EGU2020-487
https://doi.org/10.5194/egusphere-egu2020-487
EGU General Assembly 2020

Investigating the reasons for poor model performance in a changing climate

Doris Duethmann[1,2], Günter Blöschl[2], and Juraj Parajka[2]
[1]IGB Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany (duethmann@igb-berlin.de)
[2]Vienna University of Technology, Institute of Hydraulic Engineering and Water Resources Management, Vienna, Austria

Hydrological models are often applied to estimate climate change impacts on hydrology. However, several studies demonstrated that hydrological models do not perform well when applied under changing climate conditions. In order to decide on the way forward for improving hydrological modelling in climate change contexts, it is important to understand the reasons for poor performance in a changing climate, but there are only a few studies on this topic.

Here we revisit a study in Austria that demonstrated the inability of a conceptual model to simulate the discharge response to increases in precipitation and air temperature. We set up hypotheses for the differences between the observed and simulated changes in discharge and test these using simulations with various modifications of the model (including modifications of the input data, model calibration, and model structure).

The baseline model overestimates discharge trends over 1978–2013, on average over all 156 catchments, by 93 ± 50 mm yr^{-1} per 35 years. Accounting for vegetation dynamics in the calculation of reference evaporation based on a satellite-derived vegetation index, reduces the difference between simulated and observed discharge by 35 ± 9 mm yr^{-1} per 35 years. Inhomogeneities in the precipitation data, caused by a variable number of stations and, to a lesser degree, climate variability effects on the undercatch error, can explain 44 ± 28 mm yr^{-1} per 35 years of this difference. Extending the calibration period from 5 to 25 years, varying the objective function by including annually aggregated discharge data, or estimating evaporation with the Penman-Monteith instead of the Blaney-Criddle approach has little influence on the simulated discharge trends. The model structure problem with respect to vegetation dynamics has important implications for studies in a climate change context. Our results furthermore highlight the importance of using precipitation data based on a stationary input station network for studying observed hydrologic changes.