

Common borders. Common solutions.

Assessment on dynamics of coastline changes

Odessa, 15 July 2022

Zachopoulos Konstantinos, PhD Candidate, DUTH

Study areas



Democritus University of Thrace



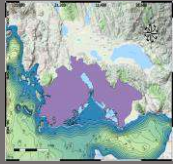
Green Alternative



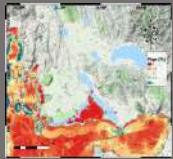
Odessa National University



Data collection



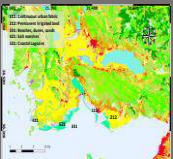
Bathymetry, GEBCO



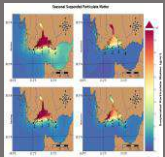
Seabed slope, GEBCO



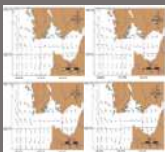
River discharge and
physicochemical data,
E-Hype



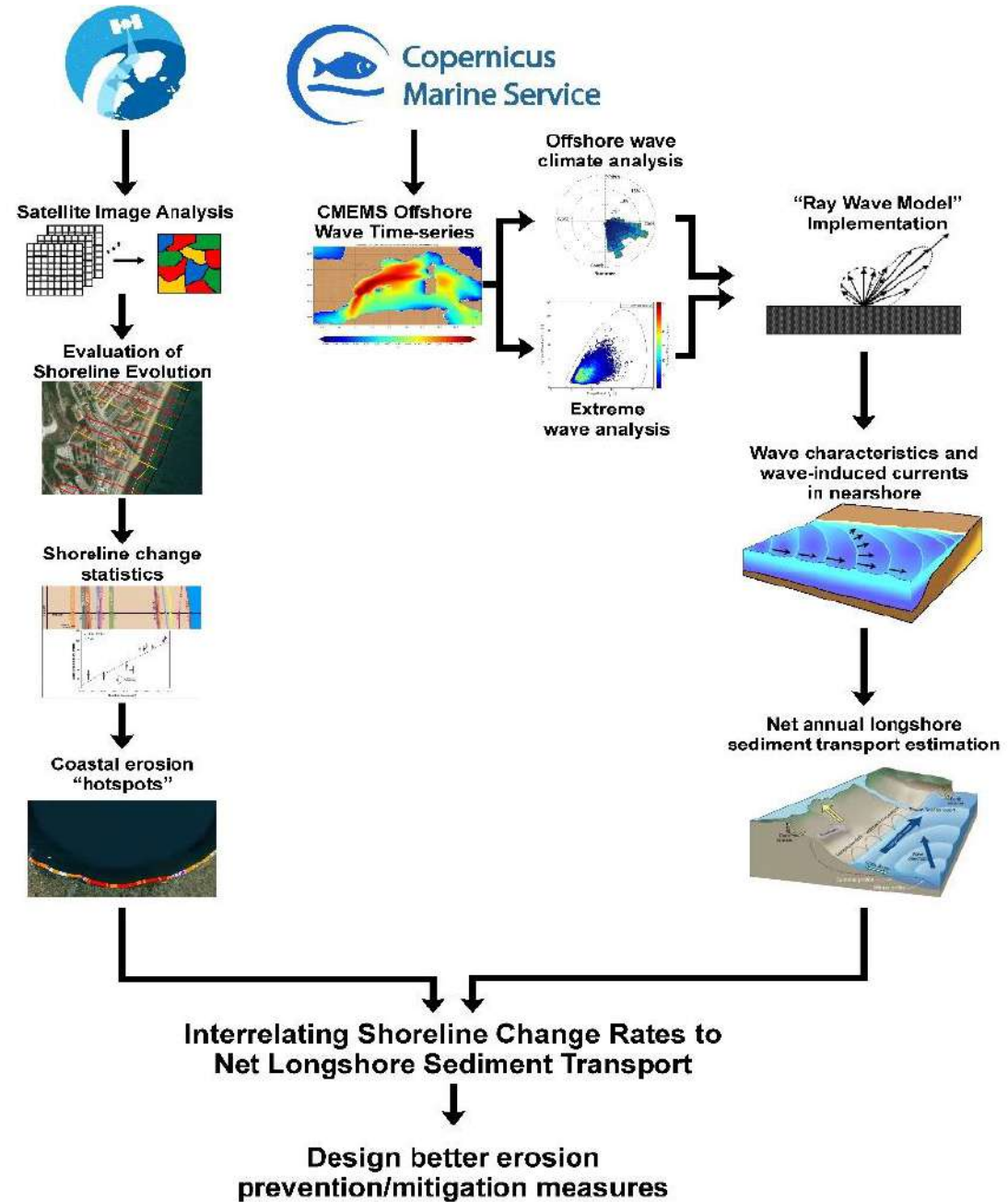
Land use,
CORINE 2018



Suspended matter,
CMEMS



Sea surface currents,
CMEMS



Methodology workflow

QGIS



NDWI



Semi-Automatic Classification Plugin
version 7

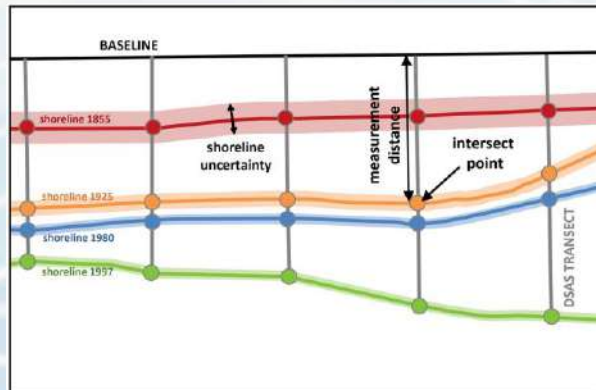


shorelines



baseline

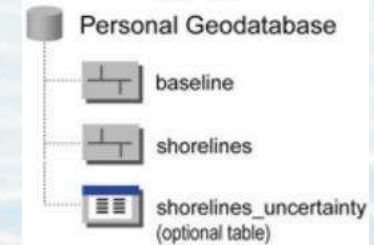
ArcGIS[®]
ESRI



DSAS

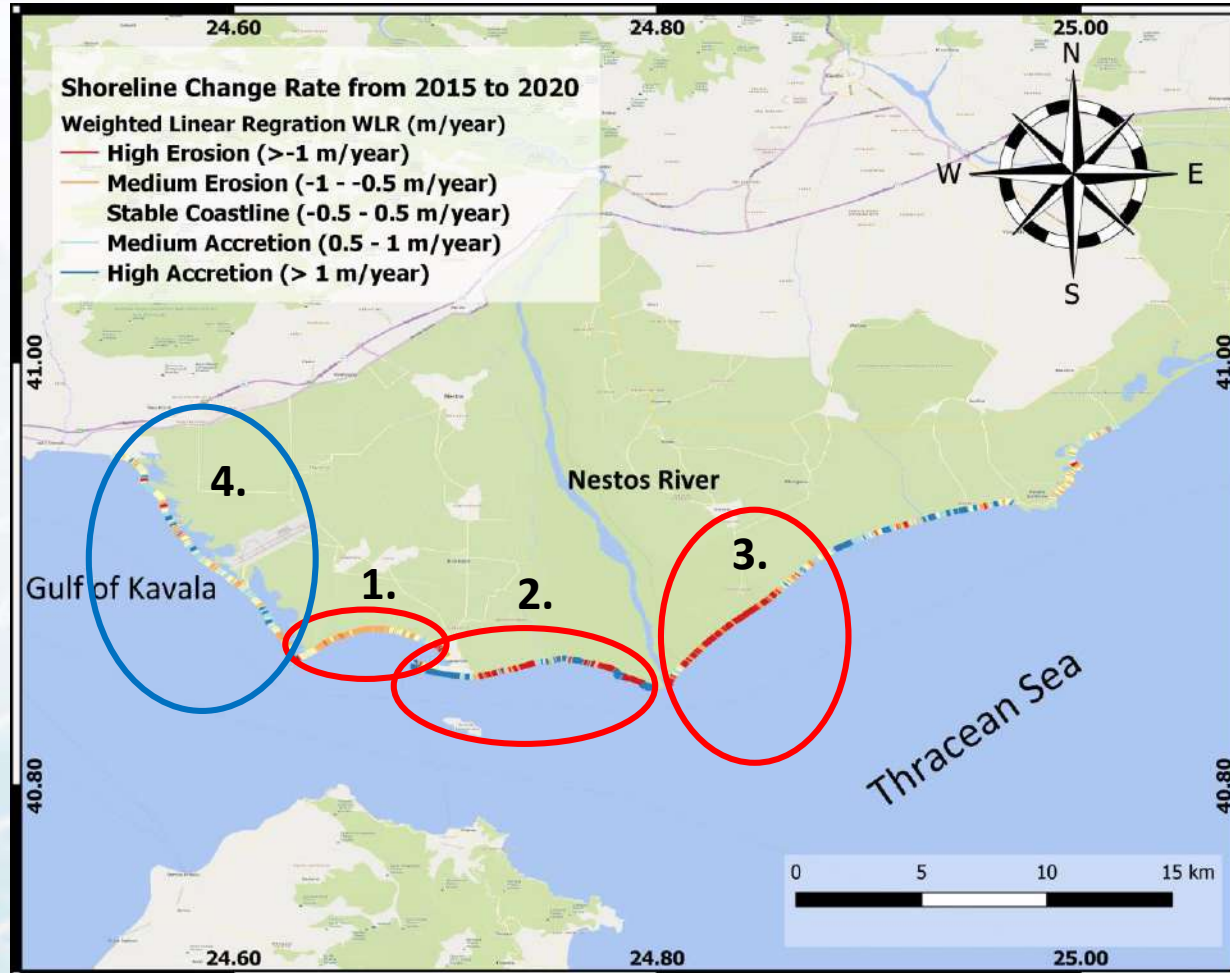


INPUT



Indicative Results

Greek Study site - Coastal erosion hotspots



Number of satellite images:

- 7 images – Landsat 4-5 and 8
- 6 images – Sentinel 2.

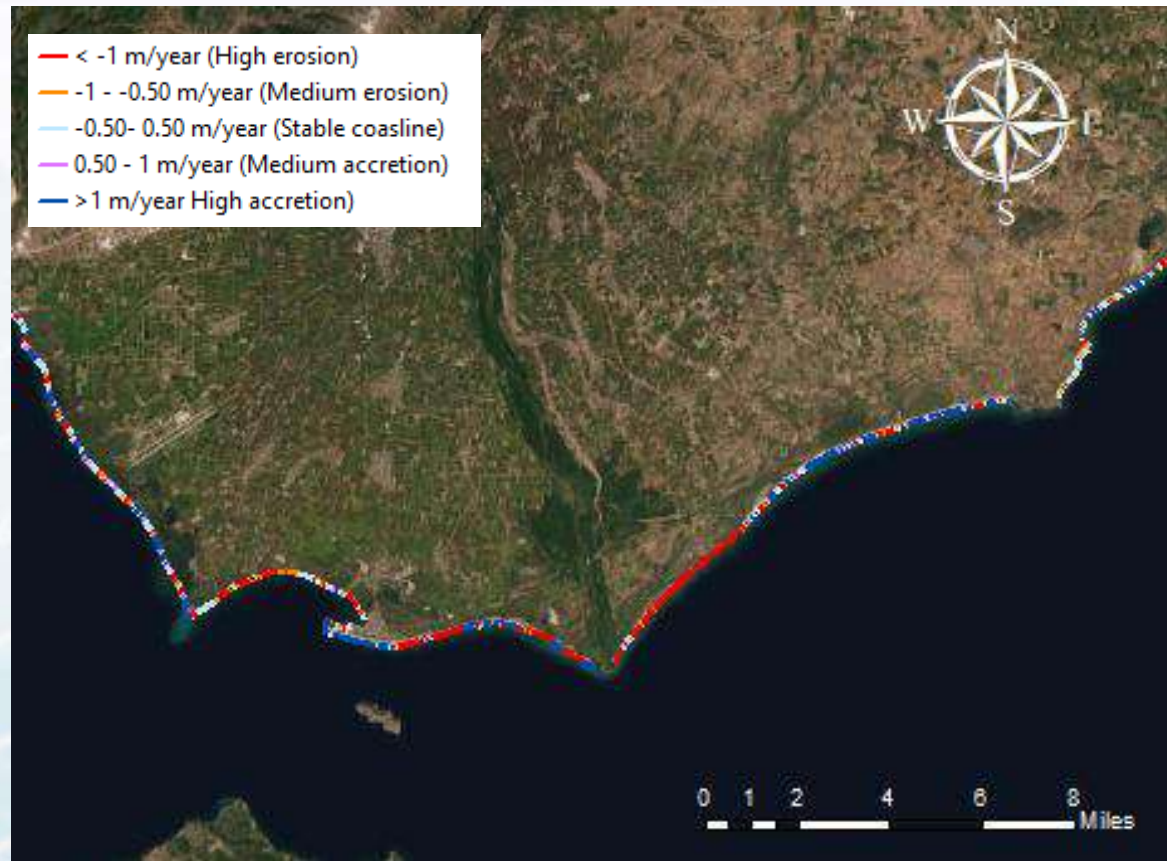
Time period:

