

Climate Change and Water Resources in the Mediterranean

By George N. Zaimes



Figure 1. MedECC scientific team

This brief is based on the report prepared by “MedECC (2020) Climate and Environmental Change in the Mediterranean Basin - Current Situation and Risks for the Future. First Mediterranean Assessment Report [Cramer, W., Guiot, J., Marini, K. (eds.)] Union for the Mediterranean, Plan Bleu, UNEP/MAP, Marseille, France, 632pp. ISBN: 978-2-9577416-0-1 DOI: 10.5281/zenodo.4768833 (see <https://www.medecc.org/first-mediterranean-assessment-report-mar1/>). This report

was prepared by the independent network of Mediterranean Experts on Climate and environmental Change (MedECC). The report was written by 190 scientists from 25 countries, all contributing in individual capacity and without financial compensation. The author of the brief was also one of the scientists as a Lead Author that contributed in the writing of this very important report for the Mediterranean.

The purpose of this brief is to present the major results of the report on water resources.

1. Water resources in the Mediterranean are scarce. The reason is because they are limited, unevenly distributed and in some areas not accessible.
 - 1.1 The northern Mediterranean has the majority of water resources (72-74%) that means 180 million people in the southern and eastern Mediterranean countries suffer from water scarcity and 80 million people from extreme water shortage.
 - 1.2 River discharge is characterized by high temporal - seasonal and inter-annual - variability and groundwater is the main source of freshwater for some Mediterranean countries.
 - 1.3 The transboundary nature of many river basins and aquifers in the region further complicates their sustainable management.
2. The scarcity of water resources causes conflicts for the different sectors of water use (agriculture, tourism, industry, people, also biodiversity conservation).
 - 2.1 In southern and eastern countries, agricultural use reaches 76-79%. In the northern part, the four sectors are much more balanced.
 - 2.2 The irrigated land of the total cultivated area in the Mediterranean is about 25% (but more than 70% in Egypt, Israel, Lebanon, Greece).
 - 2.3 The trend towards more efficient irrigation systems does not always generate water savings due to the cultivation of more water demanding crops (e.g., vegetables).
 - 2.4 Tourism activity is at its highest in summer, the same period with peak demands by irrigated agriculture, creating tensions for water resources.
 - 2.5 Municipal water use is already constrained in several Mediterranean countries exacerbated by demographic and migratory phenomena. Several northern countries have managed to reduce their municipal withdrawal while several southern and eastern countries have the opposite trend.
 - 2.6 Water-related intersectoral conflicts are likely to be exacerbated in the future because of the interactions between climate change (increasing droughts) and ongoing socio-economic and demographic trends.



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3. Disastrous flash floods are frequent affecting mainly the coastal areas, where population and urban settlements are growing in flood-prone areas. These will likely become more frequent and/or intense due to climate change.
4. Climate change, in interaction with other drivers (mainly demographic and socio-economic developments including unsustainable agricultural practices), will reduce runoff and groundwater recharge, increased water requirements for crops, increase conflicts among users, and increased risk of overexploitation and degradation.
 - 4.1 Moderate global warming will reduce precipitation and with increased evaporation, leading runoff water will decline. In many regions, this will likely increase low flow periods in summer and the frequency of no-flow events will increase.
 - 4.2 At current extraction rates, overexploitation of groundwater is likely to continue having a greater impact on decreasing groundwater levels than climate change.
 - 4.3 Important challenges to groundwater quality in coastal areas are likely to arise from salt-water intrusion.
 - 4.4 The probability of more extreme and frequent meteorological, hydrological and agricultural droughts will likely increase substantially.
5. Despite an important potential for adaptation to reduce freshwater resource vulnerability, climate change exposure cannot be fully and uniformly counterbalanced. Socio-economic developments will have in many cases greater impact on water availability compared to climate-induced changes.
 - 5.1 Strategies and policies for water management and climate change adaptation are strongly interconnected with all other sectors (e.g., the water-energy-food nexus).
 - 5.2 Most adaptation and water management strategies rely on the principles of Integrated Water Resources Management (IWRM), which is based on economic efficiency, equity and environmental sustainability.
 - 5.3 Technical solutions are available to improve water availability and the efficient use of water resources.
 - 5.4 Technology is also expected to contribute significantly to the reduction of wastewater volume, its reclamation and reuse and the reduction of impacts on sea water quality.
 - 5.5 Dams for water storage or hydropower exist in most countries, and rivers are diverted for water management in some countries. Large dams often generate social and environmental impacts.
 - 5.6 The strategy of trading commodities that cannot be produced due to lacking water (virtual water trade) can be considered a form of adaptation.
 - 5.7 Most Mediterranean countries (e.g., Portugal, Spain, Italy, Greece, Israel, Turkey) have high footprints in terms of national consumption.
 - 5.8 Water demand management, i.e., methods used to save (high quality) water, may reduce water consumption or water losses.
 - 5.9 The reduction of water losses in all sectors of water use in the Mediterranean is crucial for sustainable management and adaptation strategies.

