

Investigation of the sensitivity of weighting factor parameter in SDEB objective function

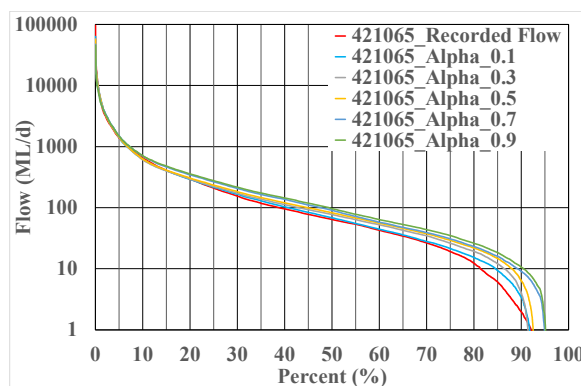
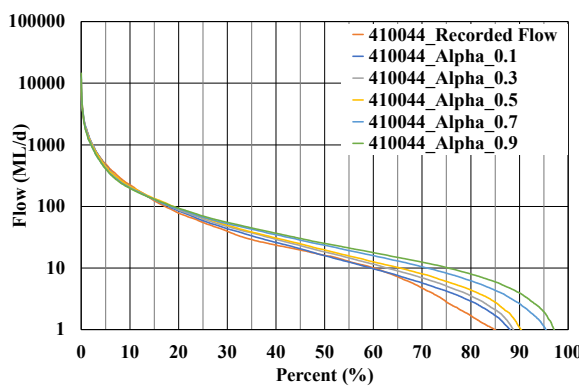
Ashok Raut, Ha Nguyen and Narendra Tuteja

WaterNSW, Parramatta, Australia
 Email: Ashok.Raut@waternsw.com.au

Abstract: WaterNSW operates a large network of dams and rivers in NSW to supply bulk water to its customers. We also plan and upgrade the infrastructure to enhance supply reliability. For this, WaterNSW has developed and used a range of hydrologic, hydraulic and water resource system models. Long-term catchment inflow is a significant input to all these models. This is calculated using catchment rainfall-runoff modelling. WaterNSW uses the eWater Source hydrologic modelling platform for wide ranging applications. Source provides a range of objective functions that seek to optimise model performance including the Absolute Bias and Square-root Daily Exceedance and Bias (SDEB), which are minimised. Our evaluation analyses of the objective functions indicate that the SDEB provides robust calibrations and therefore it has been often used in WaterNSW models. The SDEB metric is given by:

$$SDEB = \left(\alpha \sum_{i=1}^N [Q_{obs,i}^\lambda - Q_{mod,i}^\lambda]^2 + (1 - \alpha) \sum_{k=1}^N [R_{Q_{obs,k}}^\lambda - R_{Q_{mod,k}}^\lambda]^2 \right) \left(1 + \frac{|\sum_{i=1}^N Q_{mod,i} - \sum_{i=1}^N Q_{obs,i}|}{\sum_{i=1}^N Q_{obs,i}} \right)^\mu$$

where, α is a weighting factor used to reduce the impact of the timing errors on the objective function. λ is an exponent set to 0.5 and μ a power to the bias term set to 1 in Source. For details, refer to Lerat et al. (2013). The SDEB ranges from 0 to $+\infty$, where a value of 0 indicates a perfect fit between modelled and observed data. By way of example, in their study of the Flinders and Gilbert Rivers in Northern Australia, Lerat et al. (2013) used values of α equal to 0.1 for the Flinders calibration and 1.0 for the Gilbert calibration. By default, the Source has set this factor to 0.1 with the functionality for the modellers to choose a different value if justified. Most WaterNSW models used the default value. In this study, we investigate the parameter sensitivity across various catchments across a set of selected river basins in NSW. A set of four unregulated, natural head catchments were chosen from four river basins – Nepean-Hawkesbury (Gauge #212250), Shoalhaven (#215208), Lachlan (#412065) and Murrumbidgee (#410044). Calibration plots for Murrumbidgee and Lachlan catchments respectively are given below for reference. The study compares and discusses several calibration goodness-of-fit parameters around high, mid, and low flow regimes. In conclusion, the calibrations do vary with the values of α particularly low flows, the default value of 0.1 still holds good for the selected NSW catchments.



REFERENCES

Lerat, J., C.A. Egan, S. Kim, M. Gooda, A. Loy, Q. Shao, C. Petheram. 2013. Calibration of river models for the Flinders and Gilbert catchments. A technical report to the Australian Government from the CSIRO Flinders and Gilbert Agricultural Resource Assessment, part of the North Queensland Irrigated Agriculture Strategy. CSIRO Water for a Healthy Country and Sustainable Agriculture flagships, Australia.

Keywords: Rainfall-runoff, objective function, eWater Source, SDEB, weighting factor