Welcome message from the project coordinator

I’m delighted to introduce the first GLOBAQUA Newsletter. Let’s start with a short history of the European funding on multiple stressors in the aquatic environment.

European Union funding on multiple stressors

Freshwater systems in Europe are threatened by a variety of stressor (chemical pollution, geomorphological alterations, changes in land uses, climate variability and change, water abstraction, invasive species and pathogens). Chemical aquatic pollution today, comprises a wide range of emerging chemical substances, such as pharmaceuticals, personal care products, or pesticides, and even new materials such as nanomaterials and microplastics. Stressors are of diverse nature but cause adverse effects on biological communities and ecosystems. Ultimately, these effects threaten water quality and biological diversity of European as well water bodies around the world, which has important economic consequences (Vorosmarty, C. J et al 2010). Most ecosystems are exposed simultaneously to several stressors, in the so-called multiple-stress situations. In some cases stressors may act independently to each other, in some others they interact, thus leading to synergistic/antagonistic effects, either directly (if acting on the same target) or indirectly (if acting on different targets). The combination of stressors can have deleterious effects on freshwater ecosystems although most current knowledge is limited to the effects of single stressors on the chemical and ecological status of water bodies and on ecosystem functioning. During the development of NOMIRACLE, one of the first and largest multi-stressors EU projects, it was already evidenced that the focus on “chemical cocktails” should be replaced by the focus on the biological receptors (Lekke 2010) and “stressor cocktails” Holmstrup et al (2010) summarized three core problems to be tackled: 1) the need to define the most potent combinations of natural and chemical stressors, 2) the importance to address the exposure sequence to stressors, and 3) the need to move from short-term laboratory tests to field validation by means of mesocosm studies. Simultaneously, Hering et al. (2010) formulated the concept of “emerging stressors” in addition to the so-called “traditional stressors” like eutrophication. Under this framework, climate change, emerging substances, habitat deterioration, direct hydrological alteration, and invasive species are to be considered (Stevenson and Sabater 2010). It is the cumulative impact of the multiple stressors which together affect structure (biodiversity), functioning, and health of ecosystems and species (e.g., Burton et al. 2012, Segner et al. 2014). In contrast to the real world where chemical impacts on ecosystems take place in combination and interaction with other stressors, current concepts of environmental risk assessment mostly treat chemicals like stand-alone effects. In the end of this part I can be stated that possible cumulative impacts of multiple stressors on the ecological status were often neglected.

Water scarcity as key multi-stressor

Stressors such as water scarcity can limit biodiversity and economic activities in entire regions. In addition of being a stressor on its own, water scarcity can drive the effects of other stressors acting upon river ecosystems. It leads to intermittency in water flow, and therefore has implications for hydrologic connectivity, negative side-effects on biodiversity, water quality, and river ecosystem functioning. Water scarcity can amplify the effects of water pollution by reducing the natural diluting capacity of rivers. Interactions between stressors may be exacerbated by climate change. For instance, warmer temperatures and reduced river flows will likely increase the physiological burden of pollution on the aquatic biota, and biological feedback between stressors (e.g. climate change and nutrient pollution) may produce unexpected outcomes. Degradation of drainage basins, destruction of natural habitats, over-exploitation of fish populations and other natural resources, or the establishment of invasive species, are factors whose impacts combine and may give rise to synergistic effects, especially during periods of water shortage. The effects of these stressors are very relevant for the chemical and ecological status of water bodies as well as for the sustainability of ecosystem services they provide (D Barcelo and S Sabater, 2010). Water scarcity is a key stressor with direct and indirect effects. The relevance of water scarcity as a stressor is most important in semi-arid regions such as the Mediterranean basin, characterized by highly variable river flows and the periodic occurrence of low flows and even no-flows. Climate change predictions forecast an increase in the frequency and magnitude of extreme events although extremes are part of the normal hydrologic behaviour in Mediterranean-type rivers, many already show a consistent trend towards decreased discharge.