- 1985-2015, every 5 Years
- 2015-2020, every year

Validation method:

- Higher resolution satellite image
- Drone image

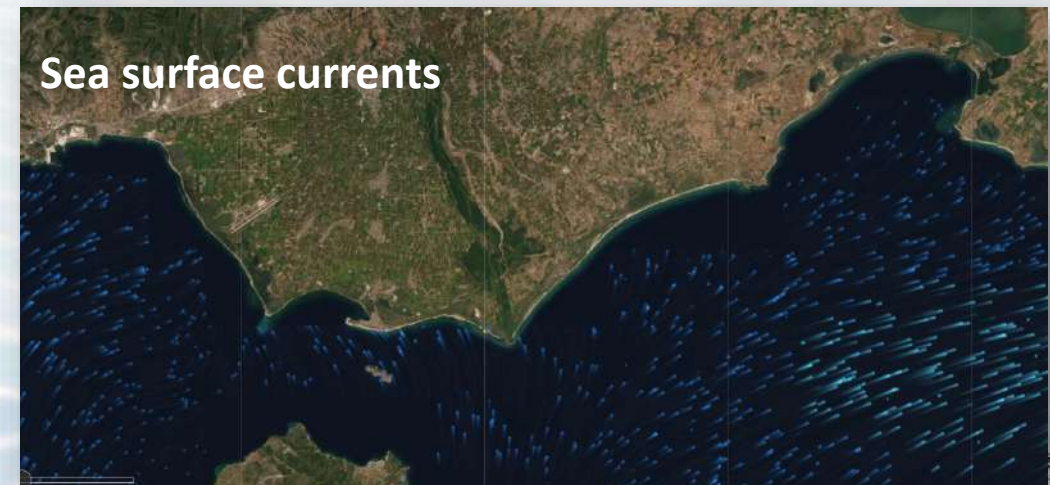
Results for the Greek study site



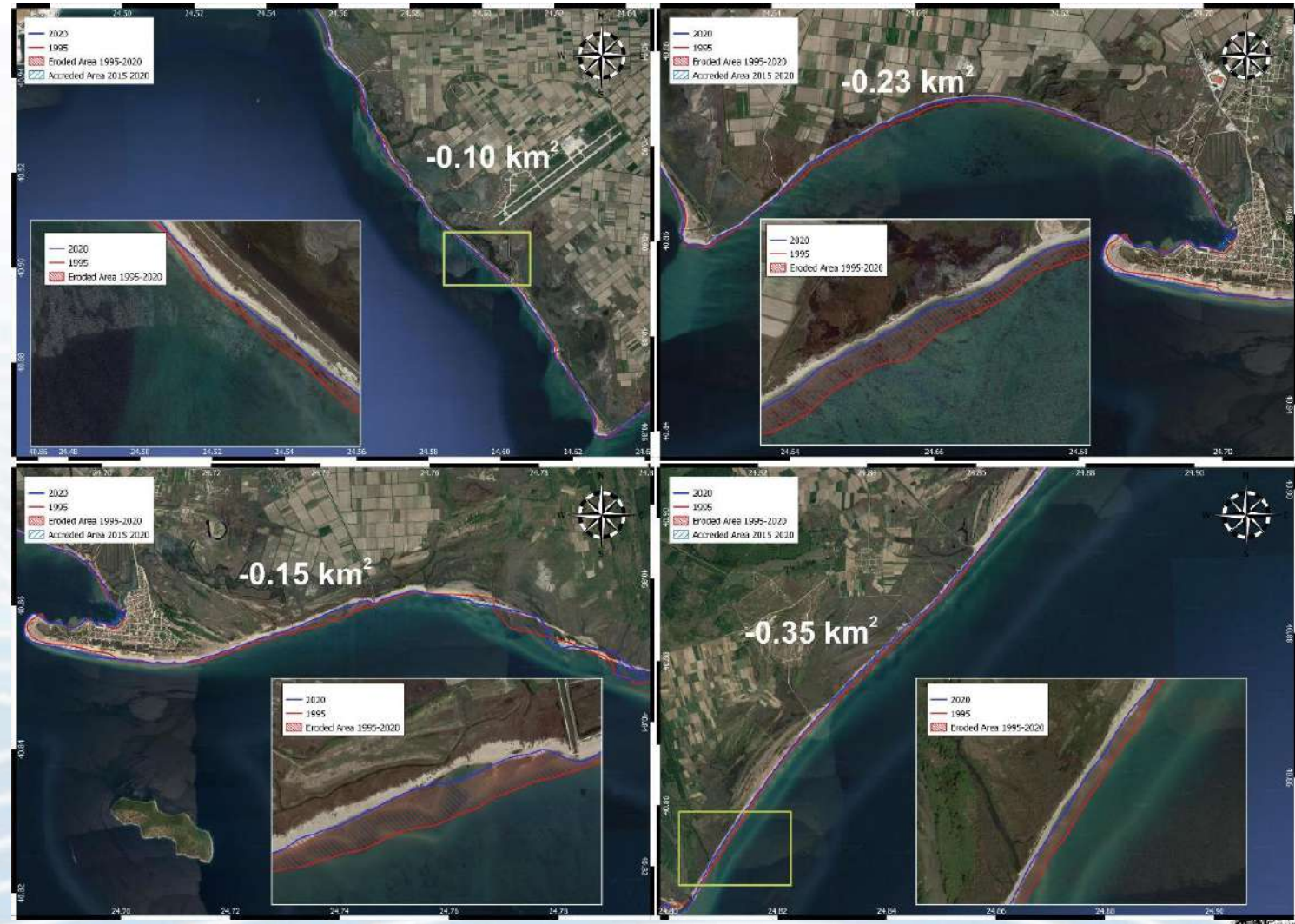
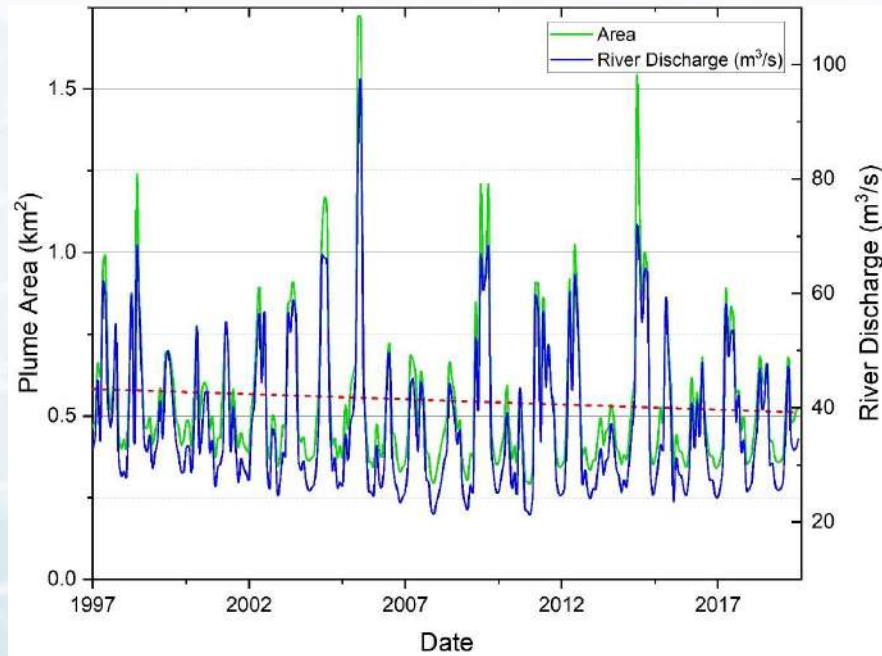
Wave action



