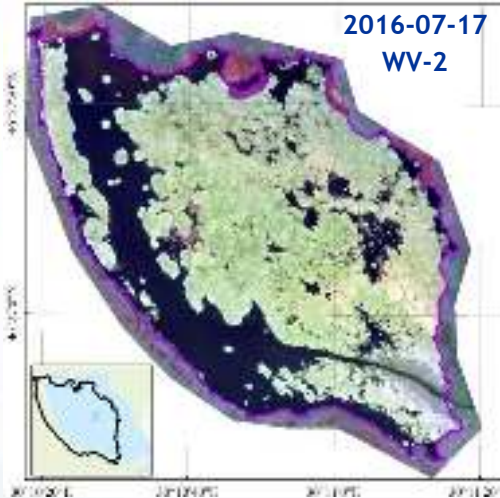
Space-born data

VHR images (MAXAR)

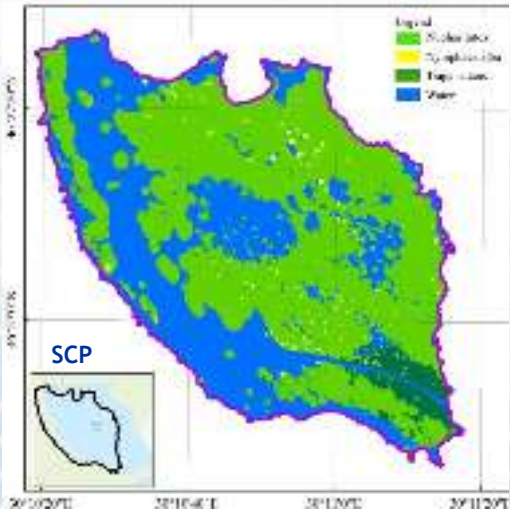
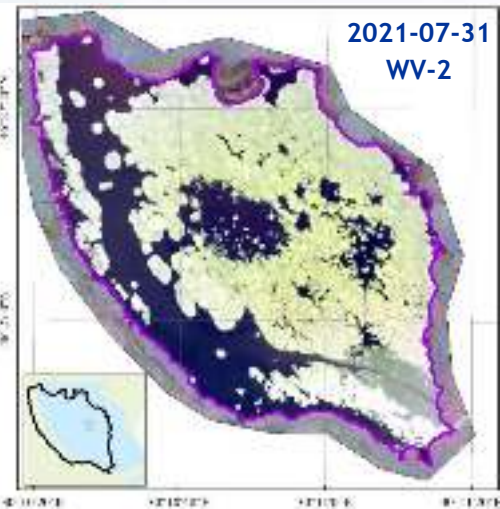
- Processing VHR images (totally 3) for selected areas (Bile lake and Dniester est.)



2016-07-17
WV-2



2021-07-31
WV-2



Space-born data

VHR images: PONTOS-UA



| Species/ cover type | 2016-07-17 | 2021-07-31 |
|-------------------------------|------------|--------------|
| <i>Nuphar lutea</i> | 61.5% | 58.5% |
| <i>Nymphaea alba</i> | | 1.0% |
| <i>Trapa natans</i> | 2.2% | 3.6% |
| <i>Ceratophyllum demersum</i> | 2.0% | Not identif. |
| Water covered area | 34.3% | 37.0% |





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Space-born data

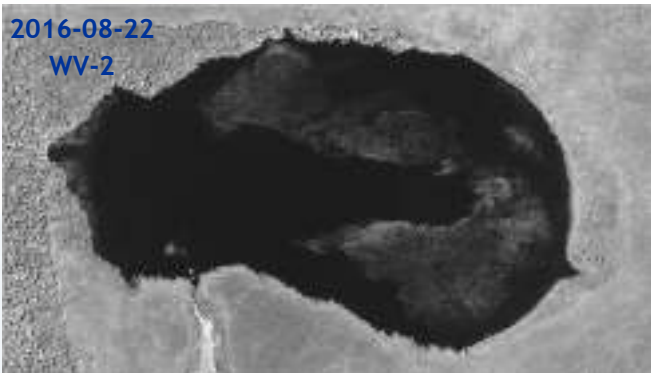
VHR images: PONTOS-GE



Water chestnut carpets (*Trapa colchica*)

