

Water Research Horizon Conference 2015
Opens Space Workshop “Futures of Hydro Systems – Societal and Scientific Challenges”
Documentation

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Kurzzusammenfassung

Der Workshop widmete sich den gesellschaftlichen und wissenschaftlichen Herausforderungen von Hydrosystemen unter den Bedingungen des Anthropozäns und dessen zukünftiger Entwicklung. Im Ergebnis der interdisziplinären Diskussion wird eine Ausweitung und Vertiefung der grundlagen- und anwendungsorientierten Forschung zu folgenden Themen empfohlen: (i) Neue Messtechniken und verbesserte Modelle zur Abbildung der regionalen Besonderheiten von Wasserbilanzen einschließlich deren anthropogene Beeinflussung; (ii) erweiterte Untersuchungen der Ein- und Auswirkungen von gegenwärtigen und zukünftigen chemischen Produkten mit einer unvollständigen Mineralisierung; (iii) Analysen des anthropogenen Einflusses auf die Ökosystemfunktionen und -dienstleistungen von Binnengewässern auf der Ebene von Ökosystemen und Landschaften; sowie (iv) konzeptionelle und methodologische Weiterentwicklung der Ansätze für eine integrierte Vorausschau und Folgenabschätzung für Hydrosysteme sowie ein prospektives Wassermanagement und -Governance.

Executive Summary

The workshop was dedicated to societal and scientific challenges of hydro systems in the Anthropocene and its future development. As result of cross-disciplinary discussion, enhancement and consolidation of basic and applied research is recommended referring to the following thematic areas: (i) new measurement techniques and improved models to better represent the regional particularities of water balances also including the anthropogenic influence; (ii) enhanced investigations on emissions and effects of current and future chemical products with incomplete mineralisation; (iii) analyses of the anthropogenic influence on freshwater ecosystem functions and services on the ecosystem and landscape level; and (iv) conceptual and methodological advancements regarding foresight and integrated assessment of hydro systems as well as prospective water management and governance.

1. Objectives of the workshop

In the Anthropocene, hydro systems are characterised by comprehensive human influence with medium and long-term change. To identify the „anthropogenic signals“ in the systems' performance and to anticipate possible futures of the systems' boundary conditions with their impacts are two major challenges to improve systems' description and ensure sustainable management. However, respective knowledge and methods are still too limited and need significant advancement. Therefore, the workshop was dedicated to jointly identify research gaps and to set priorities in future research activities across disciplines. 27 participants from 18 institutions represented natural, engineering, economic, social and planning science competences. The workshop was organised in a world-café format with impulse statements at the beginning and presentations of the table results at the end.

2. Outcomes from interdisciplinary discussion

Four thematic foci were considered for cross-disciplinary identification of research gaps and their prioritisation: (i) hydrological processes at the catchment scale; (ii) aquatic environmental chemistry for chemical compounds of particular importance for the systems' qualitative state; (iii) freshwater ecosystems; and (iv) environmental and societal change referring to the systems' boundary conditions.

2.1 Hydrological processes

There has been a clear indication of requirements for further elaboration on the terrestrial part of the hydrological cycle to advance process understanding and respective methods. This particularly should comprise (i) new techniques to measure evapotranspiration and precipitation on the regional scale; and (ii) improved models to better represent regional particularities of the water balance also including the anthropogenic influence. Open access and science-community-based approaches, data provision, processing and models have been detected as a prerequisite for accelerating innovation and knowledge sharing.

2.2 Aquatic environmental chemistry

Products of incomplete mineralisation such as pharmaceuticals and other chemicals have been identified as key chemical challenge of hydro systems in the Anthropocene and should be treated within the context of both product emissions and ecosystem effects, also considering local and regional planetary boundaries. Moreover, new and more complex products resulting from current and future developments as, for example, the *Energiewende*, urban gardening and new materials (e.g. polymers and pesticides from geotextiles) should be addressed beyond existing chemical compounds. Up to now, there is a lack of scale-specific approaches to properly analyse criticality and to efficiently manage the amount and diversity of chemicals for entire hydro systems.

2.3 Freshwater ecosystems

Anthropogenic change distinct in hydrological processes and cause-effect interrelations of chemical compounds influence ecosystem functions and services of freshwater hydro systems and trigger rapid biodiversity change. There is a need to broaden the scope of analysis, by describing and quantifying the rates of change including anthropogenic influence, and to consider questions related to a nexus approach such as the influence from food or energy production. The current emphasis on the level of species should be enhanced to also include processes at the ecosystem and landscape level.

2.4 Environmental and societal change

Future boundary conditions of hydro systems through especially environmental change, demographic change, technological innovation, economic development, urban and rural land-use dynamics so far often lack plausibility, comprehensiveness, consistency, cross-scale specificity, and spatio-temporal resolution to reflect real-world dynamics, practical relevance etc. Hence, conceptual and methodological advancements are required to overcome these limitations by (i) integrated foresight and assessment of hydro systems; and (ii) prospective water management and governance making use of story-and-simulation approaches and reflecting barriers and enablers of societal transition. This should additionally embrace appropriate evaluation concepts such as, for example, criticalities, stability and resilience, planetary boundaries and Sustainable Development Goals (SDGs).

3. Conclusions and recommendations

Outcomes of the workshop urgently demand for both a better understanding of the freshwater signals of the Anthropocene and more reliable integrated foresight methods suitable for anticipation of future hydro systems' boundary conditions and assessment of their impacts. Hereby, some of the issues require deepening ongoing research ("insufficiently answered old questions"), others to be entirely novel requesting for an incremental and explorative perspective ("unanswered new questions"). The authors recommend to initiate and foster basic and applied research for the before mentioned strands ranging from (i) new measurement techniques and improved models to represent the regional particularities of water balances also including the anthropogenic influence to (ii) enhanced investigations on emissions and effects of current and future chemical products with incomplete mineralisation and possibilities to improve degree and speed of mineralisation; (iii) analyses of the anthropogenic influence on freshwater ecosystem functions and services on the ecosystem and landscape level; and (iv) conceptual and methodological advancements regarding integrated foresight and assessment of hydro systems as well as prospective water management and governance.