EGU2020-8007
https://doi.org/10.5194/egusphere-egu2020-8007
EGU General Assembly 2020

Evaluating the small-scale space time structure of rainfall in the Convection Permitting Model of UKCP18

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Sub-daily precipitation at fine temporal resolution (~1 km2) is critical for a wide range of hydrological applications, such as flooding estimation, urban drainage design. In recent years, a step-change was given by Km-scale Convection-permitting models (CPMs), allowing for the first-time climate change projections at hydrologically relevant scales. CPMs have been now introduced in the operational climate change projections of the Met Office in the UK (UCKP18). The high-resolution hourly precipitation at a 2.2 km scales is currently available for the historical period (1980-2000) and future period (2020-2080) for the RCP8.5 scenario. It is perceived to provide a plausible tool for detailed climate impact studies. However, a question remains unanswered: is the local projection of precipitation from UKCP18 credible for hydrological use?

To answer the question, simulated hourly precipitation from the UKCP18 for the historical period is compared statistically with the observed rainfall data. Observation rainfall was obtained from UK Met Office C-band Weather Radar network and Gridded estimates of daily areal rainfall (CEH-GEAR). These were used to assess the spatial-temporal structure of rainfall, including spatial spectra, distributions of rainfall cell sizes and intensities, and their temporal growth/decay dynamics, and rainfall extremes. The statistical evaluation was performed for all climatologically distinct regions of the UK on a seasonal basis.

The results show that hourly precipitation in UKCP18 has a realistic spatial correlation structure compared to observations. However, the extreme areal mean precipitation is overestimated, particularly at scales finer than 6.6 km. Significant differences between the size and temporal dynamics of observed and modelled rainfall cells were identified, with distinct differences amongst climate regimes, highlighting the limits of applicability of current generation CPMs for hydrological forecasting.