



## BOOK OF ABSTRACT

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### I. SESSION DESCRIPTION

ID: S5

Promoting sustainability through water-related concepts, approaches and tools for quantifying ES

#### Hosts:

|                         | Title | Name                 | Organisation  |
|-------------------------|-------|----------------------|---|
| <b>Host:</b>            | Dr.   | Kremena Burkhard     | Institute of Environmental Planning, Leibniz Universität Hannover                   |
| <b>Co-host(s):</b>      | M.Sc. | Paulina Guerrero     | Institute of Environmental Planning, Leibniz Universität Hannover                   |
|                         | Dr.   | Blal Adem Esmail     | Department of Civil, Environmental and Mechanical Engineering, University of Trento |
| <b>Others involved:</b> | Prof. | Christina von Haaren | Institute of Environmental Planning, Leibniz Universität Hannover                   |
|                         | Dr.   | Nidhi Nagabhatla     | United Nations University – Institute for Water, Environment and Health (UNU-INWEH) |
|                         | Dr.   | Derek Vollmer        | Conservation International  |



### Abstract:

Multiple water-related concepts and approaches have been developed and applied in different fields of science, including surface and ground water hydrological models, hydraulic models, water-use efficiency models, and water footprint. Nevertheless, they are often applied independently within a disciplinary context, and without duly addressing the possibilities of their implementation in real-life integrated water resources management (IWRM) aiming to promote water security and sustainability. According to the UN-Water, water security is “the capacity of a population to safeguard sustainable access to adequate quantities of and acceptable quality of water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability” (UN-Water). Water security is only achievable through sustainable and informed water management. Indeed, water-related concepts and approaches can be a valuable source of hydrological and other quantitative variables that can serve as indicators for the quantification of water-related ecosystem services (ES) beyond the available monitoring data. Furthermore, through coupling of existing concepts and approaches and their integration within ecosystem service assessments, we can better and more precisely understand the existing trade-offs and synergies between the water-related and other ES and, ultimately, promote sustainable water futures. In fact, the IPBES Methodological Assessment of Scenarios and Models of Biodiversity and Ecosystem Services have identified the lack of integration between existing models and concepts as a key issue for the operationalization of the ES concept. In this session, we would like you to share your experience in relation to the application of water-related concepts and approaches for quantification of ES and to what extent such concepts and approaches have contributed to building sustainable water management.

### Goals and objectives of the session:

Some of the questions that we would like to address in this session are:

1. How different concepts, approaches and quantitative water-related tools can contribute to promoting water security and sustainable water management in real-life?
2. Specifically, what is the added value of coupling different concepts, approaches, and tools for: a) Decision-making; b) Planning; c) Practice; and d) Science?
3. What type of final results (with or without coupling) is most useful to promote water security/sustainable water management?
4. In your experience, do you think water-related concepts, approaches, and quantitative tools are well integrated in real-life water management? If not, why is that?
5. Does using water models/tools for ecosystem service assessment support and enrich the ES field? If yes, how?



If you think you can contribute to answering at least one of these questions – this is your session! We will appreciate it, if you can reflect to the questions in your presentation.

**Planned output / Deliverables:**

The session will provide an overview of the state of art in the field and identify gaps and opportunities for empowering sustainable water management through quantitative assessments.

Options to prepare a common review paper or special issue will be explored during the session.

