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Passive Microwave Soil Moisture Disaggregation radar data and relationship between soil moisture, vegetation and surface temperature

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Soil moisture is an important variable in weather and climate. The passive microwave sensors have provided soil moisture of various spatial resolutions and are available for all-weather conditions, including AMSR-E (Advanced Microwave Scanning Radiometer- Earth Observing System), AMSR2 (Advanced Microwave Scanning Radiometer 2) and SMOS (Soil Moisture and Ocean Salinity). However, the spatial resolution of passive microwave soil moisture product is restricted at tens of kilometers level and needs to be improved. Toward this issue, the SMAP (Soil Moisture Active Passive) is set to be launched in October 2014 will be the first mission to provide L-band radar/radiometer soil moisture retrievals at three resolutions. In this paper we present two distinct methods to obtain higher spatial resolution soil moisture. The first one is use of active radar data to downscale soil moisture obtained by passive radiometers. The SMAP Validation Experiment 2012 (SMAPVEX12) was taken place and provided Passive/Active L-band Sensor (PALS) observations of two along-track resolutions (650 m and 1590 m), as well as ground soil moisture measurements. Consequently the PALS data can be used for disaggregating coarse resolution passive soil moisture retrievals. Based on a change detection theory, the relationships between change in radar backscatter and change in soil moisture at both coarse and fine resolutions are examined and used for calculating high spatial resolution soil moisture from AMSR-E and SMOS. Using SMAPVEX12 ground measurements validates the disaggregation results. The second method is use of the relationship between vegetation and surface temperature to downscale soil moisture obtained from passive radiometers. The physical relationships amongst soil moisture, land surface temperature and vegetation index (Normalized Difference Vegetation Index, NDVI), the historic soil moisture data of recent 30 years at 1/8 degree NLDAS (North America Land Data Assimilation Systems) scale were studied and modeled by using the long term records of land surface model and remote sensing products, NLDAS, MODIS (Moderate Resolution Imaging Spectroradiometer) and AVHRR (Advanced Very High Resolution Radiometer). This modeled relationship was then applied to the 1 km MODIS land surface temperature for disaggregating the microwave soil moisture estimates AMSR-E and SMOS in Oklahoma. Two sets of in-situ measurements Oklahoma Mesonet and Little Washita watershed Micronet were used for validating the disaggregated soil moisture.