



Common borders. Common solutions.

Introduction to the PONTOS platform

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PONTOS Platform aims to:

- **deliver an operational platform incorporating various applications and tools for the users' community** in the form of easy-to-access and easy-to-use online services
- **support and enhance environmental monitoring in the Black Sea Basin** area with the use of Earth Observation products obtained from Earth Observation satellite missions, airborne and ground sources

- **PONTOS Data Cube**

Easy production of maps from satellite data

- **PONTOS Web Application**

Support of airborne and in-situ data management and additional tools utilizing satellite data

- **PONTOS WebGIS**

Combination of information already existing on maps (e.g., Copernicus services)

PONTOS Data Cube targets on addressing some fundamental needs of EO satellite data users:

- contains a big volume of satellite data in order to **minimize the time and complexity that their pre-processing demands,**
- **decreases time and specialized knowledge** that is required in order to access, explore and process satellite data,
- includes applications which can be used to perform analysis
- **does not require the availability of computational infrastructure** on the side of the end-user

Technologies

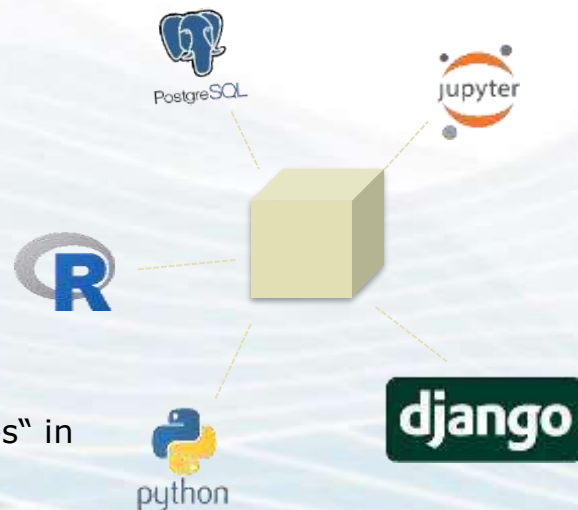
The Data cube is an open source software (Apache 2.0 license). At its core, the Open Data Cube (ODC) is a set of Python libraries and PostgreSQL database that helps you work with geospatial raster data.

In summary:

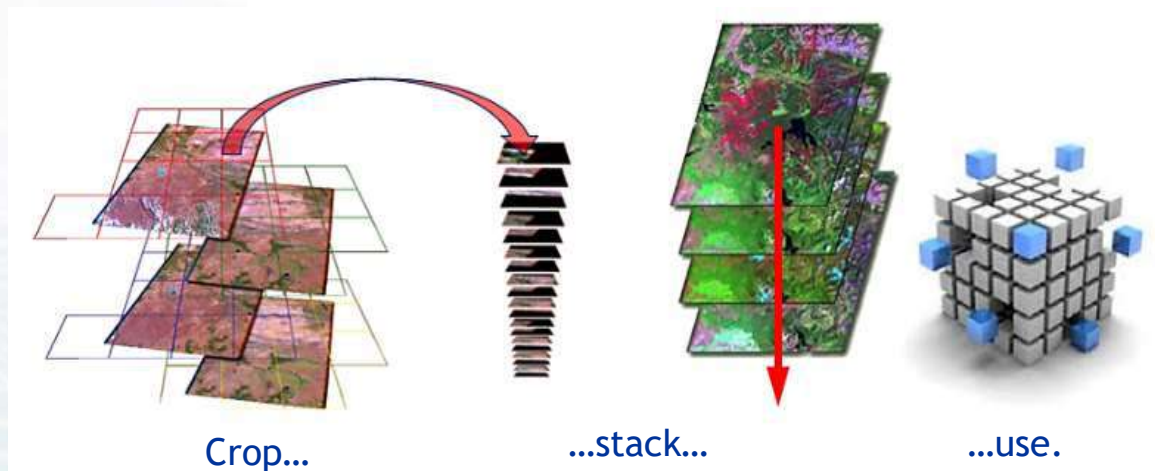
- ✓ **Django** administration panel
- ✓ **Jupyter** notebooks
- ✓ **PostgreSQL** database
- ✓ **Custom scripts** – modules written in R and Python

What does it provide?

ODC allows **analysis-ready satellite data** to be packaged in "cubes" in order to minimize data preparation complexity.

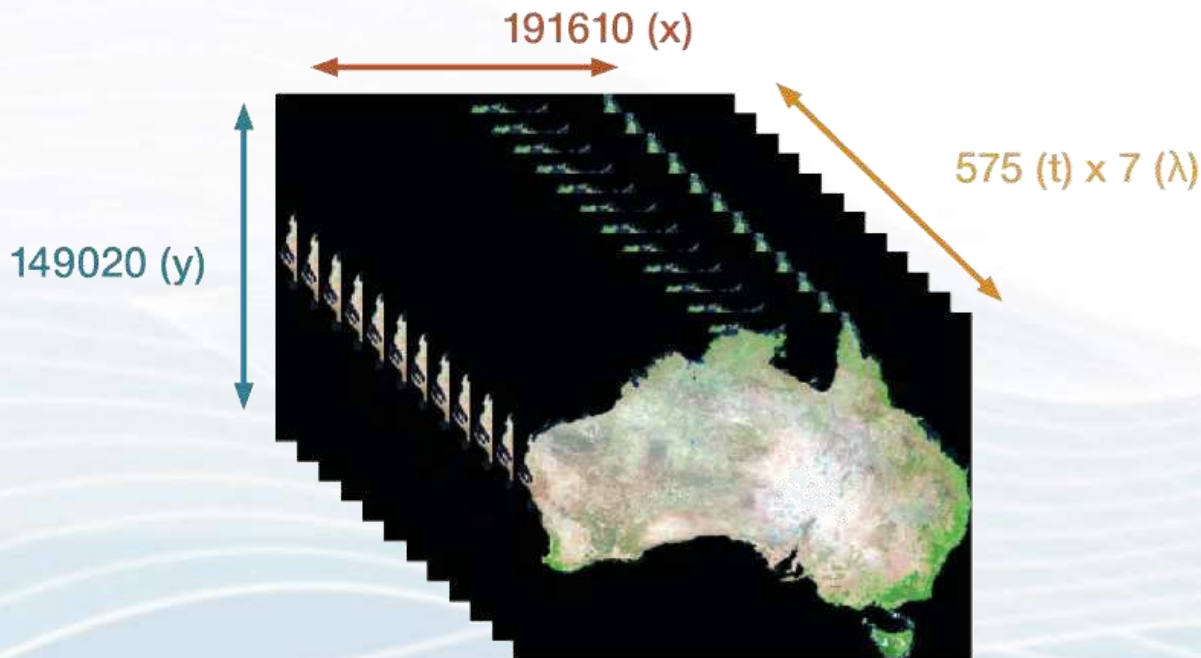


Data cubes are time-series multi-dimensional (space and time) stack of spatially aligned pixels.

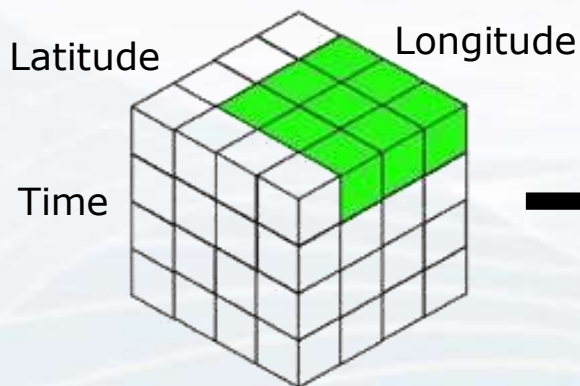


Source: Swiss Data Cube, Giuliani, G., Chatenoux, B., De Bono, A., Rodila, D., Richard, J. P., Allenbach, K., Dao, H., & Peduzzi, P.

Datacube in a nutshell

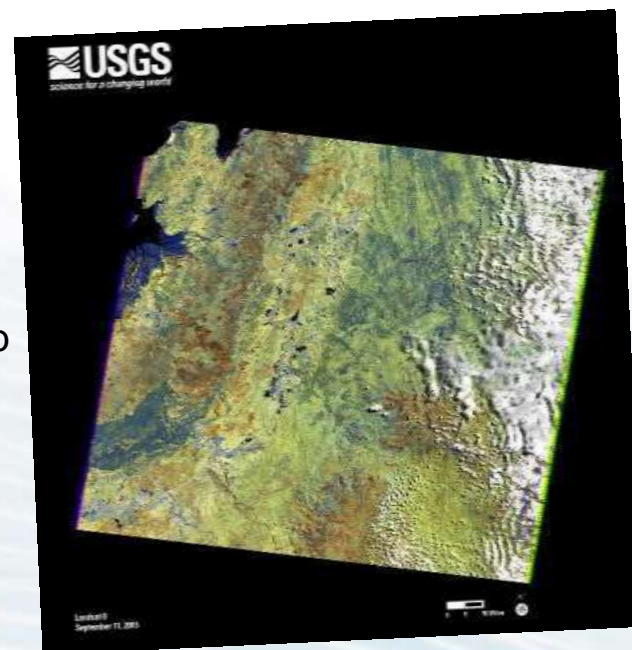


Source: Swiss Data Cube, Giuliani, G., Chatenoux, B., De Bono, A., Rodila, D., Richard, J. P., Allenbach, K., Dao, H., & Peduzzi, P.

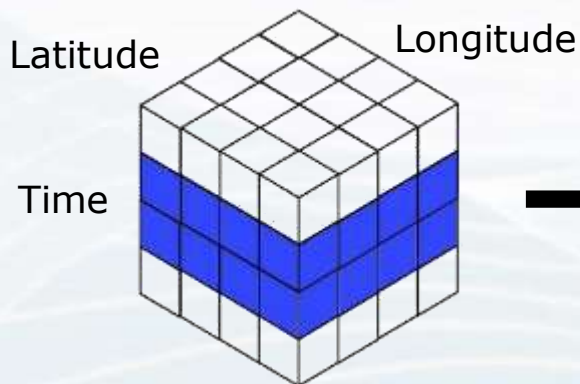


A single time slice, similar to a standard **"scene"** can be used to assess a single point in time

Pixels in the Data Cube are processed, aligned, and compressed and ready for data analysis



Adapted from CEOS

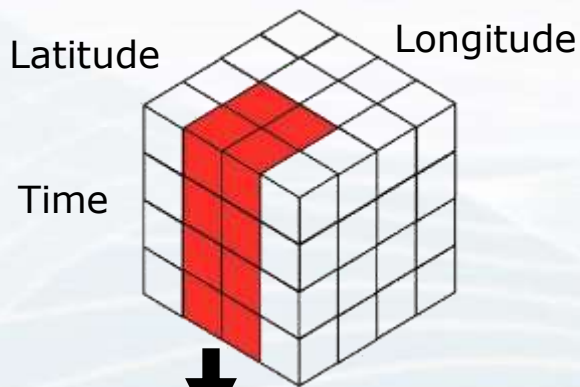


Several time slices can be combined into one to form a **"Mosaic"**. This is often used to reduce clouds or create seasonal or annual images.



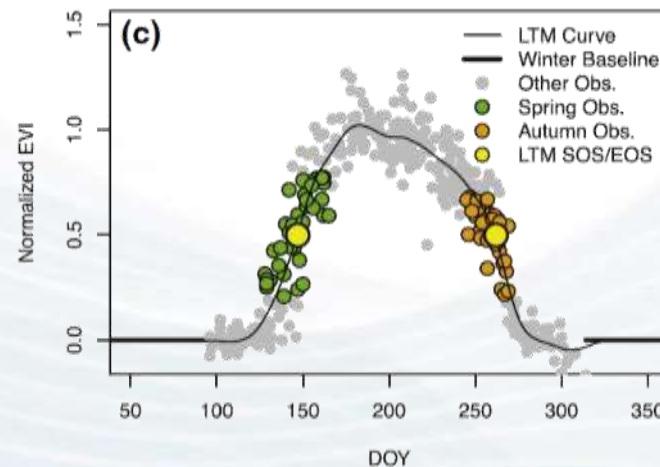
Typical Mosaics ... Most/Least Recent Pixel, Mean/Median, Geomedian, Min/Max NDVI

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



Examples of **Time Series** analyses include: Land Change (PyCCD), Water Change (WOFS), Parameter variation along a transect (Hovmoller plot)

Time Series analyses consider the variation of data over time to assess change



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

Land

- NDBI-NDVI-NDWI
- Spectral indices
- Spectral anomaly
- Fractional cover
- Custom mosaic

Water

- Water detection
- Water quality TSM
- Coastal change



Armenia

PONTOS Data Cube incorporates multiple space-borne products in the form of **ARD** satellite datasets:



Greece

➤ **Landsat 5, 7 & 8** USGS Collection 1 Higher Level SR scenes (Level 2) in a spatial resolution of 30m for the time range 1984 to present,

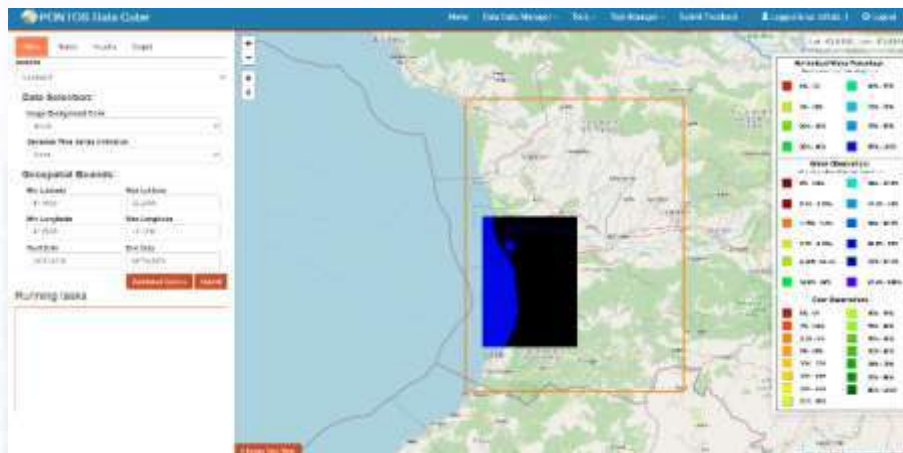
➤ **Sentinel-2** Level-2A scenes for the time range 2015 to present are being ingested in PONTOS Data Cube



