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The Climaware project: Impacts of climate change on water resources management – regional strategies and European view

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Climate projections produced with CMIP5 and applied by the Intergovernmental Panel on Climate Change (IPCC) in its fifth assessment report indicate that changes in precipitation and temperature are expected to occur throughout Europe in the 21th century, with a likely decrease of water availability in many regions. Besides, water demand is also expected to increase, in link with these expected climate modifications, but also due to socio-economic and demographic changes. In this respect, the use of future freshwater resources may not be sustainable from the current water management perspective. Therefore adaptation strategies will most likely be needed to cope with these evolutions.

In this context, the main objective of the ClimAware project (2010-2013 - www.uni-kassel.de/fb14/wasserbau/CLIMAWARE/, a project implemented within the IWRM-NET Funding Initiative) was to analyse the impacts of climate change (CC) on freshwater resources at the continental and regional scales and to identify efficient adaptation strategies to improve water management for various socio-economic sectors. This should contribute to a more effective implementation of the Water Framework Directive (WFD) and its instruments (river basin management plans, programmes of measures). The project developed integrated measures for improved freshwater management under CC constraints.
More specifically, the objectives of the ClimAware project were to:
• elaborate quantitative projections of changes in river flows and consequences such as flood frequency, drought occurrence and sectorial water uses.
• analyse the effect of CC on the hydromorphological reference conditions of rivers and therefore the definition of "good status".
• define management rules/strategies concerning dam management and irrigation practices on different time perspectives.
• investigate uncertainties in climate model – scenario combinations. The research approach considered both European and regional perspectives, to get an integrated analysis across different spatial scales.

To fulfil the objectives of the ClimAware project, the following modelling methodology was implemented. Starting from a European modelling approach of water availability and use based on the WaterGAP3 model, the changes in the hydrologic regimes and water use of different sectors were analysed. Subsequently three case studies were used to investigate the impacts of CC at a regional scale. Regional models from three different countries and focusing on three types of water management issues were developed:
• Hydromorphology (Eder basin, Germany): By using different scenarios, the influence of CC on the hydromorphological characteristics of the River Weser according to the WFD was evaluated and proposals for implementation were given. The objective was to examine, on typical river sections, how the WFD objectives can be implemented under CC constraints.
• Dam management (Seine basin, France): Water management on the River Seine for water supply and flood alleviation is partly based on the management of artificial reservoirs. The case study developed scenarios linking the impact of CC on water resources and the expected change on the uses and on the management of the system.
• Agricultural water use (Apulia region, Italy): In this region, economic and demographic changes cause an increase in the demand for good-quality municipal and industrial water. Besides, changes in the agricultural

practices increase the demand for water in the agricultural sector. Since water is scarce in this region, the study focuses on the agricultural sector, which has the largest water saving potential.
The final assessment comprises a cross-scale integration between the European and regional modelling frameworks in order to facilitate knowledge transfer and to help establishing sustainable and integrated water resources management plans.