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The Predictability of Scottish Temperature and Precipitation Variability from North Atlantic Sea Surface Temperature

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A number of studies have highlighted the regulating role that North Atlantic Sea Surface Temperatures (SSTs) play on the European climate. This study, however, suggests a more localised mechanism. Specifically, SSTs around the UK were found to have a greater influence on the variability of temperature and precipitation in Scotland.

A number of eigen techniques were used to investigate the relationships between SST in the North Atlantic and the variability of Scottish temperature and precipitation at the seasonal-to-decadal time-scale. A Canonical Correlation Analysis (CCA) was performed on the main principal components (PCs) of North Atlantic SST and temperature and precipitation during the 1960-2001 period. This analysis revealed a stronger relationship between these two terrestrial climatic variables and the European shelf seas SSTs (45°N-65°N, 20W-20E), particularly the North Sea, rather than for the SSTs over the entire North Atlantic (30°N-75°N, 80°W-30°E). Based on the above relationships, a redundancy analysis was accomplished to quantitatively assess the predictability of Scottish temperature and precipitation based on (1) the European shelf seas SSTs, and (2) the entire North Atlantic SSTs as predictors. Then, the temporal consistency of the identified sources of predictability was established for the period 1890-2001, the longest time-period for which observational data were readily available. The results indicate a good potential to forecast decadal trends in spring, summer and autumn Scottish temperatures. No significant predictability was achieved for rainfall. The statistical models developed were significantly better when SST in the European shelf seas were used as a predictor.

The potential for seasonal predictability was assessed using correlation analyses between the leading PC time series and temperature/precipitation data for the periods 1960-2001 and 1890-2001. PC time series were obtained from Empirical Orthogonal Functions (EOFs) of North Atlantic SSTs for the two oceanic regions of interest (entire North Atlantic and European Shelf Seas). Correlation coefficients were found to be significantly higher with the European shelf seas SSTs. For temperature, significant correlations are found at the 0-1 month lag, which is of limited use for seasonal prediction. Nevertheless, a high and statistically significant correlation is observed between autumn air temperature and preceding spring SST. A relationship between summer temperature and the preceding winter-spring SST is also seen. Further possibilities for seasonal prediction are observed for winter and autumn rainfall, using the preceding summer and winter SSTs, respectively, as predictors. These results were generally temporally consistent but significantly stronger for the period 1960-2001 in comparison to the period 1890-2001.