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Exploring future climate impacts on water allocations in the southern Murray Darling Basin

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Abstract: Climate change and variability will impact rainfall, water availability, and demand, but our understanding of impacts on large, interconnected river systems is incomplete. Such systems are particularly vulnerable to climate change due to the challenges in variable water allocations across the system, the dependance on intervalley water transfer, and the importance and complexity of managing environmental flows. Impacts will vary spatially, with differing climate signals, rainfall-runoff responses, and allocation systems across sub-basins within large river systems. In this paper, we "climate stress test" southern Murray Darling Basin allocations, examining differential impacts across the system, and the key drivers.

This case study aims to evaluate the vulnerability of water allocations by investigating a range of plausible climate futures, characterizing differences in impacts across the major storages of the southern connected MDB. The current river operations in the southern connected MDB assume reliability of supply from different storages, and this drives water trade and intervalley transfer patterns. Here, we examine if these historical assumptions around the relative reliability of supply in different systems are likely to hold under climate change. Understanding the likely behavior of allocations for key storages across the MDB will provide valuable information to inform future river operations challenges and likely changes in water market patterns.

In this study, climate projections were generated through an integrated framework for generating stochastic data (Fowler et al., 2022) as part of a bottom-up climate change risk assessment. The generated data included precipitation, temperature, potential evapotranspiration, and (via a rainfall-runoff model) streamflow, all on a monthly timestep. Existing water resource models of the southern MDB are large and complex, well suited to their original purpose, but their complexity makes them unsuited to a "stress testing" approach where thousands of model simulations are required to explore future climate uncertainties. To address this challenge, we developed statistical regressions between historical streamflow and allocations, which allow us to rapidly estimate high and low reliability water allocation outcomes for a given sequence of streamflow.

In the stress test, the Goulburn, Murrumbidgee and Murray allocations were subjected to a range of plausible climate futures. Current climate projection scenarios were then used to demarcate the likely range of future outcomes. The results for the three systems were compared to understand the relative impact of climate signal, rainfall-runoff and allocation policy, and the outcomes for different entitlement products.

The current relationship between water allocations in the major storages of the southern connected MDB define water delivery through the irrigation season. If water allocation relationships between storages were to change, so too would the demands of water delivery throughout the basin. An understanding of how allocations may change under probable future climate scenarios can be used to provide forecasts of available water resources and to better prepare water managers for inevitable climatic changes.

REFERENCES

Fowler, K., Ballis, N., Horne, A., John, A., Nathan, R., Peel, M., 2022, Integrated framework for rapid climate stress testing on an monthly timestep, Environmental Modelling & Software (2022), https://doi.org/10.1016/j.envsoft.2022.105339

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