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GLOBAQUA project: objectives

Ten years ago the EU funded project NOMIRACLE started, back to 2004, two new large integrated projects on multiple stressors were launched: MARS and GLOBAQUA. The project GLOBAQUA wants to tackle two major complementary objectives. In one side to answer fundamental research questions by improving, our knowledge and understanding on the relationship between multiple stressors that might determine changes in the chemical and ecological status. Bridging and integrating the chemical and ecological status under water scarcity will be a key objective of the research carried out during the duration GLOBAQUA. The second general objective is to provide tools and solutions to water manager to improve current practice and policies by considering the influence of multiple stressors under the umbrella of the Water framework Directive.

I’d like to finish by saying that I fully understand the responsibilities that the post of project coordinator brings, and I am committed to continuing to deliver and build on the outstanding project that is GLOBAQUA.

Thanks for reading it.
Best regards,

Prof. Damià Barceló
CSIC-IDAEA
GLOBAQUA Coordinator

An overview of GLOBAQUA
GLOBAQUA started in February 2014 and will last five years. Within GLOBAQUA, a cross-scale approach is applied in six representative basins. Two basins in the Mediterranean European region (Ebro - Spain and Evrotas - Greece), and one basin in North Africa (Souss Massa - Morocco) were selected to obtain a perspective where water scarcity is the main problem. One continental basin (Sava – Slovenia, Croatia, Bosnia and Herzegovina and Serbia), one Alpine basin (Adige - Italy) and one UK river basin (Anglian River - UK) were included to have a European outlook where water scarcity is a growing issue because of multiple uses and unequal distribution of precipitations.

GLOBAQUA is organised through fourteen work packages, which are grouped in five main Modules. The Module STRESSORS will understand the mechanisms behind the multiple stressors acting in each case study by collecting existing data, generating climatic, socioeconomic and land-use scenarios, analysing surface and groundwater hydrological patterns, sediment and pollutant transport, quality of the physical habitat and fate of inorganic and organic pollutants. The Module RECEPTORS will analyse the effects of the stressors on biodiversity and ecosystem at different scales via manipulative laboratory experiments using artificial streams, reach-scale measurements, and basin-scale surveys. The Module IMPLICATIONS will integrate the information generated on the effects of stressors on receptors into integrative models at the reach or basin scales. The socio-economic setting of case-study basins will be characterised to support the ecosystem services valuation. Impact of the changes in ecosystem services in economic terms on the socioeconomic development will be assessed. The Module ENVIRONMENTAL MANAGEMENT will deal with the impact of multiple stressors on water quality, quantity, and ecosystems, and with the potential implementation of the major findings on European policy. A model framework will be developed to assess scenarios affecting availability, quality and demand of water at the European scale. The Module PROJECT COORDINATION AND DISSEMINATION will guarantee communication of the results to specific target groups (researchers, policy makers, water managers, etc...), and the efficient coordination of all activities of the consortium.

References
GLOBAQUA 1st year achievements

An internal DataBase was designed and created in order to allow GLOBAQUA partners gathering the experimental data generated within the project. The DataBase is flexible to accommodate broad classes of data (e.g. penomenological, socio-economical).

A preliminary setup of land use models in the Ebro case study (DINAMICA, CLUE-S) and hydrological models (WaSiM) in the Adige case study was carried out. In this course, the determinants of land use change were investigated for the Ebro basin as a first case study. Climate model data were post-processed and analyzed.

The study of sediment transport started with a focus on the Ebro River where sediment budgets were calculated. The definition of the subsurface structures focused on the Vermigliona river (Noce, Adige catchment) where data from a previously installed monitoring system for time-lapse electrical resistivity tomography (ERT) and a distributed temperature sensing (DRT) system were evaluated, showing that these techniques allow a delineation of the hyporheic zone. A methodological approach of using turbidity as proxy for the total concentration of suspended solids, particle-bound pollutants concentrations, and fluxes in rivers was developed.

During 2014 samplings were carried out in Evrotas, Sava and Adige basins. Suitable locations for event sampling (starting in 2015) were selected together with catchments managers in Adige and Sava.

In Adige River this sampling is planned for February 2015.

Sampling in Evrotas

A sampling protocol with instructions for organising the harmonized sampling of water, sediment and biota was written. List of class contaminants that will be investigated within the river basins was also made along with all necessary information on the sample preservation and transport requirements.

Metals were analysed in water, suspended particulate matter and sediments samples from the Sava River, collected in the first sampling campaign in September 2014.

A common protocol for the biological sampling was compiled with the other sampling protocols (hydrological, chemical and functional). During 2014 biological samplings were carried out in Evrotas and Sava.

