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Analysis of the frequency of critical low water levels and flood warning water levels for the Uppest-Tisza catchment for the 21st century

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Climate change affects several sectors and environmental conditions, in particular the statistical characteristics of the runoff processes of a certain watershed. As a consequence of the higher temperature values and the altered precipitation distribution, the intensity and timing of floods and droughts, as well as their severity, may change in the coming decades. In order to develop adaptation strategies and implement an adequate water management, it is necessary to project the future trends of variables that can essentially influence water management, taking into account possible climate change scenarios, including the quantification of uncertainty.

Our aim is to investigate the runoff conditions with a special focus on the frequency of critical low water levels and the different levels of flood warnings for selected river sections (i.e. Tiszabecs, Uszti Csorna, Rahiv) in the Uppest-Tisza Basin, located in Central-Eastern Europe. For this purpose, simulations with the physically based, distributed DIWA hydrological model driven by a regional climate model simulation are completed. In order to analyse the projected changes, simulations are made for a historical period (1972–2001) as well as for two future periods (2021–2050 and 2069–2098). We also investigate how the choice of the RCP scenario (i.e. RCP2.6, RCP4.5 or RCP8.5) affects the output of the hydrological simulation. In order to assess uncertainty, time series of meteorological parameters (providing inputs for the hydrological model) are generated by a weather-generator embedded in a Monte-Carlo cycle. Therefore, several hundreds of scenarios with equal probability are available, by using only one climate model. Furthermore, a bias-correction of the climate model simulation is implemented for which the weather-generator is used by fitting the crucial distribution parameters to the reference, i.e. the so-called CARPATCLIM database.