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Leveraging remotely sensed evapotranspiration and soil moisture data for enhanced watershed modelling with the SWAT model

Soufiane Taia¹, Andrea Scozzari², Lamia Erraioui¹, Jamal Chao¹, and Bouabid El Mansouri¹

¹Natural Resources and Sustainable Development Laboratory, Ibn Tofail University, Campus Maamora, 14000 Kenitra, Morocco.

²Institute of Information Science and Technologies (CNR-ISTI), National Research Council of Italy, 56124 Pisa, Italy.

In data-scarce watersheds, hydrological models are often calibrated by using only streamflow observations. This approach may overlook crucial landscape characteristics, which, instead, may significantly affect the runoff. This study explores the integration of parameters derived from remotely sensed data, focusing on evapotranspiration, soil moisture, and runoff, to enhance the overall accuracy of the Soil and Water Assessment Tool (SWAT) model. Four calibration scenarios were implemented: S1 (streamflow only), S2 (streamflow and evapotranspiration), S3 (streamflow and soil moisture), and S4 (all variables). Results showed that S2 achieved high scores for streamflow, outperforming S1, with slight improvements observed in some cases. However, scenarios incorporating root zone soil moisture (S3 and S4) negatively impacted the streamflow estimates. Nevertheless, S2 exhibited slightly better evapotranspiration simulation, while S3 and S4 improved soil moisture representation. Hydrograph comparisons highlighted satisfactory streamflow simulations in S1 and S2, while S3 and S4 overestimated flow peaks. The results of this investigation show that embedding remotely sensed data in the SWAT model, particularly evapotranspiration and soil moisture, may not necessarily improve runoff estimations, thus a careful analysis is required to determine the role of these parameters. In fact, these parameters play a pivotal role in enabling hydrological models to achieve a more comprehensive and accurate representation of the water balance within a watershed.