Sampling in Sava

Regarding the study of the invasiveness level and forecasting of species risk, available data were examined and collected using questionnaire and contacting Water Agencies.

Data from the Ebro river basin were collected to provide data for Response Models on structural and functional diversity according to pressures identified in basins.

On July 2014 the sites in the Ebro basin were selected to design a field experiment to test the effects of WWTP on streams on communities. The indicators to measure were evaluated in a meeting done in Barcelona (December 2014).

Progress in the definition of a toolbox of methods for ecosystem functioning and in developing new tools for degradation of polymers and emerging contaminants were made. Common protocols for ecosystem metabolism and degradation of organic matter were written.

General experiment on degradation of organic matter started in Adige (UNITN). An experiment was performed on the effects of enhanced atmospheric CO2 on litter quality and degradation. An experimental water abstraction was performed in a stream to analyse impacts on communities and ecosystem functioning. Advancements were achieved on methods to calculate reaeration, necessary to analyse temporal series of metabolism. A laboratory experiment was performed at ICRA’s facilities to study combined effects of nutrients and pharmaceuticals on biofilm structure and functioning.

During 2014, the required data to estimate the 4 selected freshwater ecosystem services were gathered: water provisioning, erosion control, waste treatment, and habitat for species.

At the end of 2014, the calibration of the model on water provisioning for the Ebro and the Adige basins started, and will continue with the Sava and the Evrotas once all the hydrological data from the gauging stations in the basin will be available. Nutrient and sediment data required to calibrate the models on erosion control and waste treatment will be gathered during 2015.

All the calculations will be done with the InVest model.

An integrated methodology for the sustainable environmental and socioeconomic management of water resources ecosystem services was developed.
A three step approach was proposed, in line with the requirements of the economic analysis in the WFD and the relevant guidelines of the WATECO document. This approach consists of: socio-economic characterization of the River basin area; assessment of the current recovery of water use cost, and identification and suggestion of appropriate programs of measures for sustainable water management over space and time. The ecosystem services approach was incorporated into the proposed methodology. A cooperative platform with WP2, WP6, WP9, WP12 and WP13 was set; input will be integrated to the Stakeholder workshops (Water Framework Directive Stakeholder Workshop). The methodology to investigate the economic value of freshwater ecosystem services was reported. The Economics of Ecosystems and Biodiversity (TEEB) approach provides a framework for assessing multiple stressor and multiple outputs of a river basin, facilitating management of a complex system. Economic valuation includes monetary and non-monetary methods. An assessment of which methods are most suitable for which services along with the information required for the valuation and the sources of this data was carried out. A methodological framework to bridge the gap between TEEB and DPSIR was also proposed. An initial stakeholder workshop to identify the key services and issues within the case study was done, followed by social surveys to test the findings. The final activity will be a second stakeholder workshop to validate the findings and provide feedback on the process. Stakeholder maps are being produced for each of the case study areas.

A review of all current EU policy related to water management, with consideration of whether it addresses multiple stressors under water scarcity, was performed. Opportunities for influencing future changes to policy with the outputs from GLOBAQUA have been discussed. A more in depth analysis of the implementation of the WFD was performed, looking at the EU level, member state level and the river basin level. A number of challenges were identified in the implementation, specific to the objectives of GLOBAQUA. These were in the use of evidence in decision making; the provision of adequate and appropriate monitoring data for assessing pressures, status and measures; and in the integration of WFD objectives to all areas of policy. Emphasis was placed on the collaboration with two other projects funded in the same call: MARS (www.mars-project.eu) and SOLUTIONS (www.solutions-project.eu). In this sense common meetings with MARS were held in February 2014 (Palma de Mallorca, Spain) and October 2014 (Lisbon, Portugal), and with SOLUTIONS in October 2014 (Delft, NL).

In addition Barcelona hosted in December 2014 the first combined workshop on the effects of pharmaceuticals in river catchments with the EU funded projects Endetech, Cytothetra as well as with the Spanish funded project Scarce. These project meetings and the combined workshop strengthened the cooperation between the different experts of the projects as well as with other on-going projects.