**Related to ESP Working Group/National Network:**

[Sectoral Working Groups: S5 – ES in water management](#)

**II. SESSION PROGRAM (S5)**

**Date of session:** Tuesday, 16 October 2018

**Time of session:** 8:45 – 13:00

**Timetable speakers**

| Time      | First name | Surname    | Organization                                      | Title of presentation   |
|-----------|------------|------------|---|---|
| 8:45–9:00 | Kremena    | Burkhard   | Leibniz<br>Universität<br>Hannover                | Welcome and Introduction to<br>the Session  |
|           | Blal       | AdemEsmail | University of<br>Trento                           |   |
| 9:00–9:15 | Kremena    | Burkhard   | Leibniz<br>Universität<br>Hannover                | The added value of coupling<br>water-related models and<br>concepts for ecosystem service<br>assessment – examples and<br>steps towards sustainable water<br>management |
| 9:15–9:30 | Diana      | Derepasko  | UFZ –<br>Helmholtz<br>Centre for<br>Environmental | Towards an integrated<br>environmental flow assessment<br>at multiple scales  |



| Time        | First name | Surname       | Organization                                      | Title of presentation   |
|-------------|------------|---------------|---|---|
|             |            |               | Research  |   |
| 9:30–9:45   | Katrien    | Van der Biest | University of Antwerp                             | Protecting and restoring raw water sources through landscape restoration  |
| 9:45–10:00  | Hatem      | Khedr         | UFZ – Helmholtz Centre for Environmental Research | Trend impact analysis of land–water regulations and climate change on environmental flows and related ecosystem services in drought–vulnerable regions                        |
| 10:00–10:05 | Anna       | Schlattmann   | Leibniz Universität Hannover                      | Water use sustainability assessments – a review of concepts addressing quantitative water issues in support of the Sustainable Development Goals (SDGs) (Poster presentation) |
| 10:05–10:15 |            |               |   | Discussion  |
| 10:15–10:45 |            |               |   | Coffee<br>Break   |
| 10:45–11:30 |            |               |   | Keynote (plenary)   |
| 11:30–11:45 | Blal       | Adem Esmail   | University of Trento                              | Unpacking the urban water security nexus using ecosystem services and nature–based solutions as guiding frameworks  |
| 11:45–12:00 | Bernadett  | Gálya         | University of Debrecen                            | Evaluation of land use changes of inland water areas in the Carpathian Basin  |
| 12:00–12:15 | Erika      | Buday–Bódi    | University of                                     | Potential and challenges in geothermal groundwater  |





| Time        | First name | Surname         | Organization                          | Title of presentation   |
|-------------|------------|-----------------|---------------------------------------|---|
|             |            |                 | Debrecen                              | utilization in the Great Hungarian Plain  |
| 12:15–12:30 | Erik       | Gomez–Baggethun | Norwegian University of Life Sciences | The threatened value of white spaces: Ecosystem services provided by ice and snow |
| 12:30–13:00 |            |                 |                                       | Discussion & wrap up  |

### III. ABSTRACTS

The abstracts appear in alphabetic order based on the last name of the first author. The first author is the presenting author unless indicated otherwise.

#### 1. Type of submission: **Abstract**

S. Sectoral Working Group sessions: S5 Promoting sustainability through water-related concepts, approaches and tools for quantifying ES

#### Unpacking the urban water security nexus using ecosystem services and nature-based solutions as guiding frameworks

*First author:* Blal Adem Esmail, Nidhi Nagabhatla

*Other author(s):* Davide Geneletti

*Affiliation:* Department of Civil, Environmental and Mechanical Engineering, University of Trento, Trento, Italy, United Nations University – Institute for Water, Environment and Health (UNU-INWEH), Hamilton, Ontario, Canada

Increasing urbanization trends coupled with environmental and climate change impacts is exacerbating security and wellbeing of the urban communities. Worldwide, the hard engineering initiatives and strategies towards the water security agenda are mostly standard engineered interventions that are cost-intensive or environmentally intrusive systems. Urban Water Security is amid, the suite of challenges that are of priority for sustainable urban management. Unpacking the urban-water nexus remains pertinent to mitigate heavy damage and loss of public and private assets and human lives. Noting that, we employed ecosystem (based) services approach (EBA) and nature-based solutions (NBS) conceptual framings, to outline alternatives and practical options for addressing water crisis. Case study method is employed to explain these frameworks related, projects and interventions can serve effectively for creating a water secure and resilient communities, while support



