GLOBAQUA has just ended its 3rd year of project development. Although there are still many months to go, some of the results of the project are already published, including a special issue that has been released in STOTEN with those contributions presented in the 1st GLOBAQUA International Conference, among others. A fast revision of the work done reveals us that an interactive internet platform (Water-Hub) enabling the search and retrieval of information from already existing web sources has been designed and implemented. A comparison of high-resolution modelling with larger scale modelling for selected hydrological indicators has been performed together with the assessment of the uncertainties related to hydrological modelling on how such uncertainties may affect decisions. The main factors and relationships that drive sediment fluxes at the basin scale have been determined together with the assessment of particle related pollutant concentrations based on event sampling campaigns.

The first event-driven field samplings were performed at the Sava River under high water levels during the flush events and in the Evrotas to study the behavior of microcontaminants and nanomaterials under severe drought conditions. The biological results of the two general samplings showed a first overview of the hotspot sites where community diversity changes and some of the stressors related to these changes start to unravel. When considering ecosystem functioning, an experiment in the Ebro River basin about the interaction between urban pollution and drought has been finished and a parallel experiment on effects of olive mill effluents on stream ecosystem functioning has been designed for the Evrotas. A methodology that accounts for all components of costs, financial, environmental and resource cost has been developed in order to estimate the rate of cost recovery for water uses.

The climate change and socioeconomic scenarios have been constructed and the information on ecosystem services under each scenario is being produced. Finally, the extend to that problems and delays with the Water Framework Directive’s implementation associated with this implementation process itself were investigated. Evidence from the GLOBAQUA case have also been reviewed, securing the user perspective from the river basin level and bridging the science-policy gap. The knowledge integration has been investigated through questionnaires and interviews to enhance the collaboration of stakeholders and GLOBAQUA partners. We have been working on translating the outcomes of the analysis regarding the WFD implementation through the development of the first policy oriented briefs.

GLOBAQUA on YouTube

A dedicated YouTube channel was created to disseminate the whole video material produced along the project.

A growing number of short videos are published in the “GLOBAQUA” playlist. Among the others, you can find 1 video presenting the main aims and objectives of the project including short interviews to our Coordinator and to each Module Leader.

In addition, 4 videos describing the main features of some project case studies (Adige, Anglian, Ebro, Evrotas) as well as 1 video showing the outcomes of our last training course on the use of stable isotopes held in Ljubljana (Slovenia) last October.
Training course on the use of stable isotopes in investigations of hydrological processes and climate change

The training course was organized by Jožef Stefan Institute (JSI) in Ljubljana, Slovenia on 10-13 October 2016. 35 participants from Germany, Hungary, Serbia, USA, UK and Slovenia attended the event.

The course was designed for researchers (master, doctoral and postdoctoral level) and other scientists interested in the use of stable isotopes and other tracers in hydrological studies. On the first day, 7 invited lectures were given with the aim to introduce the basic principles behind isotopic and chemical tracer modeling. In the second day the sampling to two different locations (Zelenci – the source of the Sava River and Radovljica) was organized, while in the third day samples were prepared for stable isotope measurements.

The last day started with the presentation entitled: “Climate change: processes, impacts and markers” given by S. Lojen, followed by the presentation of results and work performed in the Sava River Basin. The students showed a high degree of interest on the topics included in the course as well as on the practical sessions.

The content and development of the course completely fulfilled the expectations of both the lecturers and the students, which was also evaluated from a participant survey. A video showing the course outcomes is available on GLOBAQUA website and YouTube channel.

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A glance at research: student field trip to visit the Adige catchment

On 4-8 April 2016, a group of 24 students of the Technical University of Munich took part in the field trip to the Adige catchment organized in the context of the Water Resources Management at the Catchment Scale lecture, offered by Markus Disse, Gabriele Chiogna and Michael Tarantik. The students were divided into 6 groups dealing with different problems present in the Adige River Basin (cryosphere and climate change, hydropower and water quality impacts, biological water quality).