**GLOBAQUA in open access journals**

**Effects of flow scarcity on leaf-litter processing under oceanic climate**

Martinez et al., Sci Total Environ, vol 503-504, pp 251-257

**Application of hypercorrelated matrices in ecological research. Computational Biology and Bioinformatics**

Karađić et al., Computational Biology and Bioinformatics, vol 2, pp 57-62

**Monitoring of event-based mobilization of hydrophobic pollutants in rivers: Calibration of turbidity as a proxy for particle facilitated transport in field and laboratory**

Rügner et al., Sci Total Environ, vol 490, pp 191-198

**Dynamics of suspended sediment borne persistent organic pollutants in a large regulated Mediterranean river (Ebro, NE Spain)**

Quesada et al., Sci Total Environ, vol 473-474, pp 381-390

**Managing the effects of multiple stressors on aquatic ecosystems under water scarcity. The GLOBAQUA project**

Navarro-Ortega et al., Sci Total Environ, vol 503-504, pp 3-9


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GLOBAQUA events

PAST EVENTS
The GLOBAQUA Kick-off meeting took place in Barcelona (Spain), in February 2014. At the same time the steering committee and the advisory board met. In June 2014 the steering committee and the advisory board met the scientific officer in Brussels.

The first annual general assembly was held in Athens (Greece) in November 2014.

In December 2014 the GLOBAQUA-Cytothreat-Endetech-Scarce Workshop “pharmaceuticals in wastewaters and surface waters under multistressors situation” was held in Barcelona (Spain).

UPCOMING EVENTS
- 02-03 March 2015 (Barcelona, Spain): technical meeting on sampling campaign
- 09-12 March 2015 (Trento, Italy): A short Course on Hydrological Modelling
- 03-07 May 2015 (Barcelona, Spain): session on ‘Prioritization and management of multiple stressors in river basins: the experience from multidisciplinary project’ at SETAC Europe 25th Annual Meeting
- 17 June 2015 (Milan, Italy): Open workshop at EXPO 2015
- 09-12 June 2015 (Copenhagen, Denmark): 13th International AquaConSoil
- 29 June - 01 July 2015 (Leipzig, Germany): Common PhD conference EDA-EMERGE, SOLUTIONS, MARS, GLOBAQUA, Healthy Aquatic Ecosystems

More detailed information on GLOBAQUA events can be found at http://www.globaqua-project.eu/en/events/

GLOBAQUA in the news

El Ebro, y otros cinco ríos mediterráneos, serán analizados para prever futuros escenarios ante el cambio global

El ICRA alerta de que la escasa legislación sobre ríos temporales perjudica su conservación

Divulgagua.usual.es - http://divulgagua.usal.es

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January 2015
www.globaqua-project.eu
GLOBAQUA communication

Feasibility of using desalination for irrigation in the Sous Massa region in the south of Morocco
Oral Presentation by IAVCHA
International Conference on Desalination Environment and Marine Outfall Systems (Muscat Oman, 13-17 April 2014)

Monitoring of event based mobilization of hydrophobic pollutants in rivers: Calibration of turbidity as a proxy for particle facilitated transport
Oral Presentation by EKUT
IDRA14 Bologna Italy, 18-21 August 2014

Assessment of river water quality in catchments: Impact of urbanization on particle bound pollutant fluxes
Poster Presentation by EKUT
SETAC Europe 24th Annual Meeting (Basel Switzerland, 11-15 May 2014)

Components of longwave atmospheric radiation: NewAge-LWRB
Poster Presentation by UNITN
PhD Days 2014 (Bologna Italy, 03 June - 02 July 2014)

Changes in stream discharge affect more benthic than hyporheic breakdown
Oral Presentation by UPV/EHU

Effects of aeration and sediment size on invertebrate interactions and litter breakdown
Oral Presentation by UPV/EHU

Effects of wastewater treatment plant effluents on the metabolism of a Mediterranean river
Oral Presentation by UPV/EHU
XVII Meeting of the Iberian Limnological Association (Santander Spain, 6 - 11 July 2014)

Multiple stressors in the Sava River watershed
Oral Presentation by JSI

So what? Consequences of altering plant litter processing in freshwaters
Oral Presentation by UPV/EHU

Multiple-trait based approaches in stream ecology: lessons for bioassessment
Oral Presentation by CNRS-LEHNA
CEMIG seminar (Belo Horizonte Brasil, 28 - 31 July 2014)

