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Winter climate variability in the North Atlantic and European region : from climate regimes to weather regimes

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The atmospheric monthly variability observed over the North Atlantic and European region in winter is multi-modal. It is well described by four distinct climate regimes that are characterized by specific pressure anomalies. The first two clusters capture the negative and positive phases of the North Atlantic Oscillation (NAO). The third (Ridge) and fourth (GS) clusters display respectively a strong anticyclonic ridge off western Europe and a zonal pressure dipole between Greenland and Scandinavia. Each regime is linked with local specific impacts in temperature, so that the regime approach allows to deduce information for temperature at local scale from large scale pressure patterns, which are generally more skillfully forecast.

EDF is the biggest electricity producer and provider in France, and its activities are very dependent on climate. Monthly averaged climate forecasts are valuable but medium to long term forecasts at daily timescale would be more appropriate for numerous operational applications, like energy demand forecasting and production management. This work so aims at linking daily weather variability with monthly to seasonal variability, based on the regimes paradigm.

To that purpose, the cluster analysis and temperature impacts methods used for monthly ERA40 re-analysis data are first applied to ERA40 daily data (over 1958-2001). The weather or daily regimes pressure patterns and impacts are compared to their monthly counterparts and analysed in terms of duration and transitions. The 4 daily regimes obtained are very similar to the monthly corresponding modes.

The link between daily and monthly regimes is then investigated using the winter days

and months partitions into the regimes. The occurrence of daily regimes is quantified using different criteria (day number, duration, transitions) that are calculated for each monthly regime and for all the winter months. The occurrence of daily regimes in a given month characterized by a given monthly regime is strongly conditioned by the monthly regime itself. The daily corresponding regime is dominant for the 4 regimes. For 3 out of the 4 regimes, there is also a secondary regime. The favored transitions also depend on the monthly regime.

The results are validated by different statistic tests. The results of this study could be used to estimate local temperature or precipitations anomalies using large scale patterns of e.g. geopotential height from seasonal forecasting models.