Morphing from flood forecasting to drought resilience water resource modelling

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Abstract: As the El Nino-Southern Oscillation (ENSO) outlook shifts from a three-year consecutive La Nina to El Nino, the focus of water resource management teams will shift from flood management to water utilisation management. The La Nina extended duration has pushed the development of flood early warning systems and hazard impact based mapping services. These data management tools focussed on maximising the utilisation of observed gauge data and forecasting numerical weather products, to assist decision makers with flood management. With the ENSO now inverting to a potential dry period, the Sunwater Operation Centre team are working on reconfiguring the same flood-based data management tools to optimise water resource utilisation from storages. The case study for a dam release optimisation tool coupled to the very same models used for flood forecasting and management simplifies the configuration by building on an already functional system.

The Sunwater Decision Support (SuDS) system is a data management tool at the core of Sunwater's Operation Centre. The SuDS system was initially structured to provide flood early warning information using configured tasks to import, process and verify data. With over 3,200 observed gauge locations, and several numerical weather prediction gridded data sets, the system has been used effectively to simulate flood outflows from dams over the past wet season. The use of a continuous hydrological model has been selected due to several model advantages including: (a) model compatibility and integration with the Delft Flood Early Warning Systems (Delft-FEWS) and has demonstrated successful application across Australia (De Kleermaeker et al. 2022); (b) the model is suitable for large-scale model applications (Alaminie et al. 2023); and (c) the transfer of hydrologic parameters across spatial and temporal scales has been found to reduce calibration time and improve the application of hydrologic models in ungauged or poorly gauged basins (van Verseveld et al. 2022).

There have been many advances in terms of availability and resolution of spatial datasets to support continuous hydrological modelling. Subsequently, the advantage of incorporating antecedent soil moisture assists the complex nature of low flow modelling, which is where drought resilience requires improved accuracy. Adapting the SuDS system's sophisticated set of configurable modules and incorporating a simple model with user-defined dynamic control rules to simulate the operation of pumps and extractions whilst routing low river flows, has been promising. Although early in the study, optimisation of the process for dam release routing to reduce losses of water exiting the scheme, whilst satisfying water orders is being investigated. This would provide the functionality for SuDS to lump water orders and consider delaying times with the intention to reduce water loss from storages, while incorporating rainfall forecasts and predicted tributary flows downstream of the dam from the continuous hydrological modelling. The shift from a fully functional flood forecast system to a drought resilient tool aims to reduce the resources, time and budget required.

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