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Improved simulation of peak flows under climate change: post-processing or multi-objective calibration?

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Climate change is expected to have large impacts on peak flows. There are, however, large uncertainties in the simulation of peak flows by hydrological models. This study aims to improve the simulation of peak flows under climate change in Lanjiang catchment, East China by comparing two approaches: post-processing of peak flows and multi-objective calibration. Two hydrological models (SWAT and GR4J) are employed to simulate the daily flows and the peaks-over-threshold method is used to extract peak flows from the simulated daily flows. Three post-processing methods, namely the quantile mapping method and two generalized linear models, are set up to correct the biases in the simulated raw peak flows. Besides, a multi-objective calibration of the GR4J model by taking the peak flows into account in the calibration process is carried out. The regional climate model PRECIS with boundary forcing from two GCMs (HadCM3 and ECHAM5) under greenhouse gas emission scenario A1B is applied to produce the climate data for the baseline period and the future period 2011-2040. The results show that the post-processing methods, particularly quantile mapping method, can correct the biases in the raw peak flows effectively. The multi-objective calibration also resulted in a good simulation performance of peak flows. The final estimated peak flows in the future period show an obvious increase compared with those in the baseline period, indicating there are probably more frequent floods in Lanjiang catchment in the future.