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A Satellite Land Data Assimilation System Coupled with a Mesoscale Atmospheric Model: Towards Improving Numerical Weather Prediction

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Soil moisture is the central focus of accurate land surface and atmospheric modeling because it partitions surface water and energy fluxes, which control land–atmosphere interactions, and therefore influences the dynamics and thermodynamics of overlying atmosphere. Though several sensitivity studies clearly demonstrated its importance in the numerical modeling, knowledge relating to the assimilation of satellite soil moisture information into the atmospheric models is still limited. As a result, this study focused on the development of a system (LDAS-A), which couples a satellite land data assimilation with a mesoscale atmospheric model. LDAS-A was designed to be a sequential land data assimilation system and assimilates lower frequency passive microwave (level 1B) brightness temperature observations for soil moisture using an advanced radiative transfer model and the ensemble Kalman filter data assimilation technique. LDAS-A was validated for the Tibetan Plateau using in-situ, radiosonde and satellite observations. The model results showed that LDAS-A effectively improved the land surface variables (i.e. surface and deep soil moisture contents and skin temperature) as well as spatial heterogeneity of soil moisture compared to no-assimilation case. The improved land surface conditions in LDAS-A improved the land–atmosphere feedback mechanism and the assimilated results provided better prediction of atmospheric profiles (i.e. potential temperature and specific humidity) when compared with radiosonde soundings.