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Incorporating Data Assimilation into Land Surface Model simulation for better estimation of Surface Soil Moisture over India

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Soil moisture is a significant environmental factor that influences both the water and energy balance at the land-atmosphere interface. Therefore, proper assessment of the spatial and temporal distribution of soil moisture is crucial for many hydrological applications such as weather forecasting, agricultural water resource management and drought monitoring. This study involves the assimilation of Soil Moisture Active Passive (SMAP) soil moisture dataset within a land surface model and the evaluation of its performance in precise estimation of soil moisture by comparing the statistics with respect to standard European Space Agency's Climate Change Initiative (ESA-CCI) soil moisture dataset. The Ensemble Kalman Filter technique has been used for assimilating SMAP soil moisture data using Noah-MP land surface model within NASA Land Information System (LIS) framework. The data assimilation (DA) framework includes Cumulative Distribution Function (CDF) matching for bias correction and twenty ensembles per tile. Meteorological forcings for the simulations have been taken from MERRA2 and IMD. Improvement or degradation due to DA has been analyzed in terms of the difference in anomaly correlation between open loop (OL) and DA soil moisture outputs with respect to the ESA-CCI soil moisture dataset over the entire Indian domain. The DA result shows improvement over larger areas in the case of MERRA2 forced simulations than IMD+MERRA2. The seasonal impact of DA in terms of the differences in DA and OL simulated soil moisture shows less variability in summer than winter. The results are validated with in-situ soil moisture datasets. Overall, the study shows that data assimilation is giving better results than open loop LSM simulation, which can be used for improved estimation of other water balance components.