Evaluation of the Australian Water Resource Assessment Landscape (AWRA-L) model, WaterDyn and CABLE

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Abstract: Assessing water resources and accounting for their availability and use at a regional and continental scale requires comprehensive and consistent information on water distribution, storage, availability, and use. This information needs to be accurate, up-to-date and take account of local climatic and hydrological conditions. It also needs to be produced in a robust, transparent and repeatable manner. The Australian Water Resource Assessment Modelling System (AWRAMS) provides nationally consistent and robust water balance estimates at a national to regional scale for the past and present using observations where available, and modelling otherwise. The AWRAMS is a new integrated continental hydrological simulation system designed and prototyped by CSIRO and the Bureau through the Water Information Research and Development Alliance (WIRADA) WIRADA initiative completed by June 2016.

The AWRAMS system uses on-ground observations and remotely sensed data sets, combined with hydrological science and computing technology, to estimate water balance fluxes and stores. This includes all major water storages, and the movement of water in and between these, at a ~5 km spatial resolution and daily time step. It is flexible enough to use all available data sources, whether modelling data-rich or data-sparse regions, to provide nationally consistent and robust estimates of water balance terms. The AWRAMS has three modelling components including a landscape water balance (AWRA-L), a groundwater (AWRA-G) and a river balance (AWRA-R).

This paper deals with the AWRA landscape model (AWRA-L) which provides credible estimates of landscape water yield (runoff and baseflow), evapotranspiration, soil moisture, and aquifer recharge across Australia, specifically for retrospective Water Resource Assessment, National Water Account and soil moisture monitoring purposes. AWRA-L is a 0.05° (~5km) gridded soil and groundwater balance model, undergoing continual conceptual and parameter estimation development, towards reducing the uncertainty and error in the water balance estimates. Significant technical improvements in the model performance and conceptual structure have been achieved to date from the initially parameterised AWRA-L v0.5 through to the current AWRA-L v4.5 over the last 7 years. This paper evaluates and compares the hydrologic performance of various versions of AWRA-L model with two similar national water balance models (WaterDyn and CABLE-SLI).

Initial comparison results indicates that streamflow performance has improved with successive versions of AWRA-L, with v4.5 performing better than WaterDyn and CABLE in terms of Nash-Sutcliffe Efficiency and bias across 295 catchments used in calibration and 294 validation catchments. This better performance is not surprising as AWRA-L is currently calibrated to streamflow, whereas CABLE and WaterDyn are not. Secondly AWRA-L is approaching the hydrologic performance of locally calibrated, nearest neighbouring catchment regionalised rainfall-runoff models such as GR4J, highlighting the good performance of the model in ungauged/uncalibrated areas. Comparison against satellite and point based estimates of soil moisture and ET have indicated that AWRA-L model performs relatively well. Variability of performance between various versions of AWRA-L model indicates that calibration to soil moisture and ET could significantly improve the model according to these variables, without degrading performance according to streamflow.

Outputs of the AWRA-L model are currently used each year by the Bureau to populate the water balance terms in the annual National Water Accounts (NWA) and regular water resources assessment products and the Water in Australia (WIA) report. In the near future, the Bureau plans that regularly updated AWRAMS products such as regional water information,, soil moisture (or evapotranspiration) and monthly status report could be provided as a service by the Bureau. The outputs provide valuable information on Australia's water resources for water management practitioners, policy makers and researchers.

Keywords: *Soil moisture monitoring, model evaluation, landsurface water balance*