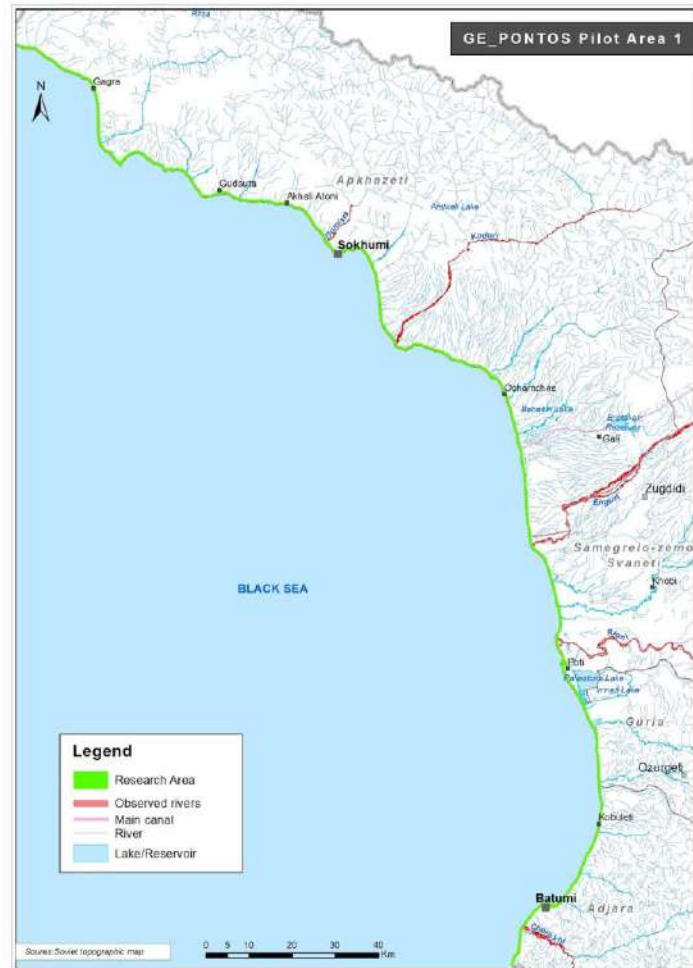
Sea surface currents



Impact of the dams on the Nestos estuaries



Georgia Study site - Coastal erosion hotspots



Number of satellite images analyzed

- Total 30 Images processed

Time period

- 1987-2013 Landsat 3-5, Landsat 8 - 5-year interval
- 2015-2021 Sentinel-2 - 2-years interval

