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Linking Euro-Atlantic blocking and North Atlantic eddy-driven jet variability

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Atmospheric blocking are persistent high-pressure systems that block the mid-latitude flow and have profound impact on the surface weather. During winter, blocking in the European-North Atlantic sector are closely related to four classical weather regimes (Atlantic ridge AR, zonal ZO, European/Scandinavian blocking BL, Greenland anticyclone GA). An alternative framework for characterizing wintertime variability in the sector is based on the North Atlantic eddy-driven jet, which has three preferred locations (southern, central, northern).

In this study we aim to reconcile these two perspectives, thus clarifying the link between large-scale flow patterns and atmospheric blocking. We use a k-means clustering algorithm to characterize the two-dimensional variability of the eddy-driven jet stream, defined by the lower tropospheric zonal wind in the ERA-Interim reanalysis (1980-2014). The first three clusters capture the central jet and northern jet, along with a new mixed jet configuration; a fourth cluster is needed to recover the southern jet. The mixed cluster represents a split or strongly tilted jet, neither of which is well described in the zonal-mean framework. Furthermore, the mixed jet is found to be linked to European/Scandinavian blocking, whose relation to the eddy-driven jet was previously unclear. Each jet configuration is associated with distinct patterns of surface cyclones and high pressure ridges, which influences precipitation and temperature over Europe. Connections are drawn between the jet stream, weather regimes, and the North Atlantic Oscillation (NAO). We show that the four jet clusters are not clearly associated with distinct NAO phases.
The results highlight the necessity of bridging from weather to climate scales for a deeper understanding of atmospheric circulation variability.