25th International Congress on Modelling and Simulation, Darwin, NT, Australia, 9 to 14 July 2023
mssanz.org.au/modsim2023

Modelling the impacts of future evapotranspiration changes on streamflow

J. Jian [a], **F.M. Johnson** [a,c] **and L.A. Marshall** [b,c]

[a] *Water Research Centre, School of Civil Environmental Engineering, University of New South Wales, Sydney, Australia*
[b] *Faculty of Science and Engineering, Macquarie University, Sydney, Australia*
[c] *ARC Training Centre in Data Analytics for Resources and Environments*
Email: jie.jian@unsw.edu.au

Abstract: Anthropogenic climate change is affecting all parts of the hydrological cycle and will increasingly lead to changes in water availability. Assessments of climate change on hydrological systems generally use conceptual rainfall runoff models. However most conceptual rainfall runoff models use Potential Evapotranspiration (PET) as a forcing and as a result calculate Actual Evapotranspiration (AET) internally as a model state. This is a problem in the context of climate change impact assessments because it is likely that vegetation processes will change in the future with both rainfall changes and changes in CO_2. However, the effects of those changes in vegetation processes on ET are not explicitly modelled in conceptual rainfall runoff models and therefore cannot currently be quantified. Whilst process-based ecohydrological models can be used to assess such questions (Stephens et al., 2020), their high computational cost and extensive data requirements, mean that it is not practical to use them operationally for future water resources assessments. Thus, a major gap in current hydrological practice is how PET and AET future changes can be included in catchment models.

In this presentation, we present results of a sensitivity analyses of future streamflow projections to a range of ET formulations in conceptual rainfall runoff models. The analyses are carried out for the Kedumba Catchment in NSW. We modified a conceptual rainfall model to include the PML_V2 model (Gan et al., 2018) which incorporates LAI data to generate more accurate canopy conductance in ET. The modified rainfall runoff model was then forced with future LAI and climate simulations and the streamflow projections compared to results from the conceptual models calibrated over the historical period with different PET formulations. Using this approach, we assess the uncertainty in streamflow estimates from both model structural choices and future climate scenarios. Future work will compare these simpler model structures to a physically-based ecohydrological model which has dynamic vegetation growth, nutrient cycling, and subsurface hydrology. Overall, this work contributes to understanding how streamflow projections are sensitive to future ET and provides a path for robust operational water resources system modelling.

REFERENCES

Gan, R., Zhang, Y., Shi, H., Yang, Y., Eamus, D., Cheng, L., Chiew, F. H. S., & Yu, Q., 2018. Use of satellite leaf area index estimating evapotranspiration and gross assimilation for Australian ecosystems. Ecohydrology, 11(5), e1974. https://doi.org/https://doi.org/10.1002/eco.1974

Stephens, C. M., Marshall, L. A., Johnson, F. M., Lin, L., Band, L. E., & Ajami, H., 2020. Is Past Variability a Suitable Proxy for Future Change? A Virtual Catchment Experiment. Water Resources Research, 56(2), e2019WR026275.

Keywords: *Evapotranspiration, climate change, vegetation processes*