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Ensemble forecasts for the midlatitudes on sub-seasonal time scales (10-60 days): exploring new products for predicting Atlantic-European weather regimes

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On sub-seasonal time scales the large-scale extratropical circulation often has a better predictability than surface weather at a specific location and time. However, classical ensemble forecast products focussing on the ensemble mean and spread are often indistinguishable from the underlying model climatology. Therefore novel approaches are needed to reveal the predictable components of the atmosphere on sub-seasonal time scales.

In the Atlantic-European region variability in the large-scale circulation is in first order dominated by the bi-modal North Atlantic Oscillation (NAO). Still it is difficult to describe multi-day variability in surface weather accurately for all of Europe based on the NAO. Weather regimes (e.g. Vautard 1990, Michel and Rivière 2011), provide an alternate concept of 4 to 8 different flow patterns, that account for most of the multi-day variability of the large-scale flow and associated surface weather on sub-seasonal time scales (e.g. Yiou and Nogaj 2004, Grams et al. 2017, Zubiate et al. 2017).

In this presentation we explore novel ensemble forecast products for 7 year-round Atlantic-European weather regimes and associated surface weather. These regimes are based on a k-means clustering of normalized 5-day low-pass filtered 500 hPa geopotential height anomalies (Z500'). The likelihood of the 7 regimes in the ensemble is explored based on the weather regime index of Michel and Rivière (2011), which describes how well each regime is established.

We suggest an intriguing visualisation of the regime behaviour that allows a forecaster to assess very quickly and easily the large-scale flow evolution in medium- and extended-range ensemble forecasts. Complemented by maps of other variables describing the large-scale flow or surface weather these products provide a sharper view on the forecast evolution than classical approaches based, for example, on the ensemble mean and spread. Currently we assess forecast skill of the suggested regime products compared to other approaches.

Further reading:
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Vautard, R., 1990: Multiple weather regimes over the North Atlantic: analysis of precursors and successors. Mon. Wea. Rev., 118, 2056–2081, doi:10.1175/1520-0493(1990)118<2056:MWROTN>2.0.CO;2.
Yiou, P., and M. Nogaj, 2004: Extreme climatic events and weather regimes over the North Atlantic: When and where? Geophys. Res. Lett., 31, doi:10.1029/2003GL019119.
Zubiate, L., F. McDermott, C. Sweeney, and M. O'Malley, 2017: Spatial variability in winter NAO–wind speed relationships in western Europe linked to concomitant states of the East Atlantic and Scandinavian patterns. Q.J.R. Meteorol. Soc., 143, 552–562, doi:10.1002/qj.2943.