Use of Aqua/AMSR-E and Synergistic Microwave Data to Study Soil Moisture Variability from Space

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Abstract

The Advanced Scanning Microwave Radiometer is one of six instruments launched on the Aqua spacecraft in May 2002 as part of NASA's Earth Observing System (EOS). Designated AMSR-E (for EOS), the instrument was provided by the National Space Development Agency (NASDA) of Japan, and is a modified version of the AMSR instrument planned for launch in late 2002 on Japan's ADEOS-II spacecraft. The AMSR instruments operate at frequencies in the range 6.9 to 89 GHz, providing global coverage in 2-3 days. The instruments have potential for improved soil moisture estimation over previous spaceborne radiometers such as the Special Sensor Microwave/Imager (SSM/I) and TRMM Microwave Imager (TMI) due to the combination of lower microwave frequency and higher spatial resolution. The AMSR-E spatial resolution varies from ~60 km at 6.9 GHz to ~5 km at 89 GHz although the higher frequencies are not useful for soil moisture estimation due to attenuation of the soil signal by atmospheric moisture and vegetation. A more advanced instrument, the Conical-scanning Microwave Imager/Sounder (CMIS), that includes an increased range of channels between 6.6 and 183 GHz, is planned for launch as part of the National Polar-orbiting Operational Environmental Satellite System (NPOESS) in the 2009 timeframe. The AMSR and CMIS instruments should provide a capability to sense soil moisture over land surfaces with low vegetation cover, but vegetation will still impose a significant limitation on the accuracy and spatial extent of the retrievals, and only the top ~1-cm surface layer will be sensed. Other microwave instruments that have shown response to surface soil moisture include the SeaWinds radars on Quikscat and ADEOS-II that operate at 13.4 GHz with ~25-km resolution. The AMSR-E and SeaWinds radiometer and radar instruments indicate complementary sensitivities to soil moisture, vegetation, and surface roughness. These sensor data can therefore be used jointly to enhance understanding of the variability of global land surface moisture. In this paper we review some of the early results from the AMSR-E instrument, including sensor and retrieval model calibration, examination of radio-frequency interference effects, and comparisons with in situ measurements of soil moisture and precipitation. We also show examples of synergistic applications of AMSR-E and SeaWinds data. Combinations of passive and active microwave sensors in an integrated observing capability are an exciting possibility for future hydrologic applications. A new mission called HYDROS that combines a passive and active microwave sensor at 1.2-1.4 GHz is described in a separate paper.