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The role of climate variability in extreme floods in Europe

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Between 1980 and 2015, Europe experienced 18% of worldwide weather-related loss events, which accounted for over US$500 billion in damage. Consequently, it is urgent to further develop adaptation strategies to mitigate the consequences of weather-related disasters, such as floods. Europe's capability to prepare for such disasters is challenged by a large range of uncertainties and a limited understanding of the driving forces of hydrometeorological hazards. One of the major sources of uncertainty is the relationship between climate variability and weather-related losses.

Previous studies show that climate variability drives temporal changes in hydrometereological variables in Europe. However, their influence on flood risk has received little attention. We investigated the influence of the positive and negative phases of El Niño Southern Oscillation (ENSO), the North Atlantic Oscillation (NAO), and the Arctic Oscillation (AO), on the seasonal frequency and intensity of extreme rainfall, and anomalies in flood occurrence and damage compared to the neutral phases of the indices of climate variability.

Using statistical methods to analyze relationships between the indices of climate variability and four indicators of flooding, we found that positive and negative phases of NAO and AO are associated with more (or less) frequent and intense seasonal extreme rainfall over large areas of Europe. The relationship between ENSO and both the occurrence of extreme rainfall and intensity of extreme rainfall in Europe is much smaller than the relationship with NAO or AO, but still significant in some regions. We observe that flood damage and flood occurrence have strong links with climate variability, especially in southern and eastern Europe. Therefore, when investigating flooding across Europe, all three indices of climate variability should be considered. Seasonal forecasting of flooding could be enhanced by the inclusion of climate variability indicators .