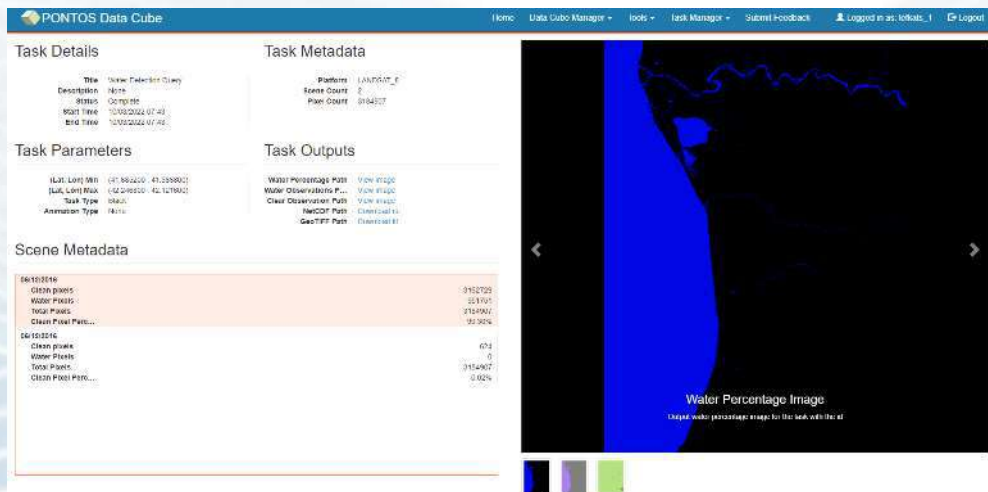
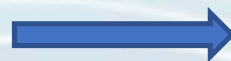
Georgia



Ukraine

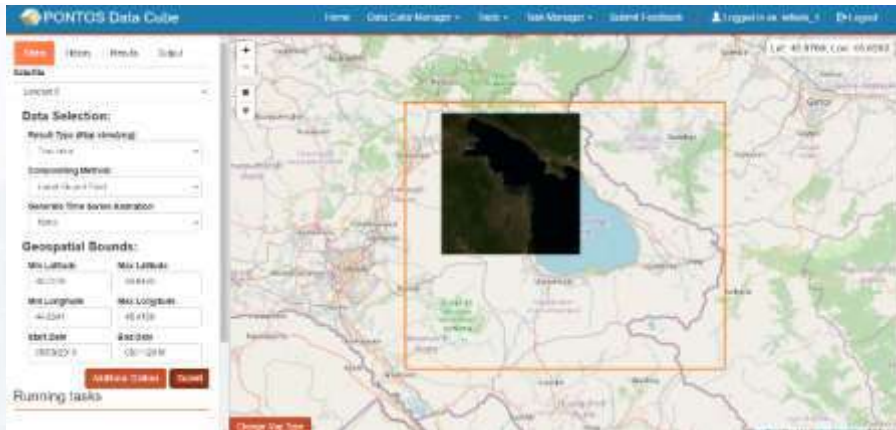


Water detection Task Manager

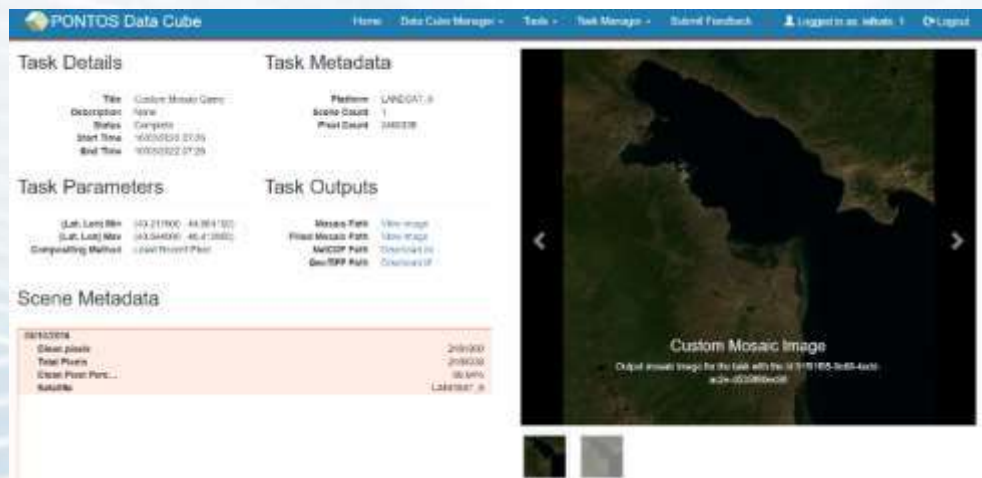


Water detection example of the Georgian pilot utilizing Landsat-8 data



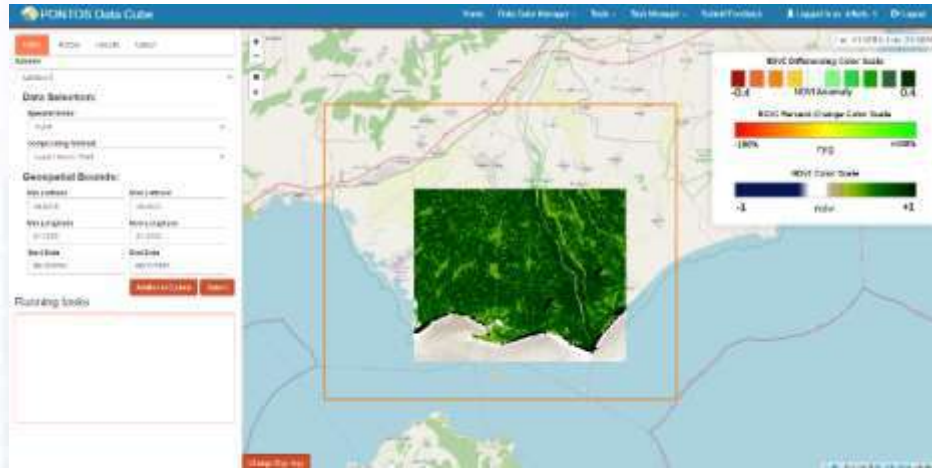


Custom mosaic example of the Armenian pilot utilizing Landsat-8 data



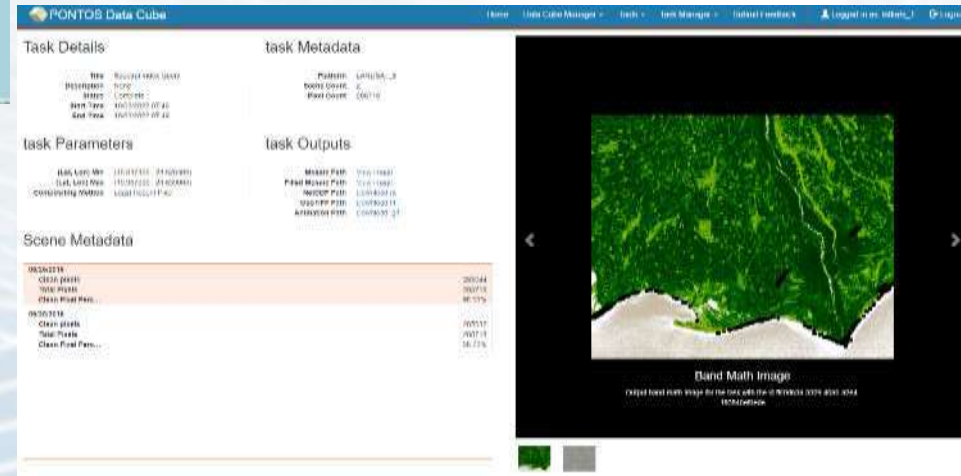
Custom mosaic Task Manager

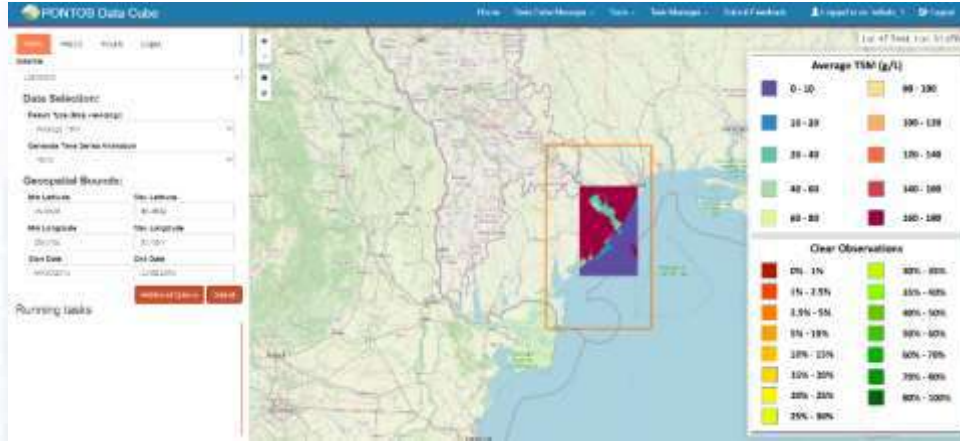




NDVI index example of the Greek pilot utilizing Landsat-8 data

NDVI index Task Manager





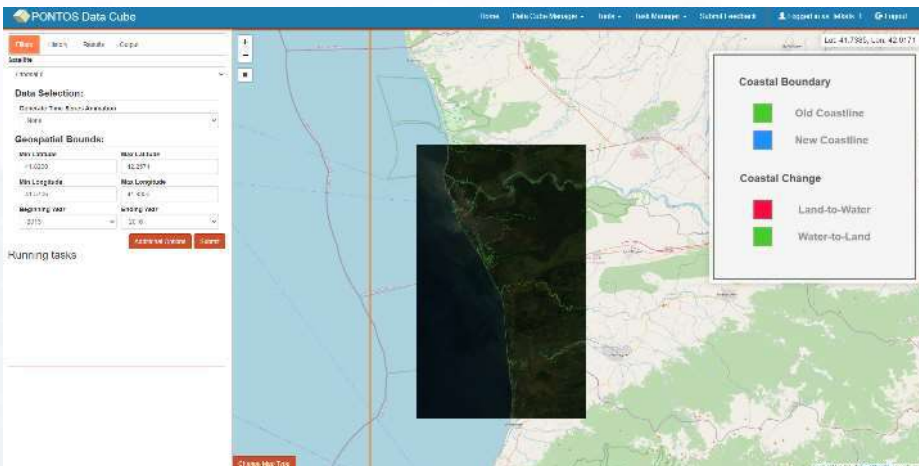
Water quality TSM example on the Ukrainian pilot utilizing Landsat-8 data



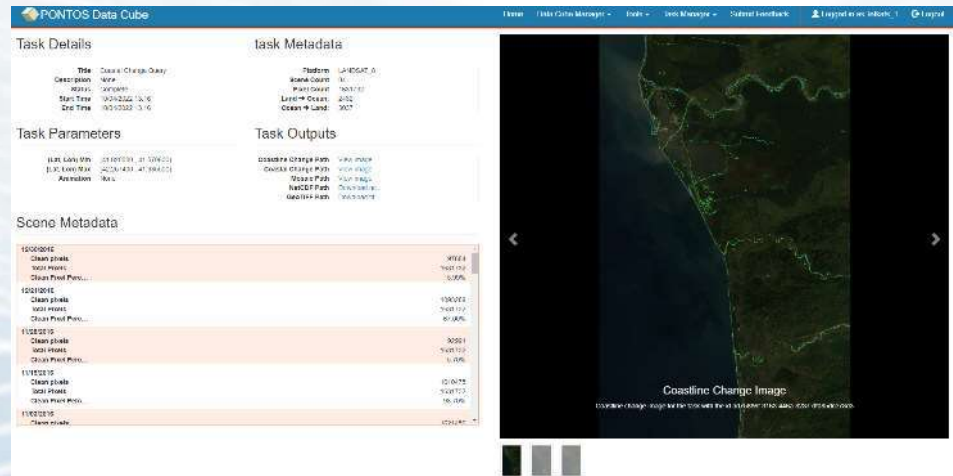
Water quality TSM Task Manager



Coastal change example of the Georgian pilot utilizing Landsat-8 data



Coastal change Task Manager



PONTOS Web Application was created to be integrated in the PONTOS platform in order to manage and analyze data that will be created within the project's lifetime, airborne and in-situ and support additional tools utilizing satellite data.

In-situ data

- Graphs generation
- Descriptive statistics calculation

Airborne data

- Visualize images
- NDVI index
- NDWI index

Satellite data

- WaterMasks
- Hydroperiod
- EODESM
- Phenology Metrics



Armenia

PONTOS Web Application incorporates data:

- **In-Situ** data collected by the PONTOS partners
- **Airborne** Data collected by the PONTOS partners
- **Satellite** data from the missions Landsat 5, Landsat 8 and Sentinel-2



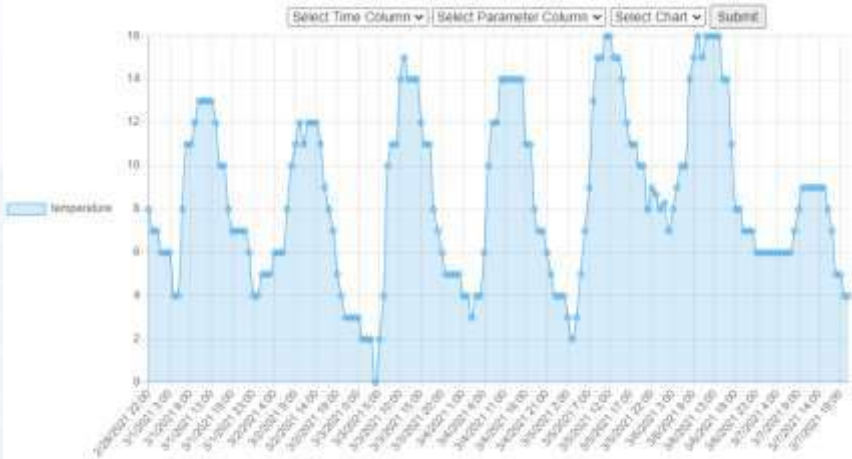
Greece



Georgia



Ukraine

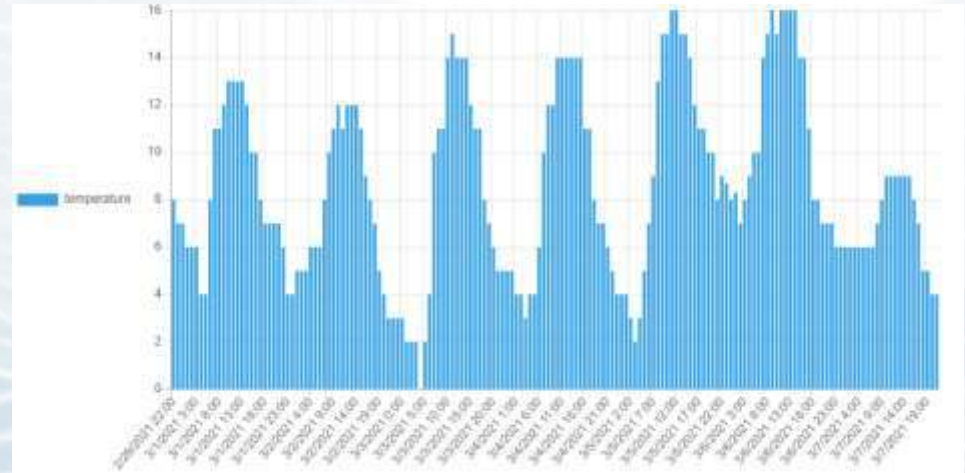


Descriptive statistics of temperature

- mean: 8.601190476190476
- median: 8.0
- variance: 15.189641439909298
- std: 3.897989054214282
- max: 16.0
- min: 0.0
- range: 16.0
- 25th percentile: 6.0
- 75th percentile: 12.0
- skewness: 0.21873062763809903
- kurtosis: -0.9388730830407406

