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Projected changes of the hydrological cycle over large European catchments as simulated by the MPI-M global and regional climate models

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For the 4th assessment report of the Intergovernmental Panel on Climate Change (IPCC), the recent version of the coupled atmosphere/ocean general circulation model (GCM) of the Max Planck Institute for Meteorology has been used to conduct an ensemble of transient climate simulations These simulations comprise three control simulations for the past century covering the period 1860-2000, and nine simulations for the future climate (2001-2100) using greenhouse gas and aerosol concentrations according to the three IPCC scenarios B1, A1B and A2. For each scenario three simulations were performed. The global simulations were dynamically downscaled over Europe using the regional climate model (RCM) REMO at 0.44° horizontal resolution (about 50 km), whereas the physics packages of the GCM and RCM largely agree. The regional simulations comprise the three control simulations (1950-2000), the three A1B simulations and one simulation for B1 as well as for A2 (2001-2100). In our study we concentrate on the climate change signals in the hydrological cycle and the 2m temperature by comparing the mean projected climate at the end of the 21st century (2071-2100) to a control period representing current climate (1961-1990). The robustness of the climate change signal projected by the GCM and RCM is analysed focussing on the large European catchments of Baltic Sea (land only), Danube and Rhine. In this respect, a robust climate change signal designates a projected change that sticks out of the noise of natural climate variability. Catchments and seasons are identified where the climate change signal in the components of the hydrological cycle is robust, and where this signal has a larger uncertainty. Notable differences in the

robustness of the climate change signals between the GCM and RCM simulations are related to a stronger warming projected by the GCM in the winter over the Baltic Sea catchment and in the summer over the Danube and Rhine catchments. We suggest that the main explanation for these differences is that the finer resolution of the RCM leads to a better representation of local scale processes at the surface that feed back to the atmosphere, i.e. an improved representation of the land sea contrast and related moisture transport processes over the Baltic Sea catchment, and an improved representation of soil moisture feedbacks to the atmosphere over the Danube and Rhine catchments.