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Improving seasonal streamflow calibration through consideration of raw ensemble spread

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Abstract: Seasonal streamflow forecasts provide vital information for a range of end users including river operators, irrigators, environmental water managers, and hydro-electric generators.

To standardize water resource products in Australia, the Australian Bureau of Meteorology (BoM) is moving from a Bayesian joint probability (BJP) statistical modelling approach (Wang et al., 2009) to an integrated physical modelling system for seasonal streamflow forecasting. The Australian Water Resources Assessment (AWRA) modelling system has been developed by BoM to inform water resource assessments, accounting, and situation monitoring. The AWRA-L (landscape) model has an approximate 5 km grid covering the country and simulates the water balance since 1911, with variables including terrestrial water store, soil moisture, evapotranspiration, and surface runoff (Frost & Shokri, 2021). AWRA-L can be forced with seasonal climate forecasts from ACCESS-S (wind speed, temperature, precipitation, solar radiation) allowing forecasting of each of these variables.

The surface runoff component can be accumulated across individual catchments to provided estimated seasonal streamflow forecasts. A total of 27-member ensemble forecasts are produced based on the ACCESS-S ensemble climate forecasts. Postprocessing of these forecasts at the catchment scale, as with other hydroclimate forecasts, is necessary to correct for bias and dispersion errors. This postprocessing is herein referred to as "calibration".

BoM has applied the BJP approach to calibrate seasonal streamflow forecasts, using only a single representative value from the forecast (e.g., mean or median). Inclusion of ensemble spread information in the calibration process may further improve the final forecasts (Zhao et al., 2022).

Here, we investigate the potential for improved calibration of seasonal streamflow forecasts through the inclusion of ensemble spread information. We compare the contribution of ensemble spread information on unimpacted catchments across Australia using the hydrological reference station (HRS) dataset (Turner et al., 2012). We find the inclusion improves forecast skill, particularly for longer lead times.

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