WATER FORECASTS FOR ENHANCED ENVIRONMENTAL WATER DELIVERY

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ABSTRACT

The Australian Bureau of Meteorology delivers a suite of operational forecast services for water-dependent decision makers, one customer group uses forecasts to inform environmental water delivery. Significant environmental sites in the Murray-Darling Basin, Australia's food bowl, have suffered due to allocation of water to irrigated agriculture. The Enhanced Environmental Water Delivery project is a multi-agency collaboration that aims to coordinate releases of environmental water from storages with natural flow events, thereby achieving ecological outcomes with less environmental water. Forecasts of streamflow and runoff will be critical to maximise outcomes and minimise unintended impacts, such as inundation above agreed limits. Water forecasting in Australia is challenging due to climatical diversity, highly variable rainfall, and ephemeral streams. Overcoming these challenges is important to provide skilful and reliable probabilistic forecasts at a range of temporal and spatial scales. These forecasts will contribute to a more equitable distribution of water resources.

1   WATER IN AUSTRALIA IS HIGHLY VARIABLE AND HEAVILY ALLOCATED

Australia is the driest inhabited continent with an average annual precipitation of 450mm and streams characterised by low runoff and large differences between maximum and minimum flow. Variable climates and frequency of weather extremes lead to a land of droughts and floods, with available surface water on a decreasing trend in most regions (Zhang et al., 2016). Floods in 2022 on the east coast of Australia saw the loss of life, inundation of thousands of homes and businesses, and $4.8b in damages.

The Millennium drought, from 2001 to 2009, resulted in unprecedented impacts on communities, industries and the environment that depends on water resources in the Murray-Darling Basin (MDB). The Water in the MDB has been heavily allocated to irrigated agriculture to the detriment of river system health and significant environmental sites, such as 16 Ramsar listed wetlands. This led to the 2007 Water Act and 2012 Basin Plan with an intention to return more water to the environment.

These policy changes have institutionalised more equitable sharing arrangements and defined agency responsibilities, for example the Australian Bureau of Meteorology (Bureau) is responsible for compiling and delivering information on water. However, the MDB spans four states of the Australian federation making water a transboundary issue with multiple stakeholders.

One innovative response to this challenge is the introduction of a water market for inter and intra valley water trade, and the subsequent purchase of water allocations for environmental use. Federal and state agencies are supported by a thriving academic sector leading to innovative forecast methods, and the private sector supplying specialist program support.

2   BUREAU PROVIDES FORECAST PRODUCTS TO SUPPORT DECISION-MAKERS

The Bureau uses observations of catchment conditions, climate indices, and forecasts of hydrometeorological variables such as rainfall, temperature, wind, and evaporation to generate forecasts of streamflow and runoff. Raw forecasts are generated using rainfall-runoff and land-surface models which are then post-processed. Forecast post-processing has been key to providing skilful and reliable forecast services at short and long lead-times for many of our services. Bureau forecast services support a diverse set of customers with water-exposed decisions and the suite of products reflects this (Australian Bureau of Meteorology, 2022). These products range from event-based flood forecast warning, 7-day ahead hourly streamflow forecasts, seasonal forecasts of streamflow, runoff, and soil moisture, and projections out to 2085.

3   FORECASTS FOR ENHANCED ENVIRONMENTAL WATER DELIVERY (EEWD)

Bureau water forecasts are currently used across the MDB by a range of users; informing water allocation announcements, storage air space management, and water purchases by irrigators and environmental water holders. However, since the introduction of the Basin Plan in 2008 it has been challenging to achieve the equitable allocation of water between competing stakeholders in the expected timeframe. To address this, the EEWD project will help coordinate and align releases of environmental water from storages with natural flows from downstream tributaries. A set of optimal delivery strategies covering a range of system scale events which maximise long-term environmental outcomes will be developed. A decision support tool will use these strategies and Bureau water forecasts to assist river operators and environmental water holders to coordinate flows at environmental assets.

Streamflow forecasting is a key piece of information that will be used by the decision support tool to plan, order, and deliver environmental water events. Forecasts will be critical to maximise outcomes achieved by deciding which natural flow events to target and when to make releases, while avoiding unintended impacts such as inundation above agreed thresholds. Forecasts developed in the unregulated reaches of the basin will be routed through the river network, along with regulated releases, by operational river system models (eWater, 2022). The interaction of these operational models with Bureau forecasts and the decision support tool will be evaluated during the first stage of EEWD (June 2024). Improvements to existing Bureau operational forecasts will be explored. These include 30-day ahead sub-seasonal streamflow forecasts (McInerney et al., 2020) which are valuable for a range of decisions (Laugesen et al., 2022), and 9-day ahead forecasts of gridded runoff (Yang et al., 2021). Innovative Bureau forecasts will give customers insight to create a more equitable distribution of water and improve the health of natural habitats in Australia.

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