On Monday, students had the possibility to observe the effect of hydropoeking at the Noce River in Mezzolombardo and then visited the Santa Giustina Reservoir in Val di Non. On Tuesday, the focus was on the hydrological experiments performed in the Vermigliana catchment. In particular, water quality measurements were taken to investigate the effect of a waste water treatment plant on the creek. Moreover, it was possible to visit the experimental site managed by the group of Alberto Bellin (University of Trento) as well as historical and modern hydropower plants.

On Wednesday, thanks to the support of Meteotrentino and the company Carosello Tonale, it was possible to discuss the effects of climate change on the Presena Glacier and to observe the color of snow using an infrared thermography under the precious supervision of Arnaldo Tonelli and Fabiana Zandonai (Fondazione Museo Civico di Rovereto). The main activity on Thursday was the investigation of chemical stressors on biota. In particular, Valeria Lencioni and her team from the Science Museum of Trento introduced the students to macrobenthos sampling and classification. On the last day, the groups analyzed the data collected during the field campaign. Overall, students provided an excellent evaluation of this lecture. They appreciated the possibility of getting to know better the GLOBAQUA project and the possibility to work side by side with international groups of scientists.

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News from Sava

The Sava River is the greatest tributary to the Danube River. It is the major drainage river system of the South Eastern Europe. Hydroelectric power plants, river traffic, intensive agricultural activities and heavy industry have important influence on environment and biota in the basin. In a view of upcoming climate changes, flood flows and draughts are expected within the Sava River basin. In 2014 hundred year floods lasted from early spring till late autumn at the Sava River, while in 2015 a dry period followed. Two general sampling campaigns have been conducted in September 2014 under high water levels, after a flood wave, and in September 2015 under low water level conditions. Ecotoxicological and microbiological characterization of the river was performed. Water, sediment fish and mussel samples were taken for chemical analysis. In addition, soil samples from flooded area were also collected for metal analyses at depths 10, 20 and 30 cm and riparian plant tissue samples for analyses of pollutant accumulation. Aquatic plants were taken as well. Within the biology part, quality elements related to wild life in river aquatic (algae, macrophytes, zooplankton, macroinvertebrates and fish) and riparian ecosystems (amphibian, reptiles, birds and mammals) were investigated. The general state of biodiversity and pressure caused by invasive aquatic species was also evaluated. Data from chemical analysis indicated that the Sava River is a moderately polluted European river. In the lower Sava stretches microbiological pollution is evident due to untreated sewage discharges. Due to intensive agricultural activities, nitrates are present as pollutants in the Sava River. In the lower Sava reaches methylmercury and dioxins are biomagnified in the predator fish. The concentrations highly exceeded the values prescribed for safe consumption of the fish. To get more deep insight on biomagnification of these contaminants, additional sampling of fish was organised at the end of August 2016. Based on outcomes of the analysis, the restrictive consumption of the predator fish will be recommended to local population of the lower Sava.

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Defining ecosystem services with local stakeholders through participative workshops

Water management is everything but an exact science. Although water management calls for biology, geology, chemistry, etc... its management is transdisciplinary, it is a social science and it is about making choices, built on values and best available information; but never on absolute “truth”. This approach is always a challenge to communicate to most engineers and adept of the so-called exact science. A participative approach to elicit stakeholders’ opinions and value is crucial in integrated water management and especially for the implementation of the Water Framework Directive. Stakeholder workshops enable to elicit perceived values, to validate assumption, to contextualise research and confront theory and methodology with stakeholders’ reality.

The objective was to define with local stakeholders, relevant ecosystem services (ESs) for each case study area and to down-scale the scenario “Myopic” and “Sustainable” to local situation. This task included the preparation of an elicitation stakeholder workshop during 2015/16 in each GLOBAQUA case study (i.e. Evrotas in Greece, Adige in Italy, Sous Massa in Morocco, Ebro in Spain, Anglian in the UK and Sava in Slovenia) in close co-operation between case study leaders and Alterra.

