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Uncertainty in high and low flows due to parameter and model structure errors: a case study for Qiantang River basin, East China.

Hydrological model simulations are inherently uncertain due to our limited understanding of nature and simplifications in representing hydrological processes. Uncertainty analysis should therefore be an integral part of each hydrological modelling study. The aim of this study is to investigate the uncertainty in simulated extreme low and high flows originating from hydrological model structure and parameters. Three different rainfall-runoff models, namely GR4J, HBV and Xinanjiang, are applied to two subbasins of the Qiantang River basin, East China to estimate the model uncertainty. The Generalised Likelihood Uncertainty Estimation (GLUE) approach is used for the three models to estimate the parameter uncertainty of each model. Uncertainty in simulated extreme flows is evaluated by means of the annual maximum discharge (MHQ) and mean annual 7-day minimum discharge (MAM7). The results show that the three models perform well. The observed daily discharge is mostly captured by the 90% confidence intervals for all three models, however the 90% confidence intervals do not cover the extreme flows for the Xinanjiang model. For extreme high flows, the bias is the largest for the Xinanjiang model and smallest for the HBV model. Low flows are mostly underestimated by all models with optimum parameter sets for both subbasins and the largest underestimation is from the Xinanjiang model. The uncertainty in high flows increases with the magnitude of the discharge. This behaviour is most obvious for the HBV model, followed by the GR4J model and the magnitude of uncertainty from the Xinanjiang model seems to be less affected by the increasing discharge. The parameter uncertainty in high flows is the largest in the HBV model and smallest in the Xinanjiang model. Low flows are more sensitive to the uncertainty than high flows. In general, the uncertainty originating from parameters is larger than the uncertainty due to model structure differences for both high and low flows.