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Identification of critical states of water resources on the regional scale under conditions of global climate change using a multi-actor based water supply model

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GLOWA-Danube (www.glowa.org) is an interdisciplinary, international project that aims to develop integrated strategies and tools for water and land use management. It is primarily concerned with the effects of Global Change on the water cycle of the Upper Danube river basin (Germany, ˜80.0000 km2). Within GLOWA-Danube 16 natural and social science simulation models are integrated in the coupled simulation system DANUBIA. Here we present the development of 'DeepWaterSupply', a model of the water supply sector comprising water extraction, treatment and distribution. DeepWaterSupply acts as a link between the natural 'supply side', simulated by a groundwater and a surface water model, and the socio-economic 'demand side', simulated by a household, tourism, farming and economy model of water consumption in the respective sectors.

The main aim of DeepWaterSupply in the context of Global Change is to model reasonable reactions of public drinking water suppliers in response to all possible changes on the supply and on the demand side. In technical systems many reactions to outside changes involve a 'human' decision. Within the Multiactor-Approach of GLOWA-Danube, deciding entities (person, organisation, ...) may be explicitly modelled and simulated as an 'actor'. An actor observes his environment and selects plans to execute as a reaction to his observations. Thereby different actors may have different course-of-actions as well as varying preferences, represented by their individual plans and their type-specific decision procedure. The Multiactor-Approach is implemented by the generic DeepActor framework as part of DANUBIA.

Based on the DeepActor framework, the DeepWaterSupply model implements the actor type 'water supply company' (WSC). A WSC compares the demands to the state of the resources on the supply side. The demands are calculated and sent to the model DeepWaterSupply at each time step (one month) by the partner models: Household, Farming, Economy and Tourism. Each of these models uses the Multiactor-Approach as well (see also contribution of Janisch et al. to session HS38). The state of the supply side, i.e. groundwater and surface water resources, is determined using results from the natural science models (Groundwater, Rivernetwork and Soil). The approach used to derive this state from variables such as groundwater level, groundwater recharge and river discharge is described in a contribution by Barthel to this session (HS15).

Depending on the results of the comparison, a WSC chooses from different plans ranging from 'business as usual' to 'crisis management'. A plan is usually split into several steps called 'actions'. The action taken is not only dependent on demand and state of the resources but also on the type of the WSC (local, group, long distance) and its location. The strictly object-oriented DeepActor framework allows a model implementation and extension (new types, plans, ...) at a minimum effort.

For the water supply sector, the Multiactor-Approach has the advantage that it facilitates a flexible and realistic response to system changes. Scenarios can be easily defined by adjusting actor types and preferences. It is important to know that the infrastructure of individual WSC is not modelled explicitly. The final goal of the DeepWaterSupply model is not to predict the development of infrastructure or even the future economical and administrative structure of the water supply system but rather to identify critical regions or states that might occur under Global Change conditions.