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BLACK SEA REGION SCIENTIFIC HORIZONS

Better understanding of the problems of geology, biology, ecology and management of the resource efficiency and environment (related to water systems) of the Black Sea region requires synergy of international scientific efforts.

On the March 22 2016, the Association of European Studies for Innovative Development of Georgia (ESIDG) organized international workshop «Resource efficiency and environment – Black Sea Region Challenges» in Tbilisi. This workshop was arranged within the framework of the Black Sea Horizon (BSH) EU- Horizon 2020 project [<https://blacksea-horizon.eu/>]. This project is co-ordinated by the Centre for Social Innovation (ZSI GmbH) from Austria and it involves 18 partners from all Black Sea countries and a number of EU members and associated countries. There are German Aerospace Center, Project Management Agency DE (DLR); Centre for Regional and International STI Studies and Support GR (CERISS); The Scientific and Technological Research Council of Turkey TR (TUBITAK); Regional Centre for Information and Scientific Development Ltd. HU (RCISD); Applied Research and Communications Fund BG (6 ARC Fund); inno TSD FR (inno); International Centre for Black Sea Studies INTL (GR) (ICBSS); Center of International Projects MD (CIP); Institute of Fundamental Technological Research, Polish Academy of Sciences PL (IPPT-PAN); Sociedade Portuguesa de Inovação, Consultadoria Empresarial e Fomento da Inovação, S.A. PT (SPI); Executive Agency for Higher Education, Research, Development and Innovation Funding RO (UEFISCDI); National Academy of Sciences of the Republic of Armenia AM (NAS-RA); Russian Foundation for Basic Research RU (RFBR); Federal State Autonomous Educational Institution of Higher Professional Education National Research University «Higher School of Economics» RU (HSE); Association of European Studies for Innovative Development of Georgia GE (ESIDG); Shota Rustaveli National Science Foundation GE (SRNSF) and Science Development Foundation AZ (SDF-AZE). Ukraine is represented by the Institute for Economics and Forecasting of the National Academy of Sciences of Ukraine (UA).

BSH has the following operational sub-goals:

1) support to the EU's external relations with the target region;

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- 2) increase the knowledge base about EU's external environment;
- 3) Stimulate bi-regional STI cooperation;
- 4) strengthen economic competitiveness between the EU states and partner-countries;
- 5) contribute to the pooling of resources of the two groups of countries;
- 6) contribute to the establishment of supportive framework conditions;
- 7) identify challenging thematic areas for mutual STI cooperation.

Duration of the project is from 2015 to 2018.

A number of common problems of the Black Sea region has been discussed during the seminar. They've included such topics, as:

- river systems in the region (ecological status, morphology, human impact, water quality);
- coastal zones (morphodynamic changes, degradation, stability, technogenesis related to the coastal zones and their impact on the coast stability and coast degradation);
- exploitation of water resources and its environmental impact (water nexus, environmental impact on water systems).

The main aims of the workshop were to discuss and identify research topics of mutual interest for research, technology and innovation cooperation between the EU Member States, Horizon 2020 Associated Countries and countries of the Black Sea region (including preparations for further calls in the Horizon 2020 Program). The seminar was attended by some 15 eminent experts from EU Member States and Black Sea countries, namely: *Armenia, Azerbaijan, Bulgaria, Georgia, Greece, Hungary, Romania, Russia, Turkey and Ukraine*. Ukraine was represented by one of the authors of this article.

During the seminar, representatives of these countries have delivered 14 reports on a wide range of scientific, technological and methodological issues, including the development and support of interdisciplinary research in the region.

Dr Michael Schultz, Chair of International Initiative Committee (*Germany*) and Dr Adrian Stanica, Project Coordinator, Scientific Director of GeoEcoMar (*Romania*) presented the report «A new distributed pan-European Research Infrastructure supporting interdisciplinary research on river-sea systems». Authors convincingly demonstrated that majority of the pressing societal challenges in Europe related to the river-sea systems. Studies of these problems require new approaches, which will integrate different scientific disciplines. Framework of such research provides innovative opportunities for cross-disciplinary and cross-boundary studies, facilitates knowledge exchange and attracts young people to science, maximises the 'impact' of investments in environmental research. This drives innovation to the centre of the knowledge triangle (Research – Education – Innovation). Authors of the report also outlined the history of DANUBIUS-RI project and its strategic importance. They discussed a number of important scientific problems, posing such questions, as: How does global climate change affect river-sea systems? How do river-sea systems respond to global climate change and increased human pressure on them? How do changing societal demands affect river-sea systems? How to increase the effectiveness of measures for river-sea systems?

