



## **Regionalising the influence of the North Atlantic Oscillation on seasonal hydrological extremes in Great Britain**

Harry West, Nevil Quinn, and Michael Horswell

University of the West of England, Centre for Floods, Communities & Resilience, Geography & Environmental Management, United Kingdom (harry.west@uwe.ac.uk)

Although some studies have shown the influence of the North Atlantic Oscillation (NAO) on rainfall in the United Kingdom (UK), these have focussed on rainfall extremes (rather than the flood- drought continuum) and have either been based on analysis of a limited number of stations, undertaken only for particular seasons, or have been based on a relatively short record. Improvements in long-range NAO prediction skill mean there is now renewed value in developing an understanding of how the NAO influences the temporal and spatial distribution of hydrological extremes.

Recent publication of nationally consistent gridded data sets such as the UK Centre for Ecology & Hydrology Gridded Estimates of Areal Rainfall (CEH-GEAR) and the Standardised Precipitation Index (SPI) time series for the United Kingdom provide new opportunities for analysis. The latter offers an additional advantage as these are conveniently scaled as a continuum of extreme wetness to extreme dryness.

We map correlations between two alternative monthly NAO indices (NAOIST - Hurrell station based, and NAOIPC - Hurrell principal components based) and two measures of rainfall; firstly, monthly SPI (SPI-1) (5x5 km grid) which we averaged spatially by the 9 UK Met Office climate regions, and secondly, CEH-GEAR rainfall, treated in the same way. We also analyse the regional frequency of wet and dry extremes in relation to prevailing NAOI+ and NAOI- phases. As far as we are aware, this is the only monthly, nationally consistent spatial analysis undertaken for a long record (1900-2015, 116yrs).

Significant positive correlations between NAOIST and monthly CEH-GEAR rainfall are found in the west, and particularly, north, for all months between October and February. While significant correlations persist in 'Scotland North' and 'Scotland West' in spring (MAM) they are largely absent in England and Wales, and no correlations are present in August. June is characterised by a marked gradient with most of England showing significant negative correlations while 'Scotland North' is positively correlated. September through to November sees a progressive shift eastward of patterns, such that by November, 'England East and North East' is the only region not showing a significant positive correlation. When NAOIPC is used, significant positive correlations are found for the north and west for the months of September through to May. The central, south west and south east regions show no significant correlations. Between June and August all of England and Wales and 'Scotland East' is significantly negatively correlated with NAOIPC, regardless of which rainfall measure is used. Our analysis shows that choice of NAOI (station based or principal components) has much more of an effect than whether this is correlated against rainfall or SPI-1.

Marked differences in the proportion of regions experiencing hydrological extremes were also noted. For example, on average in December, during NAO+ periods, 0.64% of 'Scotland North' was in an extremely dry or severely dry condition. In contrast, during NAO- periods, 6.19% of this district was similarly classified. Conversely during NAO+ periods 6.08% was extremely or severely wet, and 0.57% during NAO- periods.