

EGU 2025. HS2.2.1 *Advancing process representation for hydrological modelling across spatio-temporal scales*

Leveraging flux tower data to systematically evaluate evapotranspiration formulas in conceptual hydrological models

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References:

- Arciniega-Esparza, S., Birkel, C., Chavarría-Palma, A., Arheimer, B., & Breña-Naranjo, J. A. (2022). Remote sensing-aided rainfall–runoff modeling in the tropics of Costa Rica. *Hydrology and Earth System Sciences*, 26(4), 975–999. <https://doi.org/10.5194/hess-26-975-2022>
- Bai, P., Liu, X., & Liu, C. (2018). Improving hydrological simulations by incorporating GRACE data for model calibration. *Journal of Hydrology*, 557, 291–304. <https://doi.org/10.1016/j.jhydrol.2017.12.025>
- Bai, P., Liu, X., Yang, T., Li, F., Liang, K., Hu, S., & Liu, C. (2016). Assessment of the Influences of Different Potential Evapotranspiration Inputs on the Performance of Monthly Hydrological Models under Different Climatic Conditions. *Journal of Hydrometeorology*, 17(8), 2259–2274. <https://doi.org/10.1175/JHM-D-15-0202.1>
- Chiew, F. H. S., Teng, J., Vaze, J., Post, D. A., Perraud, J. M., Kirono, D. G. C., & Viney, N. R. (2009). Estimating climate change impact on runoff across southeast Australia: Method, results, and implications of the modeling method. *Water Resources Research*, 45(10). <https://doi.org/10.1029/2008WR007338>
- Deb, P., & Kiem, A. S. (2020). Evaluation of rainfall–runoff model performance under non-stationary hydroclimatic conditions. *Hydrological Sciences Journal*, 65(10), 1667–1684. <https://doi.org/10.1080/02626667.2020.1754420>
- Dembélé, M., Hrachowitz, M., Savenije, H. H. G., Mariéthoz, G., & Schaefli, B. (2020). Improving the Predictive Skill of a Distributed Hydrological Model by Calibration on Spatial Patterns With Multiple Satellite Data Sets. *Water Resources Research*, 56(1), e2019WR026085. <https://doi.org/10.1029/2019WR026085>
- Duethmann, D., Blöschl, G., & Parajka, J. (2020). Why does a conceptual hydrological model fail to correctly predict discharge changes in response to climate change? *Hydrology and Earth System Sciences*, 24(7), 3493–3511. <https://doi.org/10.5194/hess-24-3493-2020>
- Fowler, K. J. A., Coxon, G., Freer, J. E., Knoben, W. J. M., Peel, M. C., Wagener, T., Western, A. W., Woods, R. A., & Zhang, L. (2021). Towards more realistic runoff projections by removing limits on simulated soil moisture deficit. *Journal of Hydrology*, 600, 126505. <https://doi.org/10.1016/j.jhydrol.2021.126505>
- Gardiya Weligamage, H., Fowler, K., Peterson, T. J., Saft, M., Peel, M. C., & Ryu, D. (2023). Partitioning of Precipitation Into Terrestrial Water Balance Components Under a Drying Climate. *Water Resources Research*, 59(5), e2022WR033538. <https://doi.org/10.1029/2022WR033538>
- Gardiya Weligamage, H., Fowler, K., Saft, M., Peterson, T., Ryu, D., & Peel, M. (2025). *Characterising evapotranspiration signatures for improved behavioural insights*. <https://doi.org/10.5194/hess-2024-373>

- Grigg, A. H., & Hughes, J. D. (2018). Nonstationarity driven by multidecadal change in catchment groundwater storage: A test of modifications to a common rainfall-run-off model. *Hydrological Processes*, 32(24), 3675–3688. <https://doi.org/10.1002/hyp.13282>
- Herman, M. R., Nejadhashemi, A. P., Abouali, M., Hernandez-Suarez, J. S., Daneshvar, F., Zhang, Z., Anderson, M. C., Sadeghi, A. M., Hain, C. R., & Sharifi, A. (2018). Evaluating the role of evapotranspiration remote sensing data in improving hydrological modeling predictability. *Journal of Hydrology*, 556, 39–49. <https://doi.org/10.1016/j.jhydrol.2017.11.009>
- Kelleher, C. A., & Shaw, S. B. (2018). Is ET often oversimplified in hydrologic models? Using long records to elucidate unaccounted for controls on ET. *Journal of Hydrology*, 557, 160–172. <https://doi.org/10.1016/j.jhydrol.2017.12.018>
- Knoben, W. J. M., Freer, J. E., Fowler, K. J. A., Peel, M. C., & Woods, R. A. (2019). Modular Assessment of Rainfall–Runoff Models Toolbox (MARRMoT) v1.2: An open-source, extendable framework providing implementations of 46 conceptual hydrologic models as continuous state-space formulations. *Geoscientific Model Development*, 12(6), 2463–2480. <https://doi.org/10.5194/gmd-12-2463-2019>
- Peterson, T. J., Saft, M., Peel, M. C., & John, A. (2021). Watersheds may not recover from drought. *Science*, 372(6543), 745–749. <https://doi.org/10.1126/science.abd5085>
- Pool, S., Fowler, K., & Peel, M. (2024). Benefit of Multivariate Model Calibration for Different Climatic Regions. *Water Resources Research*, 60(4), e2023WR036364. <https://doi.org/10.1029/2023WR036364>
- Rientjes, T. H. M., Muthuwatta, L. P., Bos, M. G., Booij, M. J., & Bhatti, H. A. (2013). Multi-variable calibration of a semi-distributed hydrological model using streamflow data and satellite-based evapotranspiration. *Journal of Hydrology*, 505, 276–290. <https://doi.org/10.1016/j.jhydrol.2013.10.006>
- Saft, M., Peel, M. C., Western, A. W., Perraud, J., & Zhang, L. (2016). Bias in streamflow projections due to climate-induced shifts in catchment response. *Geophysical Research Letters*, 43(4), 1574–1581. <https://doi.org/10.1002/2015GL067326>
- Taia, S., Scozzari, A., Erraioui, L., Kili, M., Mridekh, A., Haida, S., Chao, J., & El Mansouri, B. (2023). Comparing the ability of different remotely sensed evapotranspiration products in enhancing hydrological model performance and reducing prediction uncertainty. *Ecological Informatics*, 78, 102352. <https://doi.org/10.1016/j.ecoinf.2023.102352>
- Trotter, L., Knoben, W. J. M., Fowler, K. J. A., Saft, M., & Peel, M. C. (2022). Modular Assessment of Rainfall–Runoff Models Toolbox (MARRMoT) v2.1: An object-oriented implementation of 47 established hydrological models for improved speed and readability. *Geoscientific Model Development*, 15(16), 6359–6369. <https://doi.org/10.5194/gmd-15-6359-2022>