implementation of water-related Sustainable Development Goals (SDGs). The first section will explain how the flow of ecosystem services underpins urban well-being. The second section will provide highlights of a recent global scale synthesis that explains the socio-ecological, socio-cultural, and socio-political limitations and challenges in managing, and how the NBS thinking could steer the discussions on the effective management of urban wetland systems. Overall, the knowledge and, examples of how cities and communities are considering adopting NBS to address water security needs and water-related SDGs and targets will be included. Cities and communities need to better prepared to address the existing and projected challenging in ensuring urban water security [coping with long and short-term uncertainties, designing technological and policy interventions] for the restoration of ecological infrastructure and the suite of services and benefits derived it. Therefore, our concluding notes will focus on how unpacking the urban-water nexus remains pertinent to mitigate heavy damage and loss of public and private assets and human lives.

**Keywords:** urban water security, nature-based solutions, resilience, ecosystems services

2. *Type of submission: Abstract*

S. Sectoral Working Group sessions: S5 Promoting sustainability through water-related concepts, approaches and tools for quantifying ES

### **Potential and challenges in geothermal groundwater utilization in the Great Hungarian Plain**

*First author:* Erika Buday-Bódi

*Other author(s):* Tamás Buday, Levente Molnár, János Tamás

*Affiliation, Country:* University of Debrecen, Hungary

Utilization of groundwater, especially geothermal water, is a great possibility and responsibility at the same time. It holds many uncertainties and risks from the very beginning modeling phases to its final phases. Reservoir characteristics, the purposes of utilization, the geographic, natural, the socio-economic, technical and legislative environment, and challenges of the future all determine the management of geothermal water utilization. The goal of the study is to examine the possible ways, the potential and the possible challenges of geothermal groundwater utilization in order to enhance the harmonious and sustainable implementations in practice in the northern part the Great Hungarian Plain by using tools of geoinformatics and geostatistics. To achieve this, types of the groundwater resources (hydro-geothermal characteristics, reservoirs types, thickness, porosity, depths, temperatures, etc.) are studied and the amount of groundwater and its heat



content are estimated. We investigate the thermal wells of the research area and the possible demand for geothermal energy and geothermal water for different purposes (residential, agricultural, and industrial). Already installed capacity and the potential of future utilization are also taken into consideration. There are many various ways to utilize geothermal groundwater, e.g. in greenhouse heating, soil heating, aquaculture, food drying, milk pasteurization, preheating and heating processes, evaporation and distillation processes, sterilization processes, irrigation using geothermal water, etc., which are to be developed in this region. In the study the occurring challenges are highlighted in order to reduce environmental impact and increase efficiency. The more we produce and utilize, the greater the environmental impacts, moreover, the more alignment and waste management is required. Possible complex and diverse utilization solutions are required, however, this indicates further modeling work and assessments. This research was supported by EFOP-3.6.2-16-2017-00001 project (Research of complex rural economic and sustainable development, elaboration of its service networks in the Carpathian basin).

**Keywords:** groundwater management, geothermal water utilization, Great Hungarian Plain

3. *Type of submission: Abstract*

S. Sectoral Working Group sessions: S5 Promoting sustainability through water-related concepts, approaches and tools for quantifying ES

### **The added value of coupling water-related models and concepts for ecosystem service assessment – examples and steps towards sustainable water management**

*First author:* Kremena Burkhard

*Other author(s):* Christina von Haaren, Anna Schlattmann, Felix Neuendorf, Stoyan Nedkov, Benjamin Burkhard, Bethanna Jackson

*Affiliation, Country:* Institute of Environmental Planning, Leibniz Universität Hannover, Germany,

