25th International Congress on Modelling and Simulation, Darwin, NT, Australia, 9 to 14 July 2023
mssanz.org.au/modsim2023

What is the flood risk in Australia under future climate?

Z. Khan [a], U. Bende-Michl [b], S. Srikanthan [b], E. Vogel [c], W. Sharples [b], J. Peter [b], P. Hope [b], A. Dowdy [b] and L. Wilson [d]

[a] *CSIRO Environment, Canberra*
[b] *Bureau of Meteorology, Canberra/Melbourne*
[c] *The University of New South Wales, Sydney*
[d] *Met Office, International Climate Services, Exeter, United Kingdom*
Email: zaved.khan@csiro.au

Abstract: The frequency and magnitude of extreme hydrological events, e.g., flood-producing rain and cyclones, are expected to increase as a consequence of climate change. The enhanced moisture-holding capacity of a warmer atmosphere can escalate heavy rainfall events (Sherwood et al., 2010; Yin et al., 2020). To plan and develop mitigation measures minimising potential impacts from a changing climate, understanding of plausible future climates is necessary. This is important for various industries and water-dependent sectors including agriculture, water management and flood control.

The Australian Bureau of Meteorology recently released the National Hydrological Project for Australia. This provides guidance material including assessment reports for eight Natural Resources Management (NRM) regions across Australia. The assessment includes plausible future occurrence of long-term hydro-climatic changes in these NRM regions. The assessment report includes a study of future flood scenarios, where rainfall and runoff simulated by the Bureau's operational landscape water balance model, AWRA-L (Australian Water Resources Assessment Landscape) is considered. An increase in extreme rainfall events may enhance the potential risk of flooding; however, the likelihood of flooding is heavily influenced by antecedent conditions, such as soil saturation. This case study demonstrates the change in extremely wet events in the future climate over 30-year future time slices centred around 2030 (period 2016–2045) and 2070 (period 2056–2085), compared to a historical reference period (1976–2005). The changes are determined in terms of the simulated annual maximum daily rainfall/runoff and the estimate of a 20-year return period of the annual maximum based on the Generalised Extreme Value (GEV) distribution, where this return value refers to an equivalent of a 5% chance of occurrence within any one year. We analysed a set of sixteen ensembles and two future scenarios (e.g., RCP 4.5, RCP 8.5) over all NRM clusters in Australia. The results show that both rainfall and runoff scenarios will increase in the maximum 1-day and 20-year return period for both periods 2016–2045 and 2056–2085 across most NRM clusters. Our results show that the mean rainfall tends towards little change or a decrease across all the NRM clusters. Our findings are further supported by the results from other studies (Abbs and Rafter, 2009; Alexander and Arblaster, 2009; Rafter and Abbs, 2009; Wasko and Sharma, 2017). The magnitudes of the simulated changes in extreme rainfall strongly depend on emission scenarios, the GCM or RCMs used, and periods. In addition, the results are based on a high level of spatial aggregation and cannot be applied to local scale application.

REFERENCES

Abbs, D.J., Rafter, A.S., 2009. Impact of Climate Variability and Climate Change on Rainfall Extremes in Western Sydney and Surrounding Areas: Component 4 - Dynamical Downscaling : Report to the Sydney Metro Catchment Management Authority and Partners. Aspendale.

Alexander, L. V, Arblaster, J.M., 2009. Assessing trends in observed and modelled climate extremes over Australia in relation to future projections. Int. J. Climatol. 29, 417–435.

Rafter, A.S., Abbs, D.J., 2009. An analysis of future changes in extreme rainfall over Australian regions based on GCM simulations and Extreme Value Analysis. CAWCR Res. Lett. 3, 43–48.

Sherwood, S.C., Roca, R., Weckwerth, T.M., Andronova, N.G., 2010. Tropospheric water vapor, convection, and climate. Rev. Geophys. 48. https://doi.org/https://doi.org/10.1029/2009RG000301

Wasko, C., Sharma, A., 2017. Global assessment of flood and storm extremes with increased temperatures. Sci. Rep. 7, 7945. https://doi.org/10.1038/s41598-017-08481-1

Yin, J., Guo, S., Gu, L., He, S., Ba, H., Tian, J., Li, Q., Chen, J., 2020. Projected changes of bivariate flood quantiles and estimation uncertainty based on multi-model ensembles over China. J. Hydrol. 585, 124760. https://doi.org/https://doi.org/10.1016/j.jhydrol.2020.124760

Keywords: *Future climate, floods, continental-scale, hydrological projections*