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Links between North Atlantic atmospheric blocking and recent trends in European winter precipitation

Caroline Ummenhofer, Hyodae Seo, Young-Oh Kwon, and Terrence Joyce
Woods Hole Oceanographic Institution, Physical Oceanography, Woods Hole, United States (cummenhofer@whoi.edu)

European precipitation has sustained robust trends during wintertime (January – March) over recent decades. Central, western, and northern Europe have become wetter by an average 0.1-0.3% per annum for the period 1901-2010, while southern Europe, including the Iberian Peninsula, much of Italy and the Balkan States, has sustained drying of -0.2% per annum or more over the same period. The overall pattern is consistent across different observational precipitation products, while the magnitude of the precipitation trends varies amongst data sets.

Using cluster analysis, which identifies recurrent states (or regimes) of European winter precipitation by grouping them according to an objective similarity criterion, changes in the frequency of dominant winter precipitation patterns over the past century are evaluated. Considerable multi-decadal variability exists in the frequency of dominant winter precipitation patterns: more recent decades are characterised by significantly fewer winters with anomalous wet conditions over southern, western, and central Europe. In contrast, winters with dry conditions in western and southern Europe, but above-average rainfall in western Scandinavia and the northern British Isles, have been more common recently.

We evaluate the associated multi-decadal large-scale circulation changes across the broader extratropical North Atlantic region, which accompany the observed wintertime precipitation variability using the 20th Century reanalysis product. Some influence of the North Atlantic Oscillation (NAO) is apparent in modulating the frequency of dominant precipitation patterns. However, recent trends in the characteristics of atmospheric blocking across the North Atlantic sector indicate a change in the dominant blocking centres (near Greenland, the British Isles, and west of the Iberian Peninsula). Associated changes in sea level pressure, storm track position and strength, and oceanic heat fluxes across the North Atlantic region are also addressed.