Addressing water sustainability requires a multi-dimensional approach that couples hydrological interactions within the socio-ecological system. Both physical and socio-economic water flows are complex and generally impossible to fully tackle within a single existing tool or concept. The integration of different players and perspectives are crucial for securing sustainable water consumption where all users, including biodiversity and vulnerable habitats, are not deprived of basic water supply. Adding the ecosystem services (ES) perspective to water-related analysis provides tools for understanding the competition (trade-offs and synergies) between water and other resources and ES essential for





sustainability. Herein concrete case study examples from Bulgaria and USA are presented, where hydrological models are applied in combination with the water footprint concept in order to assess the supply of water-related ES, along with demand for water purification in Bulgaria. The quantitative and spatially distributed results of the assessments are presented through maps and graphs that locate areas with high and low supply of water-related ES and provide important spatial reference for identifying vulnerable areas. The results can serve as decision support information tools in water management. Nevertheless, the integration of sustainability indicators beyond the hydrological variables is required, in order to address the water-related UN Sustainable Development Goals (SDGs). The case study methodologies are further extended and built upon for the better understanding of the sustainability of virtual water flows involved in the agricultural production and distribution. For that purpose, other relevant existing tools and concepts that have high potential to address the water security objectives are identified (based on review). Finally, the limitations and uncertainties related to the different concepts and tools are discussed (including technical aspects as scale and resolution) and to what extent they are suitable for answering the complex multi-perspective questions related to sustainable water management.

**Keywords:** water sustainability, coupling tools, decision support, SDGs, virtual water

4. *Type of submission:* **Abstract**

S. Sectoral Working Group sessions: [S5 Promoting sustainability through water-related concepts, approaches and tools for quantifying ES](#)

## **Towards an integrated environmental flow assessment at multiple scales**

*First author:* Diana Derepasko

*Other author(s):* Michael Strauch, Felix Witing, Martin Volk

*Affiliation, Country:* UFZ – Helmholtz Centre for Environmental Research, Germany

Environmental flows (e-flows) are paramount for the livelihood of aquatic ecosystems and the fulfillment of human needs. However, inappropriate river flow management, in addition to ongoing climate change, can alter the health of these ecosystems at the expenses of additional benefits that people perceive indirectly. Poorly-informed decisions are subjected to uncertainty related to socio-environmental trade-offs, system boundaries and hydro-ecological linkages. As a result, the challenges that the water sector is expected to face arise from these multi-layered fuzzy interactions that hinder the identification of desirable solutions, especially when the harmonization of conflicting interests is required. In this frame, a holistic assessment approach to support the implementation of enhanced e-flow





management practices is needed to carefully evaluate the impacts and the risks towards the maximization of nested opportunities. In order to fulfill this need, we present the conditional dependencies between e-flows components, riverine ecosystem processes and related services, made explicit by means of a probabilistic model. A multi-scale perspective will be applied to uncover influential factors that affect each spatial reference system as well as linkages among aquatic biodiversity and hydrological conditions. In addition, we will review how these relationships have been accounted for the identification of balanced regulation options. In particular, we will analyze the employment of multi-objective optimization approaches for the evaluation of stakeholders' preferences and policy options on scale-specific and spatially-explicit ecological components. Riverine ecosystem services will be considered as socio-ecological indicators. The presented knowledge-base will underpin the definition of a novel framework that can support the analysis of socio-environmental trade-offs and synergies. By doing so, it aims to contribute to the adoption of good-practices by guiding water sector actors in the identification of globally-advantageous abstraction operations. The ultimate goal is to foster the achievement of sustainable e-flow management at multiple scales.

