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Predictability and possible earlier awareness of extreme precipitation across Europe

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Extreme hydrological events can cause large socioeconomic damages in Europe. In winter, a large proportion of these flood episodes are associated with atmospheric rivers, a region of intense water vapour transport within the warm sector of extratropical cyclones.

When preparing for such extreme events, forecasts of precipitation from numerical weather prediction models or river discharge forecasts from hydrological models are generally used. Given the strong link between water vapour transport (integrated vapour transport IVT) and heavy precipitation, it is possible that IVT could be used to warn of extreme events. Furthermore, as IVT is located in extratropical cyclones, it is hypothesized to be a more predictable variable due to its link with synoptic-scale atmospheric dynamics.

In this research, we firstly provide an overview of the predictability of IVT and precipitation forecasts, and secondly introduce and evaluate the ECMWF Extreme Forecast Index (EFI) for IVT. The EFI is a tool that has been developed to evaluate how ensemble forecasts differ from the model climate, thus revealing the extremeness of the forecast. The ability of the IVT EFI to capture extreme precipitation across Europe during winter 2013/14, 2014/15, and 2015/16 is presented.

The results show that the IVT EFI is more capable than the precipitation EFI of identifying extreme precipitation in forecast week 2 during forecasts initialized in a positive North Atlantic Oscillation (NAO) phase. However, the precipitation EFI is superior during the negative NAO phase and at shorter lead times. An IVT EFI example is shown for storm Desmond in December 2015 highlighting its potential to identify upcoming hydrometeorological extremes.