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Impact of parameter uncertainty on extreme flow simulation in SWAT model under climate change

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Climate change affects hydrology and water resources significantly, including extreme flows. There are, however, large uncertainties in hydrological analysis. In this paper, the SWAT (Soil and Water Assessment Tool) model was used to evaluate the impact of climate change on extreme flows in Lanjiang catchment, one sub-basin of Qiantang River Basin, East China. This hydrological model was set up and calibrated carefully. The original parameters were replaced by aggregate parameters to reduce the computation effort. The SUFI-2 (Sequential Uncertainty Fitting Ver. 2) method was employed to estimate model parameters and analyze the uncertainties. Three future emission scenarios A1B, A2 and B2 were chosen to investigate the uncertainty in climate change projections, and a regional climate model PRECIS (Providing REgional Climates for Impacts Studies) was applied to downscale the General Circulation Model (GCM) outputs. The downscaled precipitation and temperature were put into SWAT model to simulate future flows in the period 2011-2040. Finally, extreme flows and their uncertainties were analyzed using the Generalized Pareto (GPA) distribution, and the results were compared with those using Pearson type III (PE3) and Generalized Extreme-value (GEV) distributions. The SWAT model calibration and validation results indicate that SWAT model has a good performance in Lanjiang catchment. The simulated annual discharge of Lanxi station shows an increasing trend in the baseline period (1961-1990), while a decreasing trend under both A2 and B2 scenarios, which means there may be less water resources available in this area in the period 2011-2040. The simulated future extreme flows show that, according to the GPA distribution, the design discharges in small return periods under A1B, A2 and B2 scenarios are possibly larger than those in the baseline period, while the design discharges in large return periods will be possibly smaller than that in the baseline period. The design discharges in different return periods estimated by the GPA distribution are similar with those estimated by the PE3 and GEV distributions at Misai station, indicating that the uncertainty originating from distribution functions is insignificant.