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The index-flood method in a Bayesian perspective: sensitivity to regional heterogeneity

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In regional flood frequency analysis, the commonly used index-flood method assumes that the frequency distribution of flood peaks for different sites in an homogeneous region is the same, provided that the discharge series are rescaled using a site-specific scale factor. This scale factor (index flood) is subsequently related to catchment characteristics to permit estimation of flood quantiles at ungauged sites within the region. In this work, a Monte Carlo Markov Chain (MCMC) approach is used to jointly estimate the parameters of the flood frequency distribution and the parameters relating them to catchment characteristics. The Bayesian approach allows accounting for the uncertainty associated to the estimated parameters and associating confidence intervals to the estimated flood frequency curves at ungauged sites. The consistency of the computed confidence intervals is verified through simulations of artificial sets of samples by counting in how many cases the quantile confidence interval includes the underlying parent flood frequency distribution. The limits of the method and its robustness when it is used on heterogeneous regions are checked simulating sets of samples characterized by different degree of heterogeneity, both in terms of the relation of the index-flood to catchment characteristics and in terms of variability of the underlying parent distribution.