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Simultaneous Assimilation of AMSR-E Brightness Temperature and MODIS LST to Improve Soil Moisture with Dual Ensemble Kalman Smoother

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Uncertainties in model parameters can easily cause systematic differences between model states and observations from ground or satellites, which significantly affect the accuracy of soil moisture estimation in data assimilation systems. In this paper, a novel soil moisture assimilation scheme is developed to simultaneously assimilate AMSR-E brightness temperature (TB) and MODIS Land Surface Temperature (LST), which can correct model bias by simultaneously updating model states and parameters with dual ensemble Kalman filter (DEnKS). The Common Land Model (CoLM) and a Q-h Radiative Transfer Model (RTM) are adopted as model operator and observation operator, respectively. The assimilation experiment is conducted in Naqu, Tibet Plateau, from May 31 to September 27, 2011. Compared with in-situ measurements, the accuracy of soil moisture estimation is tremendously improved in terms of a variety of scales. The updated soil temperature by assimilating MODIS LST as input of RTM can reduce the differences between the simulated and observed brightness temperatures to a certain degree, which helps to improve the estimation of soil moisture and model parameters. The updated parameters show large discrepancy with the default ones and the former effectively reduces the states bias of CoLM. Results demonstrate the potential of assimilating both microwave TB and MODIS LST to improve the estimation of soil moisture and related parameters. Furthermore, this study also indicates that the developed scheme is an effective soil moisture downscaling approach for coarse-scale microwave TB.