Regional trends in flood quantiles across Europe between 1960 and 2010

M. Bertola[(1)], A. Viglione[(2)], D. Lun[(1)], J. Hall[(1)], G. Blöschl[(1)]

(1) Institute of Hydraulic Engineering and Water Resources Management, Vienna University of Technology
(2) Department of Environment, Land and Infrastructure Engineering, Polytechnic University of Turin

INTRODUCTION 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.

OBJECTIVES The aim of this study is to assess the changes in small vs. big flood events (corresponding to selected flood quantiles) across Europe over 5 decades (i.e. 1960–2010), and to determine whether these changes have been subject to different degrees of modification in time. Moreover, it is also of interest to assess the effect of catchment area.

METHODS 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 (corresponding to selected return periods T), and the related uncertainties, are estimated and compared across Europe for different hypothetical catchment sizes (S).

DATA 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 km^2.

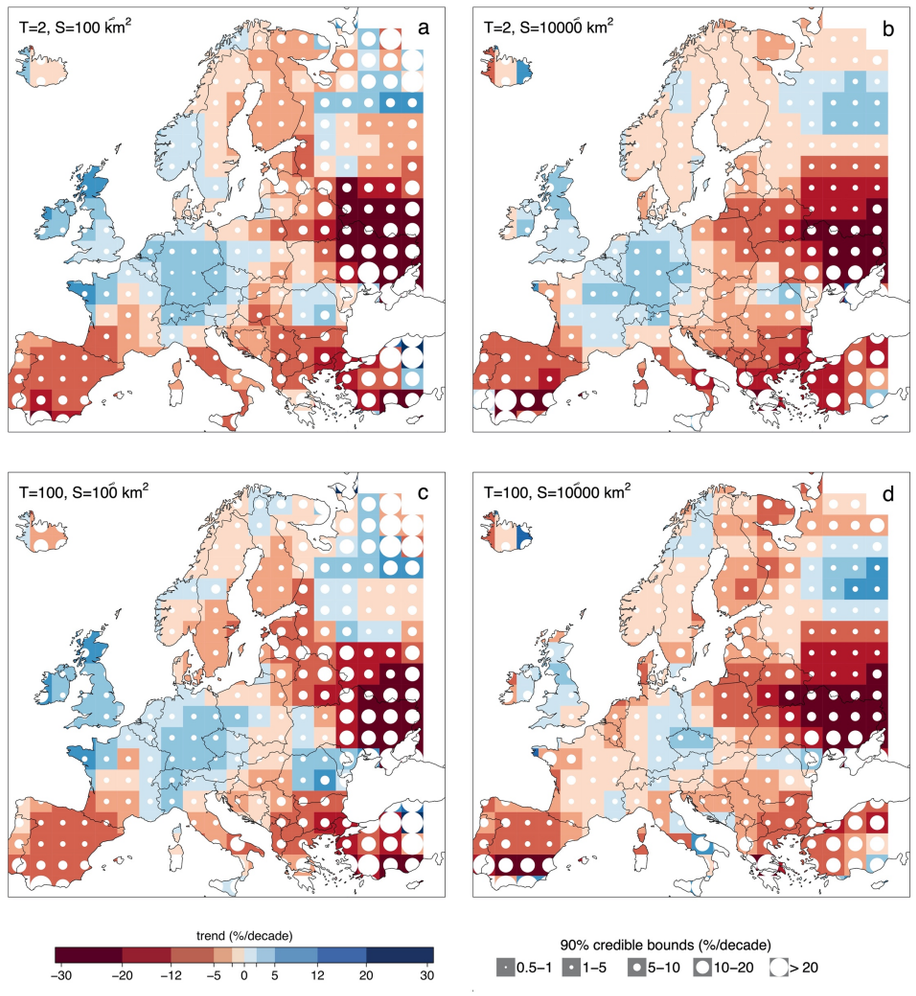

Figure 1. Trends in the median flood (T=2 years, panels a, b) and in the 100-year flood (c, d) in Europe. Results are shown for small (S=100 km^2, panels a, c) and large (S=10000 km^2, panels b, d) hypothetical catchment size. In each region the regional trend estimate (with colors) is represented together with the width of its 90% credible bounds. From Bertola et al., (2020).

Bertola, M., Viglione, A., Lun, D., Hall, J., and Blöschl, G.: Flood trends in Europe: are changes in small and big floods different?, Hydrol. Earth Syst. Sci., 24, 1805–1822, https://doi.org/10.5194/hess-24-1805-2020, 2020.

RESULTS 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 mainly positive in northwestern Europe, where the magnitude of trends decreases with increasing catchment size and for bigger return periods. In southern Europe, the regional trends are negative, with small floods experiencing a stronger decrease than large floods. In eastern Europe, 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.

CONCLUSIONS This study provides a continental-scale analysis of the changes in flood quantiles that have occurred across Europe over 5 decades. The uncertainty associated with the regional trend estimates is here assessed through their 90% credible bounds. Further research is needed to formally attribute the resulting regional change patterns to potential driving processes.

REFERNCES

Blöschl, G. et al. (2017) 'Changing climate shifts timing of European floods', Science, 357(6351), pp. 588–590. doi: 10.1126/science.aan2506.
Blöschl, G. et al. (2019) 'Changing climate both increases and decreases European river floods', Nature. doi: 10.1038/s41586-019-1495-6.

CONTACT INFORMATION

Miriam Bertola, PhD student at TU Vienna
bertola@hydro.tuwien.ac.at

CC BY

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 676027