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Projecting future changes in hydrological droughts in the UK : the impacts of bias correction and uncertainty in model predictions

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Hydrological simulations derived from future climate projections provide valuable tools to quantify potential future changes in hydrological extremes and to inform water resource management decisions. However, estimating future changes in hydrological extremes is challenging as historical and future climate projections are often subject to considerable uncertainties and biases. This can lead to incorrect and biased hydrological projections, especially when propagated through a hydrological model.

In this study, we evaluate the sensitivity of future changes in drought characteristics to potential biases in the forcing data from climate model simulations. To achieve this, a flexible national scale hydrological model, dynamic TOPMODEL, is driven by simulated current and future rainfall and potential evapotranspiration time series from a hydro-meteorological drought event set produced using the weather@home regional climate modelling system. We assess the skill of the climate model to reproduce the frequency, severity and duration of droughts for a historical baseline period (1974 – 2004) by comparing hydrological simulations driven using 100 sequences of spatio-temporally consistent weather from the weather@home drought event set to hydrological simulations driven by observational data. We show how biases in drought characteristics vary spatially and temporally for 43 UK catchments and apply a rainfall bias correction to resolve the seasonal climate model biases. We then run 100 sequences for two future time slices (2030s and 2080s) through the hydrological model using the uncorrected and bias corrected drought event sets to investigate how bias correction affects our interpretation of future changes in drought characteristics across the UK. Finally, we discuss the significance of these results for climate change impact studies focused on hydrological extremes.