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Data-based attribution of changes in flood quantiles across Europe between 1960 and 2010

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Changes in European floods during past decades have been analysed and detected by several studies. These studies typically focused on the mean flood behaviour, without distinguishing small and large floods. In this work, we investigate the causes of the detected flood trends across Europe over five decades (1960-2010), as a function of the return period. We adopt a regional non-stationary flood frequency approach to attribute observed flood changes to potential drivers, used as covariates of the parameters of the regional probability distribution of floods. The elasticities of floods with respect to the drivers and the regional contributions of the drivers to changes in flood quantiles associated with small and large return periods (i.e. 2-year and 100-year floods, respectively) are estimated by Bayesian inference, with prior information on the elasticity parameters obtained from expert knowledge and the literature. The data-based attribution approach is applied to annual maximum flood discharge seires from 2370 hydrometric stations in Europe. Extreme precipitation, antecedent soil moisture and snowmelt are the potential drivers considered. Results show that extreme precipitation mainly contributes to positive flood changes in North-western Europe. Both antecedent soil moisture and extreme precipitation contribute to negative flood changes in Southern Europe, with relative contributions varying with the return period. Antecedent soil moisture contributes the most to changes in small floods (i.e. T=2-10 years), while the two drivers contribute with comparable magnitude to changes in more extreme events. In eastern Europe, snowmelt clearly drives negative changes in both small and large floods.