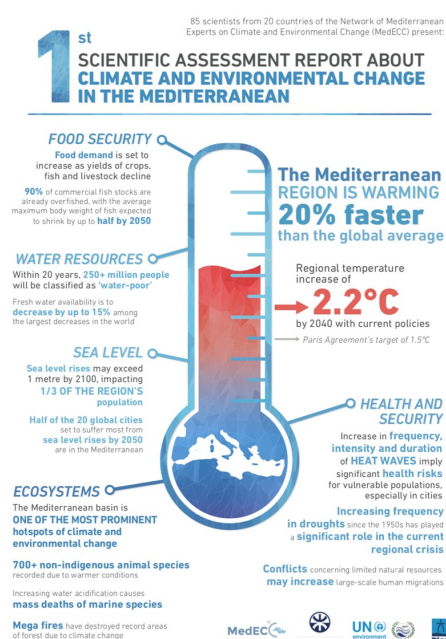


Figure 2. First scientific assessment report about climate change

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1st National Network Meeting for BSB963 “Protect-Streams-4-Sea” Project

1st Network Meeting Greece

By Valasia Iakovoglou

The 1st Protect-Streams Network meeting was hosted by the International Hellenic University (IHU) for the Greek participants and took place through ZOOM on January 29th 2021. The event was attended by 21 participants from the Regional Office of Anatoliki Makedonia kai Thraki, Forest Service, Fire Department, Geotechnical Chamber of Greece, Municipalities of the pilot area (e.g., Amfipoli), Opsometha Eis Philippous (NGO), Development Agency of Kavala, UNESCO Chair Con-E-Ect, private companies, researchers and students from the International Hellenic University, other Universities and residents from the pilot area. During the event an overview of the project and its main goals were presented. After the presentation there was a questions/answers section.