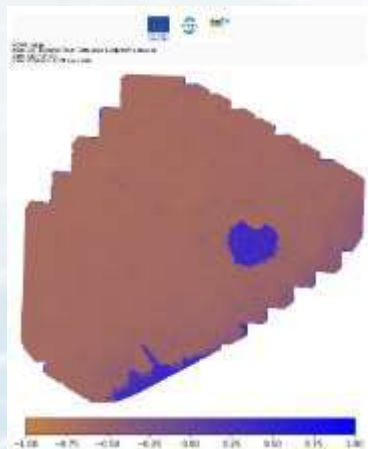
Export descriptive statistics to csv

In situ data analysis (ground temperature time-series)



Airborne data analysis of the Ukrainian pilot

NDWI index



NDVI index



NIR band visualization

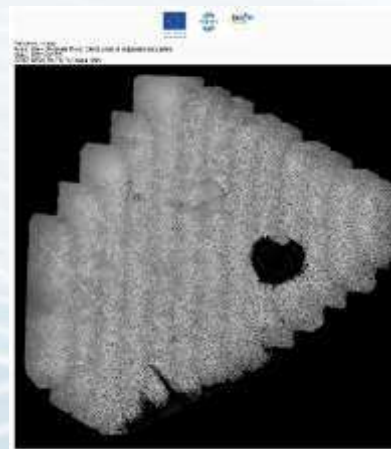


Image location detection

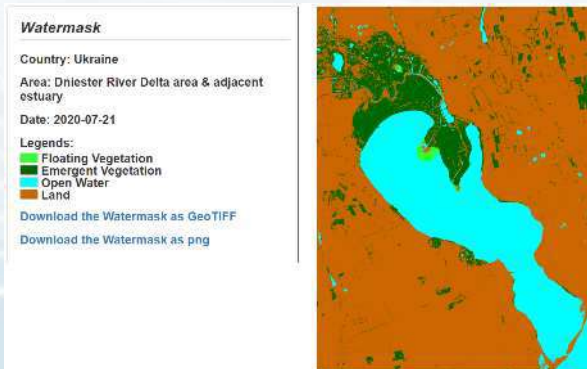


Satellite data analysis

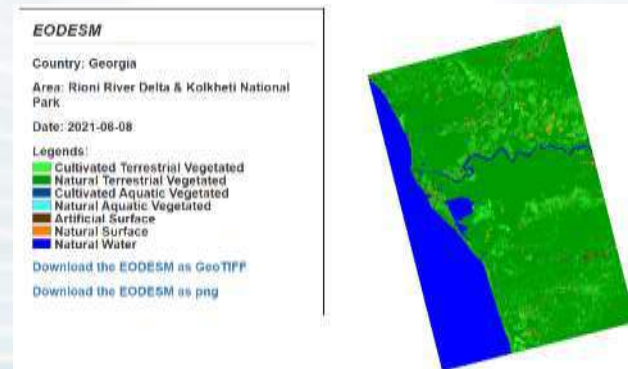
Hydroperiod visualization of the Georgian pilot



Watermask visualization of the Ukrainian pilot



EODESM visualization of the Georgian pilot

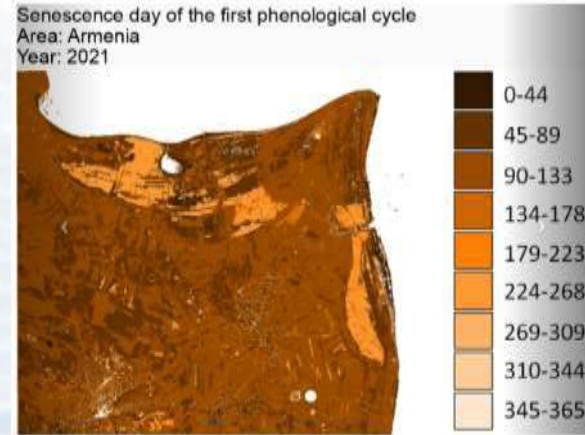
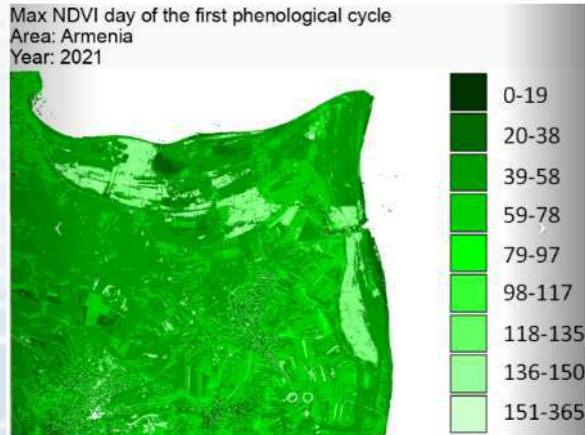
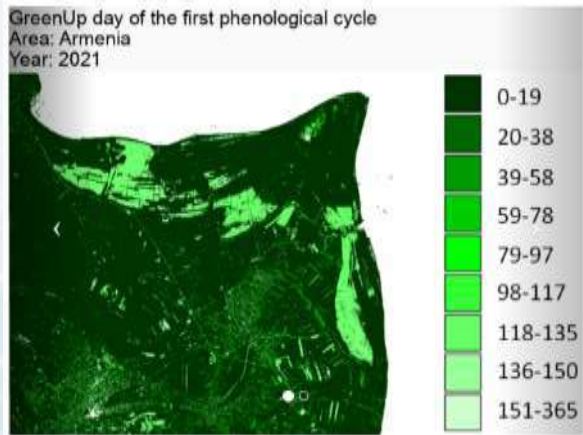


Phenology Metrics visualization of the Armenian pilot

The day that the Green up was occurred

The day that the maximum NDVI was occurred

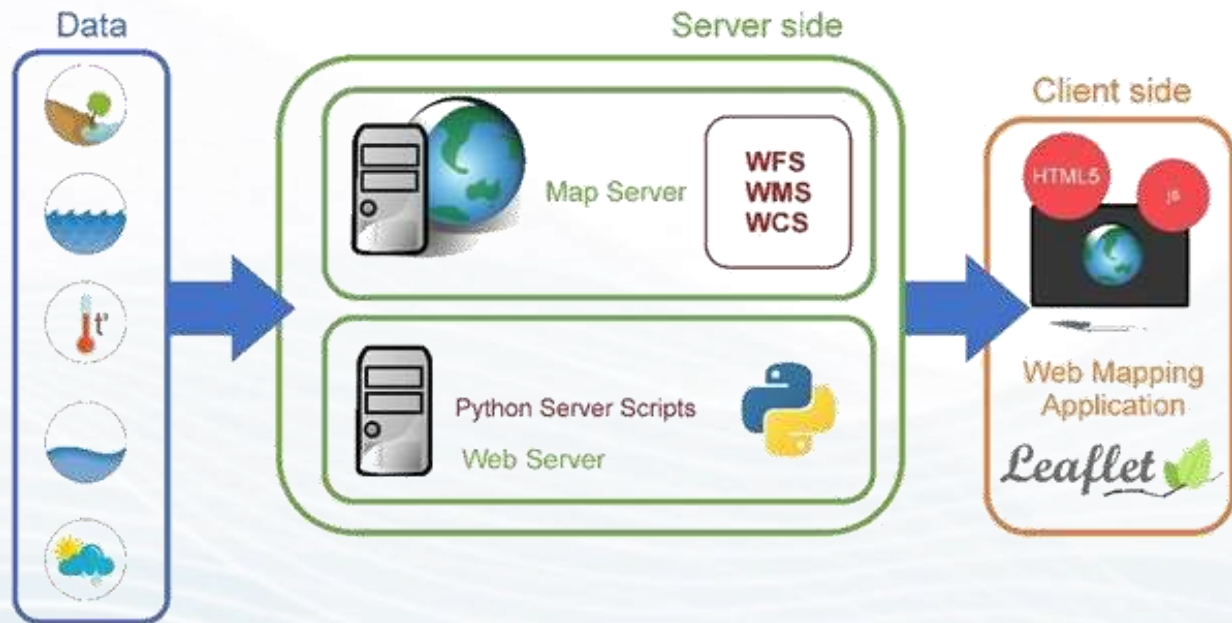
The day that the Senescence was occurred



PONTOS WebGIS was created to be integrated in the PONTOS platform in order to visualize data that are already existing in maps or will be created within the project's lifetime, and organize them in a common spatial infrastructure.

Consists of two different components:

- a **Map server** that pushes the user's queries to external Data Servers.
- a **Web Server** that hosts the PONTOS's webGIS website and handles Python Server scripts





Armenia



Georgia



Greece



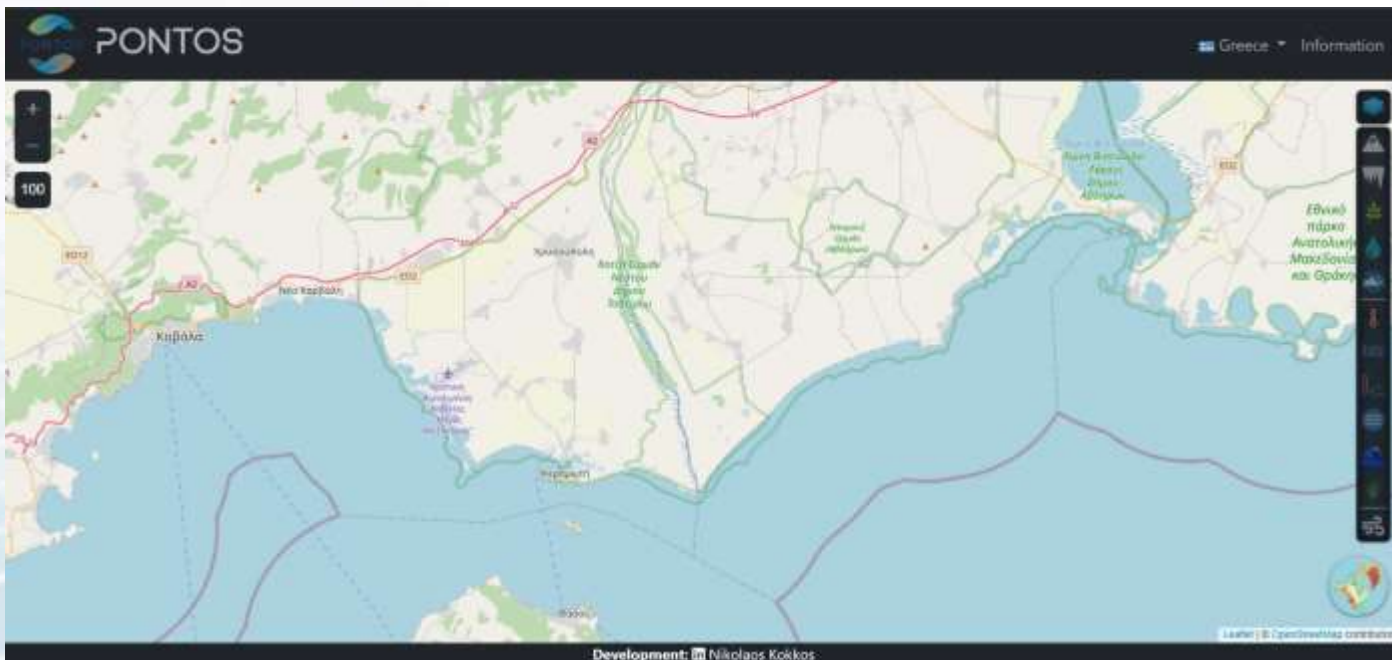
Ukraine

PONTOS WebGIS incorporates:

- **Topographic data** (NASA Database),
- **Bathymetric data** (EMODnet Bathymetry Portal),
- **Land Use/Cover data** (Copernicus Land Monitoring Service, other local services),
- **Geology, Hydrogeology** (Local services),
- **Floods** (Local services)
- **Hydrologic data** (Swedish Meteorological and Hydrological Institute),
- **Shoreline evolution data** (Sentinel 2 satellite images),
- **Oceanographic data** (Copernicus Marine Environmental Monitoring Service),
- **Meteorological data** (Global Forecasting System of NOAA).

<http://labecolftp.env.duth.gr/PONTOS>

- One webGIS website for all pilot areas.
- Every component is translated in local language.
 - **English**
 - Greek
 - Armenian
 - Georgian
 - Ukrainian



