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The influence of synoptic airflow on UK daily precipitation extremes: climate model validation

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General circulation models project an increase in extreme precipitation for the United Kingdom, with potentially devastating impacts on flooding, acgriculture, infrastructure and society. To implement successful adaptation strategies on local scales, climate projections with a high resolution are required. However, on the scales of interest, even regional climate models (RCMs) might be considerably biased or, on sub-grid scales, might not provide information at all.

In this study, we investigated the ability of the HadRM3 RCM to correctly simulate daily precipitation extremes. For future projections, it is not enough to show that time average patterns of extreme precipitation are well represented; it is furthermore important to show that also the main physical processes that control extreme precipitation and might change in the future are well reproduced. To this end, we developed a vector generalised additive model that uses large scale atmospheric circulation indices (strength, direction and vorticity) to predict local scale extreme precipitation. We fitted this model to observed data from 689 rain gauges across the United Kingdom, and to the corresponding output of the HadRM3 model. We developed a metric to quantitatively assess the ability of HadRM3 to reproduce the observed relationships on gridscales, and found that the spatial patterns of these relationships are in general well represented. However, on scales below 100km bias correction becomes necessary.