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Impacts of climate change on ecologically relevant river flow characteristics in the Danube river catchment

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River flow characteristics reflecting flow seasonality and variability such as low and high flow durations play an important role for aquatic, wetland and riparian ecosystems. Climate change might not only alter long term average flows, but also affect the hydrologic regime on smaller scales. The Indicators of Hydrological Alteration (IHA) statistics (Richter et al. 1996) characterize changes in hydrologic regime by using a suite of ecologically relevant indicators given a daily discharge time series. Eco-hydrological indicators are applied to bridge the communication gap that exists between professionals in the fields of hydrology and ecology. Such indicators can help to synthesize complex hydrological variables into ecologically-meaningful information.

For this study the eco-hydrological watershed model SWIM was applied for the whole Danube river catchment using 1224 subbasins. The SWIM model (Soil and Water Integrated Model) is a continuous-time semi-distributed watershed model, which combines hydrological processes, vegetation, erosion and nutrient dynamics at the meso- to macroscale (Krysanova et al. 1998, 2000). As the Danube river basin is climatically heterogeneous, it is characterized by a changing-complex river runoff regime varying from nival regimes in the alpine parts to mainly rain feed regimes in the lowlands. To account for these different river regimes of the Danubian tributaries, the SWIM model was calibrated separately for the major river subbasins.

After calibration and validation of the model, this study uses a set of 14 high-resolution climate change projections performed by several state-of-art GCMs and RCMs, all based on the IPCC-SRES-A1B emission scenario, from the ENSEMBLES project (EU FP6). They serve as meteorological drivers for the SWIM model to simulate future daily time series of river discharge under different scenario conditions. The derived hydrologic data series then were statistically analyzed by using selected eco-hydrological indicators to distinguish within-year variations in the stream-flow regime. The results are used to quantify the range of predictive uncertainty and to allocate robust trends.