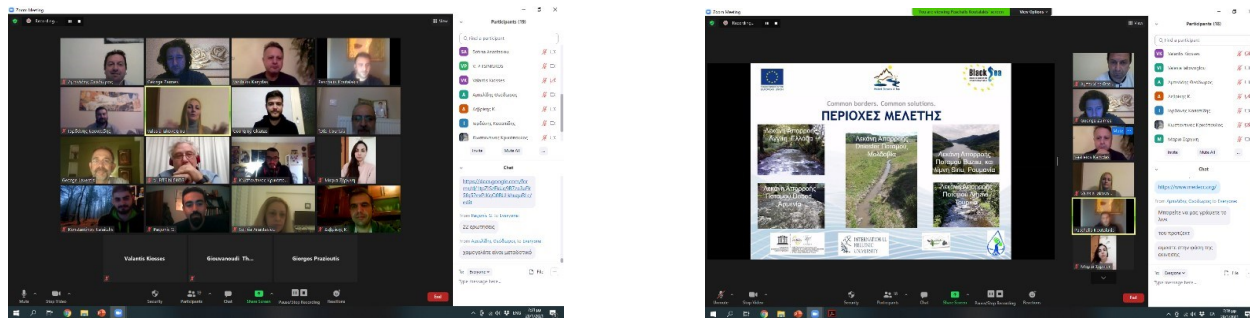


Figure 3. First Network Meeting in Greece

1st Network Meeting Romania

By Maria Marinescu

The 1st Protect-Streams Network meeting was hosted by the Buzau-Ialomita River Basin Water Administration (BIWA) and it took place through ZOOM on February 10th 2021. To attend this event, invitations were sent to the target groups that have been identified by the BIWA. Overall, the event was attended by 7 participants. The participants were from the Bucharest University, Nehoiu Municipality, Siriu Gymnasium School and Nicolae Iorga High school - Nehoiu Municipality. Each participant presented himself, specifying his work, expertise and interests regarding their involvement in the project. Maria Marinescu and Oana Ristea presented an overview of the project and its main goal and objectives. A project presentation was prepared that lasted for approximately 20 minutes.

The project team mentioned that during the project period 5 meetings will be organized within Neighbourhood Network Protect-Streams in order to disseminate the purpose and objectives of the project and its results and feedback provided by the network members will improve the deliverables of the project. During the meeting, the participants mentioned the importance of keeping surface water clean, following simple rules on collecting household waste (including plastics) and storing it in a specially designed place, the consequences of landfill waste on rivers and lakes for people and the aquatic ecosystem in general and specific in the pilot area of the project. At the end of the meeting they expressed also their intention to get involved in the activities provided in the project, especially in public awareness events.

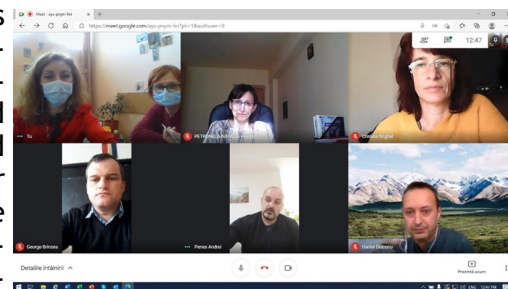


Figure 4. First Network Meeting in Romania



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1st Network Meeting Turkey

By Mustafa Tufekcioglu & Can Vatandaslar

The 1st NN meeting was hosted by Artvin Coruh University (ACU) for the Turkish participants and took place through ZOOM on January 26th 2021. The event was attended by 17 participants from Turkish target group. The participants were from the ACU, General Directorate of State Hydraulic Works (DSİ), General Directorate of Combating Desertification and Erosion (ÇEM), General Directorate of Tea Enterprises (ÇAYKUR), Hopa Chamber of Industry and Trade, The Chamber of Forest Engineers, and Turkish State Meteorological Service. Initially each participant presented briefly her/himself and the institutions or organizations they represent. ACU Project manager, Mustafa Tufekcioglu, presented an overview of the project and introduce the main objectives and work packages. A PowerPoint presentation was prepared that lasted for half an hour. After the presentation there was a Q/A section.

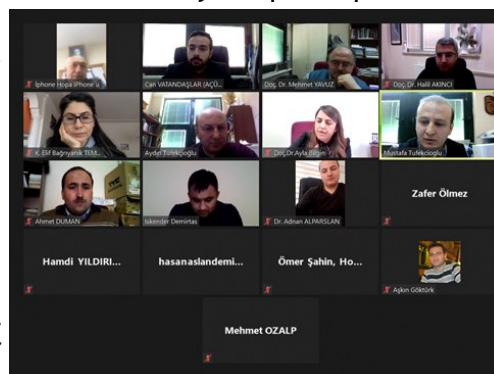


Figure 5. First Network Meeting in Turkey

1st Network Meeting Moldova

By Ecaterina Kuharuk



Figure 6. First Network Meeting in Moldova

The 1st National Network meeting was held on 29 January 2021 and had the objective to inform the interesting stakeholders (universities, research institutes, local authorities, NGOs, as well as the general public about the project objectives, the target project area, as well as methods applied. Special attention was given to attract to the event, members of the Environmental Platform, which represents the environmentally friendly community of environmental NGOs, scientists, local authorities and specialists from both banks of the Dniester River. This was created with win-win objective - to organize the inter-sectoral cooperation on environmental issues dealing with Dniester River, and to build the confidence between the residents of both banks of the River that should help minimize conflict. Stakeholders from both banks took part in the event. Initially each participant presented briefly her/himself. Ilya Trombitsky and Ecaterina Kuharuk presented an overview of the project and its main goal as well as main project methods. A PowerPoint presentation was prepared that lasted for approximately 30 minutes. After the presentation there was a questions & answers section.

