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Simulating the impact of future climate change on runoff processes in selected catchments of Slovakia

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The future development of the runoff conditions, as a consequence of climate change, is of great interest for water managers. Information about the potential impacts of climate change on the hydrological regime is needed for long-term planning of water resources and flood protection.

The aim of this study is to evaluate the possible impacts of climate change on the runoff regime in five selected catchments located in the territory of Slovakia. Changes in climatic characteristics (i.e., precipitation and air temperature) for future time horizons were prepared by a regional climate model KNMI using the A1B emission scenario. The selected climatic scenario predicts a general increase in air temperature and precipitation (higher in winter than in summer). For simulations of runoff under changed conditions, a lumped rainfall-runoff model (the TUW model) was used. This model belongs to a group of conceptual models and follows a structure of a widely used Swedish HBV model. The TUW model was calibrated for the period of 2011 – 2019. We assumed that this period would be similar (to recent/warmer climate) in terms of the average daily air temperatures and daily precipitation totals. The future changes in runoff due to climate change were evaluated by comparing the simulated long-term mean monthly runoff for the current state (1981-2010) and modelled scenarios in three time periods (2011-2040, 2041-2070, and 2071-2100). The results indicate that changes in the long-term runoff seasonality and extremality of hydrological cycle could be expected in the future. The runoff should increase in winter months compared to the reference period. This increase is probably related to a rise in temperature and anticipated snowmelt. Conversely, during the summer periods, a decrease in the long-term runoff could be assumed. According to modelling, these changes will be more pronounced in the later time horizons.

It should be noted that the results of the simulation are dependent on the availability of the inputs, the hydrological/climate model used, the schematization of the simulated processes, etc. Therefore, they need to be interpreted with a sufficient degree of caution