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Simulating transmission losses during environmental flow events in the northern Murray-Darling Basin

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Abstract: The Murray-Darling Basin (MDB) is known for facing many environmental issues including droughts, floods, bushfires, fish deaths, high salinity, algal blooms, blackwater events and acidic soils. To combat many of these issues, there has been increased emphasis placed on environmental flows and restrictions on extractions during low flows. This has highlighted the poor performance of basin-scale river system models in predicting low flows, making them unsuitable for assessing ecological impacts under such conditions.

The current study is motivated by the inability of these standard river system models to replicate environmental flow events in the northern MDB, specifically those that occurred in 2018 and 2019. The first event in 2018 was called the Northern Connectivity Event (NCE) which involved a total release of 23.2 GL from two dams (Glenlyon and Copeton) and was successful in providing environmental benefits such as improved water quality and river pool connectivity for fish migration. The event covered over a total of 2000 km of the Gwydir, Mehi, Dumaresq, Macintyre and Barwon-Darling rivers and reached the Menindee Lakes (DAWE, 2018). The following year, the Northern Fish Flow (NFF) occurred which involved a total release of 36 GL of water from the same dams, but this event only covered about 1500 km of the river system and did not reach the Menindee Lakes, even though the total release volume was higher than the NCE's (CEWO, 2019).

The large discrepancy in flow extent was due to differences in antecedent conditions (CEWO, 2019). In 2018, rainfall over upper catchment areas produced unregulated flows down the river system prior and during the NCE. In contrast, the period leading up to the NFF in 2019 was extremely dry with record low levels recorded in the Barwon-Darling. These very dry antecedent conditions caused substantial transmission losses during the NFF event due to increased alluvial storage deficits and filling of dried instream pools.

One of the objectives of the Murray-Darling Water and Environment Research Program (MD-WERP) was to develop methods that can be adopted by existing river system modelling tools to predict low flows more accurately. For this, the Dynamic Maximum Alluvium As River Storage (DMAARS) and DMAARS coupled with river dead storage (DMAARSDS) models were developed within the Australian Water Resource Assessment River (AWRA-R) framework. These models are better physical representations of river processes than loss vs flow relationships and allow explicit account of alluvium wetness and instream pool storage which are crucial for estimating the efficiency and extent of environmental flow releases during dry conditions.

The models were trialled in the Border Rivers, Gwydir and Barwon-Darling catchments while using a piecewise linear loss vs flow model as a benchmark. The new models provided improved or comparable performance, with more realistic estimates of environmental flow metrics. Scenario testing revealed that model choice significantly influences predicted outcomes, especially in terms of baseline conditions and ecological benefits such as peak water height and flow extent. Based on current findings, we recommend use of the existing dead storage functionality available in eWater Source and adoption of DMAARS which has recently been integrated into Source as a community plugin.

REFERENCES

DAWE (2018) Final Report on the Northern Connectivity Event (April – July 2018). https://www.dcceew.gov.au/sites/default/files/documents/final-report-northern-connectivity-event-2018.pdf

Doble RC, Crosbie RS, Smerdon BD, Peeters L and Cook FJ (2012) Groundwater recharge from overbank floods. Water Resources Research, 48(9).

CEWO (2019) Northern fish flow - wrap up. https://www.dcceew.gov.au/sites/default/files/documents/northern-fish-flow-wrap.pdf

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