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Hydrological model calibration for flood prediction in current and future climates using probability distributions of observed peak flows and model based rainfall

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Derived flood frequency analysis based on continuous hydrological modelling is very demanding regarding the required length and temporal resolution of precipitation input data. Often such flood predictions are obtained using long precipitation time series from stochastic approaches or from regional climate models as input. However, the calibration of the hydrological model is usually done using short time series of observed data. This inconsistent employment of different data types for calibration and application of a hydrological model increases its uncertainty. Here, it is proposed to calibrate a hydrological model directly on probability distributions of observed peak flows using model based rainfall in line with its later application. Two examples are given to illustrate the idea. The first one deals with classical derived flood frequency analysis using input data from an hourly stochastic rainfall model. The second one concerns a climate impact analysis using hourly precipitation from a regional climate model. The results show that: (I) the same type of precipitation input data should be used for calibration and application of the hydrological model, (II) a model calibrated on extreme conditions works quite well for average conditions but not vice versa, (III) the calibration of the hydrological model using regional climate model data works as an implicit bias correction method and (IV) the best performance for flood estimation is usually obtained when model based precipitation and observed probability distribution of peak flows are used for model calibration.