1st Network Meeting Armenia

By Luiza Gevorgyan

The 1st Network Meeting for the Streams-4-Sea project of the Armenian partner took place in "Armenpress" news agency on February 08th 2021. Invitations were sent to the target groups that have been identified by the Armenian Partner for the participants. Overall, the event was attended by 12 participants. The participants were from the H. Petrosyan Scientific Center of Soil Science, Melioration and Agrochemistry, Armenian State Hydrometeorological and Monitoring Service, American University of Armenia, Agrarian University and other educational institutions, NGOs and other institutions. A brief presentation of the project progress was made with the introduction of the implemented activities and approaches to be exercised for achieving the goal of the project.



Figure 7. First Network Meeting in Armenia



Research Activities

Pilot area Romania

By Maria Marinescu



Figure 8. Erosion pin

There were 2 field visits in the pilot area in which 3 representative areas were selected for the study on erosion and transportation of materials on mountain slopes where land use is predominantly forest, namely in the area of Chirlesti, Paltineni and Siriu reservoir - Groapa Vantului areas, where 2 alluvium traps and 14 erosion pins were installed.

The mounted wooden pins were painted blue, with a length of 1 m and a diameter of 8 cm. They were buried 60 cm in the ground, respectively 6 pins in the Paltineni area on the left bank of the Buzau river and 8 pins in the area of Siriu reservoir on its right slope (figure 8).



Figure 9. Alluvium trap

The alluvium traps were adapted to the relief conditions in the pilot area and were installed in the Groapa Vantului area - right slope of Siriu reservoir (figure 9) and Chirlesti locality - right bank of Buzau River.

Pilot area Turkey

By Cengizhan Yıldırım & Ahmet Duman



Figure 10. Flow measurements

In this period, more erosion pins were installed along the stream/river banks for measuring stream bank erosion. Cross-section surveys were completed. The Climate station was installed in the watershed. Water samples were started to be collected and analyzed. Stream flows are measured periodically with flow meter. Pressure transducers/measuring level were also installed to measure stream level change. More soil samples have been collected. They were partly analyzed for texture and other chemical properties in the soil lab. On the other hand, satellite images were downloaded and several index maps (e.g. NDVI, NDWI, NDSI) were created. In addition, stream centerlines were digitized in GIS.

Pilot area Armenia

By Luiza Gevorgyan & Andranik Ghulijanyan

Within the framework of “Protecting streams for a clean Black Sea by reducing sediment and litter pollution with joint innovative monitoring and control tools and nature-based practices” the following activities were carried out in Debed River Basin the Armenian Pilot Area. Four hot-spot areas have been chosen for sampling and establishment of sample plots, Gerlach traps and erosion pins. The selection has been based on the non-point sources of pollution. Remote sensing technologies and NDVI index for identification of the eroded hot-spots for the given moment have been used. Soil-water samples have been taken and are currently in the laboratory of the "Hydrometeorology and Monitoring Center" SNCO of ME of RA. For all the selected hot-spots the following parameters have been assessed: pH, Conductivity - $\mu\text{Sim/cm}$, DO% (saturation) -%, DO (concentration) - mg/l , $T^{0.0C}$.



