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Downscaling summer rainfall in the UK from North Atlantic ocean temperatures

R. L. Wilby
Department of Geography, King's College London, Strand, London, WC2R 2LS, UK
Email: rob.wilby@kcl.ac.uk

Abstract. Annual series of three stochastic rainfall model parameters — the seasonal wet day amount (or intensity), the conditional dry–day probability (or dry–spell persistence), and the conditional wet-day probability (or wet-spell persistence) — were examined using daily rainfall records for ten UK stations for the period 1901–1995. The purpose was first, to determine the extent to which these indices of summer (June–August) rainfall were correlated with empirical orthogonal functions (EOFs) of summer North Atlantic sea surface temperature (SST) anomalies: second, to evaluate the skill of EOFs of preceding winter (December–February) SSTs for summer rainfall forecasting and downscaling.Correlation analyses suggest that observed increases in summer dry-spell persistence since the 1970s coincided with positive SST anomalies in the North Atlantic. In contrast, wet-spell persistence and intensities were relatively weakly correlated with the same patterns, implying that the use of SSTs is justifiable for conditioning *occurrence* but not *intensity* parameters. Furthermore, the correlation strengths were greater for EOFs of SSTs than those reported for area-average SST anomalies, indicating that the *pattern* of SST anomalies conveys important information about seasonal rainfall anomalies across the UK. When EOFs of winter SSTs were used to forecast summer rainfall in Cambridge, the skill was once again greater for dry-spells than either wet-spells or intensities. However, even for dry–spells, the correlation with observations — whilst statistically significant — was still rather modest ($r<0.4$). Nonetheless, the results are comparable to previous investigations of summer rainfall across Europe, and suggest that forecasting skill (across the UK) originates from the predictability of the rainfall occurrence process.

Keywords: North Atlantic, ocean temperatures, downscaling, rainfall, forecasting, UK

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