Dynamics of forecast error growth along cut-off Sanchez and its consequence for the prediction of a high-impact weather event over southern France

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Despite significant advances in numerical weather prediction during recent decades, the prediction of high-impact weather (HIW) events like heavy precipitation and strong winds continues to be challenging. In this study, the representation of an extreme precipitation event over southern France is evaluated in probabilistic and deterministic forecasts from Météo-France, and the sensitivity of the HIW forecast to the initial upstream upper-level flow and low-level moisture structure is quantified. The event occurred in October 2016 during the international field experiment NAWDEX. The approach of a previously measured upper-level potential vorticity (PV) cut-off, referred to as Sanchez, induced strong moisture advection from the Mediterranean toward southern France, where it resulted in heavy precipitation and strong winds.

Many ensemble members in the 2-4 day Météo-France forecasts predicted the maximum of the extreme precipitation and the location of the upper-level PV cut-off too far to the east, with particularly bad forecasts all having the same deep convection parameterization scheme. Ensemble sensitivity analyses, PV inversion and moisture experiments reveal that the forecasts were sensitive to the upper-level flow upstream of cut-off Sanchez and the low-level moisture over the eastern North Atlantic two days before the event. In particular, errors in the representation of the jet stream south of Iceland and of the moisture structure in the warm conveyor belt inflow region were crucial for the forecast errors of the HIW. The findings illustrate the importance of downstream forecast error propagation and local moist dynamics for an accurate prediction of high-impact weather over Europe.