Figure 11. Water samples

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Pilot area Greece

By Paschalis Koutalakis

The Greek team have organized the field sampling for a) both water quality and quantity but also for b) soil and bed material sampling. The total area is 2390 sq. km distributed as follows based on the different land cover:

- Forested Areas: Total 455 sq. km (Broad-leaved (311) 424 sq. km, Coniferous (312) 24.5 sq. km, Mixed (313) 6.5 sq. km) = 19%
- Sclerophyllous vegetation - Shrubland: Total 374 sq. km (Scler. (323) 264 sq. km, shrubs (324) 110 sq. km) = 15.6%
- Natural grasslands - pastures: Total 250 sq. km (natural (321) 237 sq. km, pastures (231) 13.5 sq. km) = 10.5%
- Agricultural lands: Total 1169 sq. km (Non-irrigated arable land (211) 590 sq. km, Permanently irrigated (212) 268 sq. km, Vineyards (221) 1 sq. km, Olives (223) 1 sq. km, complex cultivation patterns (242) 201 sq. km, mixed agriculture and natural vegetation (243) 108 sq. km = 48.9%



Figure 12. Sampling Points

- sampling points (water and bed)
- sampling points (riparian)
- sampling points (agricultural land)
- sampling points (sclerophyllous vegetation)
- sampling points (natural grasslands-pastures)
- sampling points (forest)

The sampling points as well as the permanent monitoring stations will be placed in different land covers. In addition, these points will be distributed in different slope categories and different soil types. The figure 12 includes: Forested areas 15 points, Natural grasslands-pastures 15 points, Schlerophyllous vegetation 15 points, Agricultural areas 15 points, Riparian 20 points, Water & bed 20 points.

Pilot area Moldova

By Ilya Trombitsky



Figure 13. Baltata River pollution by the processing industry factory

The pilot area is the basin of Baltata River, which is a tributary of the Dniester River – one of main Moldavian rivers that flows into the Black Sea. Thus, the surface pollution and litter entering its mainstream are directly transported to the Black Sea. The pilot area has 153.9 km²; its length from northwest to southeast is 27.47 km, the width - 7.74 km. It is located within three administrative units: Chisinau municipality, Criuleni and Anenii Noi rural regions, occupying respectively 35%, 64.9% and less 0.1%

of the pilot area. It is exposed to a significant anthropogenic load due to unauthorised landfills, floating debris and microplastic in the Baltata River, lack of industrial and household wastewater treatment which is one of the potential sources of pollution of underground water-bearing strata in the Dniester River basin, and furthermore by the presence of carbonate chernozems in the area which deteriorate the quality of drinking water.

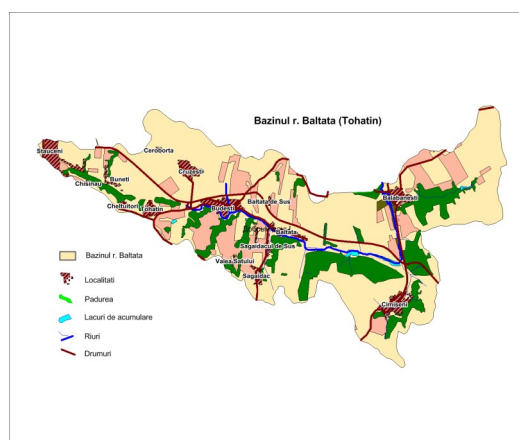


Figure 14. Baltata River Basin



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Dissemination Activities in Romania

By Daniel-Constantin Diaconu



Figure 15. Siriu reservoir

On March 22, 2021, on the occasion of the World Water Day, a contest called "We care" was launched by BIWA, in which nine teams from three educational units participated: a) Siriu Secondary School, b) "Nicolae Iorga" Theoretical High School - Nehoiu and c) "Radu Vladescu" Theoretical High School - Patarlagele. The participating teams prepared useful objects (pencil holder, vases, flower pots, jewelry, etc.) by reusing plastic objects (packaging). The aim of this competition was to raise awareness of the fact that single-use plastic objects can be transformed into objects with multiple uses.

On June 16, 2021, within the activity "WATER and our ADDICTION for PLASTIC", organized by BIWA at the Siriu Hydrotechnical System, the awarding of the winners took place. During the activity, the pupils were educated about the plastic waste pollution by Dr. Biol. Oana Ristea; specifically the categories of plastic waste and the harmful effects of macroplastic and microplastic were presented. In addition a field visit at the dam of the Siriu reservoir was organized to be informed about the history of the Siriu reservoir by the Director of S.G.A. Buzau, engineer Laura Zaharia.

