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Improved seasonal prediction of UK regional precipitation using atmospheric circulation

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In recent years, the UK has experienced severe extreme seasonal precipitation events, with instances of heavy rain leading to flooding in some regions (e.g. winter 2013-14) and periods of reduced precipitation leading to drought in others (e.g. the 2010-12 drought). Being able to forecast the risk of such events on seasonal timescales is important for enabling forward planning and the implementation of measures to mitigate the effects of these events on society.
The aim of this study is to further our understanding of whether skilful seasonal forecasts of the large-scale atmospheric circulation can be downscaled to provide skilful seasonal forecasts of regional precipitation for the UK. A simple multiple linear regression model is developed to describe winter precipitation variability in nine UK regions. The model for each region is a linear combination of two mean sea-level pressure (MSLP)-based indices which are derived from the MSLP correlation patterns for precipitation in north-west Scotland and south-east England. The first index is a pressure dipole, similar to the North Atlantic Oscillation but shifted to the east; the second index is the MSLP anomaly centred over the UK. The multiple linear regression model describes up to 76% of the observed precipitation variability in each region, and gives higher correlations with precipitation than using either of the two indices alone. The Met Office's seasonal forecast system (GloSea5) is found to have significant skill in forecasting the two MSLP indices for the winter season, in forecasts initialised around the start of November. Applying the multiple linear regression model to the GloSea5 hindcasts is shown to give improved skill over the precipitation forecast by GloSea5, with the largest improvement in Scotland.