The use of species traits in freshwater ecology: from theory towards practical applications
Invited seminar at University of Belo Horizonte (Belo Horizonte Brasil, 28 - 31 July 2014)
Oral Presentation by CNRS-LEHNA

The Chironomidae community response to substrate changes in a lowland river (Balkan Peninsula)
19th International Symposium on Chironomidae (Ceské Budejovice Czech Republic, 18-21 August 2014)
Poster Presentation by IBISS

Elaboration of a European Chironomidae (Order Diptera) trait database at the genus level using a fuzzy coding approach
19th International Symposium on Chironomidae (Ceské Budejovice Czech Republic, 18-21 August 2014)
Oral Presentation by CNRS-LEHNA

Studio della vorticita nei mezi porosi etereogenei
Componenti della radiazione solare ad onda lunga: NewAge-LWRB
IDRA14 - Convegno Nazionale di Idraulica e Costruzioni Idrauliche (Bari Italy, 08-10 September 2014)
Poster Presentations by UNITN

La hidromorfología y el funcionamiento de los ecosistemas fluviales, claves para restaurar los servicios ecosistémicos
VI congreso Argentino de Limnología (La Plata Argentina, 14-18 September 2014)
Oral Presentation by UPV/EHU

Emerging contaminants: mode of actions, risks and control perspective
Ecotox 2014 (XII Congreso Brasileiro de Ecotoxicologia) (Guarapari Brasil, 26 Septembre 2014)
Oral Presentation by IDAEA-CSIC
Emerging contaminants: mode of actions, risks and control perspective
Ecotox 2014 (XII Congreso Brasileiro de Ecotoxicologia) (Guarapari Brasil, 26 Septembe 2014)
Oral Presentation by IDAEA-CSIC

Analysis, fate and effects of emerging environmental contaminants in the aquatic environment
Symposium Molecular Sciences: Facing Up to Major Societal Challenges (Nancy France, 02-03 October 2014)
Oral presentation by ICRA

Hydrological model of Ljubljansko polje aquifer
4th Geological Congress (Ankaran Slovenia, 08-10 October 2014)
Oral Presentation by JSI

Development of integrated land use and water management scenarios based on climatic and socio-economic forcing
Poster Presentation by LMU

Water scarcity in humid-climate streams: a manipulative experiment
Oral Presentation by UPV/EHU

Changes in stream discharge affect more benthic than hyporheic breakdown
Oral Presentation by UPV/EHU

Effects of aeration and sediment size on invertebrate interactions and litter breakdown
Oral Presentation by UPV/EHU

Assessment of global change impacts on groundwater resources in Sous- Massa basin
Oral Presentation by IAVCHA

Assessment of the potential of the Wastewater Treatment and Reuse in Morocco under climate and global changes
Poster Presentation by IAVCHA

Fate, effects and management of emerging contaminants in Mediterranean river catchment under water scarcity
Oral Presentation by IDAEA-CSIC

EuroMED Cooperation. Inland and marine water challenges (Napoli Italy, 03-04 November 2014)

Driving forces of land use change in mountainous catchments – The Ebro basin
Oral Presentation by LMU

A short analysis of the CMIP5 precipitation projections over the Adige catchment
Oral Presentation by LMU

MICMoR Research Forum (Fresing, 13 November 2014)

Fate, Effects and Management of Emerging Contaminants in River Catchments under Water Scarcity
Oral Presentation by IDAEA-CSIC

Water: the greatest global challenge (Dublin Ireland, 28 November 2014)

Persistence of wastewater-related xenobiotics during transport along an urban river segment
Oral Presentation by EKUT

Globaqua-Cytothreat-Endetech-Scarce Workshop (Barcelona, Spain, 02-03 December 2014)

Aldaketa klimatikoaren albo-ondorioak: ur detrakzioen eragina ibai-ekosistemen funzionamenduan
Oral Presentation by UPV/EHU

Klimagune Workshop 2014. Opportunities and challenges for rural area in the context of climate change (Bilbao Spain, 04 December 2014)

Best practices of using saline water in agriculture in Morocco
Oral Presentation by IAVCHA

Arab Water Forum (Cairo Egypt, 09-11 December 2014)
www.globaqua-project.eu