Realised added value in rainfall trends and variance from regional climate models

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Abstract: We evaluated the ability of Regional Climate Models (RCMs) to reproduce observed means, inter-annual variance, and trends for rainfall indices that are important for runoff generation in southeast Australia (Teng et al, 2023). To assess the performance of the RCMs without being influenced by the performance of the forcing Global Climate Model (GCM), we forced the Weather Research and Forecasting model (WRF) and Conformal Cubic Atmospheric Model (CCAM) with ERA-interim reanalysis data. We compared the performance of two different configurations of each RCM with ERA-interim at both observational and ERA-interim grid resolutions of 5 km and ~80 km, respectively.

The RCMs outperformed ERA-interim in representing the spatial patterns and magnitude of mean rainfall at the ERA-interim spatial resolution. They also represented the general spatial patterns of variance, but systematically underestimated the inter-annual variability over much of the domain. While the RCMs performed better than ERA-interim in reproducing the magnitude of trends, they still underestimated inter-annual variability. Notably, the RCMs can reproduce the decline of cool-season rainfall in southeast Australia, which has had significant impacts on water resources. CCAM ESCI-12 generally outperformed the other models across all rainfall indices, partly because of atmospheric spectral nudging and an improved land-surface scheme.

Based on our findings, we recommend focusing future research on the development of RCMs in areas where they currently underperform, such as reproducing inter-annual variability. We also recommend using bias correction methods that correct variance but preserve trend with RCMs to produce the next generation of Australian hydro-climate projections generated from CMIP6.

REFERENCES

Teng, J., Bennett, J., Charles, S., Chiew, F., Ji, F., Potter, N., Fu, G., Thatcher, M., Remenyi, T., 2023. Trend and variance in regional climate models – validation and hydrological implications. Journal of Hydrology, under review.

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