WAT-40 ORAL PRESENTATION · WATER TRACK · REMOTE SENSING, GIS & AI FOR WATER

Evaluating SMAP L4 Root-Zone Soil Moisture against Hydrologically Simulated Soil-Water States in the Upper Kelani River Basin, Sri Lanka

Y. A. D. K. H. Wijayarathna[1,2*], H. G. L. N. Gunawardhana[1,2], G. M. C. A. Perera[1,2], R. L. H. L. Rajapakse[1,2]

[1]*UNESCO-Madanjeet Singh Centre for South Asia Water Management (UMCSAWM), University of Moratuwa, Moratuwa 10400, Sri Lanka*

[2]*Department of Civil Engineering, University of Moratuwa, Moratuwa 10400, Sri Lanka*

**Corresponding author: wijayarathnayadkh.25@uom.lk*

DOI: https://doi.org/10.31705/ICEWSE.2026.58

Abstract

Soil moisture regulates the conversion of monsoon rainfall into runoff, making it significant for flood forecasting. Satellite products such as the Soil Moisture Active Passive (SMAP) mission provide soil-moisture estimates but remain poorly evaluated in data-scarce tropical monsoon regions, particularly Sri Lanka. This study evaluates the consistency of SMAP L4 Version 7 root-zone soil moisture with soil-water states simulated by a discharge-calibrated Hydrologic Engineering Center–Hydrologic Modeling System (HEC-HMS) model of the upper Kelani River Basin above Hanwella (1,818 km^2). A continuous 11-subbasin HEC-HMS model used a 5 km grid, Gridded Deficit and Constant Loss, and SoilGrids-based Saxton and Rawls parameters. It was calibrated against daily discharge for 2020 and validated for 2021 (Nash–Sutcliffe 0.70, R 0.86, PBIAS −8%). Simulated soil-moisture deficit was converted to volumetric soil moisture and compared with 9 km SMAP using anomaly, day-to-day changes, lag, and flood-event analyses. Direct agreement between the two series was weak (R = 0.31; negative Nash–Sutcliffe), partly reflecting grid-scale mismatch between SMAP and HEC-HMS across steep terrain and canopy attenuation of retrievals under dense Wet Zone vegetation. Correspondence was stronger after removing the mean (R = 0.55) and for day-to-day changes (R = 0.39); the catchment-averaged series correlated at 0.58, increasing to 0.72 at a 17-day lag. Overall, SMAP captured aspects of sub-seasonal variability despite limited agreement in absolute magnitude, suggesting greater suitability for monitoring soil-moisture anomalies and wetness trends than directly updating HEC-HMS states in tropical basins.

Keywords: *antecedent soil wetness; data-scarce basins; flood and drought forecasting; remote sensing; tropical monsoon catchment*