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Design flood estimation at locations with no data or short records in a Bayesian framework

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Estimating design floods at location with no measurements or short records is a major challenge for operational hydrology. The aims of this study are to (i) develop a regional flood frequency model that consists of a regression model for the index flood and the parameters in the growth curve; (ii) assess and attribute the uncertainty to the components of the regional flood frequency model, (iii) develop flexible approaches for combining a regional flood frequency model with local data and provide recommendations for how to combine local and regional data. Annual maximum flood data from 529 gauging stations were used for the model development. We re-parametrized the Generalized Extreme Value (GEV) distribution into an index flood component and growth curve component, and we used the median flood as the index flood. The model was estimated using a MCMC algorithm within a Bayesian framework. The Bayesian approach was also used to combine local and regional data. Two approaches were used (i) combining local and regional data to estimate the index flood (ii) combining local and regional data to estimate both the index flood and the growth curve. Simulation experiments were carried out to assess the performance of these approaches. We see that in particular for data records shorter than 10 years, we can benefit from combining the local and the regional model by both approaches. We also constructed a prior for use in local analysis that complied with the distribution of the regional model for three key quantiles. For the index flood, the regression model was successfully estimated and evaluated using a three-step cross validation approach. The most important variables for predicting the index flood were mean annual runoff, river length and lake percentage. The attribution of uncertainty showed that most of the uncertainty was found in the index flood component.