On July 11, 2021, the activity "The plastic fishing season has opened" ("S-a deschis sezonul de PETscuit"), was organized by BIWA at the Siriu reservoir and Buzau river. Our team, together with 130 volunteers from several institutions and NGOs, collected, in two hours, 1000 bags, the equivalent of 50 cubic meters of waste. Volunteers were from: Institution of the Prefect of Buzau County, Local authority from Siriu, Nehoiu si Patarlagele Buzău County Inspectorate for Emergency Situations, Children from the Theoretical High School "Nicolae Iorga" Nehoiu, Students from the Faculty of Geography University of Bucharest, Outdoor Events NGO, Sacele Sports Club Association NGO, Green Adventure NGO and Leytto events SRL-Nehoiu NGO.



Figure 16. Trash collection

Project Presentations

Dissemination Presentations

- The "Protect-Streams-4-Sea" project was highlighted at the Joint Operational Programme Black Sea Basin 2014-2020 9th Newsletter, June 2021.
- **George Zaimes**, presented the "Protect-Streams-4-Sea" project to the master students of the *Analysis and Management of Anthropogenic and Natural Disasters Program, International Hellenic University, GREECE*. 29/05/2021.
- **George Zaimes**, presented the "Protect-Streams-4-Sea" project to graduate students of *Iowa State University, USA* for the course ENSCI 698: Seminar in Environmental Science. 26/04/2021
- **George Zaimes**, presented the "Protect-Streams-4-Sea" project to the master students of the *Man & Water Program, International Hellenic University, GREECE*. 24/04/2021

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Presentations at International conferences

- **Protect-Streams-4-Sea - an innovative research project for the sustainable water management of the Black Sea.** *Presenter: P. Koutalakis.* Co-authors: G.N. Zaimes, M. Tufekcioglu, D.C. Diaconu, I. Trombitsky, A. Ghulijanyan, M. Marinescu, V. Iakovoglou. International Workshop “Sustainable Management of Water resources and Riparian Areas,” June 5th 2021 online.
- **UNESCO Chair Con-E-Ect: Mapping Sustainability for Riparian Areas, Deltas & Humans through the Collaboration of Universities, Stakeholders and Decision Makers.** *Presenter: G.N. Zaimes.* Co-authors: V. Iakovoglou, D. Emmanouloudis. Med 2020 International Conference “THE MEDITERRANEAN: SCIENTIFIC EXPERTISE FOR DECISION-MAKERS - Climate and environmental research to support sustainable development goals,” November 16th-18th, 2020 online.
- **Monitoring, identifying and mitigating litter, soil erosion and sediment pollutants in the Black Sea region.** *Presenter: G.N. Zaimes.* International Conference “Academician L.S. Berg – 145,” organized in frames of “Environmental Platform” of the Confidence Building UNDP program with financing of the EU, March 19th 2021
- **Hydrological modeling in water related research.** *Presenter: R. Corobov and I. Trombitsky.* International Conference “Academician L.S. Berg—145,” organized in frames of “Environmental Platform” of the Confidence Building UNDP program with financing of the EU, March 19th 2021
- **Approaches to evaluation of soil erosion in Dniester River basin.** *Presenter: E. Kuharuk and O. Crivova.* International Conference «Academician L.S. Berg—145», organized in frames of “Environmental Platform” of the Confidence Building UNDP program with financing of the EU, March 19th 2021
- **Plastic river pollution - risk for recreational activity.** *Presenter: D.M. Vasile, E. Avram, O. Ristea, M. Marinescu, D.C. Diaconu.* Conference on “Public Recreation and Landscape Protection—with sense hand to hand”, May 10th-11th, 2021 online.
- **Environmental education in Romania - flood risk.** *Presenter: F. Toma, D.M. Vasile, J. Filova, D.C. Diaconu.* Conference on “Public Recreation and Landscape Protection—with sense hand to hand”, May 10th-11th, 2021 online.

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The long-term objective “Protecting streams for a clean Black Sea by reducing sediment and litter pollution with joint innovative monitoring and control tools and nature-based practices (BSB963)”

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