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Simulation of global warming effects on the water balance of the upper Danube catchment

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Under Global Change conditions, most of the hydrological processes and such the water balance are directly affected. To understand and predict the potential effects of climatic changes it is necessary to be aware of the nonlinearity and complexity of the interactions between climate, soil and vegetation and the dependency on the scale on which these interactions are investigated. The assessment and simulation of the multidisciplinary network of related processes is at the core of contemporary hydrological sciences. Within the framework of the GLOWA-Danube project (www.glowa-danube.de), which is a transdisciplinary research initiative funded by the Federal Ministry of Education and Research (BMBF), alternatives for a sustainabe water resources management in the Upper Danube watershed under Global Change conditions are examined. For this purpose the decision support system DANUBIA was developed which combines integrative models to simulate the relevant natural and socio-economic processes: DANUBIA comprises submodels for meteorology, hydrology, hydrogeology, biology and glaciology as well as actors-based models for farming, economy, water supply, private water use and tourism. Land surface are described processes are described in a spatial resolution of 1 km and a temporal resolution of 1 hour. In this work the effects of a series of Climate Change scenarios based on IPCC trends of future temperature and precipitation on the water balance of the catchment are presented. A procedure was developed to generate a synthetical, 100 year time series of meteorological input data (2005-2104) driving the scenario simulations by selecting and rearranging months with optimal fit to the IPCCs trend from a 33 year time series of actual station recordings (1971-2003). Thus it was ensured that the physical plausibility of the observations is conserved. The results show the most important effects of

the predicted global warming on the single components of the water balance: the increase of temperature and precipitation is accompanied by an increase of radiation and evapotranspiration, but a decrease of groundwater recharge. All trends are significant in the first half of the scenario period, then they stagnate. This notable effect is caused by the limited range of conditions given by the set of measurements which can not entirely represent the predicted trends. The presented expert simulation scheme indicates that it is feasible to assess climate change effects with physically based models for mesoscale areas even for scenario durations according to the IPCC horizon.