



Drought risk modelling and forecasting framework to inform the implementation of the National Water Scarcity Policy Plan in Scotland



Stevenson¹, J.L., Schurch², N., Adams¹, K., Gagkas¹, Z., Jabloun, M¹., Naha, S³., Frantsuzova, A.², & Glendell, M¹.

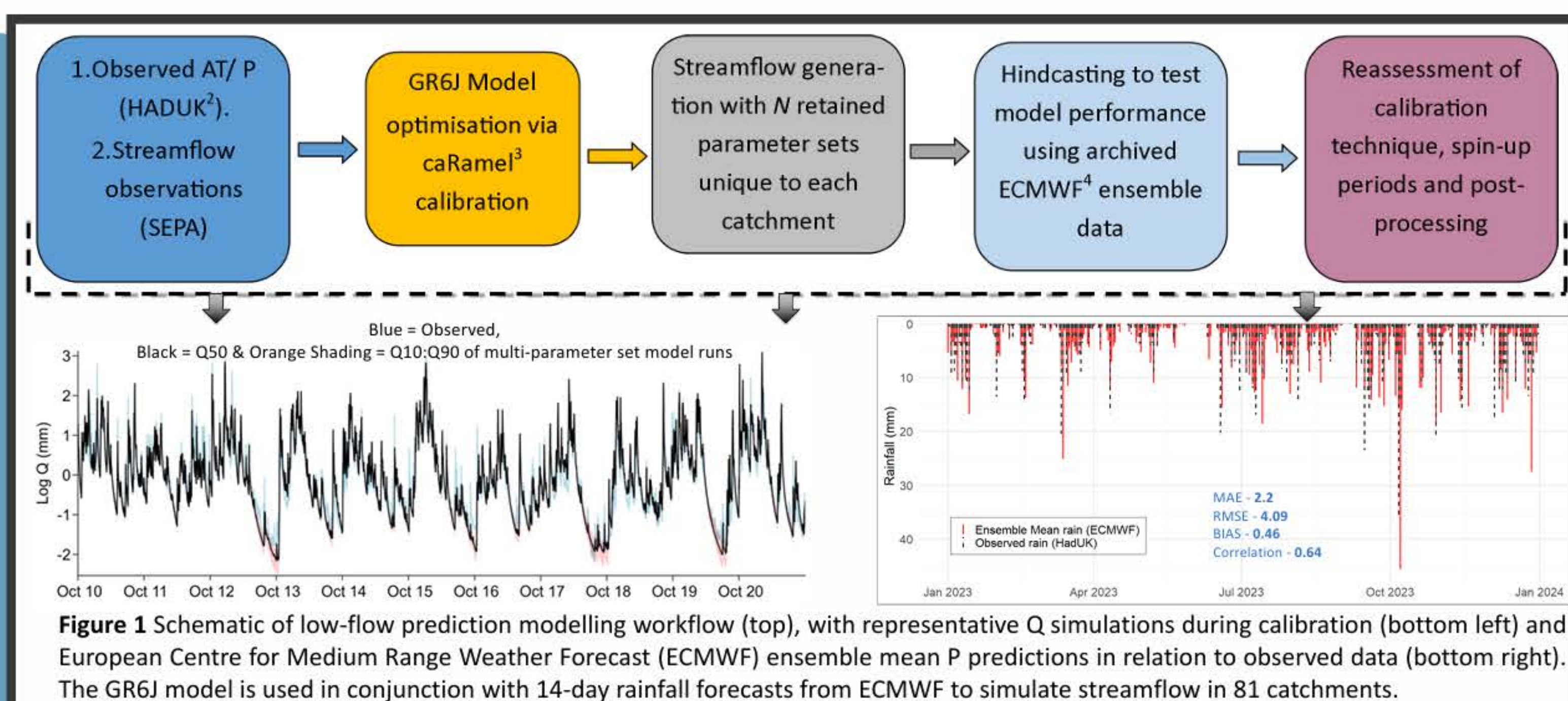
¹The James Hutton Institute, Craigiebuckler, Aberdeen, UK; ² Biomathematics and Statistics Scotland, Aberdeen, UK; ³ HR Wallingford, Oxford, UK.

Correspondence: jamie.stevenson@hutton.ac.uk

Introduction

By 2050 droughts may almost double in parts of Scotland¹, impacting a range of water users. Here, we showcase multiple tools to inform future adaptation responses:

- a drought risk modelling and forecasting framework to inform the implementation of the National Water Scarcity Plan in Scotland.
- an open-source R package, *wscall*, combining multi-window rolling-average smoothing approach with a history-matching framework to characterize hydrological drought events in near-real-time.
- a probabilistic catchment-scale water resources decision-support tool to evaluate drought risk to 2050.



wscall - probabilistic modelling of drought periods:

- Multi-timescale smoothing helps improve drought detection and reduce early-stopping.
- Better at bridging of short rainfall periods.
- More conservative identification of starts/ends.
- History-matching probabilistic early warnings based on live monitoring of 320 river gauge stations.



Figure 2 *wscall* user interface showing the home page for catchment filtering (left) and multi-timescale smoothing for the River Dee (Woodend; right).

