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Atmospheric circulation and peak river discharges in Europe

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Atmospheric forcing is thought to be the most important factor for causing annual and decadal variations in fresh water fluxes from the continents. However, no single atmospheric pattern has been found that satisfactorily relates to discharges over large areas. The largest river basins in Europe are located in west and central Europe. This area is the transition zone of the North Atlantic Oscillation (NAO) influence, where consequently neither precipitation nor river discharge is strongly linked to the NAO index. Most other studies into links between atmospheric forcing and river discharge have focussed on mean flow, rather than peak discharges, and most other studies have looked at averaged river discharges over periods of 10 or more years rather than inter-annual variability. This paper presents the analysis of long-term inter-annual correlations between atmospheric forcing and winter (December-February) precipitation, and mean and peak winter discharges as observed at 614 stations across Europe. Three forcing indicators are assessed: the NAO index and the frequency of western circulation as described by the subjective Großwetterlagen classification and the objective weather types classification system of the German Weather Service. The results show that mean winter precipitation, as well as mean and peak winter river discharges in central and west Europe are correlated to the frequency of western circulation as described by the two weather type classification systems. The NAO index accurately describes variation in discharges mostly in north and south Europe. This points to the fact that no single atmospheric indicator can be used to predict contemporary or future changes in the surface hydrology of Europe.