



## IN PONTOS A NEW GENERATION OF SCIENTISTS TURN SATELLITE DATA INTO USEFUL INFORMATION

Copernicus assisted environmental monitoring across the Black Sea Basin

## PONTOS-EU.AUA.AM

In October and November 2021, all partners of the PONTOS project organized and conducted the first set of training sessions on Earth Observation and Environmental Monitoring for young scientists and practitioners within the capacity-building efforts of the project. About 100 young scientists and practitioners attended the training sessions. The training was held online via internet and by physical meetings in different countries.

The participants of the Earth Observation and Environmental Monitoring training represent national and local authorities, NGOs, water management and nature conservation bodies, educational, and research institutions, learning the use of multidimensional and multispectral earth observation tools and products. Some of these will soon be available through the PONTOS platform, offering easyto-use and easy-to-access free online services for various specialists, including those without technical skills to write codes and algorithms for processing data.

The training was designed to include theoretical and practical components, including fieldwork.

The first two days included an introduction and use of earth observation (EO) tools and applications, such as Sentinel Hub, EarthTrack, SNAP, and Copernicus Open Access Hub, Earth Observation Data for Ecosystem Monitoring (EODESM) system, as well as the presentation of the upcoming <u>PONTOS platform</u>.

The training has demonstrated the great potential of EO daily use for all the participants, from a student to a regional authority representative. EO is a source of objective information to monitor the environment and can raise the stakeholder's awareness of its state significantly, especially in the Black Sea Basin countries, in most of which the in-situ environmental monitoring network is still underdeveloped.

One of the participants of the training in Armenia, Dr. Lusine Hambaryan, a senior researcher in the RA National Academy's Hydroecology and Ichthyology Institute indicated that the practical knowledge gained during the three-day training will help her combine the results from laboratory research. The training also touched upon the need to improve the analysis of image data for better results.



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On the third day of the training, a field trip was organized to the project pilot areas in Armenia and Georgia, where the team conducted data collection for the validation purposes which is considered one of the most important steps in the remote sensing process.

As Professor George Sylaios of the Democritus University of Thrace said when concluding the training sessions in Greece, mentioned the following. In PONTOS we are gradually creating the infrastructure for the provision of knowledge support services to local businesses and public services and contribute to the creation of a new generation of scientists capable of transforming scientific data into useful information and therefore into a lever for sustainable local development, innovation and entrepreneurship.



OS Newsletter #3

Field trip in Georgian pilot area



PONTOS pilot demonstration site in Greece



Field trip in Armenian pilot area



PONTOS training in Ukraine



## PONTOS'S UKRAINIAN PILOT AREA: DNIESTER RIVER DELTA

OS Newsletter #3

The Ukrainian pilot area (PONTOS-UA) is located in the northwestern part of the Black Sea and consists of two subareas: the coastline and the Dniester river delta.

The coastline includes the most popular beaches and recreational areas in the south of Ukraine, from the city of Odessa to the Danube Delta. A significant part of the Dniester Delta is included in the Lower Dniester National Nature Park. The river is connected to the Black Sea through the adjacent Dniester Estuary, which is of great ecological and economic importance to the region.

The pilot area faces challenges such as coastal erosion, nutrient pollution affecting drinking and irrigation water quality and ecosystems, disruption of river water flow (due to impacts of hydropower plants) affecting habitats/biodiversity and agricultural water supply, forest fires and wetland burning.

Within the framework of the PONTOS project, Odessa National I.I. Mechnikov University actively involved stakeholders in cooperation, informed them about achievements, developments and gained experience. identified their and requirements and wishes. For this purpose, an of potential online meeting stakeholders (brainstorming event) was held in the summer of 2021. The aim of the event was not only to inform the stakeholders about the project progress, but also to present the PONTOS platform and its tools to improve the capacity to use Earth Observation (EO) data. The participants represented all target groups of the project: national, regional and local authorities, sectoral agencies, small and medium enterprises, business support organizations, nongovernmental organizations, academic and research institutions, and international organizations. All participants underlined the important role of the PONTOS project, as the global problems faced by the countries of the Black Sea basin urgently require joint action and cross-border cooperation.

