

A regional coupled approach to water cycle prediction during winter 2013/14 in the United Kingdom

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Abstract

A regional coupled approach to water cycle prediction is demonstrated for the 4-month period from November 2013 to February 2014 through analysis of precipitation, soil moisture, river flow and coastal ocean simulations produced by a km-scale atmosphere-land-ocean coupled system focussed on the United Kingdom (UK), running with horizontal grid spacing of around 1.5 km across all components. The Unified Model atmosphere component, in which convection is explicitly simulated, reproduces the observed UK rainfall accumulation (r^2 of 0.62 for daily accumulation), but there is a notable bias in its distribution – too dry over western upland areas and too wet further east. The JULES land surface model soil moisture state is shown to be in broad agreement with a limited number of cosmic-ray neutron probe observations. A comparison of observed and simulated river flow shows the coupled system is useful for predicting broad scale features, such as distinguishing high and low flow regions and times during the period of interest but are shown to be less accurate than optimised hydrological models. The impact of simulated river discharge on NEMO model simulations of coastal ocean state is explored in the coupled system, with comparisons provided relative to experiments using climatological river input and no river input around the UK coasts. Results show that the freshwater flux around the UK contributes of order 0.2 psu to the mean surface salinity, and comparisons to profile observations give evidence of an improved vertical structure when applying simulated flows. This study represents a baseline assessment of the coupled system performance, with priorities for future model developments discussed.

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