Low flow prediction from land surface temperature

Wenjing Yang[a], Huade Guan[a]

[a] *National Centre for Groundwater Research and Training, and Ecology Evolution and Environment Section of College of Science and Engineering, Flinders University, Adelaide, SA 5001, Australia*
Email: wenjing.yang@flinders.edu.au

Abstract: Low flow prediction is important for water management to support ecosystem functioning and biodiversity preservation in dry season and during drought events (Aryal et al., 2020). Prediction of low flow is often done by hydrological modelling or statistical relationship with climate variables and catchment characteristics (Chagas et al., 2024). However, hydrological models often prioritize high-flow performance at the expense of low-flow accuracy, while statistical models face challenges in accounting for anthropogenic influences such as irrigation.

We propose an alternative approach that uses land surface temperature (LST) to predict low flows. Low flows are closely linked to shallow groundwater storage, which supports groundwater-dependent vegetation (GDV). When groundwater levels decline to critical thresholds, GDV begins to show stress signals, which can be detected via canopy temperature and reflected in LST. Therefore, spatial and temporal patterns of LST may carry information about shallow groundwater storage and, consequently, low flows.

We test this hypothesis in selected catchments across Australia, exploring the potential of LST-based indicators for low-flow prediction. Results show that in 61% of catchments, low flow has a significant 2–6 month lagged linear relationship with LST, with R^2 >0.6, indicating that low flow in dry months can be predicted 2–6 months in advance based on remotely sensed LST and its derived variables.

This approach offers a novel pathway to integrate LST data into low-flow forecasting, with implications for understanding low-flow pattern and improving water resource management during dry periods (Peterson et al., 2021).

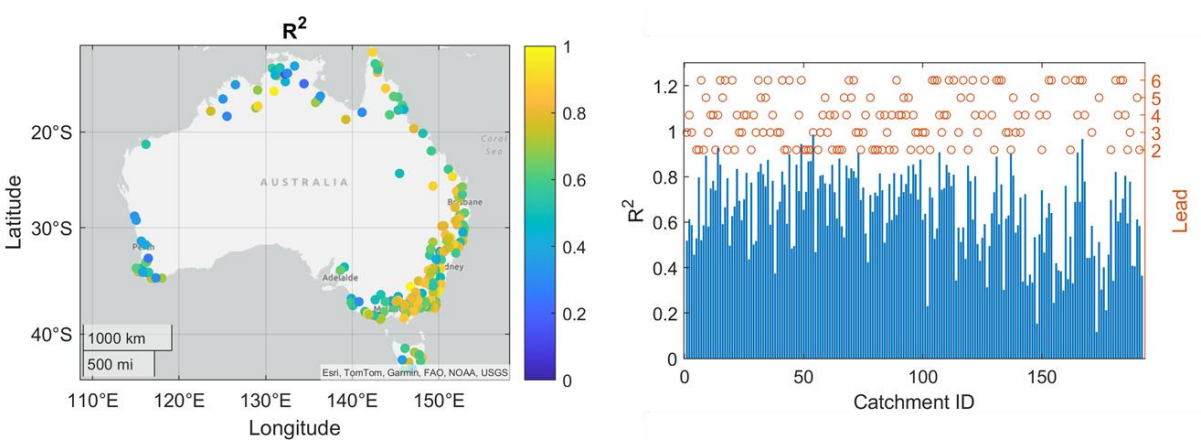

Figure 1 Preliminary relationship between LST and low flows. (a) Highest coefficient of determination (R2) patterns between LST and low flow at different lead times (months). (b) Lead time of prediction across catchments.

REFERENCES

Aryal SK, Zhang Y and Chiew F (2020) Enhanced low flow prediction for water and environmental management. Journal of Hydrology, 584: 124658.

Chagas VBP, Chaffe PLB and Blöschl G (2024) Regional Low Flow Hydrology: Model Development and Evaluation. Water Resources Research, 60(2).

Peterson TJ, Saft M, Peel MC and John A (2021) Watersheds may not recover from drought. Science, 372(6543): 745-749.

Keywords: *Drought, low flow, land surface temperature, seasonal forecast, Australia*