In order to increase the capacity of in the EO data use, the Ukrainian participants attended the workshops organized by the project in the framework of the four planned assessments: (i) Coastline Dynamics Assessment, (ii) Wetland and Floating Vegetation Cover Assessment, (iii) Integrated Assessment of Chlorophyll Concentration and Eutrophication Dynamics, (iv) Assessment of Water Balance and Water Stress Indices in Agroecosystems.

The report on the dynamics of coastal line changes is planned to be completed in October 2021 and will be available to the public shortly thereafter. Until then, we need to highlight a few important points:

 Landsat imagery for 1980-2020 (with a 5-year increment) was processed using the DSAS tool using the modified approach developed by DUTH.



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- The modified DSAS method was found to be more effective (2-3-fold) compared to a conventional GIS method.
- For complicated riparian areas with high tortuosity and high erosion/accumulation rates, processing time increases because more time is required for 'manual' review and correction of DSAS results using the additional software GIS.
- Preliminary analyses have shown that two areas the Danube Delta (1) and Odessa Bay (5) - have maximum erosion and accretion rates. Therefore, these two areas are of particular interest to both scientists and stakeholders.

The project will conduct field investigations in the Ukrainian pilot area. The field surveys in the Dniester Delta (Dniester Estuary and Lake Bile) were conducted in April, June, July, August and September 2021 using ONU's transport and equipment (four-wheel-drive



vehicle, boats, field instruments and tools for sampling and monitoring). During each survey, the following was conducted:

- Observation and measurement of hydrological and physicochemical parameters of the water;
- Water sampling to determine chlorophyll concentration and hydro chemical composition in the laboratory;
- Mapping of the water surface to identify vegetation cover (different vegetation types) using the UAV (quadcopter) purchased with the project funds and partly involving the ONU multispectral UAV;
- Sampling of plants to identify phenological characteristics.

All data collected will be used to determine the spatial and temporal distribution of chlorophyll concentrations - reasons, causes, dynamics and consequences of eutrophication phenomena in the context of assessment (iii), to determine vegetation cover and boundaries of different types of aquatic vegetation in the context of assessment (ii), and to validate/improve the quality of some EO data (space imagery/space-derived products) interpreted for the pilot area by comparing the real condition of the area and its 'reflection' by the space-derived products. In the future, this will help to save resources (time, money, effort, etc.) for environmental monitoring. The results of the validation will be used for the development of the interactive PONTOS platform tools, which will be made available to the public.

For the assessment (iv) of agricultural water balance and water stress indices, wheat and sunflower were selected from the typical spring crops as the most common crops in Odessa region in 2019; two representative fields were selected. The works carried out included:

- Installation of soil moisture and temperature loggers in the soil profile at both sites using the ONU vehicle and equipment;
- Deployment of ONU's automated weather station at one of the fields;
- Conducting regular aerial observations (May-September) using the UAV (quadcopter) purchased from the project funds and partly involving ONU's multispectral UAV;
- Sampling of vegetation (in July) to determine wet and dry biomass.



Figure 2. field measurements, sampling and mapping in the Dniester mouth and adjacent estuary (photo credit: Sergiy Medinets).

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Figure 3. Field measurement, sampling and mapping in Bile Lake (photo credit: Sergiy Medinets).

To perform the Assessment (iv) of agricultural water balance and water stress indices, out of typical spring crops wheat and sunflower were selected as the most frequent crops in Odessa Region in 2019; two representative fields were chosen. The work done comprised:

- Installation of soil moisture and temperature loggers in the soil profile at both sites using the ONU vehicle and equipment;
- Use of the ONU's automatic weather station on one of the fields;
- Performing of regular (May-September) aerial observations using the UAV (quadcopter) purchased through the Project funds and partially involving the ONU's multispectral UAV;
- Sampling of vegetation (in July) to determine wet and dry biomass.