**Keywords:** e-flows, multi-criteria optimization, trade-offs, ecosystem services, integrated assessment

5. *Type of submission: Abstract*

S. Sectoral Working Group sessions: [S5 Promoting sustainability through water-related concepts, approaches and tools for quantifying ES](#)

### **Evaluation of land use changes of inland water areas in the Carpathian Basin**

*First author:* Bernadett Gálya

*Other author(s):* Lajos Blaskó Csaba Juhász, János Tamás, University of Debrecen,

*Affiliation, country:* University of Debrecen, Institute of Water and Environmental Management, Debrecen, Hungary. University of Debrecen, Arid Land Research Center, Debrecen, Hungary

Management, Debrecen, Hungary

The study of land use change is increasingly focusing on global and regional environmental problems (deforestation, water scarcity, climate change), for which complex monitoring of the Earth's surface and its use is essential for forecasting trends and predicting future conditions. Production risk includes risks and uncertainties of growth processes in crop production. Quantitative and qualitative characteristics of products may be determined by different factors including, inter alia, drought, inland water and diseases. Preparing for



climate change plays a major role in the sustainable use of different resources usable for agriculture. Regarding the risk of climate change, risks associated with water constitute one of the main threats for agricultural production. Extremes in water management occur often in the same year and mostly in the same region, however, in other instances they may vary a lot both in time and space. The experience gained over the last decade confirms that in the Carpathian basin despite the more frequent droughts, risks of inland inundations and floods must also be taken into account. Land use change may adversely affect the run-off and accumulation processes and it may increase the risk of inland water occurrence. One of my purposes was the assessment of relations between the run-off and accumulation processes of inland water applying time series of remote sensing radar data since one possible approach for monitoring the inland water phenomena and characterising its occurrence risk might be the evaluation of radar images. Thus, the land use changes were evaluated between 2006 and 2012 in the sample area, furthermore based on Sentinel 1 data, water patches were limited in case of irrigated arable lands and grasslands. This research was supported by EFOP-3.6.2-16-2017-00001 project (Research of complex rural economic and sustainable development, elaboration of its service networks in the Carpathian basin).

**Keywords:** CLC, Sentinel 1, land use changes, inland water, radar

6. *Type of submission:* **Abstract**

S. Sectoral Working Group sessions: [S5 Promoting sustainability through water-related concepts, approaches and tools for quantifying ES](#)

### **The threatened value of white spaces: Ecosystem services provided by ice and snow**

*First author:* Erik Gomez-Baggethun

*Affiliation, Country:* Norwegian University of Life Sciences (NMBU) and Norwegian Institute for Nature Research (NINA), Norway

A large body of literature has paid attention to the ecosystem services produced by vegetation and wetlands, often portrayed as forms of 'green and blue infrastructure'. In contrast, very little attention has been devoted to understand the ecosystem services provided by ice and snow, or what we may refer to as 'white infrastructure'. Ice and snow permanently cover more than ten percent of the Earth surface, and act as important regulators of global climate, ocean currents and other important Earth system processes. Some 77% of the globe's freshwater are bound up within the ice. Besides the critically important role they play as providers of regulating ecosystem services at global scale, ice and snow provide a wide range of benefits to local peoples. They provide tourism and



recreational opportunities and can be core cultural elements of people's sense of place and identity, especially in the arctic regions. By glossing over the value of white spaces, we do not only overlook a vitally important source of ecosystem services to humans, but also the one that is most vulnerable and immediately threatened by climate and other global change. This paper aims to fill this knowledge gap by drawing attention to the importance and vulnerability of white spaces. First, we introduce, characterize and critically discuss the notions of white spaces and white infrastructure. Second, we classify and describe the most important ecosystem services provided by ice and snow. Third, we provide practical examples to illustrate the ecological, social and economic values of white spaces. Finally, we discuss the perspectives for white infrastructure and related ecosystem services in the face of global warming. The paper concludes making a case for establishing ecosystem services from white spaces more firmly in the science and policy agendas.

