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Use of regional climate model simulations as input for hydrological models for the Hindukush-Karakorum-Himalaya region

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Abstract. The most important climatological inputs required for the calibration and validation of hydrological models are temperature and precipitation that can be derived from observational records or alternatively from regional climate models (RCMs). In this paper, meteorological station observations and results of the PRECIS (Providing REgional Climate for Impact Studies) RCM driven by the outputs of reanalysis ERA 40 data and HadAM3P general circulation model (GCM) results are used as input in the hydrological model. The objective is to investigate the effect of precipitation and temperature simulated with the PRECIS RCM nested in these two data sets on discharge simulated with the HBV model for three river basins in the Hindukush-Karakorum-Himalaya (HKH) region. Six HBV model experiments are designed: HBV-Met, HBV-ERA and HBV-Had, HBV-$Met_{CRU\text{-}corrected}$, HBV-$ERA_{Benchmark}$ and HBV-$Had_{Benchmark}$ where HBV is driven by meteorological stations data, data from PRECIS nested in ERA-40 and HadAM3P, meteorological stations CRU corrected data, ERA-40 reanalysis and HadAM3P GCM data, respectively. Present day PRECIS simulations possess strong capacity to simulate spatial patterns of present day climate characteristics. However, also some quantitative biases exist in the HKH region, where PRECIS RCM simulations underestimate temperature and overestimate precipitation with respect to CRU observations. The calibration and validation results of the HBV model experiments show that the performance of HBV-Met is better than the HBV models driven by other data sources. However, using input data series from sources different from the data used in the model calibration shows that HBV-Had is more efficient than other models and HBV-Met has the least absolute relative error with respect to all other models. The uncertainties are higher in least efficient models (i.e. HBV-$Met_{CRU\text{-}corrected}$ and HBV-$ERA_{Benchmark}$) where the model parameters are also unrealistic. In terms of both robustness and uncertainty ranges the HBV models calibrated with PRECIS output performed better than other calibrated models except for HBV-Met which has shown a higher robustness. This suggests that in data sparse regions such as the HKH region data from regional climate models may be used as input in hydrological models for climate scenarios studies.

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