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What will the weather do? forecasting flood losses based on oscillation indices

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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. Early action triggered by timely information on possible emerging impact has the potential to reduce these losses, playing a substantial role on social and economic development. The importance of the early action systems has been recognized by the seventh global target of the Sendai Framework for disaster risk reduction that urges for the development of impact-informed early warning systems.

Despite great advancements in flood forecasting technologies, it remains challenging to produce useful impact-based forecast information in a way to trigger early actions that mitigate risks. Overcoming the challenges to act based on the forecast requires an understanding of the existing forecast tools, and a deeper comprehension of the dynamics between hydrometeorological hazards and impacts.

Previous studies have shown spatial and temporal relationships between large-scale climate oscillation and flood risk, flood occurrence and flood losses in Europe. However, little is understood about the skill of these oscillations in forecasting flood losses. Using a database of flood losses (NatCatSERVICE of Munich Re), we examined the skill of large-scale climate oscillation - the El Niño Southern Oscillation (ENSO), the North Atlantic Oscillation (NAO), the East Atlantic/West Russian pattern (EA/WR) and the East Atlantic Pattern (EA) and the Scandinavian Pattern (SCA) - in forecasting seasonal and sub-regional Flood Losses in Europe.

Using multiple linear regression models to analyse relationships between the indices of climate variability and Flood Losses, we found that at the Pan-European level and sub-regional scales, flood losses are linked to the interaction with all five indices of climate oscillation. The largest effect is found in spring between SCA and NAO, in which large-scale Pan-European flood losses are expected to be 26 times more costly (approximately 2500 million euro) than average when the SCA positive interacts with the negative phase of the NAO. At sub-regional scale, the largest effect is found in winter in Eastern Europe between EAWR and NAO, in which large-scale flood losses of approximately 3600 million euro (292 times higher than average) are expected when the SCA positive interacts with the negative phase of the NAO. Since large-scale indices of climate variability can be predicted with longer lead times than weather variables, sub-regional impact-based forecast could be developed for regions where a significant relationship is found between large-scale indices of climate variability and flood losses.