In 2016 DANUBIUS-RI was included to the new project for the ESFRI (European Strategy Forum on Research Infrastructures) road map. In 2016–2017, it must be filed an application for funding for the preparatory phase of the broader program.

The report «Influence of the coastal zone technogenesis – related changes on the coast development» by Vakhtang Gvakharia (Gamma Consulting Ltd, Georgia) was devoted to the problems of natural and man-caused degradation of coastal zone of the Black Sea.

It is known that the length of the Black Sea coast line is ~ 4,340 km: 300 km belong to Bulgaria, 313 km to Georgia, 225 km to Romania, 475 km to the Russian Federation, 1,400 km to Turkey and 1,628 km to Ukraine. The key problems of the coastal countries are coastal erosion and the coastline degradation. The main factors that cause these processes are global and environmental factors such as 1) global change and sea level rise in general; 2) regional characteristics – coastal morphology, elevation and geological structure, neo-tectonic regimes and others.

Important roles also belong to the anthropogenic factors:

1) changes in hydrologic characteristics (water/sediment supply, regulation of floods, etc.),

2) man-made littoral structures, such as breakwaters, ports, etc., which modify littoral circulation;

3) uncontrolled utilization of beach material,

4) dredging of sand too close to the beaches or within the river mouth bars, etc.

As the result, we can observe further coastal erosion, land losses, environmental changes and economic degradation of the coastal zone.

One of the main problems, discussed in the report “Means for reduction of the Black Sea coast degradation & provision of its sustainable development” by Irakli Apashvili from Gamma Consulting Ltd, Georgia, is the degradation of coastal zone – mitigation measures. According to the author, the current estimated deficit of the beach forming material is 12–15 million m³. To reverse degradation and to achieve sustainable development the coastline requires 200–300 thou. m³ – for shingle beaches and 300–400 thou.m³ – for sand beaches (annually).

There are following propositions, aimed at stabilization of the shoreline: a) development of strategic plan for preservation of the littoral dune by increase of the beach sand to ensure full dissipation of wave energy, b) beach nourishment, c) arrangement of sediment-retaining hydrotechnical structures.

In the report of G. Lominadze, G Kavlashvili, I. Javakhishvili, Tbilisi State University Vakhushti Bagrationi Institute of Geography, Georgia «Development of the river deltas of the Black Sea east coast» were demonstrated that development and stability of the deltas are dependent on the following factors:

- the beach creating sediment balance, its incoming and outgoing components;
- direction of the alongshore flow of the sediment;
- stability of the submarine canyons’ heads;
- sea-level eustatic fluctuations;
- the degree of anthropogenic influence.

The first four of these factors belong to natural ones and in the second half of the Holocene they were determined by regimes of the deltas’ coastal zone stability.

The anthropogenic factor caused irreversible negative impact and now it is necessary to take special measures for keeping of stability of the deltas.

In the report “Determination of hot spots along Black Sea coasts of Turkey and HOT Black Sea project” of Ch. Ioakeimidis (Greece) problems of co-ordination of different Black Sea on Hot Spot problems – related projects were discussed. Hot Spot means a limited and definable local land area, stretch of surface water or specific aquifer that is subject to excessive pollution and necessitates priority attention in order to prevent/reduce the actual or potential adverse impacts on human health, ecosystems or natural resources and amenities of economic importance (Bucharest Convention LBS Protocol, http://www.blackseacommission.org/_od_LBSAProtocol.asp).

The Hot Spots Methodology is intended to ensure common approach to the identification, assessment and ranking of Hot Spots, located within the Black Sea area and to exert impact on the state of the Black Sea.