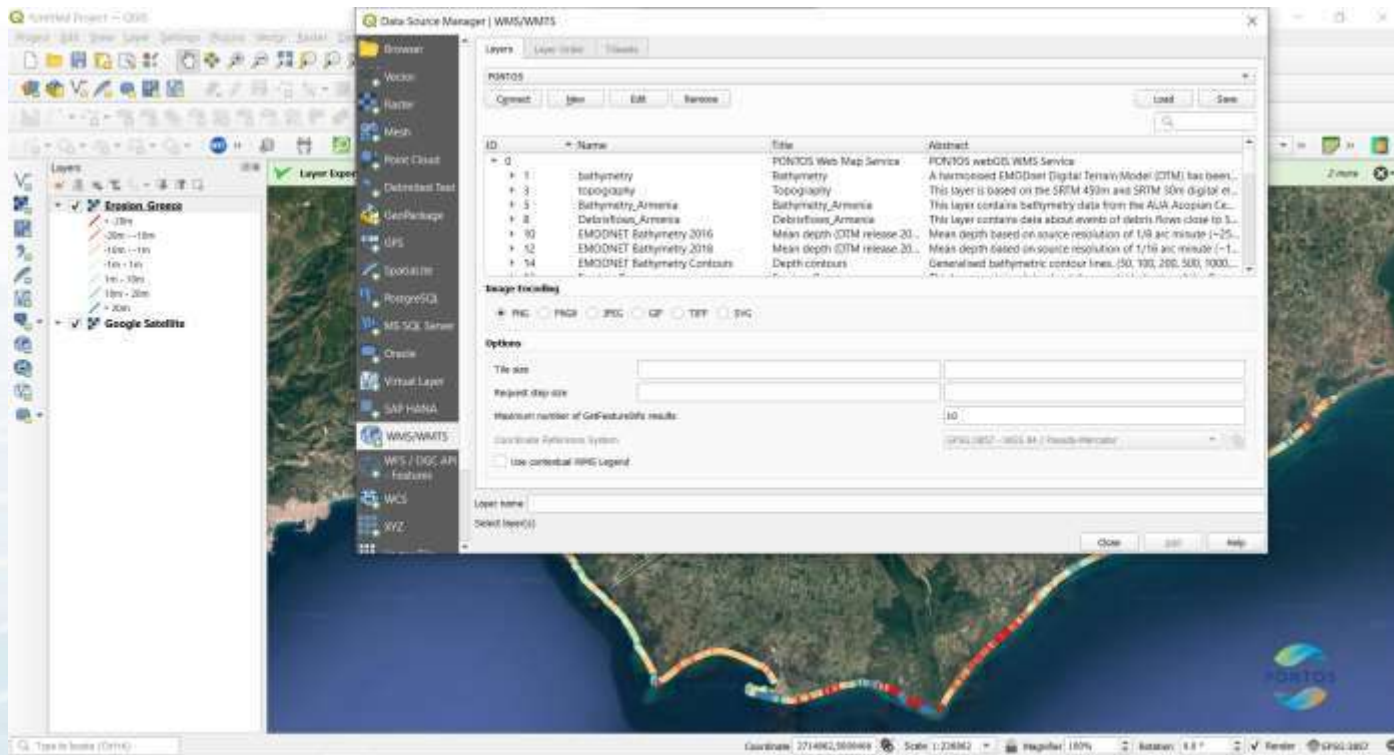
<http://labecolftp.env.duth.gr/PONTOS>

Armenian

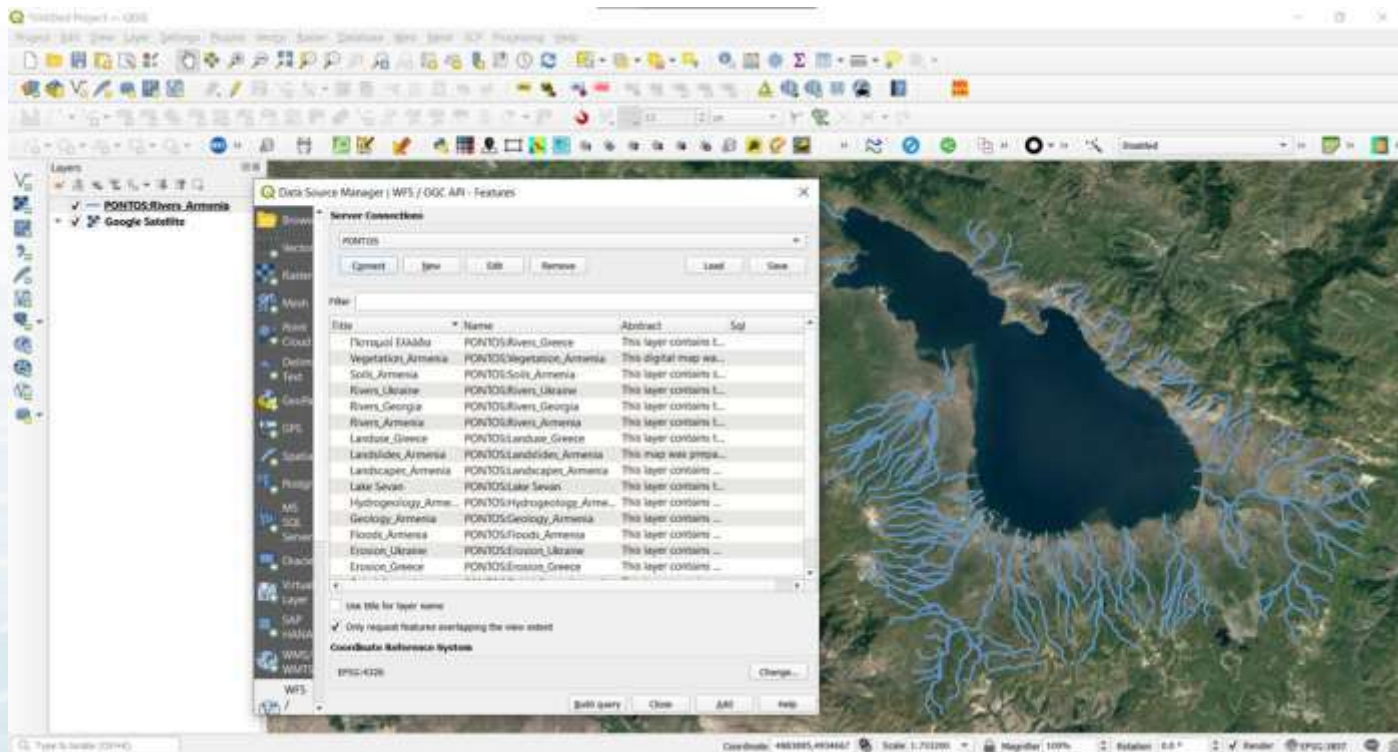




- Fully compatible with mobile devices



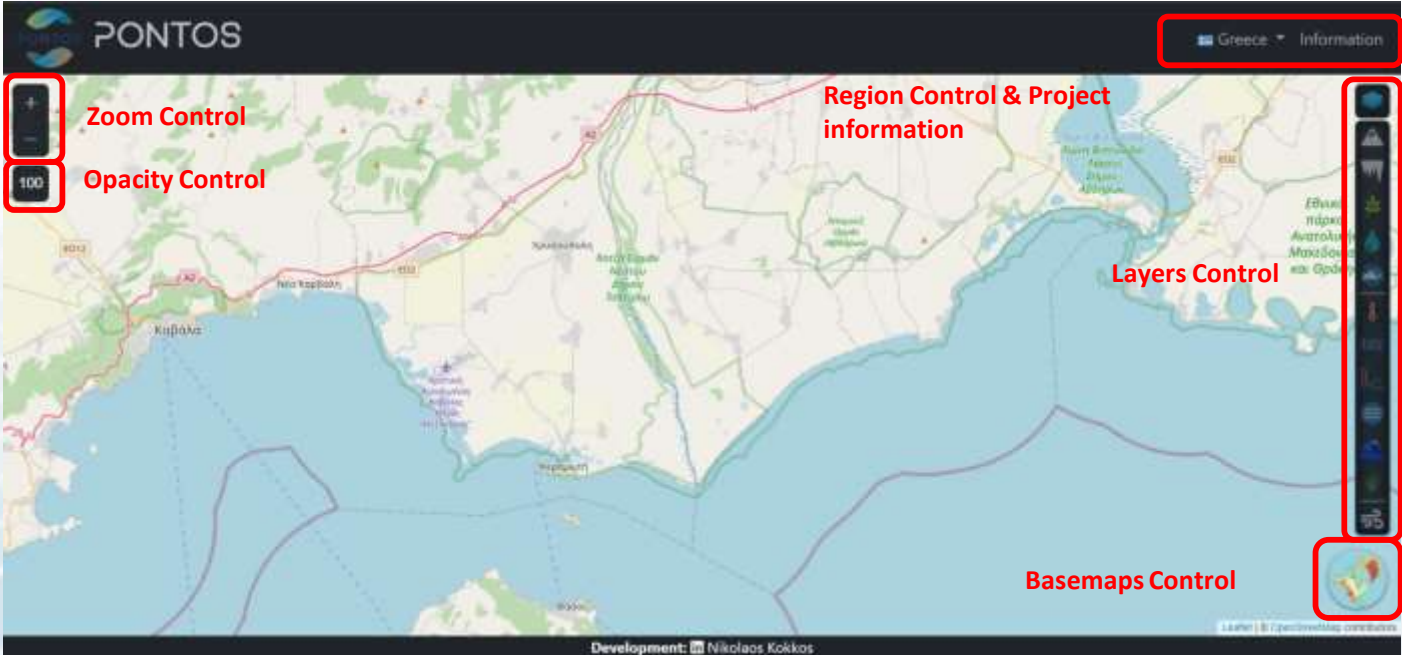
WMS service: <http://labecolftp.env.duth.gr:8080/geoserver/PONTOS/wms>



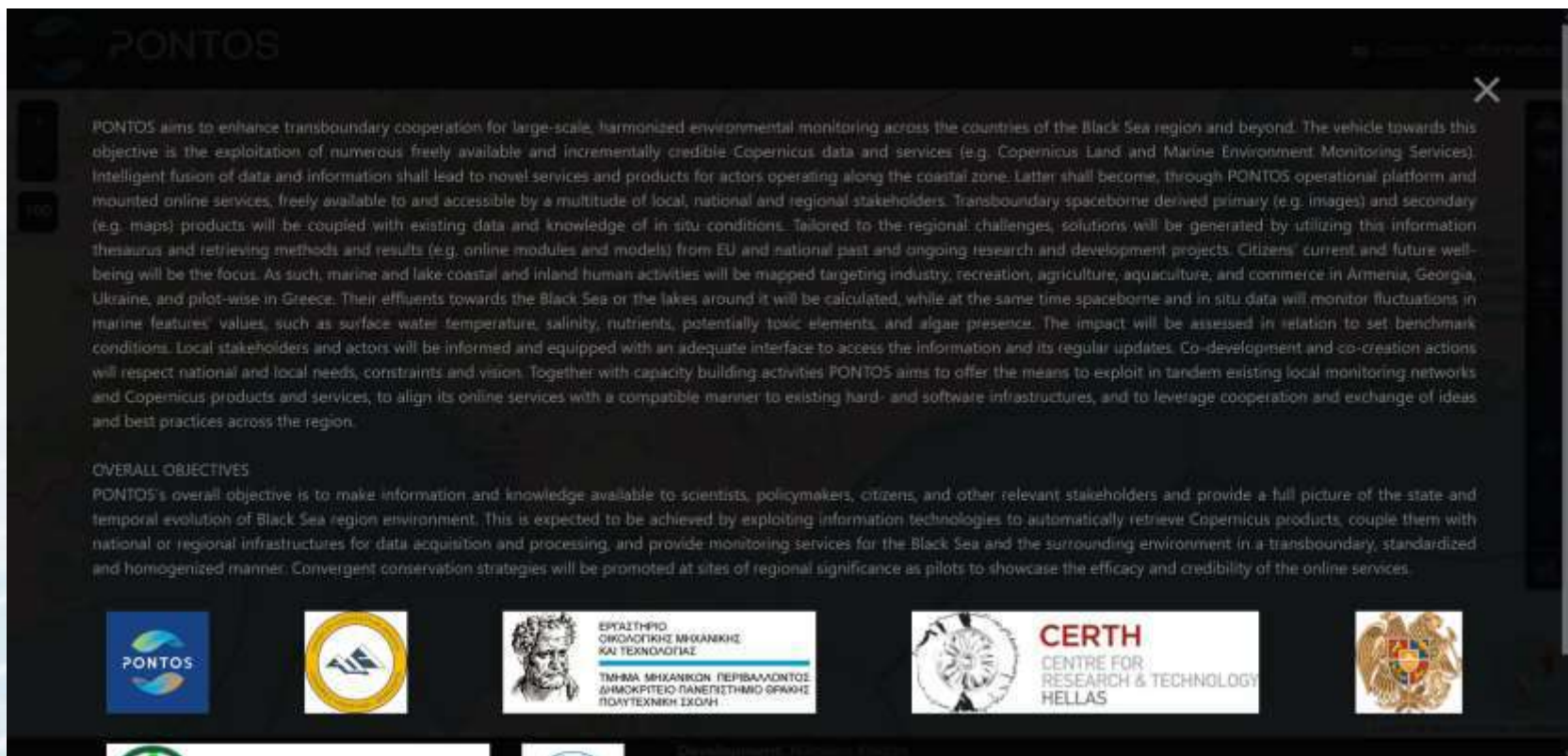
WMS service: <http://labecolftp.env.duth.gr:8080/geoserver/PONTOS/wfs>

- 5 components:

- Region Control & Project information
- Layers Control
- Basemaps Control
- Zoom Control
- Opacity Control



Layers control is automatically being modified based on the available datasets for each local site



