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Seasonal predictions of energy-relevant Essential Climate Variables through Euro-Atlantic Teleconnections

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Accurate and reliable information from climate predictions at seasonal time-scales can have an essential role to anticipate climate variability affecting supply of renewables energy and to stabilize and secure the energy network as a whole. A number of recognized modes of variability -often called teleconnections- explain a large part of Earth's climate variations and represent an important source of climate predictability. The leading atmospheric variability modes in the Euro-Atlantic sector (EATC) affect surface variables such as 2 meters temperature, solar radiation downward, and surface wind anomalies in Europe.

Characterizing EATC in observations and assessing their simulation and prediction and their impact on the energy sector can help to better understand patterns of seasonal-scale inter annual variability in renewables resources and to consider to what extent this variability might be predictable up to several months in advance. Furthermore EATC can be used to formulate empirical prediction of local climate variability (relevant for the energy sector) based on the large scale atmospheric variability modes predicted by the forecast systems.

To achieve this goal we analyze reanalysis dataset ERA5 and the multi-system seasonal forecast service provided by the Copernicus Climate Data Store (C3S).

Geopotential height anomalies at 500 hPa have been employed to compute the four Euro-Atlantic teleconnections North Atlantic Oscillation, East Atlantic, Scandinavian and East Atlantic-West Russian. The impacts of those four variability modes on the energy - relevant essential climate variables have been assessed in both observed and predicted system. We have found that the observed relationship between EATC patterns and surface impacts is not accurately reproduced by seasonal prediction systems. This opens the door to employ hybrid dynamical-statistical methods. The idea consists in combining the dynamical seasonal predictions of EATC indices with the observed relationship between EATCs and surface variables. We reconstructed the surface anomalies for multiple seasonal prediction systems and benchmarked these hybrid forecasts with the direct variable forecasts from the systems and also with the climatology. The analysis suggest that predictions of energy relevant Essential Climate Variables are improved by the hybrid methodology in almost all Europe.