**Common borders. Common solutions.**



**PONTOS** | Copernicus assisted environmental monitoring across the Black Sea Basin

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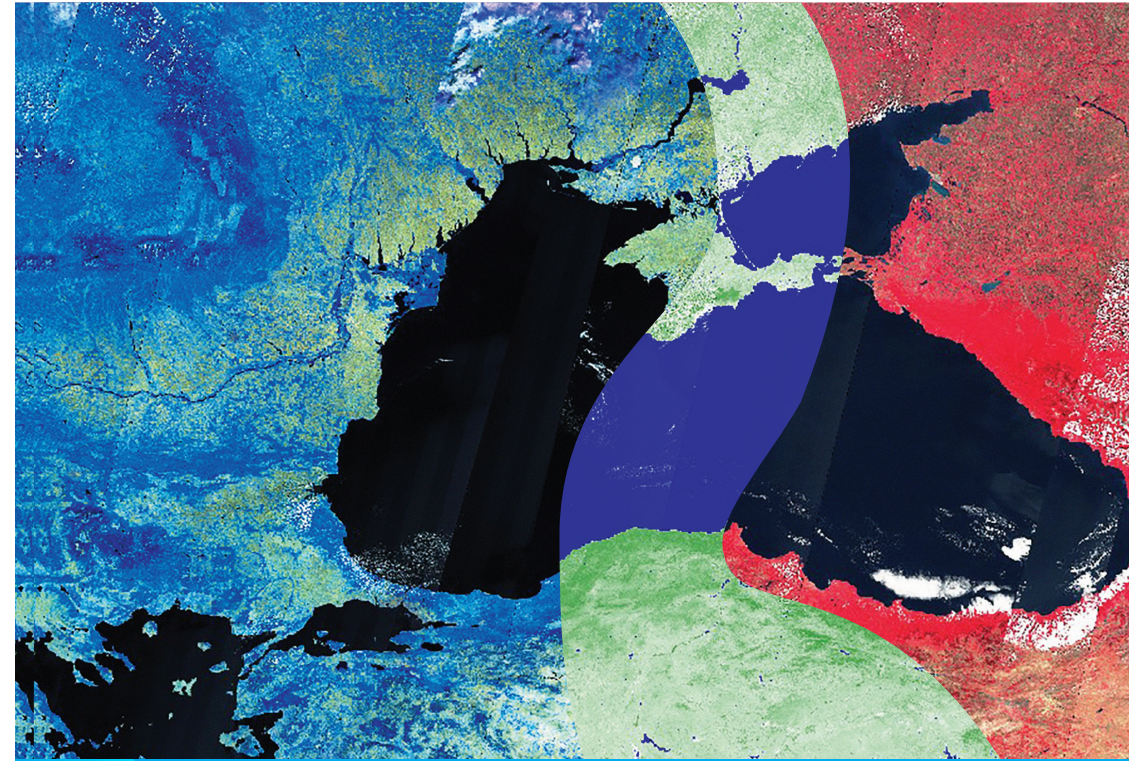**Phone:** +374 60 612 520
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**Copernicus assisted environmental monitoring across the Black Sea Basin – PONTOS**

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# ABOUT PONTOS

Copernicus assisted environmental monitoring across the Black Sea Basin-PONTOS is a 30-month project funded by the European Union's ENI CBC Black Sea Basin Programme 2014-2020.
The key outputs of the project include:
1. Creation of PONTOS operational platform and tools.
2. Assessment of environmental issues in four pilot areas using Earth Observation (EO) data and services.
3. Training and capacity-building activities for stakeholders.
4. Establishment of local groups on water management and pollution prevention in all participating countries.

The PONTOS project aims to support and enhance environmental monitoring in the Black Sea Basin area. This will be made possible with the use of Earth Observation products satellite, airborne and ground sources. The project team will test the environmental monitoring system in pilot sites across Armenia, Greece, Georgia, and Ukraine.

# PONTOS PLATFORM AND SERVICES

The PONTOS project makes information about the Black Sea environment from the EU Copernicus Earth Observation platform accessible to scientists, policymakers, citizens, and other relevant stakeholders through an operational platform combining various applications and tools for the users and stakeholders.

The PONTOS Platform offers *easy-to-use and easy-to-access free-of-charge online services* for various specialists, including those who do not have the technical expertise to write codes or algorithms to process data.

The PONTOS platform automatically retrieves and manages satellite, airborne, and in-situ data automatically finds and utilizes existing maps from the Copernicus and other repositories, and allows data uploads from end-users.