Validation

- in-situ measurements
- higher resolution satellite image



→ Accretion
→ Erosion

Apkhazeti Region

1987-2013

Erosion: 54.28%

Accretion: 45.72%

2015-2021

Erosion: 56.57%

Accretion: 43.43%

Adjara, Guria, Samegrelo-Zemo Svaneti Region

1987-2013

Erosion: 22.21%

Accretion: 77.79%

2015-2021

Erosion: 33.89%

Accretion: 99.11%

Ukrainian Study site - Coastal erosion hotspots

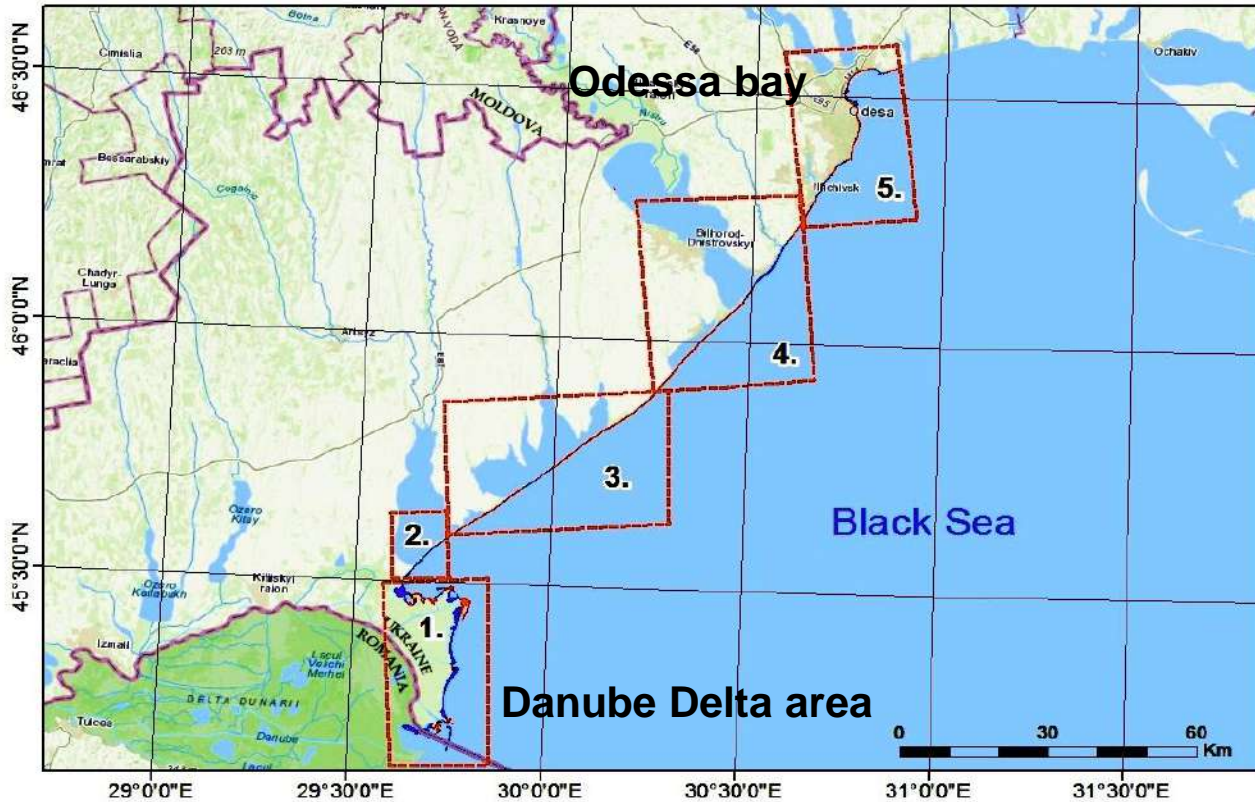
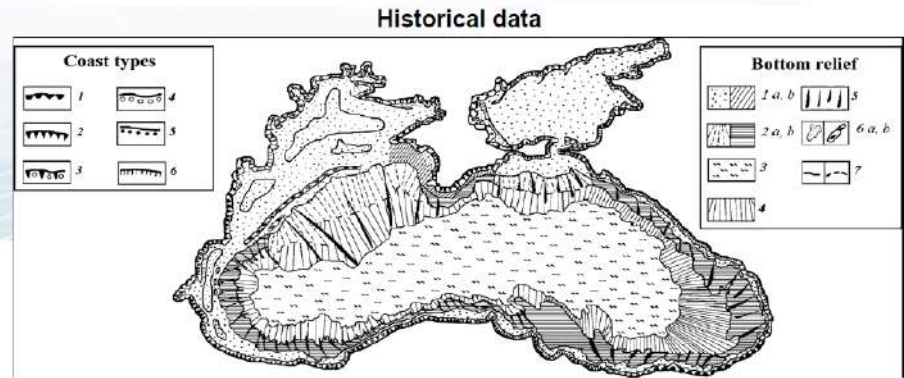


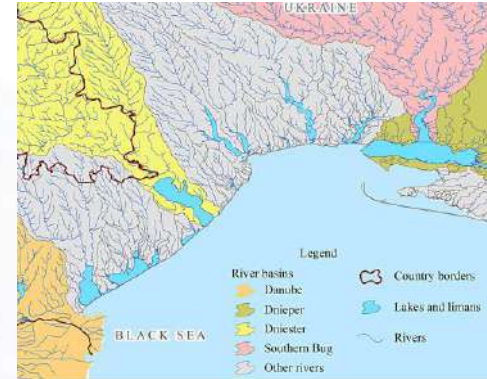
Table 2. Data product specifications used for Ukrainian pilot assessment [USGS Earth Explorer, 2021; Planet Explorer, 2021].

| Data Products | Number of images retrieved | Resolution | Year of Image Acquisition | Source |
|---------------|----------------------------|------------|---------------------------|----------------------|
| Landsat 3 MSS | 1 | 60 m | 1980 | Earth Explorer, USGS |
| Landsat 4 TM | 1 | 30 m | 1983 | |
| Landsat 5 TM | 12 | 30 m | 1985-2010 | |
| Landsat 7 | 2 | 30 m | 2000 | |
| Sentinel 2 | 4 | 10 m | 2015 to 2020 | Copernicus Hub |