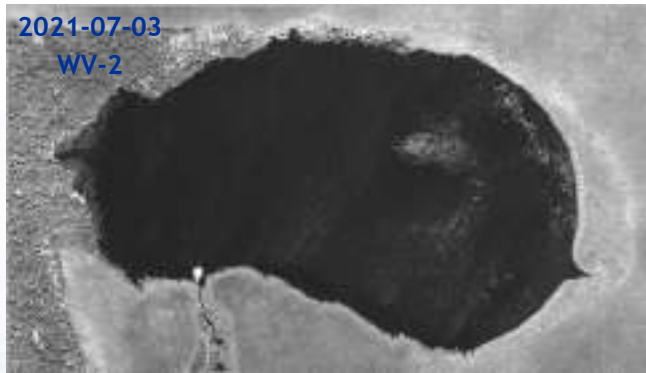
2016-08-22

WV-2



2021-07-03

WV-2



Images of the lake Partotskali covered with water chestnut carpets

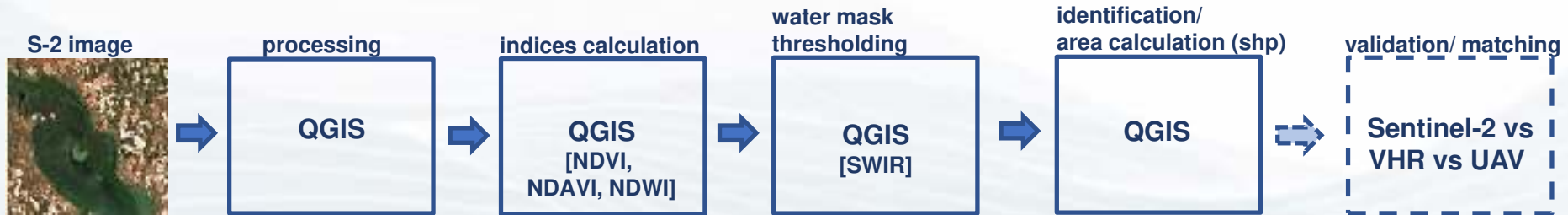
- Largest habitat of floating vegetation in study area
- Carpet of the water chestnut (*Trapa colchica*) covered 16 ha out of the 21.6 lake in 2016
- Carpet areas of the water chestnut change significantly year by year



Space-born data

Sentinel-2 images (Copernicus)

- Processing of S-2 images using automatic approach with CERTH algorithm





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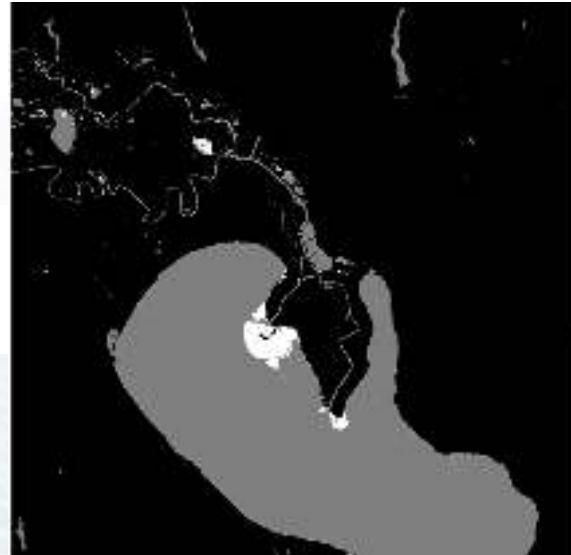
Space-born data

Sentinel-2: PONTOS-UA

Floating vegetation identification



S2: 2019-07-02



CERTH improved algorithm



ONU in-situ observations: 2019-07-17





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Space-born data

Sentinel-2: PONTOS-GE

Water chestnut carpets (*Trapa colchica*) identification and delineation in the Partotskali lake