Figure 4: UAV mapping of the wheat and sunflower fields studied (photo credit: Sergiy Medinets).



Figure 5. installation of soil moisture and temperature metres and an automatic weather station in the studied fields (photo credit: Sergiy Medinets).

Apart from its value for the economy of the region and the country, as well as for the wellbeing of the local population, the pilot area of the project also has great cultural and ecological significance. It includes protected including Ramsar wetlands areas, of international importance. These areas are characterized by rich flora and fauna, fish spawning areas, bird nesting sites and beautiful landscapes. ONU researchers - the project participants - are therefore doing their best to preserve this picturesque corner of Ukraine for future generations.



Aghavni Harutyunyan, PONTOS project manager, and Garabet Kazanjian, PONTOS project researcher, elaborate on the project and the environmental issues it tackles. /ARM/



## PONTOS WEBSITE VISITOR MAP



Figure 6: PONTOS website visitors on the map





## PONTOS KNOWLEDGE GAP ANALYSES CONDUCTED AMONG STAKEHOLDERS

In June-July, 2020 all PONTOS partners from Armenia, Greece, Georgia, and Ukraine, organized four brainstorming sessions inviting multi-stakeholder groups, including representatives public from the local authorities, regional and national public authorities, sectoral agencies, nongovernmental organizations, higher education, and research institutions, business sector, and international organizations. The key objectives of the four events were to introduce the Earth Observation (EO) technologies, Copernicus products, and services, their application in the environmental monitoring, share with the audience PONTOS platform and its tools to, and, of course, receive feedback from the various stakeholders.

The main goal of the brainstorming events was to identify the user requirements needs. The key outcome of the four events is a trustworthy gap analysis knowledge and training strategy development.

PONTOS Data Cube, WebGIS and Web Application



Figure 7:Questionnaire results on the interest of the participants toward different types of PONTOS platform services or which service participants will use most.

Data Type: Satellite, Airborne and In-situ



Figure 8: According to the questionnaire results in all four countries, stakeholders mostly use the following data types for decision making.

A questionnaire was developed by the project researchers which aimed at opening up a lot of unknowns to the project team about the main target groups and the application of EO systems, to collect the needs of the stakeholders, to analyze the knowledge gap in the field, as well as to get an initial feedback on the PONTOS platform, understand the ways in which the general public can benefit from PONTOS services and outcomes. The findings or response are important input to the project activities. This helps the team to understand the right direction of the capacity building activities based on the needs of the target groups. Some of the findings showed the further need for training on the main directions and fields of the application of EO products in different countries; another important finding is the remarkable number of the users of Geographic Information Systems (GIS) in all partner countries; most respondents from all partner countries were aware of the European Union's Earth Observation Programme Copernicus, but have minor experience working with this Programme. The data collected during the questionnaire were analyzed by the Green Alternative, project partner from Georgia and a list of recommendations and needs are shared with all partners.





## COASTAL EROSION ASSESSMENT ALONG THE NESTOS RIVER DELTA SHORELINE: THE IMPACT OF RIVER DAMMING AND CLIMATE CHANGE

The Greek Pilot area extends along the coastal zone, on both sides of the Nestos River. Nestos river is a transboundary system, originating from the Rila Mountains, in central Bulgaria, crossing the mountainous terrain of Bulgaria, and then entering Greece, passing through the protected Nestos Gorges and eventually discharging to the Thracian Sea, in Northern Greece. The river forms a significant ecosystem throughout its course, whilst at the deltaic zone a floodplain is formed, covering approximately 440 km2. Coastal and riparian wetlands form a unique natural ecosystem protected by the Ramsar Convention. The coastal zone's total length is estimated at around 50 km. Along the western part of the coastline, a complex system of lagoons (Vassova, Eratino, and Agiasma lagoons) is situated; to the center, the Keramoti gulf and the western Nestos River delta: and to the east. the eastern Nestos river deltaic zone and two of the most popular beaches in Thrace (Maggana and Myrodato).