Distinctive features of this methodology are the following:

- the methodology allows to reliably identify and rank Hot Spots located on the territory of the Black Sea catchment area;
- when ranking common criteria for all Black Sea chosen countries were taking into consideration availability of data;
- the list of criteria contains environmental, socioeconomic, and integrated indices;
- the methodology includes an expert scoring (expert-judgement), but also mathematical methods for estimating the effect of Hot Spots on the environment of the Black Sea;

The project overall objective of the hot spot studies is to foster cross-border partnership for the development of harmonised policy and utilization of scientific studies relevant to monitoring and addressing environmental threats in the Black Sea Basin in the field of land-based sources of pollution.

The project specific objectives:

- harmonise river monitoring programmes;
- harmonise Hot Spots identification and prioritisation;
- update the Lists of Hot Spots, on the basis of common methodology;
- provide data/information management tool to support decision-making in the field of Hot Spots management;
- share competencies to increase capacity in hot spots management embracing the adaptive approach and market-based instruments for pollution control;
- increase public awareness and stakeholders participation in decision-making related to hot spots.

Project main deliverables include: Guidelines on public participation in Ecological monitoring and management of the environment; Guideline on BEPs and BATs in use of market-based instruments for water pollution control; LBS Monitoring Black Sea Rivers Monitoring: guiding harmonization; LBS Monitoring Report; Exit strategy guidelines.

Adrian Stanica (Romania) has presented results of the FP7 DANCERS project «DANube macroregion: Capacity building and Excellence in River Systems (basin, delta and sea)» (EC GA 603805/2013). Specific objectives of the project included such tasks: critically analyse the achievements in integrated river – delta – sea management in the Danube Region; understand links between the achievements, deliverables and results of the work performed; define a set of instruments to enhance environmental research and innovation in Danube Region. This project included 15 partners from different EU and non-EU states. Research topics comprised such areas: pathways of transport and accumulation of litter(plastic) and pollutants (including emerging pollutants (e.g. nanoparticles) in the Danube – Black Sea system and their impacts on local ecosystems; dynamics of dissolved organic matter in the Danube River – Danube Delta – Black Sea System; understanding river-sea interaction processes in the Danube Delta transitional environments; managing dams and reservoir lakes as critical sediment traps and bottlenecks for river habitat continuity; ensuring safe and continuous navigation while restoring the Danube green corridors (with strengthened natural protection from floods); developing sustainable agricultural practices (crops, husbandry) while obtaining good water quality in the Danube – Black Sea system; utilization of the latest Earth observation (EO) technologies coupled with in situ measurements for an upgraded Danube – Black Sea

environmental monitoring system; dealing with Eutrophication in the Danube – Black Sea interaction zone by using algae as 2nd Generation Biofuels; restoring natural habitats in the Danube floodplains – Danube Delta and lagoon systems as support for fisheries revival and some others. Project participants proposed to create special research funding agencies in the Danube Region with the assistance of the JPI Water and the EC DG Research & Innovation.

Academician Gennady G. Matishov (Russian Federation, RAS) has prepared the report «The Sea of Azov – Black Sea basin in the system of large marine ecosystem». He proposed to use modular assessment for sustainable development studies of marine systems, and then come to the integrated indicators.

Corresponding Member of NAS of Ukraine, Doc. of Sciences (marine geology) V. Iemelianov (Ukraine, NASU) has focused on main European Union and Ukrainian policies and directives relevant to marine and regional sustainability. He observed key Ukrainian scientific centers that implemented these policies and assessed Ukrainian proposals for Horizon 2020 and for future bi- or multilateral joint projects. Ukraine has a number of legal acts, which regulate activities in Black sea and Azov sea regions. They deal with different aspects of exploration and utilization of existing resources of these seas. Seven scientific institutes within the National Academy of Sciences of Ukraine only have research projects, related to the Black sea. Mr. Iemelianov stressed importance of the project «Multipurpose monitoring, evaluation and prediction of the dynamics of the marine environment and resource base of Black Sea in the face of increasing antropogenic pressure and climate change» (2013–2015). The aim of this project was to develop theoretical, technical and technological foundations for sustainable and environmentally friendly utilization of resources of the Azov-Black Sea basin within Ukraine. Unfortunately, the largest institutes of NASU maritime profile, including research vessels based in Sevastopol, have appeared outside of the jurisdiction of Ukraine since 2014. However, despite all the difficulties, a new State Institution «Scientific Hydrophysical Center of NAS of Ukraine and the Ministry of Education and Science of Ukraine» was created in 2016. Ukrainian scientist has proposed several topics for common research, including studies of dynamics of coastal and offshore ecosystems, impact of antropogenic factors on environment in the region, specific projects on studies of estuaries, lagoons and some others.

