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Assimilation of Satellite Soil Moisture observation with the Particle Filter-Markov Chain Monte Carlo and Geostatistical Modeling

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Soil moisture simulation and prediction are increasingly used to characterize agricultural droughts but the process suffers from data scarcity and quality. The satellite soil moisture observations could be used to improve model predictions with data assimilation. Remote sensing products, however, are typically discontinuous in spatial-temporal coverages; while simulated soil moisture products are potentially biased due to the errors in forcing data, parameters, and deficiencies of model physics. This study attempts to provide a detailed analysis of the joint and separate assimilation of streamflow and Advanced Scatterometer (ASCAT) surface soil moisture into a fully distributed hydrologic model, with the use of recently developed particle filter-Markov chain Monte Carlo (PF-MCMC) method. A geostatistical model is introduced to overcome the satellite soil moisture discontinuity issue where satellite data does not cover the whole study region or is significantly biased, and the dominant land cover is dense vegetation. The results indicate that joint assimilation of soil moisture and streamflow has minimal effect in improving the streamflow prediction, however, the surface soil moisture field is significantly improved. The combination of DA and geostatistical approach can further improve the surface soil moisture prediction.