S2-derived NDVI



Minimum mean NDVI value over 2015-2021

S2-derived NDVI

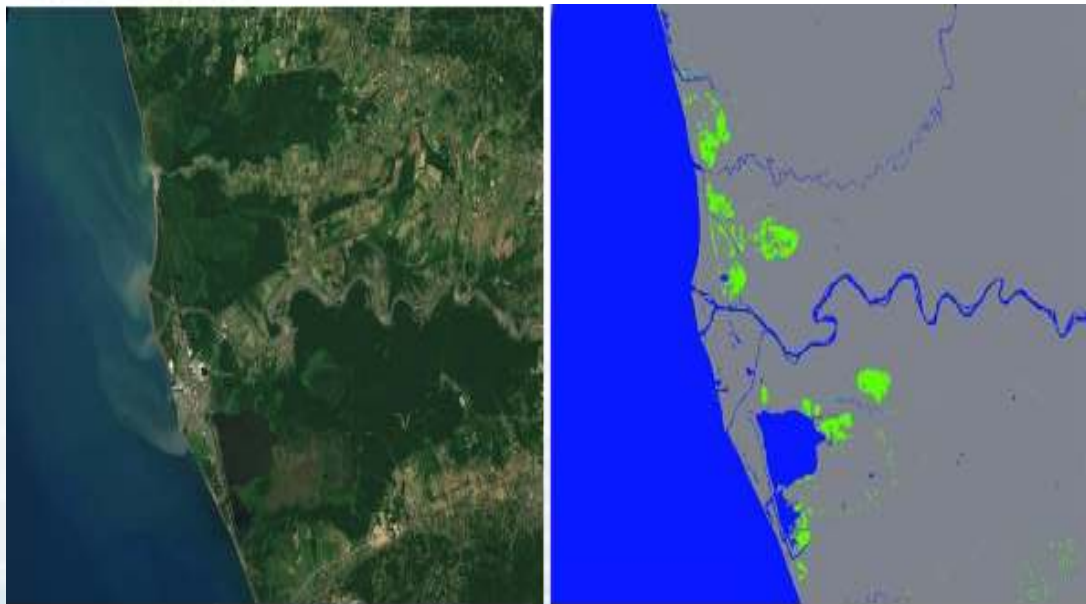


Maximum mean NDVI value over 2015-2021





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Wetlands and floating vegetation detection for Kolkheti NP, Georgia on 23.06.2020 (CERTH data; non-modified algorithm)



**EUNIS habitat: C1.2412.
water chestnut carpets**



*In situ data: green color shows percolating bogs with Sphagnum (D1.16).
damaged, inactive bogs, dominated with dense purple moorgrass Molinia D1. 121*

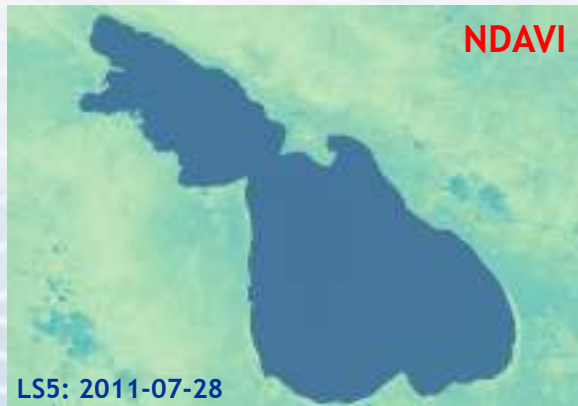
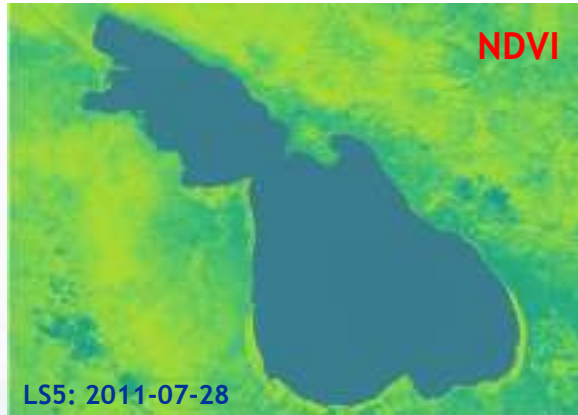


