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Climate change impacts on extreme discharges in the Rhine basin

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The Rhine basin is a major river basin in Western-Europe. Its dense population and heavy industrialization make it sensitive to damage caused by extreme floods and droughts. Under climate change, the hydrological regime of the river Rhine is expected to change from both snowmelt and rainfall driven to more rainfall driven, leading to more extreme rainfall events in winter and less discharge in summer. To quantify the changes in distributions of both extreme floods and low-flow events, we use a combination of regional climate scenarios and a distributed hydrological model. Climate scenarios were provided by the Max Planck Institute fur Meteorology in the framework of the EU FP6 Integrated Project NeWater. Output data from a general circulation model were dynamically downscaled using a regional climate model to a resolution of 0.088 degrees over the entire Rhine basin, at a temporal resolution of 1 hour. Three scenarios were created, each spanning the period 2001-2100, based on three CO2-emission scenarios as defined by IPCC, ranging from low to high CO2-emission increases: B1, A1B and A2. The climate scenarios are fed to the Variable Infiltration Capacity (VIC) model to obtain river discharge information at various locations throughout the Rhine basin. VIC is a land surface model, solving the coupled water and energy balance and also accounting for sub-grid variability in land use and hydrological behavior. The VIC model was calibrated for eight sub-basins separately using atmospheric data which was obtained in a similar way as the climate scenarios but spanning the period 1991-2000. From the coupled model simulations, for every emission scenario a time series of river discharge spanning the entire 21th century is obtained, from which distributions of both extreme floods and low-flows are derived and compared to distributions from historical datasets. From these distributions, quan-

titative estimates are obtained about changes in magnitudes and frequencies of floods and droughts in the Rhine basin.