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Groundwater Development from Remotely Sensed Soil Moisture

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Editorial

To extract soil hydraulic characteristics from remotely sensed (RS) soil moisture footprints, several inversion modelling-based techniques have been developed /used. Based on the collected soil parameters, hydrological models with shallow ground water (SGW) table depths in soils predict daily root zone soil moisture dynamics. The presence of SGW table depths in soils has a major impact on model performance; yet, SGW table depths are frequently unknown in the field, resulting in model output uncertainties. To circumvent these limitations, we devised a dynamic ground water (DGW) data assimilation approach that considers SGW table depths over time for estimating effective unsaturated zone soil hydraulic characteristics. Numerical studies, including synthetic and field validation trials, were conducted to verify the DGW data assimilation scheme. The Little Washita (LW) watershed in Oklahoma and the Olney (OLN)/Bondville (BOND) sites in Illinois were chosen as separate hydro climatic zones for the numerical investigations.

In the simulated settings, we examined the DGW scheme in homogeneous and heterogeneous (layered) soil columns with varying soil textures and vegetation covers, as well as fixed and dynamically changing SGW table depths over time. Under various simulated settings, the DGW-based soil characteristics matched the observations better than those that simply include fixed ground water (FGW) table depths in time. Despite uncertainties, our proposed data assimilation approach performed well in field validations in forecasting soil hydraulic characteristics and SGW table depths at the point, airborne sensing, and satellite scales. These data back up the resilience of our suggested DGW technique in regional field applications. As a result, the DGW method could make pixel-scale soil moisture footprints based on satellite platforms more accessible and useful. Soil moisture at the root zone is a critical component of hydrology, meteorology, and agriculture all around the world. In the geographical and temporal domains, direct and indirect approaches can be utilised to estimate root zone soil moisture. The direct approach has a reasonably high accuracy at the point scale, but it has significant drawbacks (e.g., high cost, time-consuming, and restricted availability at spatial-temporal scales.

By minimising the disparities between observed and SWAP-based soil moisture dynamics, the newly developed simple iteration algorithm (IA) was merged with DGW data assimilation to find the optimal soil parameters and time-variant SGW table depths. Numerical tests with synthetic settings and field validation experiments were carried out to verify our approach. The Little Washita (LW) watershed in Oklahoma and the Olney (OLN)/Bondville (BOND) sites in Illinois, which are in different hydro climatic areas, were used for the numerical investigations. The FGW and DGW techniques determined the effective soil hydraulic characteristics from the synthetic near-surface (0–5 cm) soil moisture dynamics at the ARS 136 site under fixed SGW table depths of 300, 200, and 100 cm for individual SL, SiL, and CL soils. The existence of SGW table depths in the unsaturated zone has a significant impact on soil parameter estimations, according to studies by Ines and Mohanty and Shin. The suggested DGW system, which takes into account both soil hydraulic characteristics and SGW table depth dynamics in time, performed admirably in both synthetic and field validation, demonstrating the durability of our technique in field settings. As a result of our methodology, pixel-scale soil moisture footprints based on satellite platforms may become more available and applicable.

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