The Platform offers the following services:

● Open Data Cube (ODC): easy production of maps from satellite data
● PONTOS Web Application: airborne and in-situ data management support
● PONTOS WebGIS: combination of already available information already existing on maps



*Figure 1. PONTOS Platform Services*

## Ukrainian Pilot Area



*Picture 8. The Dniester mouth: Dniester River entering the Dniester estuary, July 2021 (photo credit: ONU). Large areas of floating vegetation with water nut (Trapa natans) interspersing with yellow pond lily (Nuphar lutea) are seen.*

## Georgian Pilot Area

The Georgian pilot areas are the Coastal Line and the Kolkheti (Colcheti) Lowlands in west Georgia. The former, covering the entire coastline of Georgia, is facing a threat of severe coastal erosion caused by a combination of sea-level rise, the tectonic sinking of the land, alteration of the river, and the sediment flow. The latter covers the downstream part of the Rioni river, including the delta area. The main ecosystems there, are ancient deciduous Colchic forests and wetlands, the Colchic rainforests being the most humid temperate deciduous rainforests that host 1,100 species of vascular plants, particularly woody species, bryophytes, almost 500 species of vertebrates, and a high number of invertebrates. Among the environmental problems that the region faces are the reduction of the river and sedimentation flow, which affects the delta area and natural habitats due to the construction of several regulating dams and reservoirs in the Rioni Basin, that caused severe degradation or loss of spawning sites of Sturgeon species (including Atlantic sturgeon). Among other threats are water pollution and the degradation of wetlands, as well as deforestation.

The Ukrainian Pilot area is located in the orthwestern part of the Black Sea, consisting of two joint study sub-areas — the coastal line and the Dniester River Delta. The coastal line includes the best beaches and recreational areas in the South of Ukraine, from Odessa city to the Danube River Delta. A substantial part of the Dniester Delta area belongs to the Lower Dniester National Nature Park; through the adjacent Dniester Estuary, having high environmental and economic significance for the region, the river connects to the Black Sea. The Pilot area faces such challenge as coastal erosion and nutrient pollution impacting drinking and irrigation water quality, wildfires and burning of wetlands, river water discharge perturbation (due to the impact of hydropower structures and reservoirs). The Ukrainian pilot area is important for the economy of the region and the country. Besides, it is very significant from the environmental viewpoint. It comprises valuable protected areas including the Ramsar wetlands of international significance. Those territories are notable for their rich flora and fauna, fish spawning areas, birds nesting grounds and wonderful landscapes. This picturesque nook of Ukraine should be conserved for the future generations.



*Figure 10. Churia Wetlands in the Georgian Pilot Area*

# PONTOS OPEN DATA CUBE APPLICATION

*easy production of maps from satellite data*

### LAND

● Urbanization (NDBI-NDVI-NDWI false-color composites)
● Spectral Indices (NDVI, NDWI, NDBI, etc.)
● Spectral Anomaly (NDVI, NDWI, NDBI, etc.)
● Fractional Cover

### WATER

● Water Detection (using the Water Observations from Space -WOfS- algorithm)
● Water Quality (Total Suspended Matter (TSM), see figure 6))
● Coastal Change

### GENERAL

● Cloud Coverage
● Custom Mosaic (e.g., geometric median composite RGB images)

* *PONTOS Project will develop additional applications.*

PONTOS ODC empowers the end-users with the ability to easily explore, manage, analyse and visualize Analysis Ready Data (ARD) from satellite missions for each pilot area.



*Figure 2. Data Cube. Source: Swiss Data Cube, Giuliani, G., Chatenoux, B., De Bono, A., Rodila, D., Richard, J. P., Allenbach, K., Dao, H., & Peduzzi, P.*

## BENEFITS OF USING ODC

● Decreased time and specialized knowledge to access, explore and process satellite data.
● Efficient time series analysis of EO satellite data.
● Consistent data architectures that allow tools and algorithms sharing.
● Open source software solutions that are promoted through community contributions.
● Constant user support.
● Free and open EO satellite data and application algorithms.



*Figure 3. Data Cube: multi-dimensional Data Cubes (DC) are considered as an innovative approach and an effective solution in storing, organizing, managing and analysing EO data by addressing volume, variety and velocity challenges.*
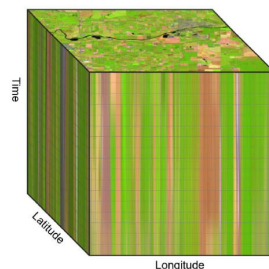
# PONTOS PILOT SITES

PONTOS project studies four pilot areas: Lake Sevan and its catchment area (Armenia), the entire coastline of Georgia and Kolkheti (Colcheti) Lowlands (Georgia), Nestos River, its delta, the coastline zone close to the delt (Greece) and beaches and recreational areas from Odessa city to the Danube river delta, Dniester river delta area, and adjacent estuary (Ukraine).

