Future Soil Moisture Satellite Missions and Research Needs

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Abstract

During the coming decade, launches of a number of satellite microwave sensors will provide new and unique opportunities for acquiring global information on the amount and distribution of surface soil moisture and its frozen/thawed state. This new information will provide potentially significant enhancements to the predictive capabilities of numerical weather and climate models as well as improved capabilities for monitoring and predicting floods, droughts, and other natural hazards. The development focus has been on L-band (1.4 GHz) passive microwave sensors (radiometers) as the basis for new satellite mission concepts since these instruments are uniquely suited to acquiring soil moisture information over a wide range of vegetation and heterogeneous terrain, and under nearly all weather conditions. Active microwave sensors (radars) can provide higher spatial resolution measurements and, in combination with passive sensors, enhanced information on surface moisture and its freeze/thaw condition. The soil moisture and surface freeze/thaw state together control the 'surface resistance' to water and energy exchanges at the surface. Among the new soil moisture mission concepts under consideration for launch in ~2005 or later are the Soil Moisture and Ocean Salinity (SMOS) and Hydrosphere States (HYDROS) missions, and higher-resolution follow-on missions. These missions use different but complementary technological approaches to surface soil moisture sensing. In the nearer term, launches of the Advanced Scanning Microwave Radiometers (AMSRs) on the NASA EOS-Aqua and National Space Development Agency of Japan ADEOS-II satellites in 2002, and similar instruments to be launched in subsequent years as part of Department of Defense and National Polar-orbiting Operational Environmental Satellite System (NPOESS) programs, will provide new C-band (~6.9 GHz) data that will be useful for soil moisture monitoring under more limited vegetation and environmental conditions. There are many opportunities, and research needs, to be addressed in developing innovative approaches to utilization of the new satellite-derived data. Issues include development of new processing and retrieval algorithms, methods for jointly assimilating satellite-derived and in-situ data into hydrologic models, and validation of derived soil moisture data and products. An overview of the current soil moisture mission and planning status, and ongoing and needed research, will be provided in this paper.