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Using potential robustness of conceptual rainfall-runoff models to understand model uncertainty under a changing climate

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Conceptual rainfall-runoff (CRR) models are commonly used to understand how climate change may affect river flows, floods and droughts. However, they are often characterized by poorer performance when used to simulate a different climate from that of the calibration period. This is generally referred to as 'low model robustness' and has been thoroughly explored using historical data. This study extends this idea to focus on uncertainty in model predictions under a changing climate, defined as 'potential robustness'. To achieve this, we use a stochastic weather generator to produce synthetic rainfall time-series, which represent a range of possible future changes in rainfall, including scenarios that are very different from the historical climate. We then apply a generalized split-sample test framework to assess the potential robustness of three CRR models on three catchments. The relative potential robustness among models are contrasting across catchments, which are related to both the model structures and the uniqueness of individual catchments. This study illustrates a transferable empirical testing strategy to understanding variabilities in CRR model predictions. Such approach can improve our knowledge of model behaviour, and thus informs the suitability of alternative models for hydrological climate change impact assessments.