The sediment transport to the coastal zone is mainly influenced by the Nestos River discharge, the water exchange through the lagoon inlets and the outflow from the irrigation and drainage canals, interrupting the coastline continuation. From 1995 and onwards, the sediment supply to the deltaic zone was reduced by approximately 84 %, in relation to historical sediment yields, due to Nestos river damming. The two hydropower dams, Thissavros and Platanovrisi, modify the hydrology of the river and alter its capacity to supply water, nutrients and suspended sediments to the coastal zone. Nestos River presently supplies the coastal zone with fresh water, having a total annual runoff ranging between  $600 \times 10^6$  and  $800 \times 10^6$  m<sup>3</sup>, with limited seasonal variability. The freshwater exiting the river mouth exhibits a limited hydrographic signature, covering the first surface meter of the water column, throughout the year.

The PONTOS project applied a common methodological framework to study the coastline evolutionary processes at all pilot areas in Armenia, Georgia, Greece, and Ukraine. This methodology entails the extraction of historical shorelines by processing satellite images from the Copernicus Hub database, using a semiautomatic image classification technique. More precisely, in the Greek study site, the analysis was applied in two periods (1985-2015 and 2015-2020), analyzing historic satellite images.

The higher shoreline retreat is observed from 1995 and onwards, when Nestos river dams were constructed, decreasing the river outflow and the sediment transport to the coastal zone. About 0.85 km<sup>2</sup> of sandy beaches have been eroded over this 25-year period. Approximately 0.15 km<sup>2</sup> have been lost at the Keramoti Gulf, nearly 0.23 km<sup>2</sup> at the western coast of Nestos River delta, and more than 0.35 km<sup>2</sup> at the eastern coast of the Nestos River delta. In the last five years (2015-2020), the coastline on both sides of Nestos estuaries is vulnerable to coastal western shoreline erosion; the was retreated by up to -30 m, with an erosion





rate from -0.4 up to -5 m/year, and to the east with erosion rate up to -2.6 m/year. Additionally, in Keramoti Gulf, erosion dominates along the entire coastline within the period 2015-2020. The shoreline retreated gradually, and an extensive sandy area was lost at the western delta (up to -15 m).

In parallel, climate change is expected to induce further pressure on the Nestos coastal zone, due to the sea level rise effect and the increase in the frequency and severity of extreme storm events. Coastal authorities are faced with the increasingly complex task of balancing development and managing coastal vulnerabilities and risks. In that sense, the Integrated Coastal Zone Management (ICZM) provides a framework to resolve conflicts, mitigate impacts of short-/long-term uses, and support strategies for sustainable coastal management.



Figure 9: Net Shoreline Movement estimated; a) for the period 1985 to 2015 (left), and b) for the period 2015 to 2020 (right)

### AUA BECOMES A MEMBER OF THE EUROPEAN COMMISSION'S COPERNICUS ACADEMY

In July 2021, the American University of Armenia (AUA) Acopian Center for the Environment became a member of the Copernicus Academy. The European Commission's Copernicus Academy currently has a network of over 170 members.

The Copernicus Academy was launched by the European Commission as part of Copernicus User Uptake activities. The network of Copernicus comprises Universities, Research institutions, Business schools, both Private and Non-profit organizations from Participating Countries (EU27, Norway and Iceland) and from all around the globe.

OS Newsletter #3



This membership enables AUA to enhance its network contacts, to exchange ideas and best practices across borders and disciplines and to learn and contribute to the use of Earth Observation/Copernicus data in various application fields.

This is an excellent platform to foster collaboration among educational institutions and established commercial operators or entrepreneurs making innovation reach the market to benefit citizens and the future of our planet.

The goal of the network is to link research and academic institutions with authorities and service providers, facilitate collaborative research, develop content for lectures and training sessions, design traineeships, as well as generate materials that empower the next generation of researchers, scientists, and entrepreneurs to use Copernicus data and information to their full potential.

