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Retrieving Soil Physical Properties via Assimilating SMAP Brightness Temperature Observations in the Community Land Model

Hong Zhao[1], Yijian Zeng[1], Xujun Han[2], and Bob Su[1,3]
[1]Faculty of Geo-Information Science and Earth Observation, University of Twente, Hengelosestraat 99, Enschede 7514 AE, The Netherlands.
[2]Chongqing Engineering Research Center for Remote Sensing Big Data Application, School of Geographical Sciences, Southwest University, Chongqing 400715, China.
[3]Key Laboratory of Subsurface Hydrology and Ecological Effect in Arid Region of Ministry of Education, School of Water and Environment, Chang'an University, Xi'an, 710054, China.

Basic soil physical properties (i.e., soil texture and organic matter) and associated soil hydraulic properties (i.e., soil water retention curve and hydraulic conductivity) play an essential role in land surface models (LSMs) for estimating soil moisture. With the physical link between soil properties, LSMs and Radiative Transfer Models (RTMs), the soil physical properties can be retrieved, using a LSM coupled with a microwave L-band emission observation model in a data assimilation framework. To this purpose, this paper couples an enhanced physically-based discrete scattering-emission model with the Community Land Model 4.5 (CLM), to retreive soil physical properties using the Local Ensemble Transform Kalman Filter (LETKF) algorithm, assimilating Soil Moisture Active and Passive (SMAP) Level-1C (L1C) brightness temperature at H and V polarization (and) separately, assisted with in situ measurements at the Maqu site on the eastern Tibetan Plateau. Results show the improved estimate of soil properties at the topmost layer via assimilating SMAP (H, V), as well as at profile using the retrieved top-layer soil properties and a prior depth ratio. The use of and shows varied sensitivities to retrievals of different soil compositions (i.e., sand, clay, silt) and soil moisture estimates. However, analyses show that the retrieved soil properties with fine accuracy are not sensitive factors affecting soil moisture estimates. Instead, uncertainties of CLM model structures shall be considered, such as the fixed PTFs (pedotransfer functions), the hydraulic function describing soil water retention curve and the water stress function determining root water update.