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Estimation of instantaneous peak flow from daily data using the HBV model

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The length of the observed instantaneous peak flow (IPF) period has a great influence on the flood design whereas these high resolution flow data are not always available. Our previous research has shown that IPFs can be derived from the easier available observed long time series of mean daily flows (MDFs) using a multiple regression model. The primary aim here is to explore the possibility of deriving frequency distributions of IPFs using hydrological modelling with daily and hourly time steps in comparison.
In the post-correction approach the rainfall-runoff model is operated on daily time steps , a flood frequency distribution is fitted to the simulated annual MDFs and the resulting daily quantiles are transferred into IPF quantiles using the multiple regression model. In the pre-processing approach, hourly rainfall is produced by disaggregation of daily data. Then the rainfall-runoff model is operated on hourly time steps resulting in a frequency distribution of IPFs. In addition, two calibrations strategies for the hydrological model using the hydrograph and using flow statistics, respectively, are applied for both approaches. Finally, the performances of estimating the IPFs from daily data using these two approaches are compared considering also the two different calibration strategies. The hydrological simulations are carried out with the HBV-IWW model and the case study is carried out for 18 catchments of the Aller-Leine-River basin in northern Germany.
The results show that: (1) the multiple regression model is capable to predict IPFs with the simulated MDFs as well; (2) the estimation of extreme flow quantiles in summer is not as good as in winter; (3) both of the two approaches enable a reasonable estimation of IPFs; (4) if on hand the hydrological model is calibrated on the hydrograph the post-correction approach with daily simulations is superior and if on the other hand the model is calibrated on flow statistics the pre-processing with hourly simulations is better; (5) the overall best performance is obtained by hourly simulations with pre-processing of rainfall data.