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Large-scale drivers of local precipitation extremes in convection-permitting climate simulations

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The Met Office 1.5-km UKV convective-permitting models (CPM) is used to downscale present-climate and RCP8.5 60-km HadGEM3 GCM simulations. Extreme UK hourly precipitation intensities increase with local near-surface temperatures and humidity; for temperature, the simulated increase rate for the present-climate simulation is about 6.5% K**-1, which is consistent with observations and theoretical expectations. While extreme intensities are higher in the RCP8.5 simulation as higher temperatures are sampled, there is a decline at the highest temperatures due to circulation and relative humidity changes. Extending the analysis to the broader synoptic scale, it is found that circulation patterns, as diagnosed by MSLP or circulation type, play an increased role in the probability of extreme precipitation in the RCP8.5 simulation. Nevertheless for both CPM simulations, vertical instability is the principal driver for extreme precipitation.