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Non-Stationarity of Wintertime Atmospheric Circulation Regimes in the Euro-Atlantic Sector

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Atmospheric circulation regimes can be used to study links between regional weather and other climate processes, like sudden stratospheric warmings. For these studies it is important to know whether there is any background non-stationarity in the regimes themselves. To identify regime non-stationarity model ensemble data is needed to have sufficient data. However, models are noisy in their representation of circulation regimes making obtaining the signal difficult. We propose a new method, in the form of a constraint on the ensemble-member similarity in the clustering method, to identify the signal of the non-stationary regime dynamics.

We use ECMWF SEAS5 hindcast data to identify six wintertime circulation regimes over the Euro-Atlantic sector (NAO+/-, Atlantic Ridge (AR) +/- and Scandinavian Blocking (SB) +/-), which has been found to be the optimal number of regimes in a previous study. Implementing the constraint leads to more robust regimes and the identification of a stronger inter-annual signal in the regime occurrence rates than without the constraint. The clearest signal on inter-annual timescales is found during strong El Niño years. During those years the NAO+ becomes less frequent, while the SB- occurs more often. The signal in the occurrence rate of the NAO- is weaker than for the NAO+. Without the implementation of the constraint this difference in the strength of the signal between the two phases of the NAO cannot be detected. Thus, the constraint on the ensemble-member similarity allows for identifying a non-stationary signal that otherwise is more difficult to obtain.