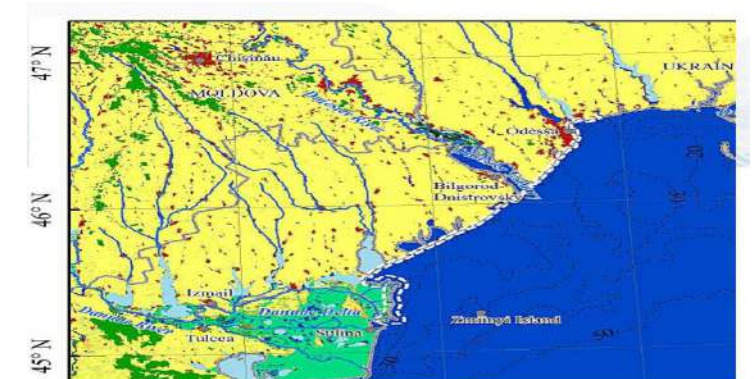
Ukrainian Study site - Data list



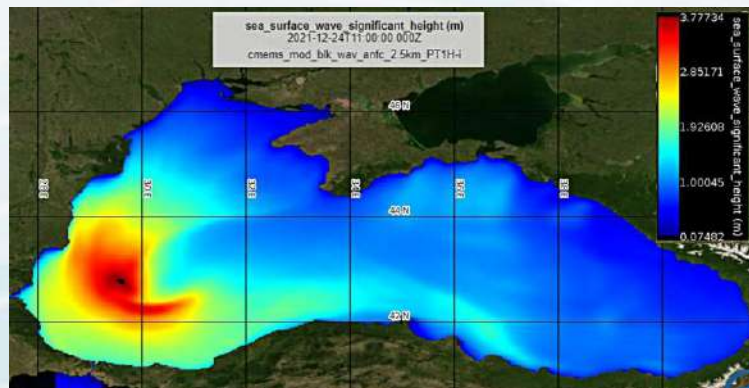
Topography of the coasts and floor of the Black Sea



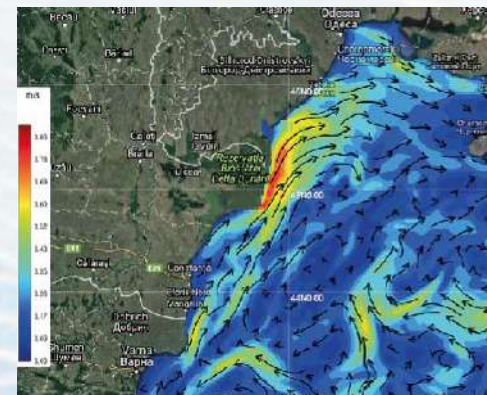
Hydrographic map



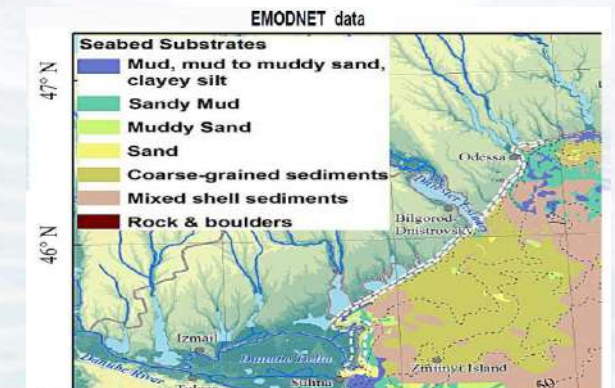
Land cover map



Sea surface wave significant height



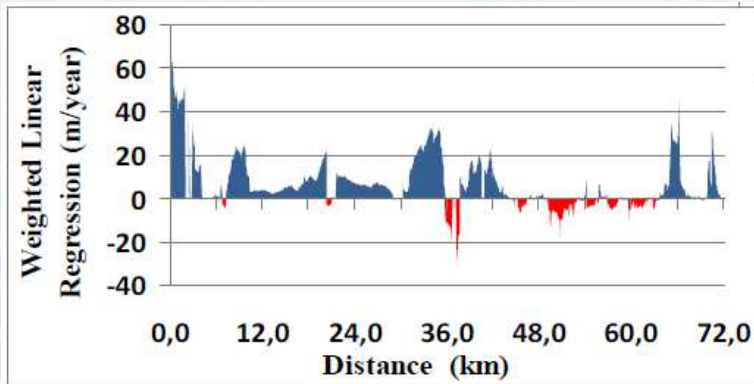
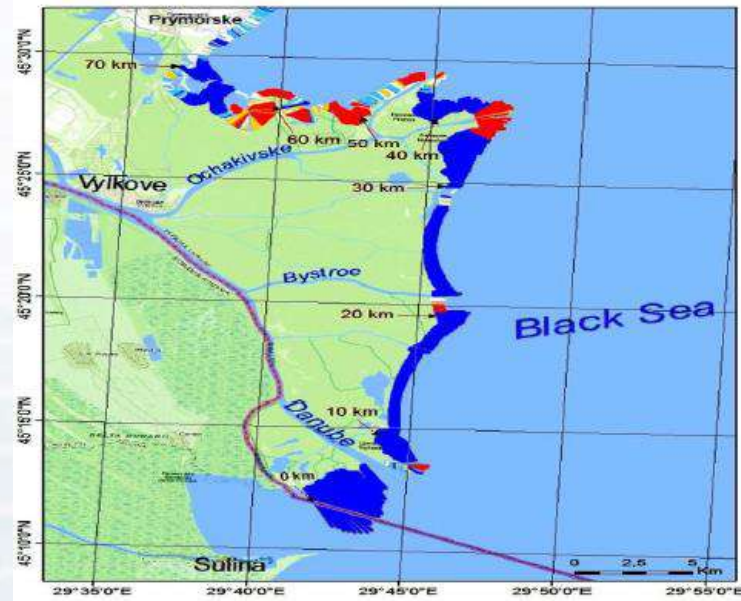
Sea currents analysis



