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# Influence of large-scale atmospheric circulation on hydrometeorological extremes in Central Europe: Insights from a 5500-year flood layer time-series in varved sediments of Lake Ammersee (southern Germany)

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External forcing and low-frequency internal climate variability affect non-stationarity in the frequency of hydrometeorological extremes like floods on up to millennial time-scales. However, understanding of flood responses to varying climate boundary conditions is limited due to the lack of long observation based hydrological records. Detrital layers in varved lake sediments allow to overcome these limitations providing flood time-series for millennia, down to seasonal resolution.

The Ammersee lake/catchment setting is well suited for flood reconstruction. High water tables in the northern catchment and low water holding capacities of the alpine soils favor the translation of precipitation extremes into floods by surface excess overland flow. The rather small catchment and steep slopes of the alpine foothills produce temporarily short but intense flood peaks. Late moraine, flysch, and molasse formations provide abundant erodible detrital material for downstream transport into the gully shaped lake by only one main tributary, River Ammer. Varved lake sediments allow precise detection and dating of the deposited flood layers.

A seasonal 5500-year time-series of 1501 flood layers was established from a varved Lake Ammersee sediment profile using microfacies analyses, $\mu$-XRF scanning at 200 $\mu$m resolution, and varve counting. Flood layer frequency shows decadal to millennial-scale oscillations and changes in amplitude up to a factor of seven. Based on direct calibration against meteorological data and using reanalysis models, our results suggest (1) that the frequency of floods at Lake Ammersee likely is representative for the frequency of rainfall extremes over large parts of Central Europe and (2) that the temporal distribution of these extremes is presumably modulated by the prevalent phase of the East Atlantic-Western Russia dipole, a zonal seesaw of atmospheric pressure over Europe.