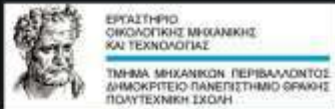



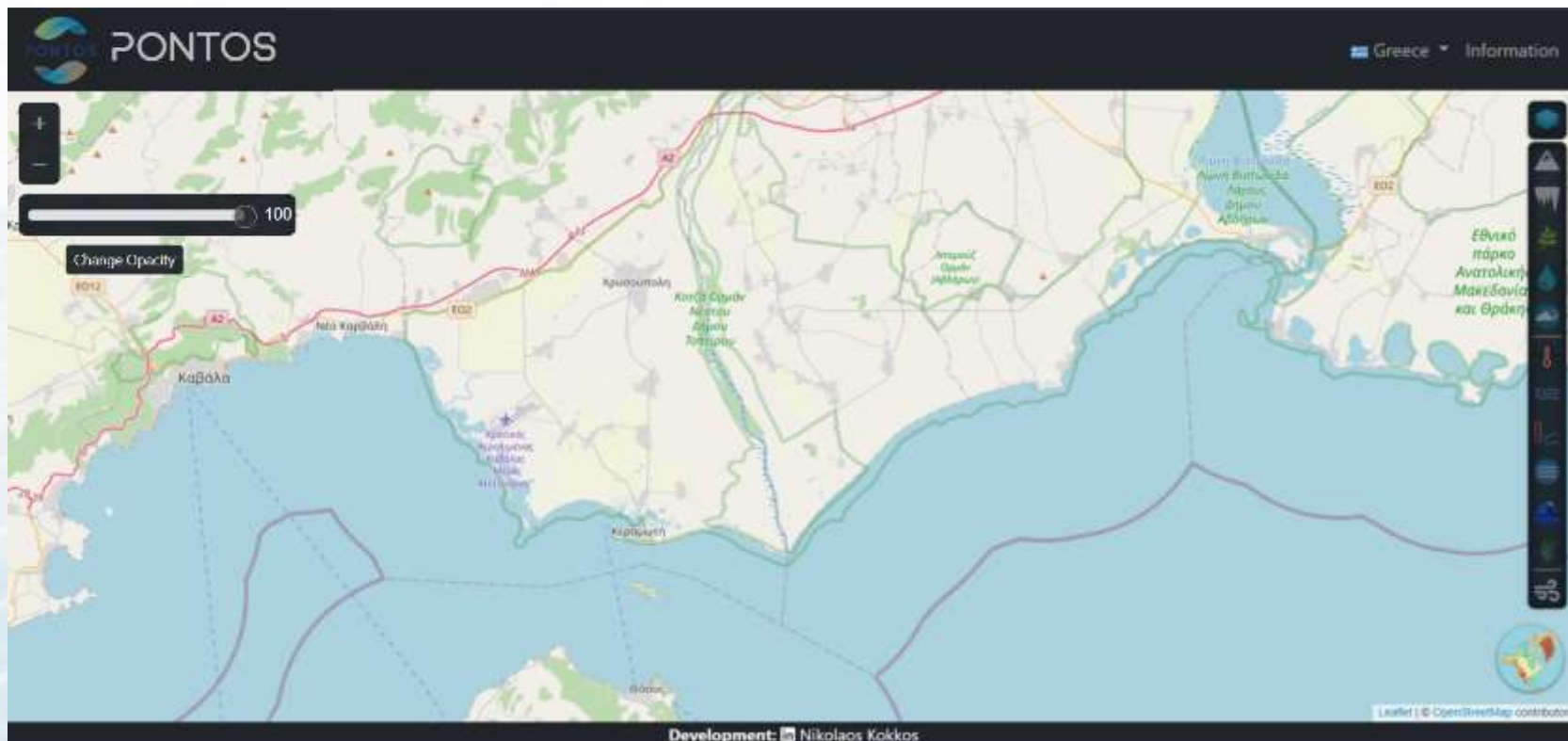
PONTOS

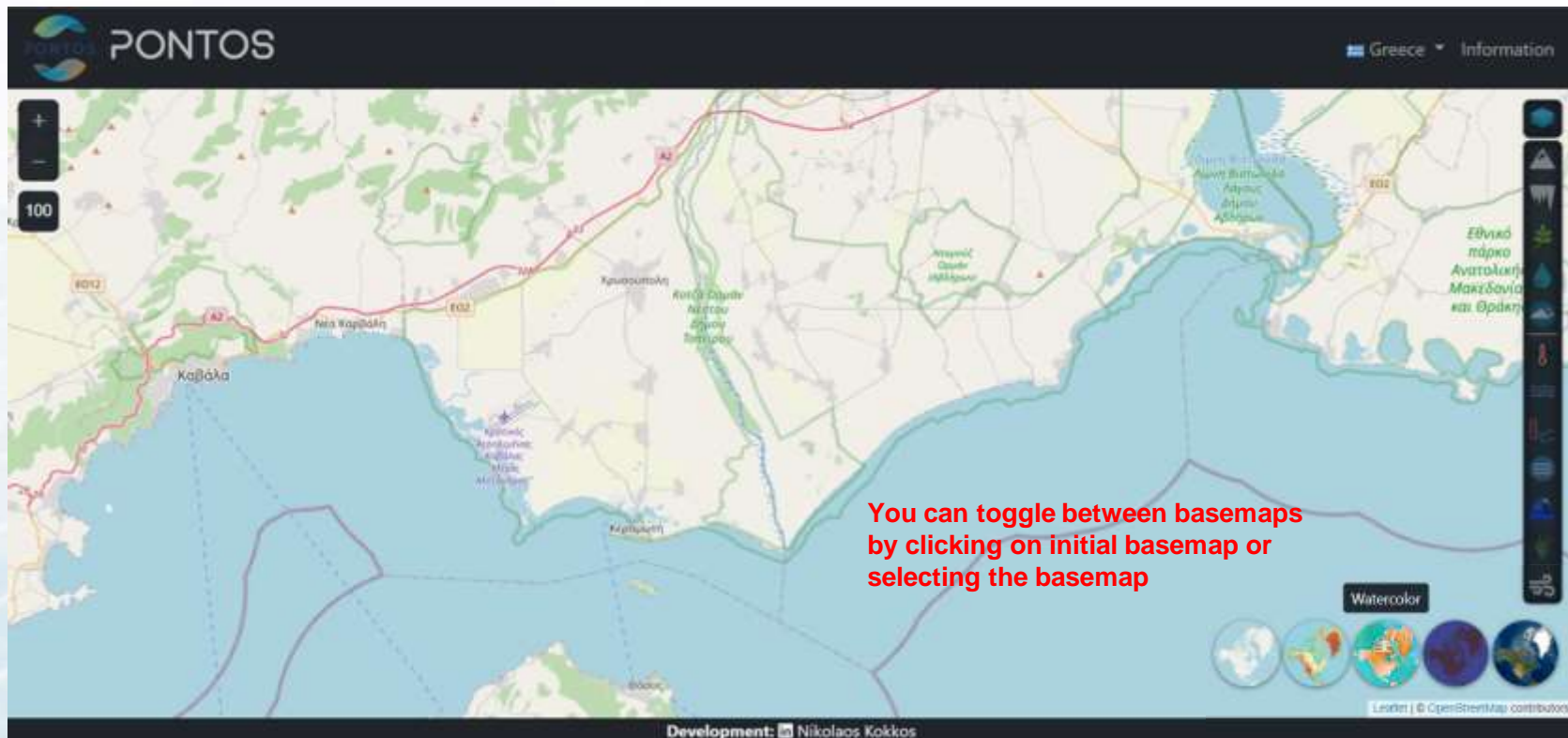
PONTOS aims to enhance transboundary cooperation for large-scale, harmonized environmental monitoring across the countries of the Black Sea region and beyond. The vehicle towards this objective is the exploitation of numerous freely available and incrementally credible Copernicus data and services (e.g. Copernicus Land and Marine Environment Monitoring Services). Intelligent fusion of data and information shall lead to novel services and products for actors operating along the coastal zone. Latter shall become, through PONTOS operational platform and mounted online services, freely available to and accessible by a multitude of local, national and regional stakeholders. Transboundary spaceborne derived primary (e.g. images) and secondary (e.g. maps) products will be coupled with existing data and knowledge of in situ conditions. Tailored to the regional challenges, solutions will be generated by utilizing this information thesaurus and retrieving methods and results (e.g. online modules and models) from EU and national past and ongoing research and development projects. Citizens' current and future well-being will be the focus. As such, marine and lake coastal and inland human activities will be mapped targeting industry, recreation, agriculture, aquaculture, and commerce in Armenia, Georgia, Ukraine, and pilot-wise in Greece. Their effluents towards the Black Sea or the lakes around it will be calculated, while at the same time spaceborne and in situ data will monitor fluctuations in marine features' values, such as surface water temperature, salinity, nutrients, potentially toxic elements, and algae presence. The impact will be assessed in relation to set benchmark conditions. Local stakeholders and actors will be informed and equipped with an adequate interface to access the information and its regular updates. Co-development and co-creation actions will respect national and local needs, constraints and vision. Together with capacity building activities PONTOS aims to offer the means to exploit in tandem existing local monitoring networks and Copernicus products and services, to align its online services with a compatible manner to existing hard- and software infrastructures, and to leverage cooperation and exchange of ideas and best practices across the region.

OVERALL OBJECTIVES

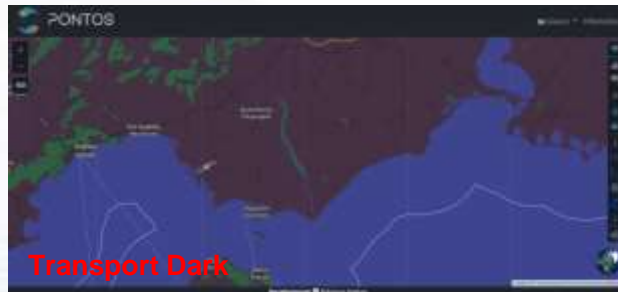
PONTOS's overall objective is to make information and knowledge available to scientists, policymakers, citizens, and other relevant stakeholders and provide a full picture of the state and temporal evolution of Black Sea region environment. This is expected to be achieved by exploiting information technologies to automatically retrieve Copernicus products, couple them with national or regional infrastructures for data acquisition and processing, and provide monitoring services for the Black Sea and the surrounding environment in a transboundary, standardized and homogenized manner. Convergent conservation strategies will be promoted at sites of regional significance as pilots to showcase the efficacy and credibility of the online services.





The screenshot displays the PONTOS web application interface. At the top left, the PONTOS logo is visible. The top right corner shows a language dropdown set to 'Greece' and an 'Information' link. The main area is a map of Greece, showing a coastal region with labels for 'Καβάλα', 'Νέα Καρβάλη', and 'Καβάλας Αερολιμένας'. A red line indicates a route. On the right side, there is a vertical toolbar with various map controls like zoom, pan, and layers. At the bottom right, there is a 'Watercolor' section with five circular basemap thumbnails: a white map, a yellow map, a green map, a blue map, and a dark blue map. A text box in the lower right of the map area contains the instruction: 'You can toggle between basemaps by clicking on initial basemap or selecting the basemap'. The bottom of the interface shows 'Development: Nikolaos Kokkos' and 'Leaflet | © OpenStreetMap contributors'.



The screenshot displays the PONTOS web application interface. At the top left, the PONTOS logo is visible. The top right corner shows a location dropdown set to 'Greece' and an 'Information' link. The main area is a map of the Black Sea coast, showing various geographical features and data layers. A red text box on the map reads: "You can show and hide layers control". On the right side, a vertical panel contains a list of layers with corresponding icons and toggle buttons. The layers listed are: Topography, Bathymetry, Landuse, Hydrology, Coastal behavior, Water temperature, Salinity, Water level, Currents, Waves, Seagrass, and Wind. The panel is highlighted with a red border. At the bottom of the map, the text "Development: Nikolaos Kokkos" is displayed.