Probabilistic catchment scale water resources management decision-support tool -

Leveraging meteorological, hydrological, agricultural and socioeconomic drought indicators across future scenarios to understand sectoral vulnerabilities.

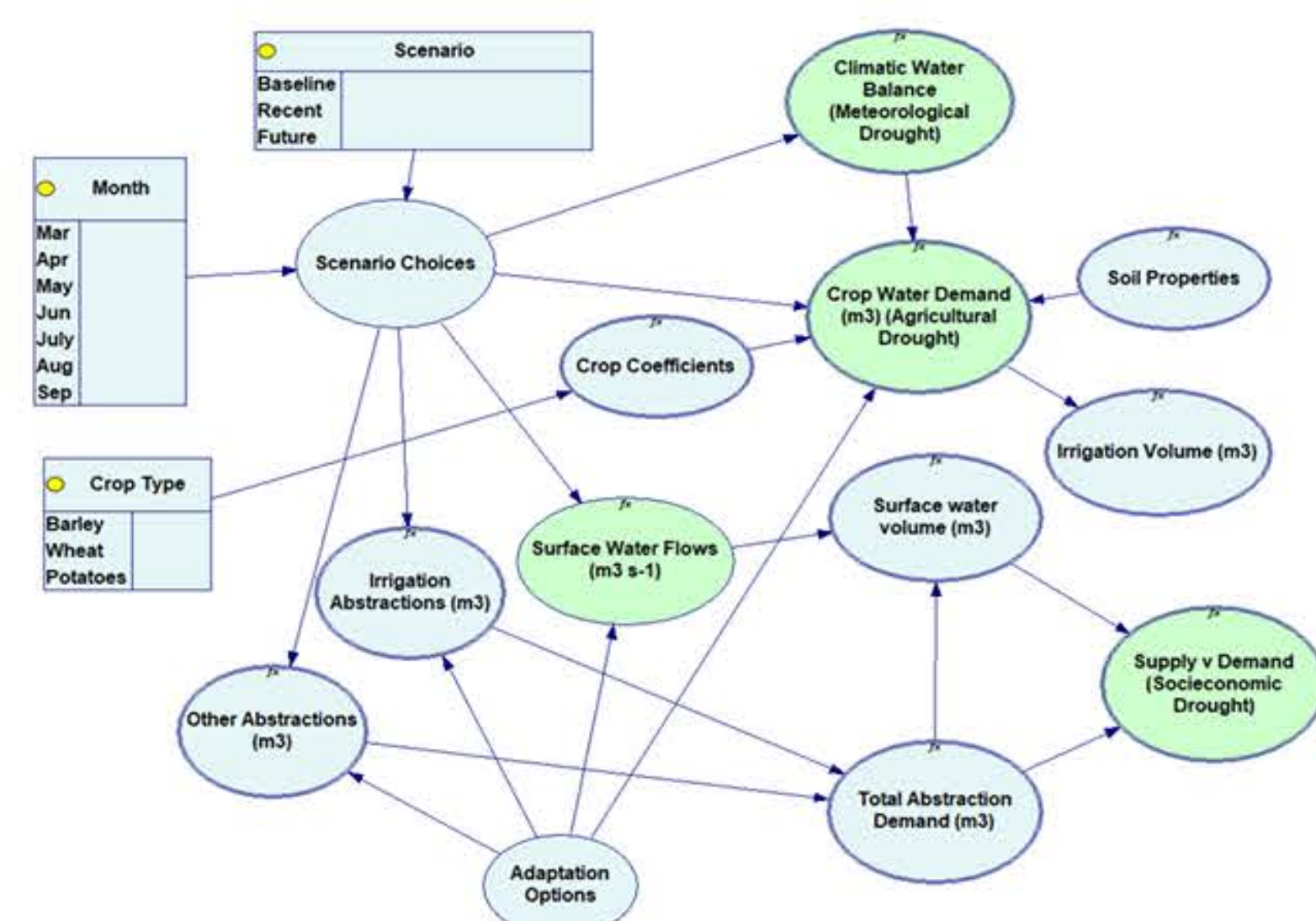


Figure 3 Schematic of catchment-scale water resources decision-making support tool

References

1. Naha *et al.* (2025). <https://dx.doi.org/10.2139/ssrn.5214283>
2. Met Office. (2018). <http://catalogue.ceda.ac.uk/uuid/4dc8450d889a491ebb20e724debe2dfb>
3. Le Moine *et al.* (2026). <https://doi.org/10.32614/CRAN.package.caRamel>
4. ECMWF Archive. (2026). <https://www.ecmwf.int/en/forecasts/access-forecasts/access-archive-datasets>

RESAS

Rural & Environment Science and Analytical Services

Scottish Government
Riaghaltas na h-Alba

Outlook:

- Inclusion of semi-distributed and AI (LSTM) based models for streamflow prediction across Scotland.
- Multi-model integration with *wscall* to provide probabilistic low-flow predictions and inform drought alerts.
- Upscaling of Bayesian network-based decision support tool for water resources management across Scotland