## Greek Pilot Area

The Greek Pilot area covers the Nestos River Delta and the Vistonikos Lagoon complex, a wetland area of high ecological significance protected by the Ramsar Treaty and being part of the Natura 2000 network. The coastline of the area and six coastal lagoons of the Nestos and Vistonikos complexes are at the center of attention of the PONTOS Project. These lagoons are: Eratino, Agiasma, Lafri, Porto Lagos, Xirolimni and Ptelea. The shoreline exhibits long-term signs of substantial erosion, especially after Nestos River damming. The lagoons are affected by agricultural residues, mostly nitrogen and phosphorus compounds, inducing frequent eutrophication incidents. Finally, the salination of coastal aquifers and the freshwater mismanagement should be reversed utilizing modern precision irrigation technologies. All the above issues will be studied within PONTOS framework, using the Copernicus-developed satellite products.



*Figure 8. Nestos River Delta,*



*Figure 7. In the image, you can see the river called Karchaghbyur, which empties into Lake Sevan and is one of the sources of the lake's water pollution. As could be seen in the image, algal blooms are a direct indication of increased flux of nutrients into the lake. Satellite and drone images are great tools to identify such sources in vast surface areas. This image is representative of the whole Black Sea Basin as currently, the rivers are one of the greatest sources of Black Sea pollution.*

## Armenian Pilot Area

The Armenian Pilot area includes Lake Sevan, the largest freshwater source for Armenia, and its catchment area. The urgent challenges are similar to those of river delta sites of other Pilot Areas, including nutrient pollution, insufficiently treated wastewaters, biodiversity loss, perturbation of ecosystem functioning, illegal fishing, etc. Moreover, land cover changes due to water level changes, and urban encroachment became a big challenge.

The following assessments are being undertaken within the Pilot Site
1.Assessment on forest cover changes induced by fires/burned areas and its consequences for the Sevan lake during the period of 2009-2019.
2.Assessment of changes in wetland and floating vegetation cover for 2009-2019.
3.Integrated assessment of eutrophication incidents for 2009-2021 (frequency and magnitude), and their relation to land-based nutrient fluxes.
4.Assessment of agriculture water balance, water productivity, and water stress indices assessment.

# PONTOS WEB APPLICATION
## *airborne and in-situ data management support*

PONTOS Web Application is created to be integrated in the PONTOS platform to manage and analyze airborne and in-situ data to be created within the project. The web application is complementary to PONTOS Data Cube and PONTOS WebGIS. The Web Application Services will be available in English, Armenian, Greek, Georgian, and Ukrainian languages.

## WEB APPLICATION TOOLS

1. Existing Airborne Data Management (Spectral indices calculation; Data visualisation ability; Output downloading in .png or GeoTIFF format).
2. Data Uploads from End-Users (Supports in-situ and airborne data uploads; Extraction of descriptive statistics regarding the dataset; Export outputs; Airborne data visualisation; Spectral indices calculation).
3. Existing In-situ Data Management (Generation of graphs; Extraction of descriptive statistics regarding the dataset; Output downloading in .csv format)
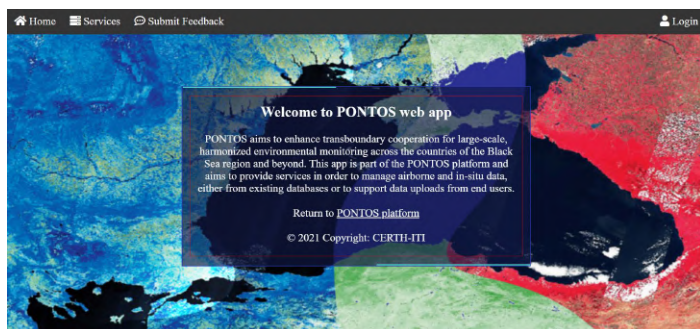
*Figure 4. Web Application Homepage*

# PONTOS WebGIS
## *a combination of already available information already existing on maps*

PONTOS WebGIS service interactively visualizes the spatial data collected in the PONTOS project and organized in a common spatial infrastructure. The system combines the principles and tools of Geographic Information Systems (GIS) and aims to harmonize the large and multi-dimensional datasets collected within the Project.
The main purpose of WebGIS is to further enhance the user experience in terms of user accessibility, data aggregation and data visualization.