Topography



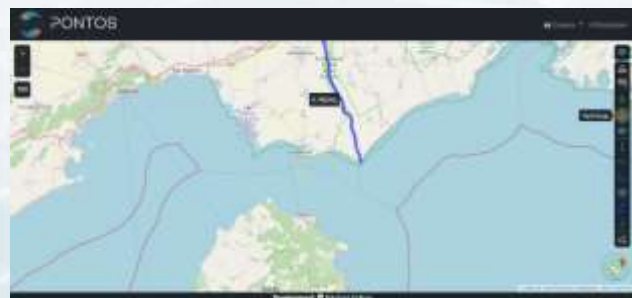
Bathymetry



Landuse



Hydrology



Coastline Movement



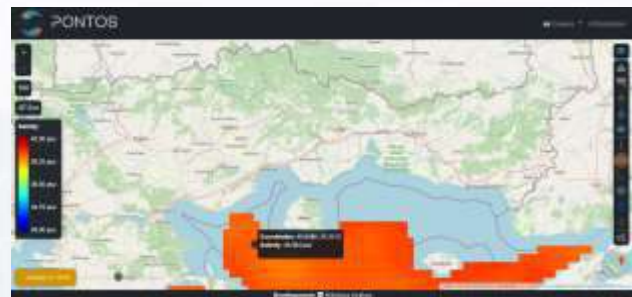
Water Temperature



Salinity

Water Level

Currents



Waves

Seagrass

Weather

Topography

Vegetation

Landcover



Landslides

Soils

Landscapes

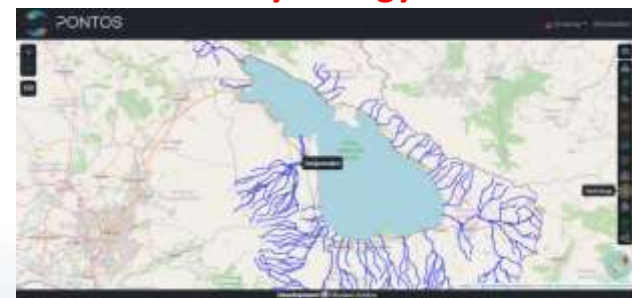
Geology



Hydrogeology



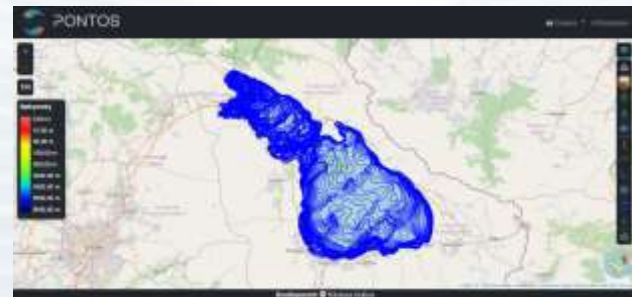
Hydrology



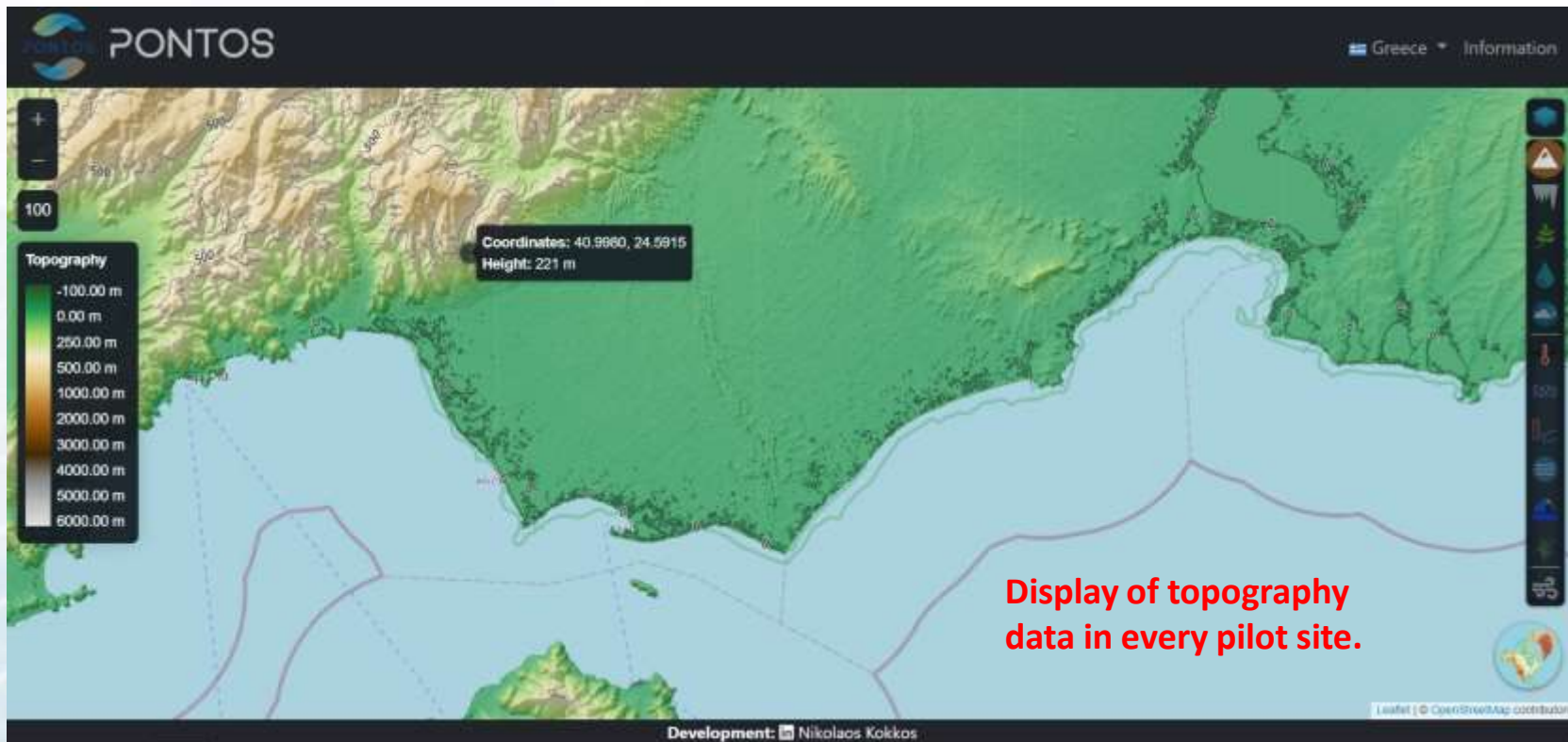
Floods

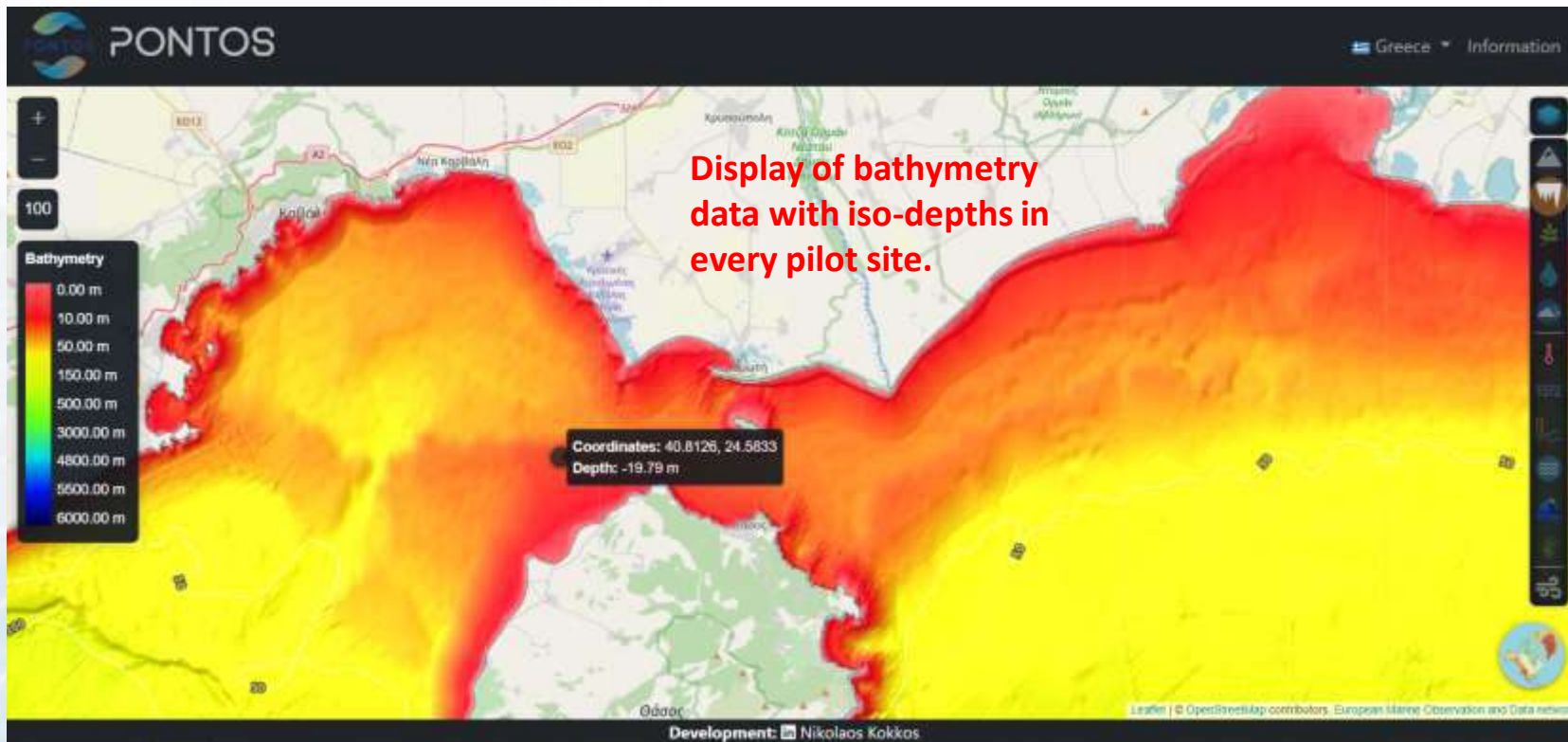


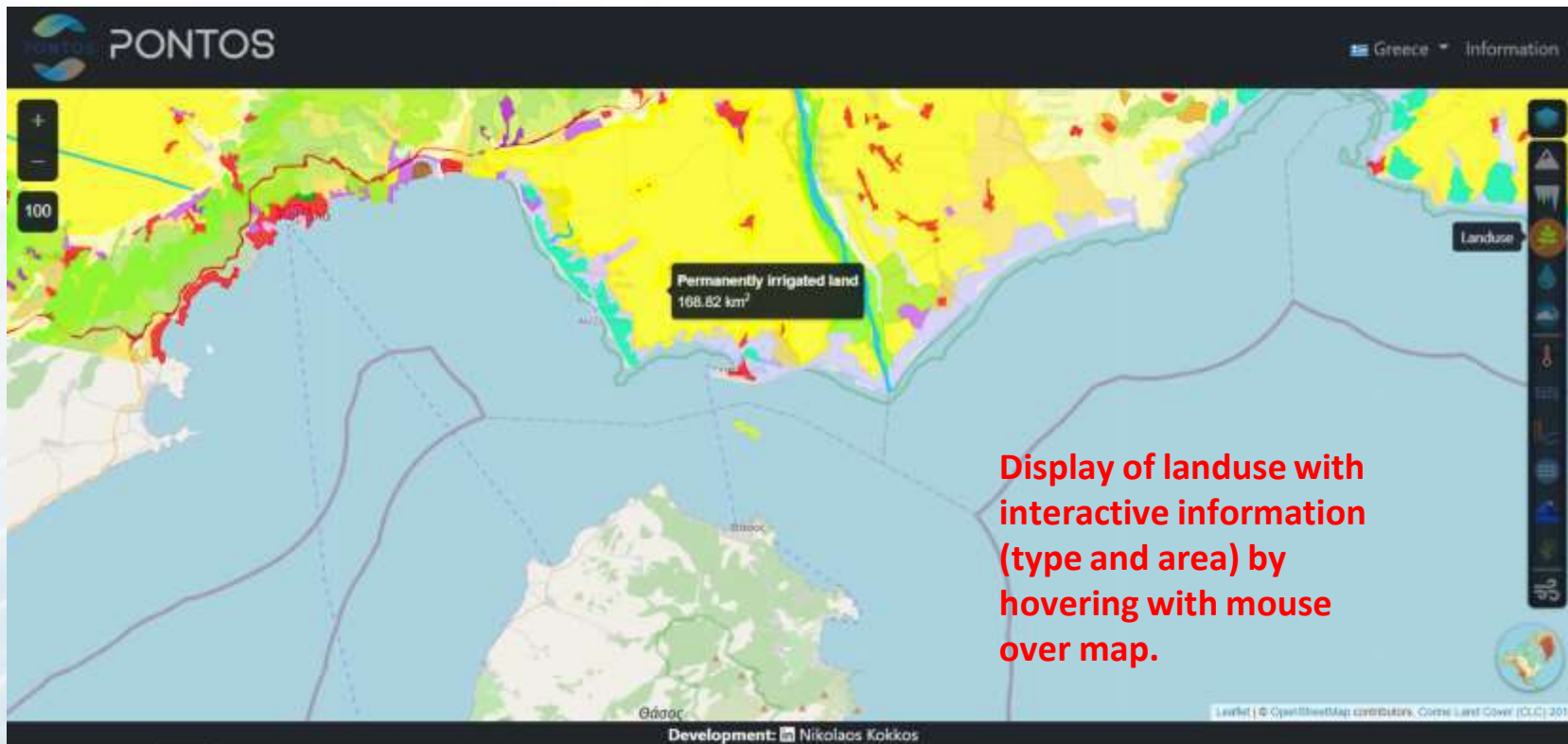
Debris Flows



Bathymetry





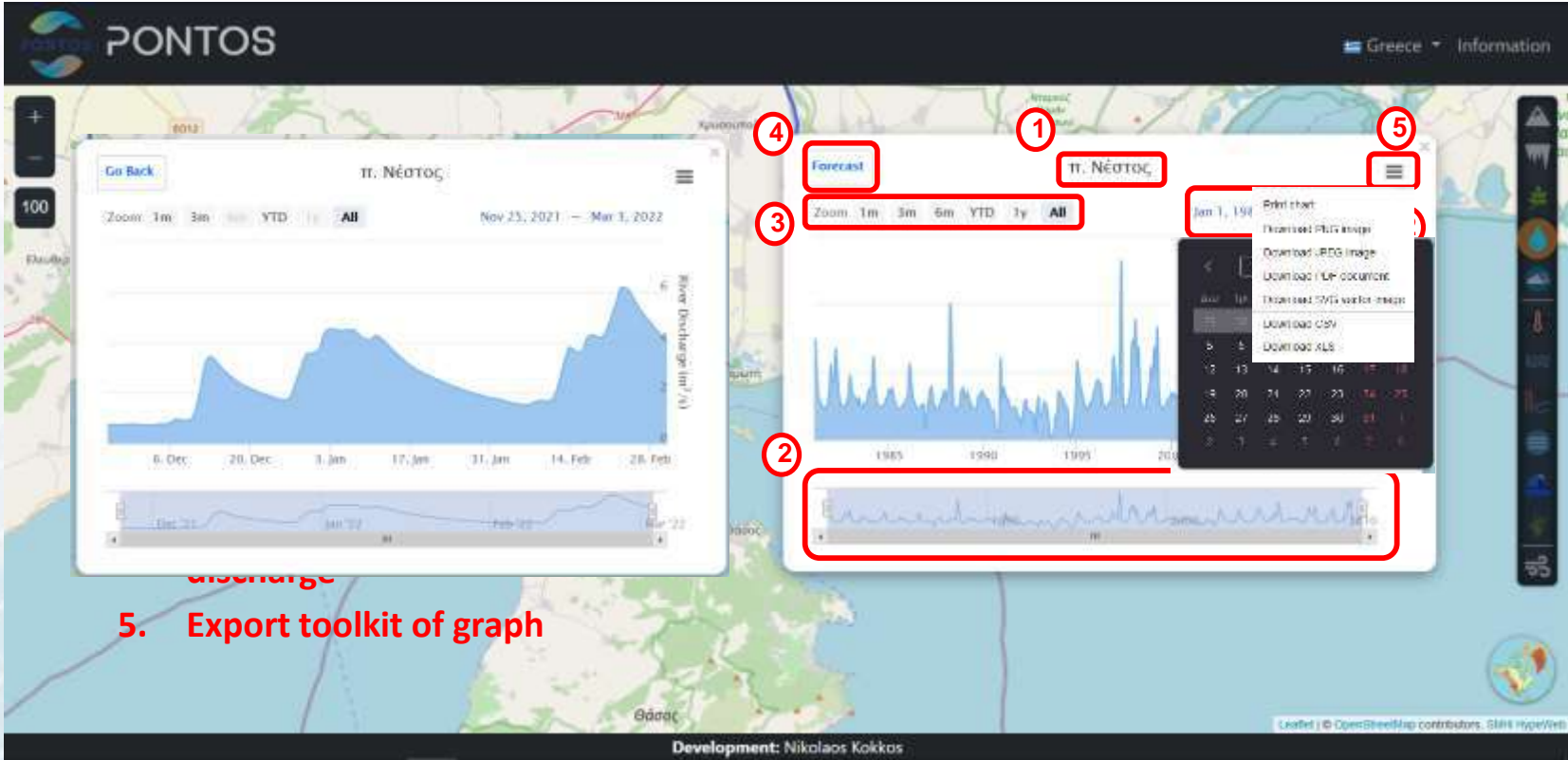


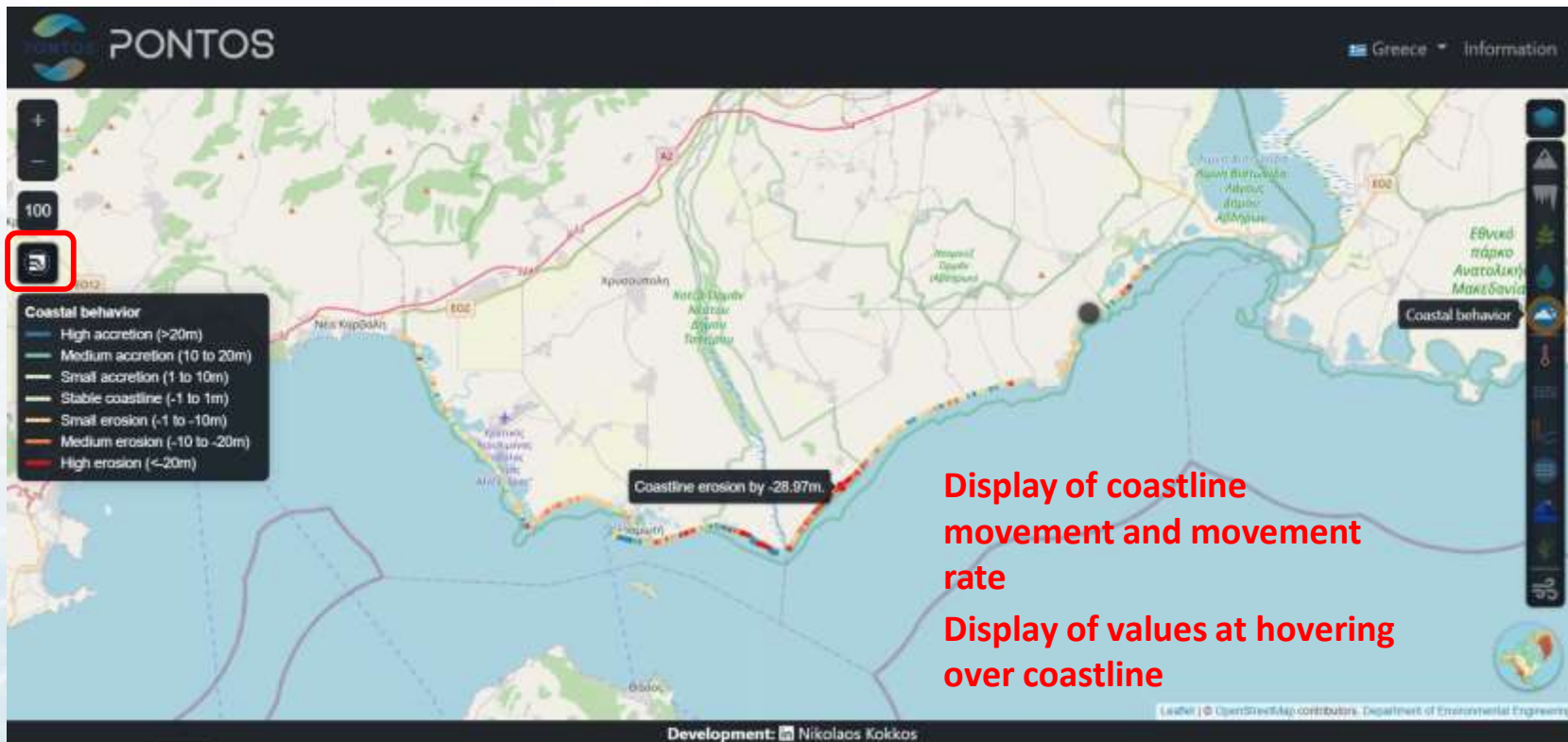
Display of landuse with interactive information (type and area) by hovering with mouse over map.

