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Atmospheric circulation patterns associated to the variability of River Ammer floods: evidence from observed and proxy data

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The relationship between the frequency of River Ammer floods (southern Germany) and atmospheric circulation variability is investigated based on observational Ammer discharge data back to 1926 and a flood layer time series from varved sediments of the downstream Lake Ammersee for the pre-instrumental period back to 1766. A composite analysis reveals that, at synoptic time scales, observed River Ammer floods are associated with enhanced moisture transport from the Atlantic Ocean and the Mediterranean towards the Ammer region, a pronounced trough over Western Europe as well as enhanced potential vorticity at upper levels. We argue that this synoptic scale configuration can trigger heavy precipitation and floods in the Ammer region. Interannual to multidecadal increases in flood frequency, as recorded in the instrumental discharge record, are associated to a wave-train pattern extending from the North Atlantic to western Asia with a prominent negative center over western Europe. A similar atmospheric circulation pattern is associated to increases in flood layer frequency in the Lake Ammersee sediment record during the pre-instrumental period. Furthermore, river Ammer flood frequency variability is associated with distinct patterns in various extreme climatic indices. In particular, high frequency of river Ammer floods is accompanied by high frequency of warm days (TX90p index) and positive anomalies of absolute maximum temperature (TXx) over northeastern Europe. Such extreme temperature patterns occur in connection with low cloudiness over this region forced by flood related atmospheric circulation pattern during summer. We argue that the complete flood layer time-series from Lake Ammersee sediments covering the last 5500 years, contains information about atmospheric circulation and extreme climate indices variability on inter-annual to millennial time-scales.