WebGIS supports the visualization of **chlorophyll concentration (see Figure 5), land uses, water salinity and temperature, hydrology, weather, topography data.**

**Users of PONTOS webGIS service will be able to easily access, select data layers and visualize data on the four pilot areas (see page: 5) obtained: a) from external data sources, like the Copernicus Hub for Sentinel satellite imagery, the Earth Explorer for other satellite data, the CMEMS and EMODnet repositories, b) the external data from national/regional databases, c) the data produced by the PONTOS Consortium within the frame of the project, to assess coastal erosion, water balance and uses, eutrophication, floating vegetation and forest changes, and d) the geospatial data uploaded by end-users and stakeholders at the selected pilots.**

*Figure 5.Visualisation of chlorophyll concentration data in Thracian Sea through WebGIS*
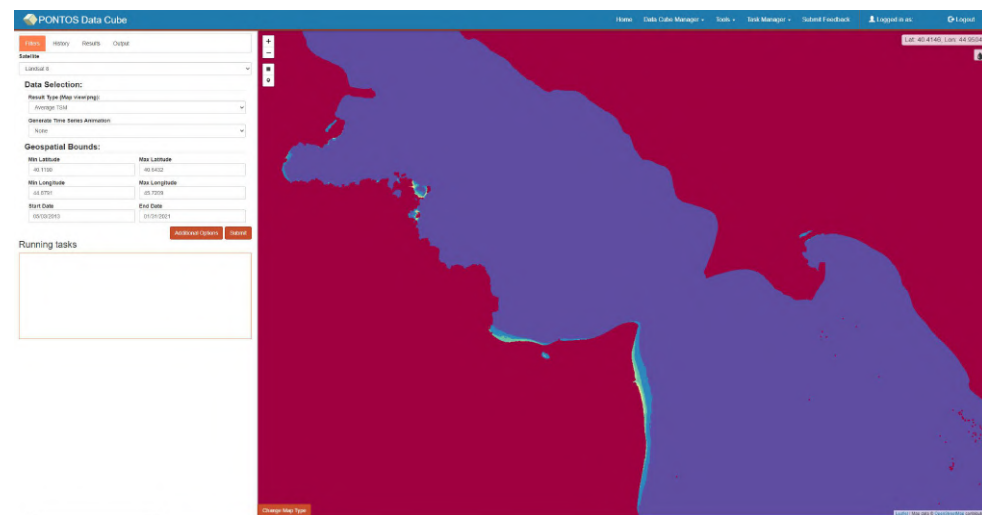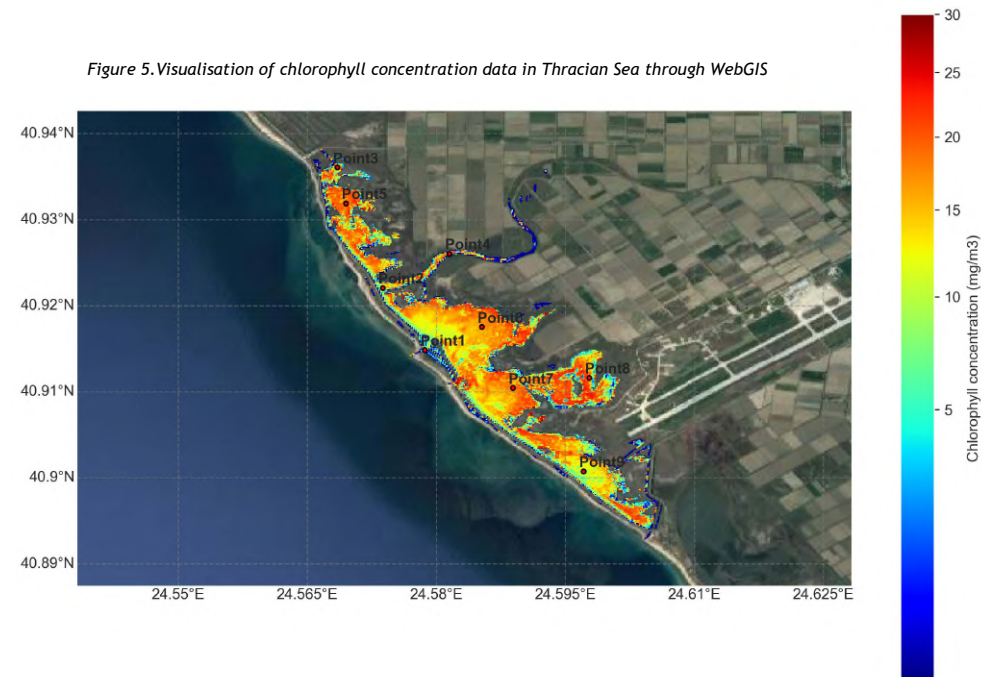
*Figure 6. Lake Sevan: Average Total Suspended Matter (TSM) calculated on Open Data Cube (ODC)*