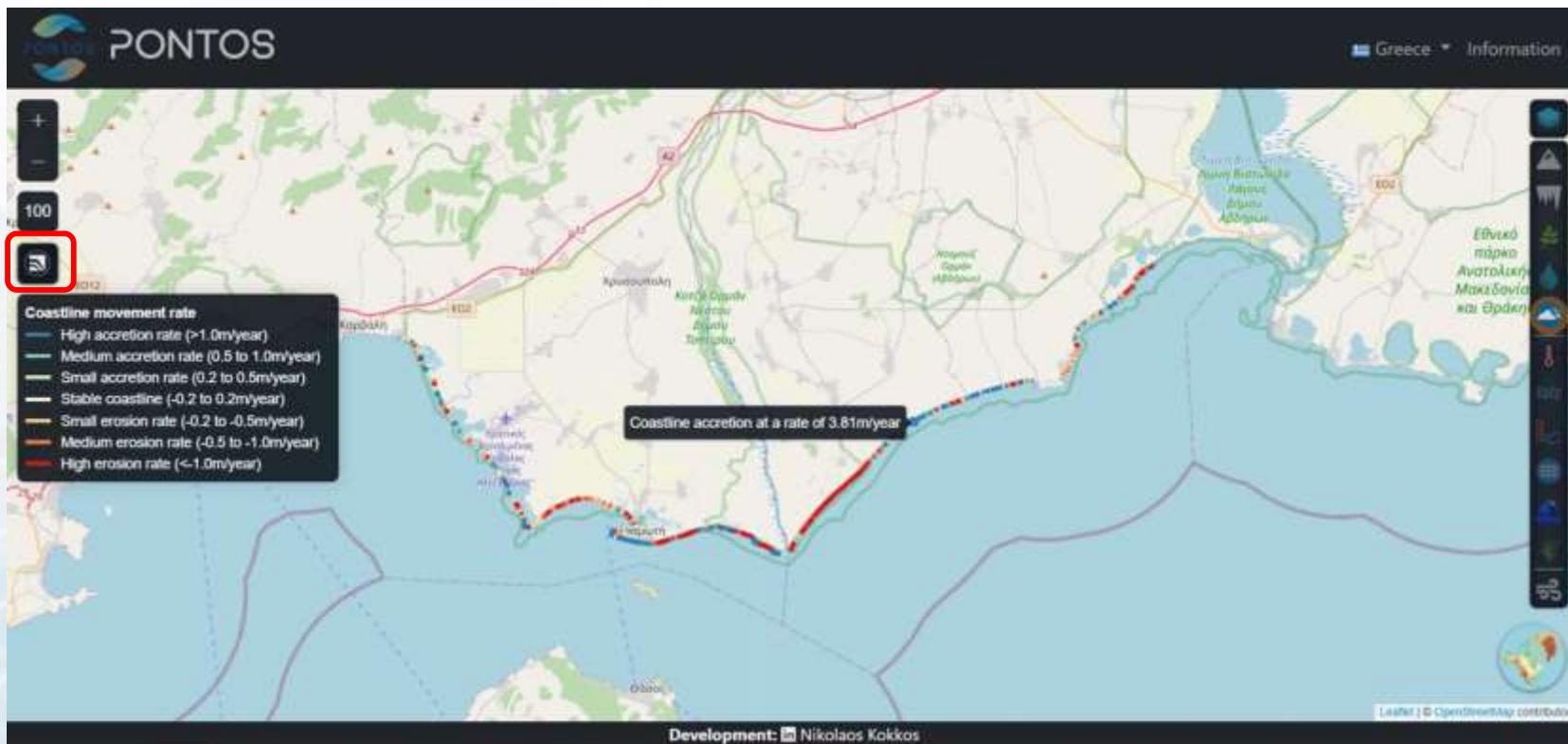
Display name of the rivers in local language.

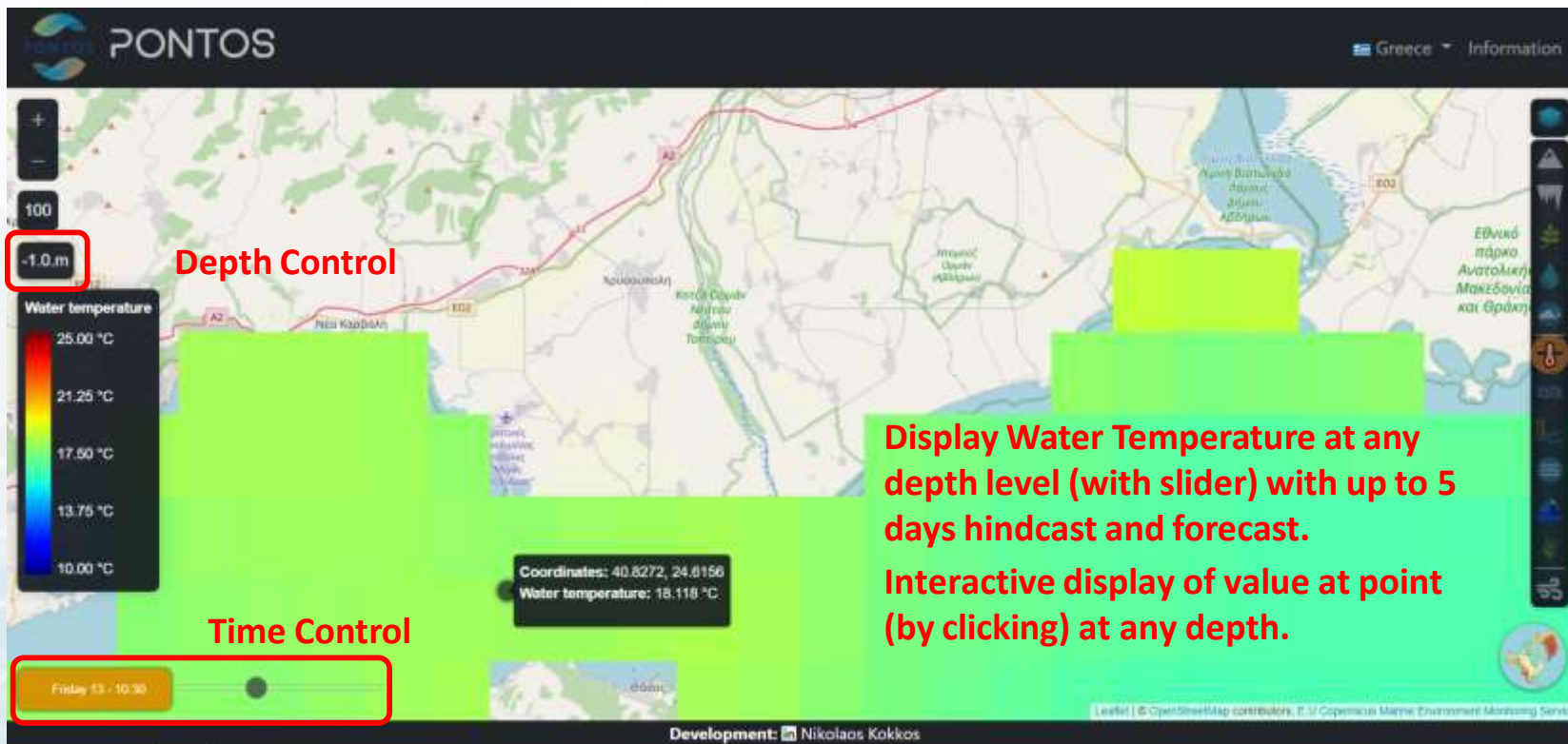
Display of river discharge data in every pilot site.