The methodology of the workshop was based on a dynamic sequence of group and individual activities to stimulate reflection and group intelligence. Each workshop started with the project objectives and a short introduction of the concept of ESs to the stakeholders. This activity enabled to start with common definitions and shared understandings. The definition ESs was done by 4 groups of 4-6 stakeholders each. Restitution of ESs by categories (Provisioning, Regulating, Cultural and Supporting) was done in plenary session.

The list of ESs that was assessed is the result of the aggregation and discussion of identified ESs per group. This list was processed into a specific questionnaire that was used during the second part of the day. This was a real-time questionnaire definition and implementation activity.

Spider web graphics were developed to illustrate the potential of ESs to contribute to local prosperity in each case study (i.e. in this page, the one referred to Ebro river basin). Colored pick represents how a given ES is perceived to bring respectively economic prosperity, cultural identity, quality of the living environment, biodiversity and social cohesion.

The stakeholders were finally asked to give their feedback and opinion about the quality of the workshop. Most participants agreed or strongly agreed with most criteria for evaluation.

In conclusion, the workshops enable to bridge the science policy gap. In the frame of GLOBAQUA we will assess population understanding and perception of water scarcity and programmes of measures aimed at the recovery of ecosystems. This activity is expected to provide unique insight on citizens’ perception on ecosystem services and the Directive.

Questions addressed during the workshop:

- Which ESs are important in the region?
- Who benefits from ESs provided by the natural environment in the region?
- Which ESs have (more) potential to contribute to local prosperity in the region?
- Which ESs are currently threatened by a decrease in the quality of the natural environment in the region?
First GLOBAQUA Policy Oriented Briefs

The ultimate goal of GLOBAQUA is to explore how current EU freshwater policy will need to be adapted to minimise the ecological, economical and societal consequences of water scarcity and ongoing global change.

EU freshwater policy contains other elements, but the Water Framework Directive (WFD), is of over-arching importance. The Directive was adopted to replace traditional management practices, predicated upon the command and control paradigm that looked at pressures in isolation and reduced environmental systems to their constituent elements when setting specific water objectives. Its introduction aimed to facilitate a shift from these policies to a holistic approach integrating all parts of the wider environmental system. Acknowledging that catchments differ from each other in terms of both socio-political and natural conditions, it signified a shift towards river basin management and systems thinking. The WFD was recognised as the first European Directive that focused on environmental sustainability and its introduction and innovations created a revolutionary prestige for the Directive, which was considered as a potential template and pilot for future environmental regulations.

However, fifteen years after the WFD was introduced, achieving its objectives remains a challenge. Despite some good progress, nearly half of EU surface waters (47%) did not reach the good ecological status in 2015 – a central objective of EU water legislation. In essence, the WFD has been criticised due to the limited progress in delivering water quality improvements across Europe.

In order to understand the problems with the WFD implementation, policy analysis and research undertaken within GLOBAQUA has been summarised in a first set of policy briefs. The briefs shed light on why the great expectations that came with the Directive have not yet been fully realised.

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MAIN MESSAGES

• The effectiveness of the WFD and its approach has been widely questioned due to the limited progress in delivering water quality improvements across Europe.

• The absence of the harmonised transposition of the WFD paradigm, the key to delivering good ecological status, was identified as a fundamental problem with its implementation.

• The process of acquiring in depth understanding of the catchment rather than the more traditional focus on policy compliance requires a fundamental shift to systems thinking.

• Improving water status by managing pressures, improving participation and interdisciplinarity to address the complex issues associated with water management, all call for a transition towards systemic thinking that can only be achieved with real transformational change.

