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Are flood occurrences in Europe linked to specific atmospheric circulation types?

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Flood damages are amongst the most costly climate-related hazard damages, with annual average flood damage in Europe in the last few decades of around €4bn per year (Barredo, 2007). With such economic and sometimes human losses, it is important to improve our estimations of flood risk for time scales from a few months (for increased preparedness) and to several decades (necessary to establish long-term flood management strategies).

This paper investigates links between the occurrence of flood events and the atmospheric circulation patterns that have prevailed in the days leading to the flood. With the recent advances in climate modelling, such links could be exploited to anticipate the extent of potential damages due to flood using seasonal atmospheric forecasts products or future climate projections.

The research is undertaken at a pan-European scale and exploits latest research in automatic classification techniques developed within the EU research network COST733 Action. Daily flow data from over 450 sites were used, available from the Global Runoff Data Centre, the European Water Archive, the UK National River Flow Archive and the French Banque Hydro. The atmospheric circulation types were defined following the Objective GrossWetterLagen classification (OGWL) developed by (James, 2007) using the ERA-40 mslp re-analysis, similar to the Hess-Brezowsky subjective classification (Hess and Brezowsky, 1977).

Flood events were here defined according to the peak-over-threshold method, selecting the highest independent peaks observed in streamflow time series. The association between flood and atmospheric circulation types is assessed using two indicators. The first indicator calculates the difference between the frequency of occurrence of a circulation type CTi during a flood event to that for any day, expressed in percent. The significance of the anomaly is assessed using the 2 statistics. The second indicator measures the probability of finding at last k days of N* of CTi using historical frequencies of occurrence. N* represents the number of days preceding a flood when the atmospheric conditions could significantly influence flood production processes, and could be interpreted as an upper limit of the concentration time of the basin. This evaluates the persistence of an atmospheric circulation type CTi prior to a flood event, and the associated level of significance.
The indicators are calculated at-site and discussed regionally. Results show significant links with two circulation types related to Cyclonic Westerly (Wz) and the Low over the British Isles (TB), while the anticyclonic northwesterly type (Nea) systematically doesn't occur before any flood event.

References

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