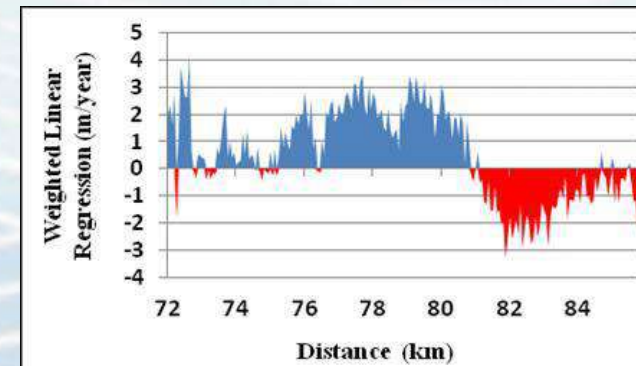
Seabed substrates map

Ukrainian Study site - Coastal erosion hotspots

Danube Delta

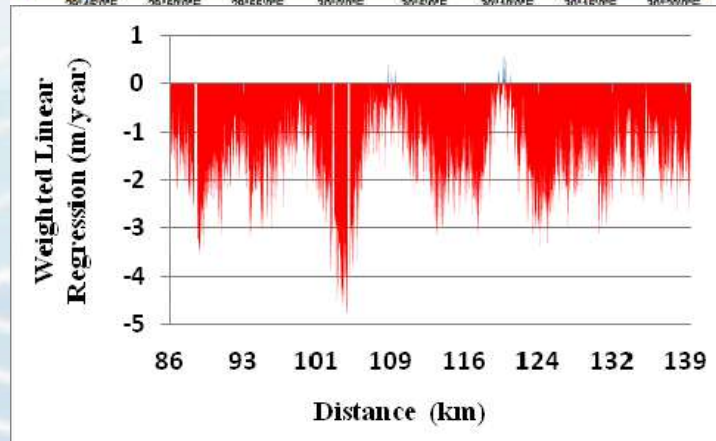


Sasyk estuary

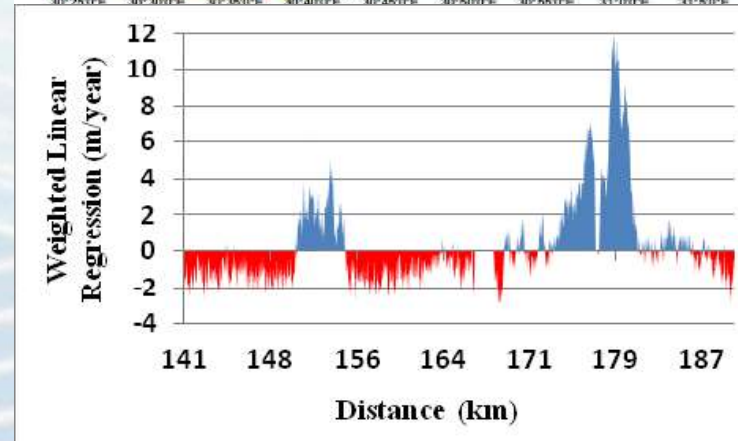
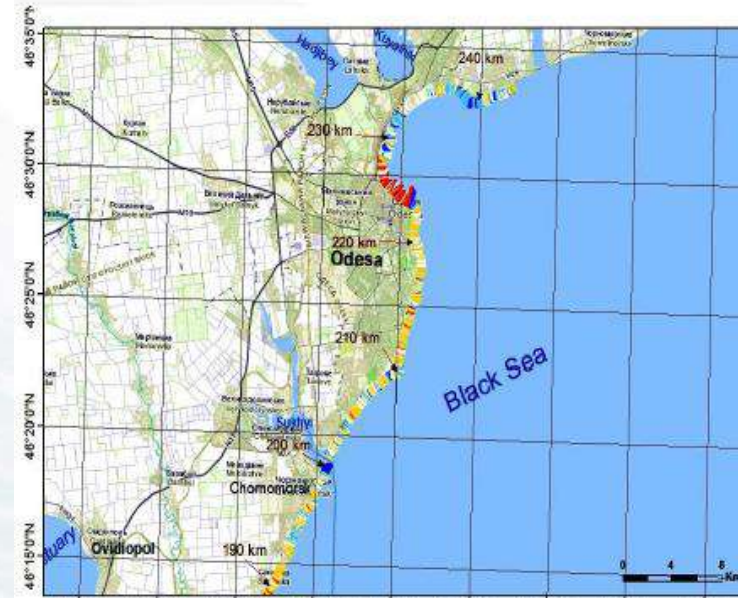


Ukrainian Study site - Coastal erosion hotspots

Sasyk estuary – Budakskiy estuary



Sukhiy estuary – Odessa bay



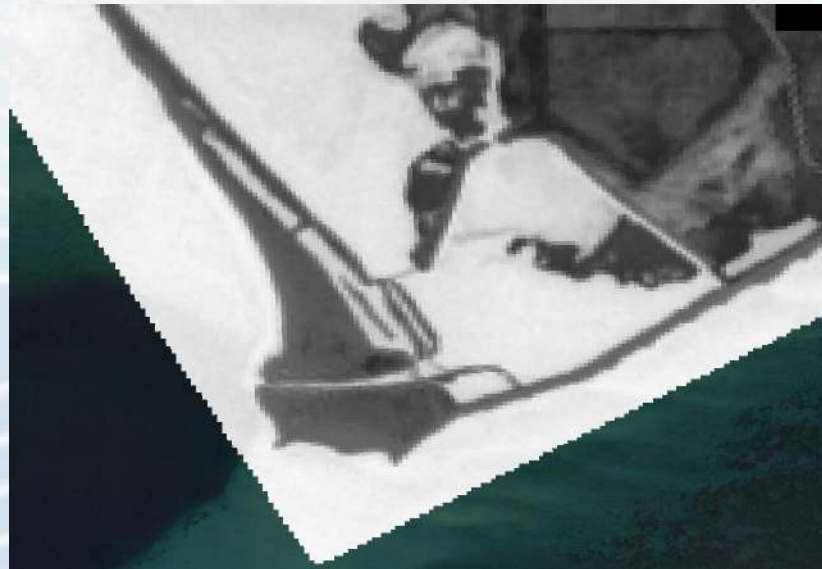
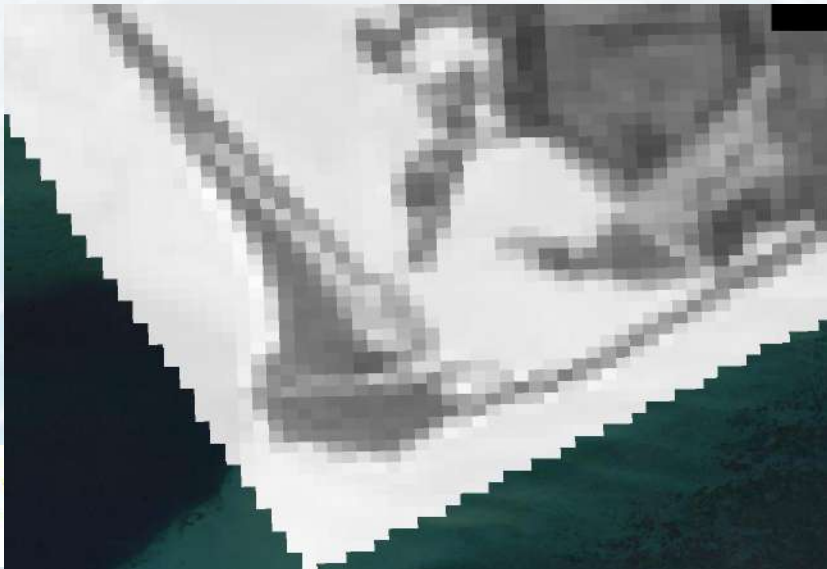
Validation