**Keywords:** white infrastructure, ice, integrated valuation, climate change, Arctic

7. *Type of submission:* **Abstract**

S. Sectoral Working Group sessions: [S5 Promoting sustainability through water-related concepts, approaches and tools for quantifying ES](#)

**Trend impact analysis of land–water regulations and climate change on environmental flows and related ecosystem services in drought–vulnerable regions**

*First author:* Hatem Khedr

*Other author(s):* Felix Witing, Michael Strauch, Martin Volk

*Affiliation, Country:* UFZ – Helmholtz Centre for Environmental Research, Germany

Land–water management, along with climate change, influence environmental flows and related ecosystem services especially in vulnerable dry regions (low flows). A number of land (e.g. crop rotations) and water management (e.g. abstraction rates) practices in two drought–vulnerable catchments of central Germany are investigated. The study areas are subject to increasing demand on water from different water users including agriculture (food and bioenergy production), domestic use, and natural requirement for aquatic ecosystems (habitat provision), in addition to clearly observed water quality issues. Land cover changes and management practices are most likely to influence and/or alter the hydrological functioning in the catchments, while it could either exacerbate or mitigate climate change consequences depending on the followed management strategy. Such potential impacts





need to be analyzed and understood in order to propose sustainable adaptation measures for provisioning and regulation ecosystem services within vulnerable regions. Consequently, we investigated temporal trends in hydrometeorological variables of 60 years (1956–2016) from Eine (180 km<sup>2</sup>) and Goetsche (50 km<sup>2</sup>) catchments. Trend-Free-Pre-whitening-Mann-Kendall (TFPW-MK) trend analysis is implemented to assess the significance of patterns. An initial analysis has shown decreasing trends in low flows and precipitations with increasing trends in air temperature and evapotranspiration. These trend tests have quite low significance, but they indicated possible reductions in streamflow (water provision) over either the entire test period, or during sub-record periods (seasonal dry periods). This is attributed to two factors: 1–increasing water demand, 2–climate change. Further trends are to be measured for baseflow indices which could relate to the impact of different soil tillage practices and vegetation types on soil properties (i.e., infiltration capacity, soil water repellency) and thus streamflow. The results are highlighting the importance of considering both vegetation types/dynamics and land/water management practices when assessing hydrological impacts on environmental flows and related ecosystem services for future mitigations.

**Keywords:** ecosystem services; environmental flow; low flow; land cover change; land management; water management; climate change; trend analysis; Mann-Kendall.

8. *Type of submission: Abstract*

S. Sectoral Working Group sessions: [S5 Promoting sustainability through water-related concepts, approaches and tools for quantifying ES](#)

### **Protecting and restoring raw water sources through landscape restoration**

*First author:* Katrien Van der Biest, Jan Staes

*Affiliation, Country:* University of Antwerp, University of Antwerp, Belgium

Climate forecasts indicate drier and warmer summers with more extreme precipitation (summer storms). The increase in air temperature is expected to result in a higher demand for water, as shown in the summer of 2017. During winter periods, on the other hand, total rainfall will increase. Many river basins in Europe have a disturbed hydrological system resulting from surface sealing, changes in land use, straightening and canalization of rivers for navigation and agriculture, drainage of wetlands for agriculture etc. This affects the way in which the hydrological system is capable to deal with the more extreme precipitation and temperature patterns. In 2018, the Interreg project PROWATER has been launched, involving partners from Belgium, the Netherlands and UK. The key principle of PROWATER is to make





more efficient use of (temporary) surpluses on water balances and not to drain this excess water, but to keep it upstream so that it remains available to compensate for shortages during drought episodes (summer). With this project we will not only demonstrate the potential water gains from these measures, but also develop a communication campaign and set up demonstration sites to make private owners aware (we will transform 15 ha of coniferous forest and restore 5 ha of source marshes in the vicinity of existing extractions). By identifying, quantifying and demonstrating the additional benefits (ecosystem services) of these remedial measures, the full spectrum of benefits associated with such measures can be recognized, which will further enhance the support base. Finality of the project is setting up a subsidy system for the implementation of infiltration and retention measures and embedding that as part of a climate adaptation fund.

**Keywords:** drought, adaptation measures, water restoration, landscape