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Space-born data

LandSat: PONTOS-AM

Floating vegetation identification





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Space-born data

Sentinel-2: PONTOS-AM

Floating vegetation identification

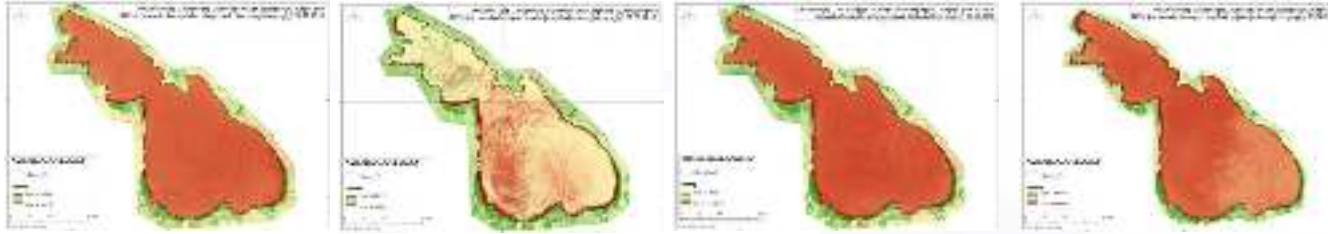
2016-14-09

2017-08-20

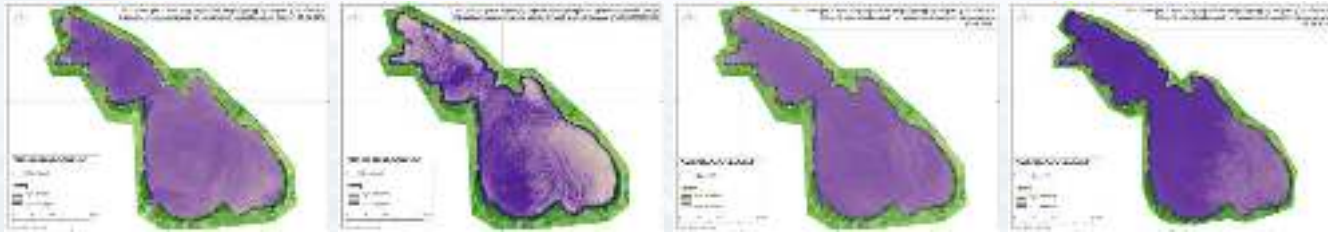
2018-08-30

2019-08-15

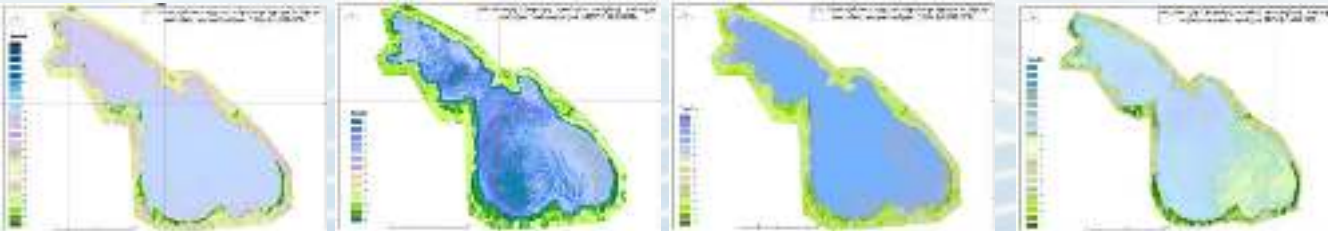
NDVI



NDAVI



LULC
classification



Floating vegetation cover variation
over 2016-2019

| Year | Area, ha |
|------|----------|
| 2016 | 174 |
| 2017 | 179 |
| 2018 | 154 |
| 2019 | 189.6 |





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Assessment on changes in wetland and floating vegetation cover [D.T.1.2.4]

| | Armenia | Georgia | Ukraine |
|--|--|----------------------------|---|
| Progress | 70% | 50% | 75% |
| Description of the issue | Finished | In progress | Almost finished |
| Field surveys | In progress [2 completed, 2 - next year] | [Planned for this summer] | Finished [4 survey campaigns: UAV mapping, veg. sampling] |
| Results & analysis LS and S2 (CERTH contr.) | In progress In progress [LS6/8 and S2: 2010-2020] | In progress In progress | In progress In progress [LS8 and S2: 2009-2021] |
| VHR images | In progress [] | In progress | Finished [3 WV-2] |
| UAV mosaics | In progress | In progress | Finished |
| Validation (CERTH contr.) | S2 vs VHR | S2 vs VHR | S2 vs VHR vs UAV |
| Discussion | Started | Not started | Started |
| Conclusion and Recomm. | Not started | Not started | Not started |



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Дякуємо за увагу!
Հնորիակալութիւնն ուշադրութեան համար!
მადლობთ ყურადღებისთვის!
Σας ευχαριστώ για την προσοχή σας!

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