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Prediction variability between rainfall-runoff models and future climate projections from Global Climate Models

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Global warming can potentially lead to changes in future rainfall and runoff that will significantly impact on regional hydrology and future water resources availability. With increasing demand and potential changes in future water resources, there is a need for climate change impact assessment to guide water planning and investment. The large-scale climate impact studies commonly use conceptual rainfall-runoff models with the future climate projections from global climate models (GCMs) to estimate the impact on future water availability.

Numerous conceptual rainfall-runoff models have been used in climate change impact on runoff studies. This paper assesses the ability of six widely used lumped conceptual daily rainfall-runoff models, Sacramento, SIMHYD, SMARG, IHACRES, AWBM and GR4J in reproducing observed runoff in model calibration and compares their climate change impact simulation results. The modelling study is carried out using observed daily climate and streamflow data from 240 unregulated catchments in southeast Australia. The modelling is carried out for 0.05o grids to allow a better representation of the spatial patterns and gradients in rainfall.

A simple empirical daily scaling method is used to generate the future daily climate series informed by 15 GCMs for the SRES A1B, A2 and B1 emission scenarios in the Intergovernmental Panel on Climate Change Fourth Assessment Report (IPCC 4AR). The daily rainfall simulations from multiple runs of 15 GCMs for two 20-year time slices, 2046 to 2065 (SRES A1B, A2 and B1 experiment) and 1981 to 2000 (20th century experiment) are used in the daily scaling method to take into account the changes in the daily rainfall distribution as well as changes in seasonal means. The model parameters calibrated against the historical observed streamflow data are used with the future climate projections from global climate models to estimate future runoff.

The results indicate that there is variability between runoff estimated using different conceptual rainfall-runoff models for historical climate. However, the differences between the rainfall-runoff models are relatively small compared to the runoff estimated by a rainfall-runoff model using future rainfall projections from the different GCMs.