Currently, AUA is leading a 30-month project funded by the European Union's ENI CBC Black Sea Basin Programme 2014-2020 called Copernicus assisted environmental monitoring across the Black Sea Basin -PONTOS. PONTOS aims to enable and enhance participation, knowledge, and skills of local and regional actors, scientists and government employees and citizens an essential ingredient for enhancing the use of Copernicus products and services for the environmental monitoring of the Black Sea. The PONTOS operational platform and its tools will be publicly and freely available on the PONTOS website by the end of December 2022.

#### AUA ACOPIAN CENTRE FOR THE ENVIRONMENT AND INTERREG VOLUNTEER YOUTH (IVY) PARTNER ON YOUTH OPPORTUNITIES

After a multi-stage selection process, two volunteers received an offer to volunteer within the PONTOS project. The activities to be carried out by the volunteers will promote the involvement of young people from different backgrounds and origins in of various aspects environmental protection. In addition to enrich the joint transnational teams with new perspectives. In this way, the AUA consolidated its role as regional hub for excellence а and cooperation, while the participating young people will have the unique opportunity to develop their skills responsibly and in an exciting environment. The volunteers added value to the project by assisting in knowledge development and research and training activities under the project. They also helped to spread and promote crossborder solidarity and raise awareness of the impact of the Interreg Impact Initiative.

IVY is an action that aims to offer young people aged 18-30 the opportunity to participate as volunteers in cross-border, transnational or interregional programmes and related projects. It is part of the European Solidarity Corps and represents a volunteering experience that enables young people to show solidarity and support cooperation between regions. Volunteering is at the heart of IVY.



Read more about IVY on the official website: https://www.interregyouth.com/.

#### Siniorita Chatziapostolidou joins the AUA Acopian Centre through the EU IVY programme

The Acopian Centre for the Environment at the American University of Armenia (AUA) is pleased to host Ms. Siniorita Chatziapostolidou from Greece under the EU Interreg Volunteer Youth (IVY) programme.

Ms. Chatziapostolidou is a student at the Department of Product and System Design Engineering of the University of the Aegean.

She brought her skills and knowledge to the project by contributing to the improvement of the UI /UX design of the PONTOS website, researching on the development of serious games through the use of Copernicus-based environmental monitoring throughout the Black Sea basin - PONTOS project deliverables - and to other tasks related to the project.



Picture: Siniorita Chatziapostolidou in the Armenian Pilot Area, Lake Sevan

## Valeria Kormys joins AUA Acopian Center through the EU IVY Program

Valeria Kormysh is a fresh master's graduate from Italy in International Relations with a focus on EU – Latin American relations. As a student, Valeria promoted and assisted different EU Youth Programs such as Erasmus+, ESC, Salto Youth in the United Kingdom and Spain. Furthermore, she was involved as a researcher at the Universidad de las Américas de Puebla (Mexico) where she analyzed the migration flows in the state of Puebla and created reports and assessments about the political situation of villages experiencing social conflicts. During her volunteering at the Acopian Center for the Environment, Valeria brought her analytical and research skills to support researchers of Copernicus assisted environmental monitoring across the Black Sea Basin – PONTOS project with the assessments in the project's pilot site (pontos-eu.aua.am). She assisted the team in organizing and processing the data and information through the preparation of reports and articles. Through this partnership, the AUA Acopian Centre for the Environment reaffirmed its role as a regional hub for excellence and collaboration, enabling participating youth to develop their skills while fostering solidarity and raising awareness of the impact of Interreg Programme.





#### PONTOS PROJECT COORDINATION MEETING YEREVAN HELD ONLINE

On December 16, 2021, within the frameworks of the EU-funded "Copernicus Assisted Environmental Monitoring Across the Black Sea Basin - PONTOS" project, a two-hour online project coordination meeting was held.

About 30 participants from partner institutions participated in the meeting. During the meeting, partners had the opportunity to showcase their delivered work and outputs, discuss and receive feedback as well as plan the forthcoming activities. After each presentation, there was a discussion providing insights into the work done and sharing ideas on the challenges and risks that may arise.



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CROSS BORDER