• Implementing the WFD like any other directive is not going to work. Unless current implementation efforts are reviewed or revised, the fading aspirations of the initial great expectations could disappear for good.
Recent publications

**Module 1 ▶ STRESSORS**

Age-ranked hydrological budgets and a travel time description of catchment hydrology – Rigon et al., Green Hydrology and Earth System Sciences 20, 4929–4947.


Optimization of the procedure for efficient dispersion of titanium dioxide nanoparticles in aqueous samples - Vidmar et al., Analytical Methods 8, 1194-1201.

MALDI-TOF MS Imaging evidences spatial differences in the degradation of solid polycaprolactone diol in water under aerobic and denitrifying conditions - Rivas et al., Science of the Total Environment 566, 27–33.

Using total suspended solids (TSS) and turbidity as proxies for evaluation of metal transport in river water - Nasrabadi et al., Applied Geochemistry 68, 1-9.

Selecting regional climate scenarios for impact modelling studies - Renate et al., Environmental Modelling & Software 78, 191-201.


Flooding modifies the genotoxic effects of pollution on a worm, a mussel and two fish species from the Sava River - Aborgiba et al., Science of the Total Environment 540, 358-367.


**Module 2 ▶ RECEPTORS**


Nutrients versus emerging contaminants - or a dynamic march between subsidy and stress effects on stream biofilms - Aristi et al., Environmental Pollution 212, 208-215.

Haplotype variation in the Physa acuta group (Basommatophora); genetic diversity and distribution in Serbia - Raković et al., Mediterranean Marine Science 17, 292-301.

Shared effects of organic microcontaminants and environmental stressors on biofilms and invertebrates in impaired rivers - Sabater et al., Environmental Pollution 210, 303-314.


Stream Biofilm Responses to Flow Intermittency: From Cells to Ecosystems - Sabater et al., Frontiers in Environmental Science 4, 14.

Synthesising the trait information of European Chironomidae (Insecta: Diptera): Towards a new database - Serra et al., Ecological Indicators 61, 282–292.

**Module 3 ▶ IMPLICATIONS**

Biochemical indicators and biomarkers in chub (Squalius cephalus L.) from the Sava River - Mihailović et al., Science of the Total Environment 540, 368-376.


**Module 4 ▶ ENVIRONMENTAL MANAGEMENT**

Development of an integrated methodology for the sustainable environmental and socio-economic management of river ecosystems - Koundouri et al., Science of the Total Environment 540, 90-100.

This is a selection of the articles published in 2016, these ones and much more can be downloaded at www.globaqua-project.eu
Workshop on reconnaissance of trace organic compounds and metals in GLOBAQUA river basins

This GLOBAQUA workshop will compile the data obtained from the chemical analysis performed in the samples from the GLOBAQUA basins. Several priority and emerging pollutants, as well as nanomaterials, have been analysed in Adige, Evrotas and Sava in order to identify relevant multi-stress situations across these basins of study. With these data it is possible to study the fate and behaviour of these pollutants under multiple-stress conditions and their potential effects on ecosystems as well as their associated risk. As a further step the preliminary results of the controlled field experiments and manipulative laboratory experiments testing the effects of multiple pressures on fate and behaviour of pollutants will be also presented.

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Forthcoming events

- International Symposium - LABS in a CRYSTAL BALL: New trends for multi-components analysis
  2-3 March 2017, Barcelona, Spain
  www.aoaceurope.com

- International Symposium - The effects of global change on floods, fluvial geomorphology and related hazards in mountainous river
  6-8 March 2017, Potsdam, Germany
  jalopez@uni-potsdam.de

- EGU2017 - European Geosciences Union General Assembly 2017
  23-28 April 2017, Vienna, Austria
  www.egu2017.eu

- IASWS 2017 - 14th International Symposium on the Interactions between Sediments and Water
  21-26 May 2017, Taormina, Italy
  www.iasws2017.altervista.org

- AquaConSoil 2017 - Sustainable Use and Management of Soil, Sediment and Water Resources
  26-30 June 2017, Lyon, France
  www.aquaconsoil.org

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