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

Understanding river system sensitivity to climate variation

A. Shokri [a], D. Robertson [a], A. Freebairn [b] and N. Potter [b]

[a] CSIRO Environment, Melbourne, Australia
[b] CSIRO Environment, Canberra, Australia
Email: ash.shokri@csiro.au

Abstract: Climate variability and change present significant challenges to river systems worldwide, with implications for water security, ecosystem health, and socio-economic development. To effectively manage water and adapt to climate change, it is essential to understand river system sensitivity to climate variation. In Australia, analysis of river systems is traditionally undertaken with models run using historical forcing. Assessments of climate change impacts are then undertaken by perturbing this historical forcing data according to projections from global climate models. Australia's climate is well known to display large inter-annual and inter-decadal variability and therefore analyses that rely heavily on historical sequences of forcing data are likely to underestimate the range of water management outcomes, for example the reliability of urban or rural water supply, that are possible under both historical and future climate conditions.

This paper describes a preliminary investigation into the sensitivity of water resources system outcomes to climate variability and change. The investigation contrasts historically observed climate conditions to stochastic sequences generated using a model that explicitly describes inter-annual and inter-decadal variability. The sensitivity to two climate change scenarios is investigated by applying change factors to the stochastic climate simulations. Climate forcing data are converted to river system inflow sequences using a rainfall runoff model. The river system model water management and balance components, including evapotranspiration, infiltration, and runoff, under various scenarios of climate and land use change.

We undertake our investigation for a case-study catchment using a combination of operational rainfall-runoff and river system models. Results indicate water availability and allocations are highly sensitive to changes in climate, with significant reductions in water availability under scenarios of reduced rainfall and increased evapotranspiration. Figure 1 illustrates the effect of a 5% and 10% reduction in rainfall while evaporation increases by 7%, represented by the allocation exceedance probability curve for high security and general security licenses.

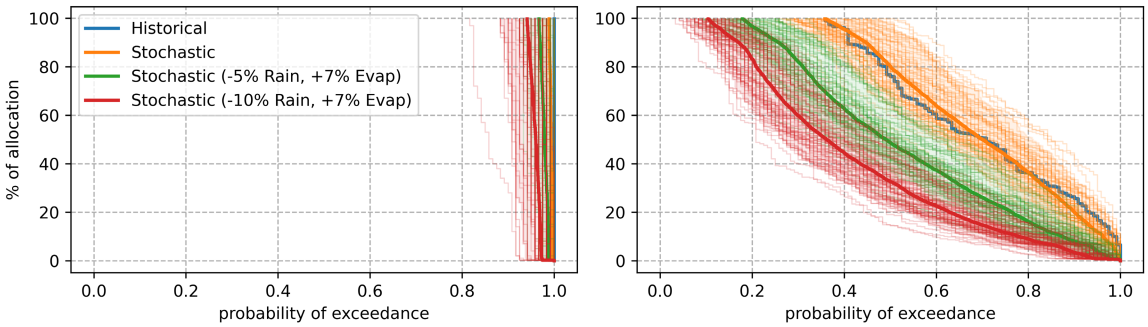

Figure 1. Sensitivity of allocation exceedance probability curve for (a) high security and (b) general security licences to climate variability and change

In conclusion, this study highlights the importance of understanding river system sensitivity to climate variation for effective water management and adaptation to climate change. Future work will systematically explore the vulnerability of a wide range of river system outcomes to climate change.

Keywords: *River systems modelling, climate variability, water management*