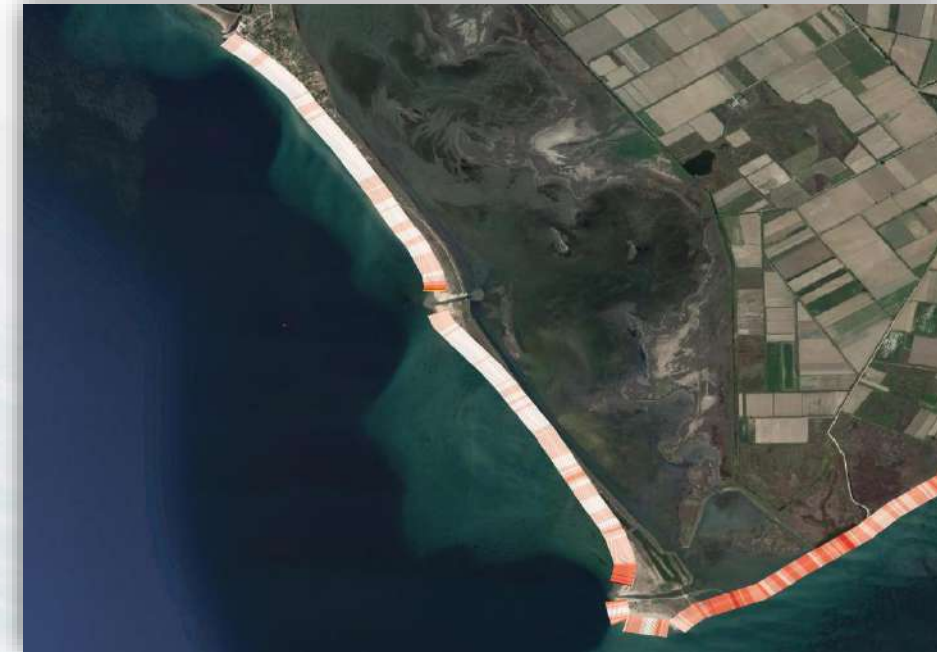
| | Landsat 8 OLI | Sentinel 2B | GeoEye1 |
|------------|---------------|-------------|----------------|
| DATE | 19/10/2020 | 22/10/2020 | 22/10/2020 |
| Time | 08:58 | 09:10 | 09:12 |
| Resolution | 30 | 15 | 0.46, 1.84 |
| Band | G, NIR | G, NIR | Pan, RGB & NIR |

Landsat 8 OLI

Sentinel 2B

GeoEye1





***The error is evenly distributed across all images, so the relative retreat of the shoreline via satellite images is reliable**

Evaluation of the method




Advantages

- **Low cost** and **easy** erosion assessment
- Covers **long period** (1980s - today)
- **Reliable results** especially in long **sandy** beaches

Disadvantages

- Uncertainties in **rocky** or **muddy** coastal areas
- Uncertainties in **very shallow** areas
- The **accuracy** is related to the **satellite image resolution**

Training material

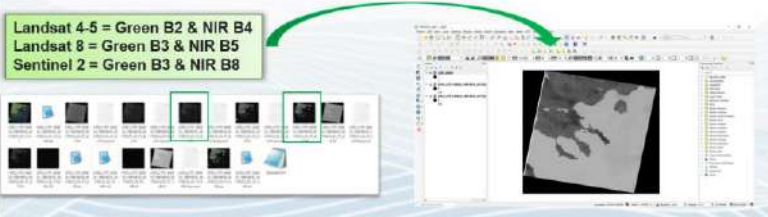
  




Common borders. Common solutions.

Step 1: Import the Green and NIR Band Images

- Decompress the downloaded file
- Find the **GREEN** and **NIR** band images
- Import band images in the QGIS (Drag & Drop or Copy & Paste).

Landsat 4-5 = Green B2 & NIR B4
Landsat 8 = Green B3 & NIR B5
Sentinel 2 = Green B3 & NIR B8




  




Common borders. Common solutions.

Step 2: NDWI calculation using raster calculator

From the top bar select **Raster - Raster Calculator**, and the raster calculator window opens

- In the **"output layer"** field select the file to save the new layer (the NDWI image)
- In the field **"Raster calculator expressions"**, import the NDWI equation using the bands from the **"raster bands"** field
- Import the brackets and the symbols from the **"Operations"** field
- Then press OK
- The new NDWI image is created and uploaded in the layer panel




  

Common borders. Common solutions.

Step 3: Clip NDWI image

From the top bar select **Raster - Extraction - Clip Raster by Extent...**, and the **Clip Raster by Extent** window opens

- In the input layer field select the NDWI image
- In the Clipping extent field, select the button on the right and select the **"Draw on canvas"**
- Select the area of interest on the QGIS map by drawing a rectangular
- In the field **"Clipped (extent)"** define the name of the new image and save to the working directory file
- From the **"Clip Raster by Extent"** window select run
- A new Clipped file is created



Actions



Ukraine

Brainstorming event
July 6, 2021

1st training session
October 27-28, 2021

Local Open Workshop
21st July

2nd Training Session
26-27 July

Georgia

PONTOS Brainstorming event

1st training session,
including field trip in coastal area

Exchange information/data with relevant scientific and state institutions

2nd training session,
including field trip in coastal area

Greece

PONTOS Training of trainers Webinar
08-09 December 2020

PONTOS Brainstorming event webinar
26 May 2021

1st training session,
webinar
October 2021

GEOTEE Training for flood and erosion assessment Webinar
28 February 2022

1st training session,
including field trip
June 2022



Thank you for your attention!!!