

Global Change: Challenges for Regional Water Resources

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Within the last few decades humans have changed Earth's ecosystems more rapidly and extensively than ever before in human history (Ellis et al. 2010, Millennium Ecosystem Assessment 2005, Vitousek et al. 1997). In addition, the world has undergone vast social and economic changes (UNEP 2007, World Bank 2011). Discussions of accelerated global change are widely focused on climate change issues. Global change, however, is marked by the interdependence of physical, biogeochemical, economic, social, cultural, demographic and political processes. Humans are simultaneously partly responsible for and affected by the changes. The challenge is to identify the regional impacts of global change while taking account of a wide range of global and regional processes. By focusing on water as the resource, we accept that challenge in this special issue. Water is the basis for any kind of terrestrial or aquatic life, and the regional development of natural landscapes and societies depends to a large extent upon the availability and quality of fresh water. At the same time, water resources are affected by a wide range of changes. For instance, increasing temperature increases evapotranspiration, which can increase regional water scarcity. In addition, land use has an influence on evapotranspiration and, therefore, can influence regional water availability as well. Demographic and economic changes, on the other hand, tend to alter the quantity of water used as well as the quality of natural water bodies. Thus, water as a resource is particularly suited as a focal topic when discussing regional impacts of global change. In order to foster such discussion, and with the aim of contributing to policy-making and wider public discourses, the Berlin-Brandenburg Academy of Sciences and Humanities (BBAW) established the interdisciplinary research group *Global Change –*

Regional Development in 2008 for a period of three and a half years, bringing together a wide range of expertise. The BBAW working group examined water-related consequences of global change impacting the region of Berlin-Brandenburg and possible responses¹. Berlin-Brandenburg is a very interesting and revealing region for a number of reasons. First, the impact of climate and demographic change is already noticeable there. Second, the region has been marked by a drastic structural change of agriculture and industry since the early 1990s, which has led to new land-use systems, the disappearance of old industrial sites and a great loss of jobs. In addition, small-scale heterogeneity in terms of population density and of the contrast between urban and rural areas have a share in making the Berlin-Brandenburg region a kind of 'laboratory' for changes that are also likely to affect other parts of the world.

This special issue of DIE ERDE presents selected key topics discussed within the BBAW working group, including work by group members and invited external researchers, containing nine articles highlighting "Regional Water Challenges" resulting from different kinds of environmental and social changes. We aim to present the complexity of interaction between changes and responses. While the first four articles focus on describing climatic and hydrological changes and their causes, the following five articles focus more on possible mitigation and adaptation measures. *Ulrich Cubasch* and *Christopher Kadow* open with a comparison of global climate change estimates with change observed and predicted for the Berlin-Brandenburg region. The changing climate is a driver for changes in regional water balances. Other drivers include manifold

anthropogenic influences on the water cycle, as indicated by *Christoph Merz* and *Asaf Pekdeger*. As the authors describe, process-based knowledge of this cycle is essential for water management. *Gunnar Nützmann*, *Christian Wolter*, *Markus Venohr* and *Martin Pusch* examine the anthropogenic influence on rivers and lakes in terms of water quantity and quality during the last three millennia. While focusing at first on physical changes, such as river regulation, they also describe the effects of waste-water disposal and the diffusive nutrient input to water bodies by agriculture, with a negative impact on fish populations being one example of ecological consequences. *Sonja Germer*, *Knut Kaiser*, *Oliver Bens* and *Reinhard Hüttl* summarise local case studies concerning changing groundwater and lake levels as well as river discharge rates over the last three decades in the Berlin-Brandenburg region. The reviewed studies highlight the regional scope of the respective changes. The authors delineate the complex setting of the causes as well as consequences of ecosystems and society. As the causes can differ locally, adaptive responses might need to do so, too.

On a regional scale, *Gunnar Lischeid* and *Marco Natkin* discuss the potential of land-use change to mitigate water scarcity. Another measure to mitigate water scarcity or adapt agriculture to it is the increase of water use efficiency. For the state of Brandenburg, *Katrin Drastig*, *Annette Prochnow* and *Reiner Brunsch* examine how the efficiency of water use can be increased in plant production and livestock farming. Potential adaptation measures included in an integrated water management scheme are brought into focus by *Joachim Quast* for a former wetland in Brandenburg: the Oderbruch. While this latter paper discusses adaptation from an agricultural point of view, *Dagmar Schönheinz*, *Uwe Grünwald* and *Hagen Koch* investigate, from a technical perspective, potential adaptation measures for the Lusatia region that should become part of its regional integrated water management system. This contribution includes an interesting discus-

sion about the potential of water transfer from neighbouring catchments. Also from a technical point of view, *Frank Hüesker*, *Timothy Moss* and *Matthias Naumann* analyse why water infrastructure has to be adapted. This concluding contribution exemplifies how social, economic and environmental changes can influence the actual and future suitability of today's infrastructure. The articles of this special issue seek to demonstrate that a cross-disciplinary perspective on water-related regional changes can highlight several common challenges, including the uncertainty of future changes, the need for long-term monitoring and the crucial rule of being aware of the temporal or spatial scale on which processes of change and impact take place.

Note

¹ The whole range of key findings has been published in the working group's final publication: *Hüttl, R.F., R. Emmermann, S. Germer, M. Naumann und O. Bens* (Hrsg.): *Globaler Wandel und regionale Entwicklung. Anpassungsstrategien in der Region Berlin-Brandenburg*. – Berlin-Brandenburgische Akademie der Wissenschaften, Interdisziplinäre Arbeitsgruppen, Forschungsberichte 26. – Heidelberg et al.

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