Dr. V. Asatryan (Armenia, Institute of hydroecology and ichthyology of SCZHE NAS) delivered a report «Current state of surface waters' quality monitoring in Armenia and related issues». He focused on such key topics: trans-boundary water resources; lake Sevan and spheres of possible cooperation in its studies; climate change effect on surface waters; circulation of water and fish farming; problems of implementation of water monitoring according to EU WFD demands. He stressed that the climate change is likely to decrease water supply in trans-boundary basins in Southern Caucasus by 45–65% till the end of the century. Unfortunately, wastewater collection and treatment systems are not sufficiently provided and operational in the region, which makes the problem even worse. Water infrastructure construction plans by Kura-Araks basin countries to be used for irrigation, water supply, and hydropower generation are dangerous for other riparian countries because of the potential impacts. There are also growing concerns with respect to the declining quality of water in the country. There is a necessity for development of multimetric indices for different river basins in all countries of BS region to meet the requirements of EU WFD and for harmonization of monitoring outputs within the countries.

Professor I. Mustafaev (National Academy of Sciences, Azerbaijan) presented the report «Environmental impact of floods in Kura and Araz rivers». He noted that floods

affected several regions of his country regularly. There were more than 150 floods in 1990–2003 only. Total economic losses could reach more than 1 billion USD. The last large flood was in 2010. There is a special program in Azerbaijan on flood prevention with detailed description of corresponding functions of local and central authorities, scientists and international organizations.

Mr. Ferenc Jordan (Danube Research Institute, Centre for Ecological Research Hungarian Academy of Sciences Budapest, Hungary) delivered the report «Food web gradients: quantifying human impact on ecosystems», in which he described connections between developments in maritime research and food production chains with special attention to fishing and cultivation of sea products. This could be solved by creation of ecosystem services, special databases and development of partnership.

In his report «Caucasus ecoregional ecological problems» Valeriy Shmunk (WWF-Russia) paid special attention to Black Sea wetlands, migration bird ways, pollution in the Black Sea area.

Ms. Georgia Chantzi (ICBSS, Moldova) has informed about the EU-sponsored project «Black Sea Horizon Project». Key idea of this project is development of co-operation between the EU and the countries from the Black sea region. This co-operation has to be stimulated and there are already several instruments, including IncoNet EECA, IncoNet CA/SC, BILAT-RUS and some other projects; BSEC Working Group on Cooperation in Science & Technology: 3rd BSEC Action Plan on S&T (2014-2018) and some others. Black Sea Horizon Project has its own role, which is in establishing direct links between the parties by establishing common research priorities and organization of joint projects.

At the end of discussion, participants of the event have proposed topics for future calls within a framework of Horizon 2020 Program. Key among them:

- utilization of Black Sea biotic and abiotic resources for Smart and Sustainable Blue Growth;
- understanding, monitoring and preventing marine natural hazards in the Black Sea basin;
- integrated management of the Black Sea coast under increased anthropogenic pressures and climate change. Building innovative adaptation management plans with the involvement of the coastal communities;
- solving conflicts and developing sustainable development plans in river-delta-sea continua in the Black Sea Region. Connecting freshwater with marine ecosystems via the transitional environments;
- harmonisation of data collection, analysis and use in river-sea systems in the Black Sea Region and development of highly complex models as critical tools to support successful management scenarios and plans;
- restoring the common Black Sea identity (Science and Society in the Black Sea Region);
- strengthen the Research and Innovation capacities in the Black Sea Region. Continuation of the Upgrade Black Sea Scene (dedicated Integration Activity for the Black Sea Research Network).

To our mind Ukrainian scientists must take an active part in the joint international projects within the Black Sea region. Thus the authors are recommending to all Ukrainian marine researchers to look on the site <https://blacksea-horizon.eu/>, considering that the basic events on the implementation of the Black Sea Horizon Project will occur in 2017 and early 2018.