EGU21-10982
https://doi.org/10.5194/egusphere-egu21-10982
EGU General Assembly 2021

Mapping Spatio-Temporal Variability in NAO Rainfall Signatures

Harry West, Nevil Quinn, and Michael Horswell
University of the West of England, Centre for Water, Communities & Resilience, Geography & Environmental Management, Bristol, United Kingdom of Great Britain – England, Scotland, Wales (harry.west@uwe.ac.uk)

The North Atlantic Oscillation (NAO) is often cited as the primary atmospheric-oceanic circulation or teleconnection influencing regional climate in Great Britain. As our ability to predict the NAO several months in advance improves, it is important that we also continue to develop our spatial and temporal understanding of the rainfall signatures which the circulation produces.

We present a novel application of spatial statistics to explore variability in monthly NAO rainfall signatures using a 5km gridded monthly Standardised Precipitation Index (SPI) dataset. We first use the Getis-Ord Gi* statistic to map spatially significant hot and cold spots (clusters of high/wet and low/dry SPI values) in average monthly rainfall signatures under NAO Positive and Negative conditions over the period 1900-2015. We then look across the record and explore the temporal variability in these signatures, in other words how often a location is in a significant spatial hot/cold spot (high/low SPI) at a monthly scale under NAO Positive/Negative conditions.

The two phases of the NAO are typically more distinctive in the winter months, with stronger and more variable NAO Index values. The average monthly SPI analysis reveals a north-west/south-east 'spatial divide' in rainfall response. NAO Positive phases result in a southerly North Atlantic Jet Stream bringing warm and wet conditions from the tropics, increasing rainfall particularly in the north-western regions. However, under NAO Negative phases which result in a northerly Jet Stream, much drier conditions in the north-west prevail. Meanwhile in the south-eastern regions under both NAO phases a weaker and opposite wet/dry signal is observed. This north-west/south-east 'spatial divide' is marked by the location of spatially extensive hot/cold spots. The Getis-Ord Gi* result identifies that the spatial pattern we detect in average winter rainfall is statistically significant. Looking across the record, this NW/SE opposing response appears to have a relatively high degree of spatio-temporal consistency. This suggests that there is a high probability that NAO Positive and Negative phases will result in this NW/SE statistically significant spatial pattern.

Even though the phases of the NAO in the summer months are less distinctive they still produce rainfall responses which are evident in the monthly average SPI. However, the spatiality in wet/dry conditions is more homogenous across the country. In other words the 'spatial divide' observed in winter is diluted in summer. As a result, the occurrence of significant hot/cold spots is more variable in space and time.

Our analysis demonstrates a novel application of the Getis-Ord Gi* statistic which allows for spatially significant patterns in the monthly SPI data to be mapped for each NAO phase. In winter

months particularly, this analysis reveals statistically significant opposing rainfall responses, which appear to have long-term spatio-temporal consistency. This is important because as winter NAO forecasting skill improves, the findings of our research enable a more spatially reliable estimate of the likely impacts of NAO-influenced rainfall distribution.