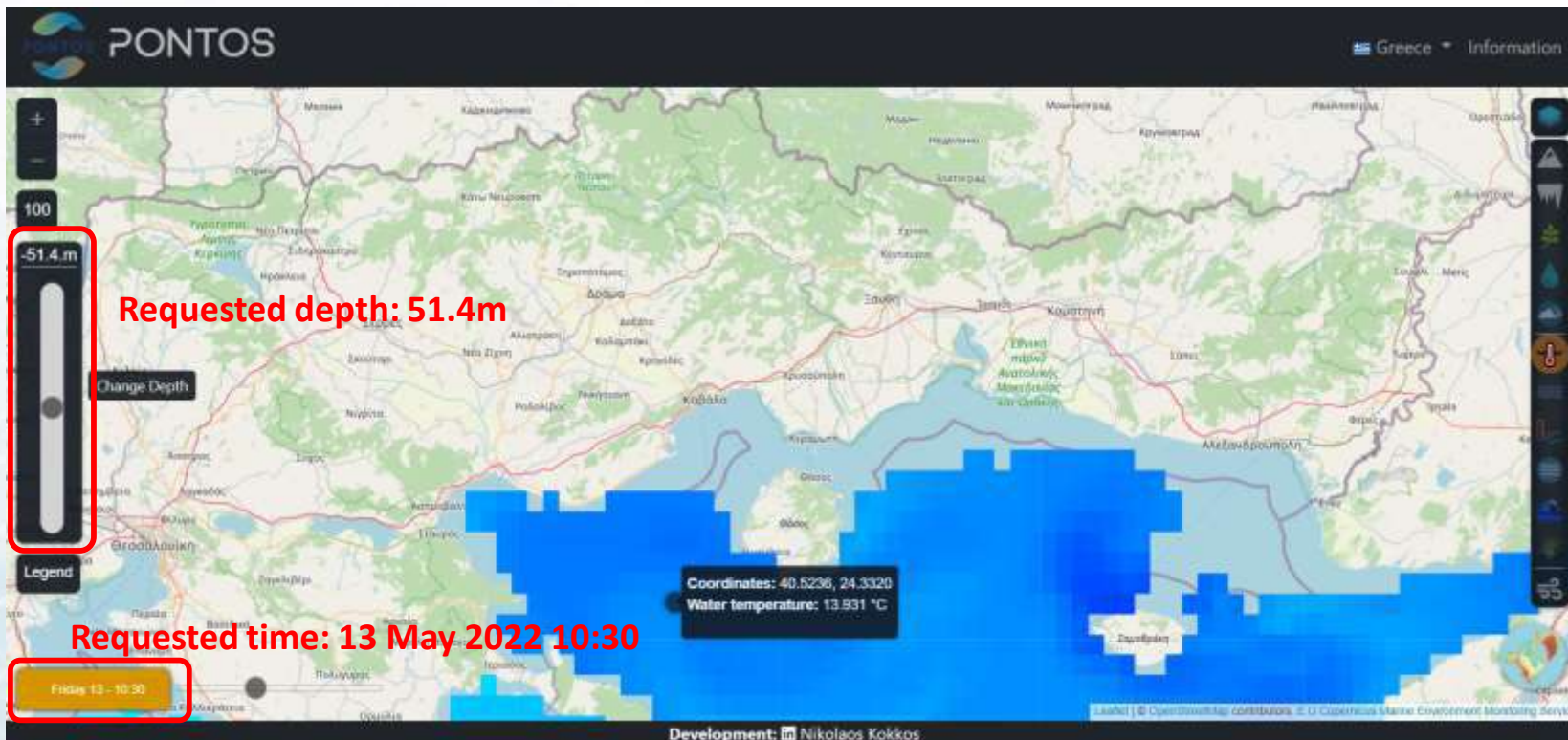
Development: Nikolaos Kokkos



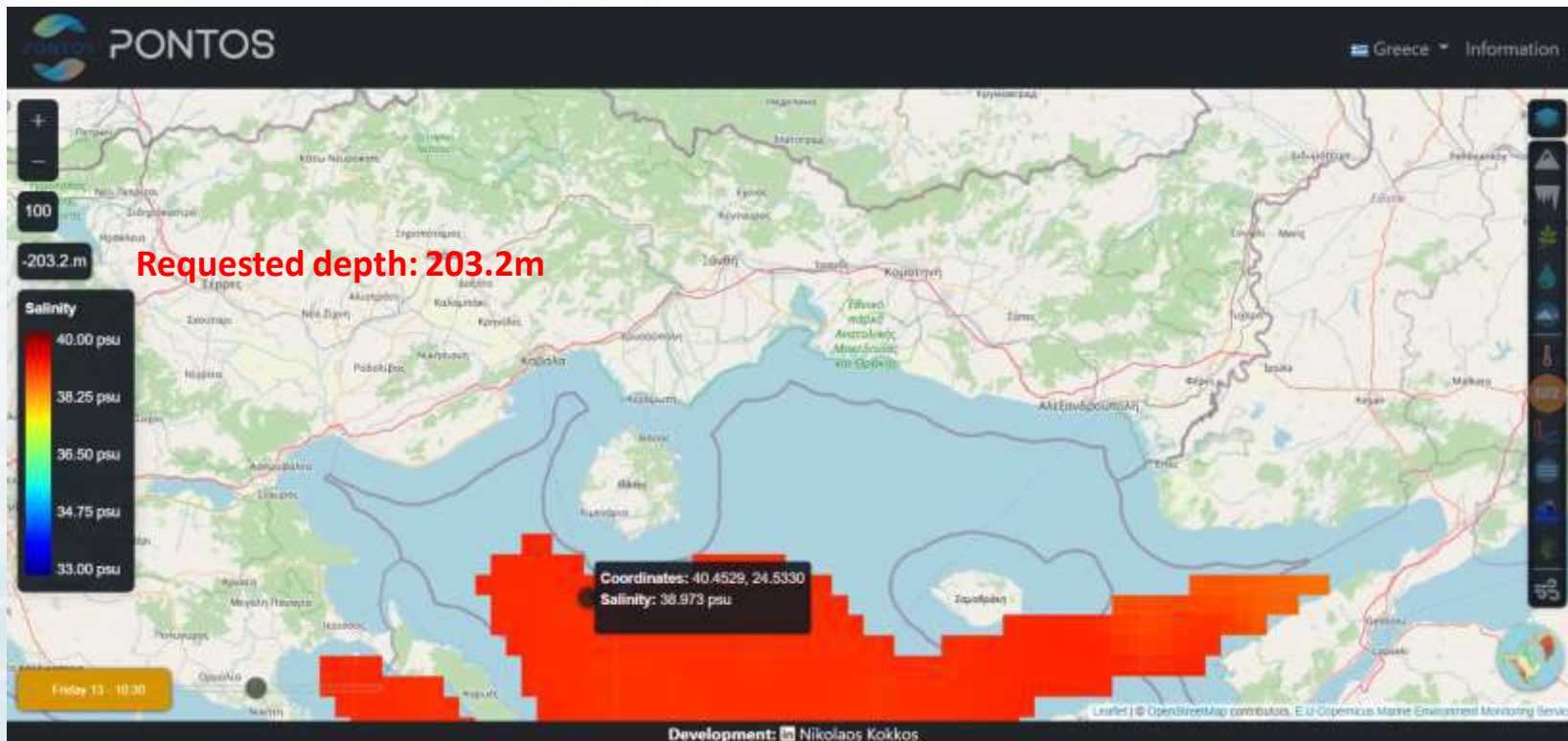




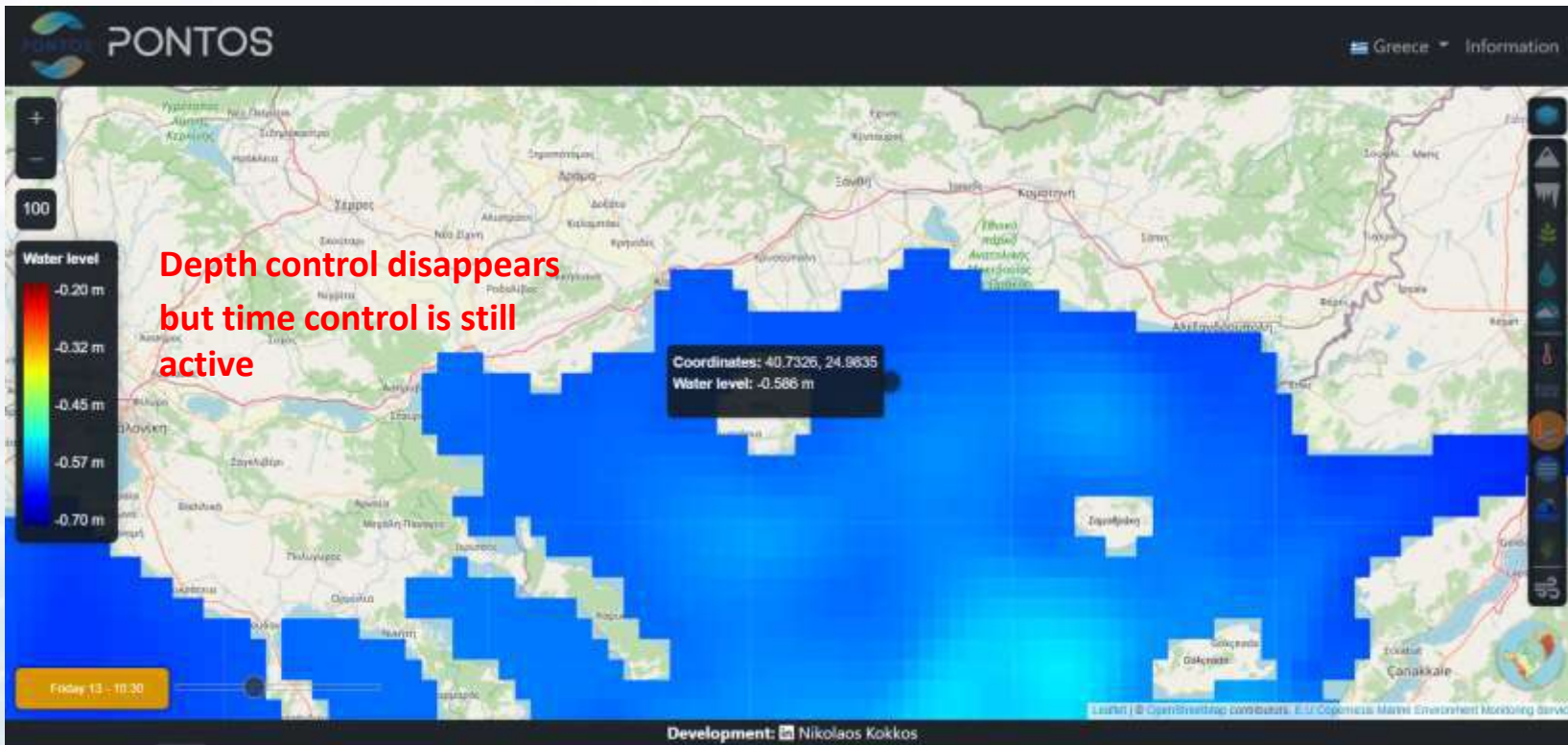


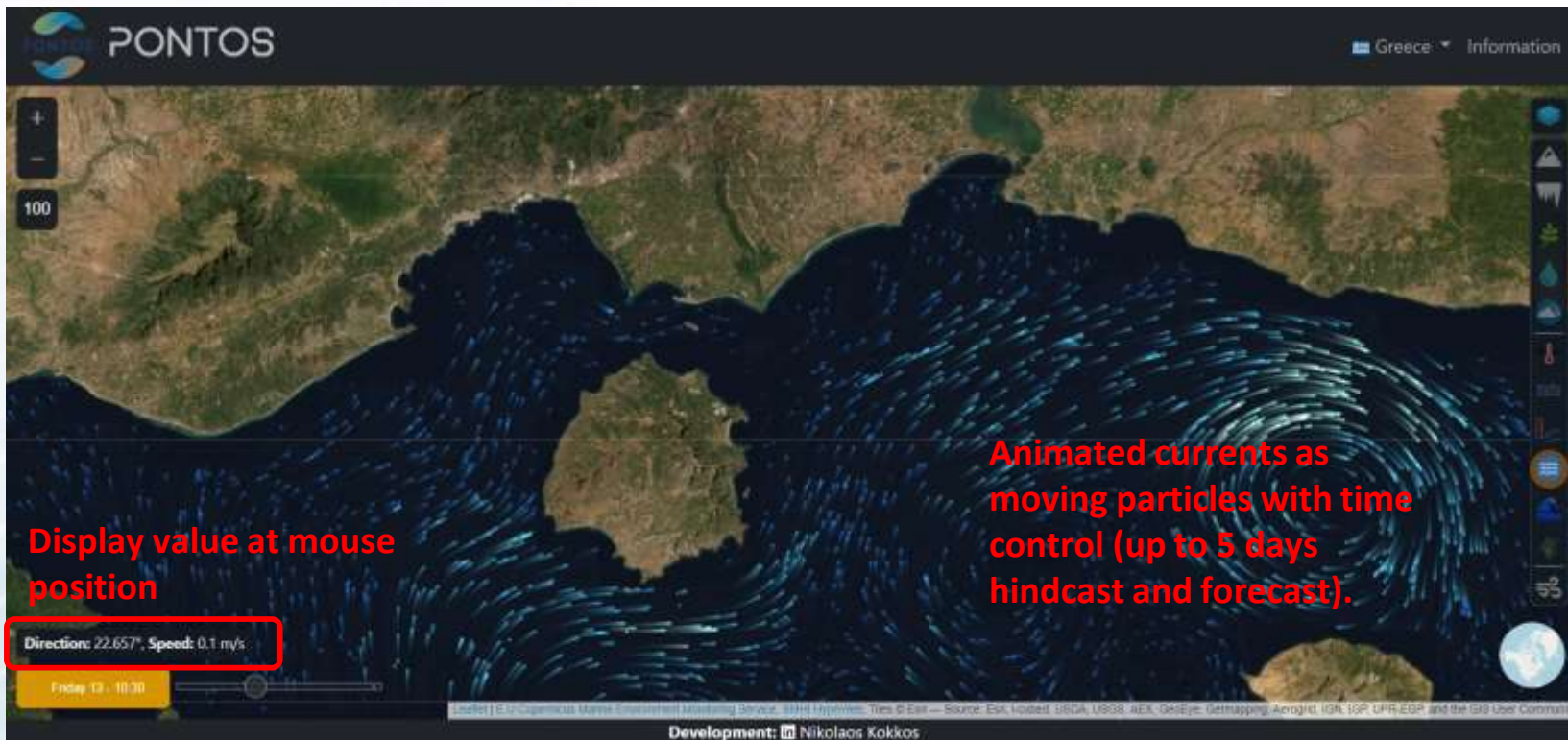


Layers Control – Salinity

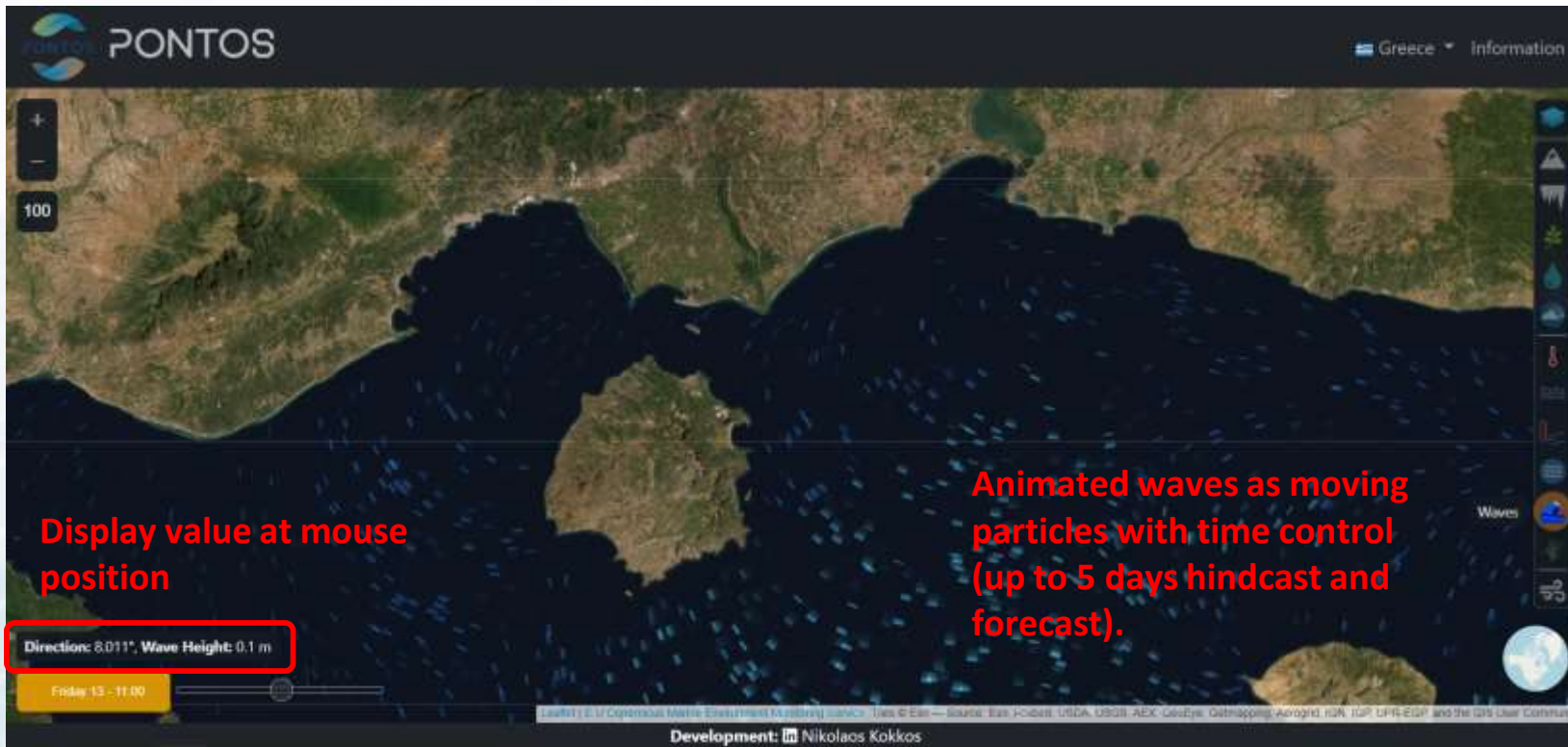


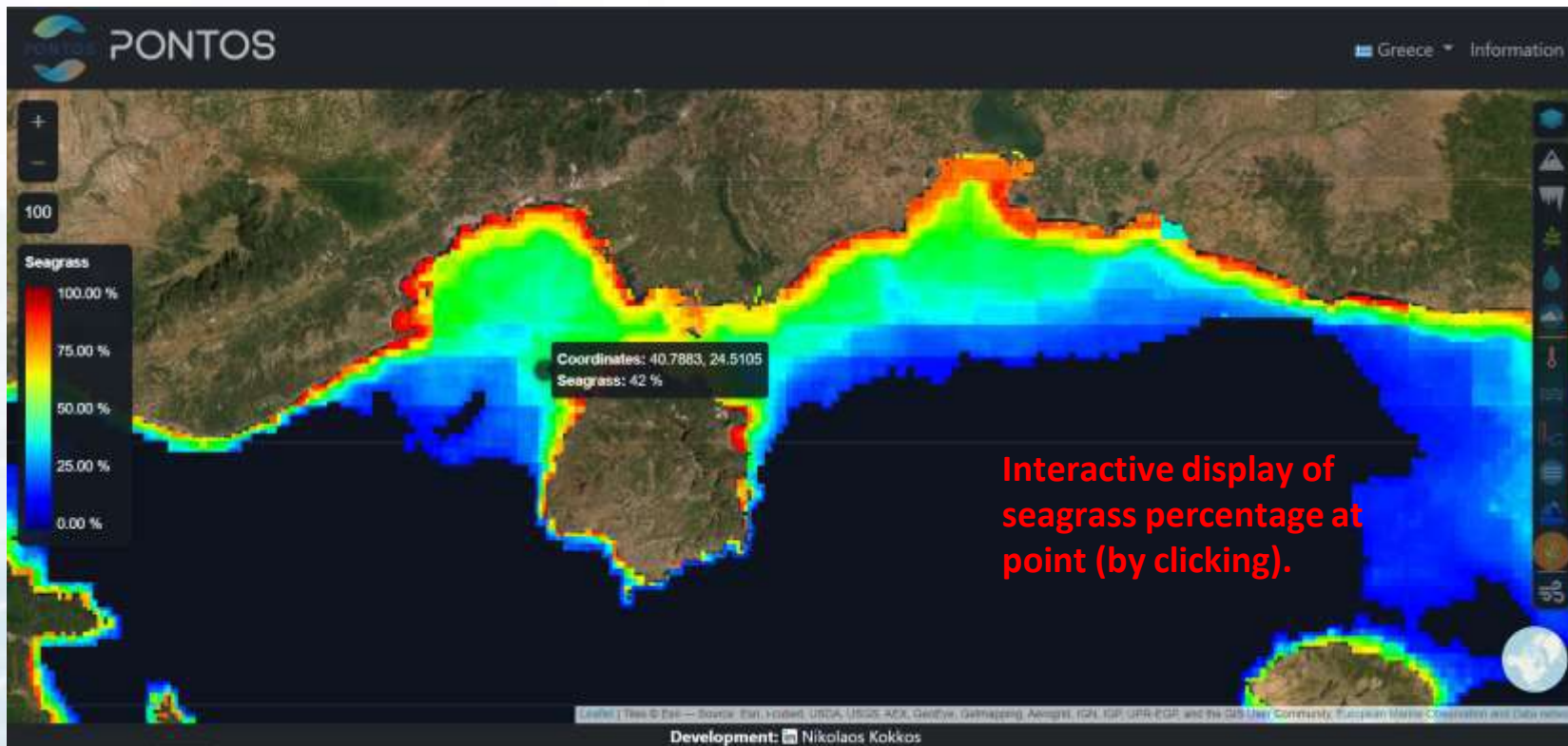
Layers Control – Water Level





Layers Control – Waves





Interactive display of seagrass percentage at point (by clicking).

Layers Control – Weather

The screenshot shows the PONTOS web application interface. At the top left is the PONTOS logo. At the top right, it says "Greece" and "Information". The main area is a satellite map of Greece with a weather overlay. A white popup window titled "Weather:" is open, displaying the following data:

- Weather:
- Clouds: overcast clouds
- Air Temperature: 21.43°C
- Air pressure: 1019 hPa
- Humidity: 85%
- Cloud Coverage: 87%
- Wind Speed: 1 Beaufort
- Wind Direction: Southeast (135°)
- Source: openweathermap.org
- Time: 13.05.2022 11:33 Utc
- Weather Station: Potos
- Station ID: 9992234
- Station Location: 24.6739, 40.6098

At the bottom left, a red box highlights the text: "Directions: 58.22°, Wind Speed: 1 Bft".

At the bottom right, there is a red text annotation: "Display of wind as moving particles (up to 5 days hindcast and forecast)."

At the bottom center, there is a red text annotation: "Display value at mouse position".

At the bottom of the map, there is a yellow button that says "Friday 13 - 09:00".

At the very bottom of the page, it says "Development: Nikolaos Kokkos".



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Common borders. Common solutions.

Thank You

Շնորհակալություն

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