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Regional trends in flood quantiles across Europe between 1960 and 2010

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Evidence of past flood regime changes in Europe has been shown by several local and regional trend detection studies. These studies typically analysed changes in the mean or median flood. In this work, we investigate regional trends in the 2-year flood and in the 100-year flood. Additionally, it is of interest to investigate the effect of catchment scale on the changes in time of the selected flood quantiles. We analyse 2370 flood records, selected from a newly available pan-European flood database, with record lengths of at least 40 years over the period 1960-2010 and catchment areas ranging from 5 to 100 000 km². In order to estimate the regional trend in flood quantiles, a non-stationary regional flood frequency approach is used, consisting of a regional Gumbel distribution whose parameters are allowed to vary with time and with catchment area. A Bayesian Markov Chain Monte Carlo (MCMC) approach is used for parameter estimation. With a spatial moving window approach, regional trends of the selected flood quantiles, and the related uncertainties, are estimated and compared across Europe, for hypothetical catchment sizes ranging from 10 to 100 000 km². Distinctive patterns of flood regime change are identified for large regions across Europe which depend on flood magnitudes and catchment areas. The resulting trends in flood magnitudes are positive (with the exception of very large catchments) in Atlantic catchments, where the magnitude of trends decreases with increasing catchment size and for bigger return periods. In Mediterranean catchments the regional trends are negative, with small floods experiencing a stronger decrease than large floods. In Eastern European catchments, the regional trends are clearly negative, with larger magnitudes (in absolute value) for larger catchments; they do not appear to vary substantially with the return period.