The NASA Soil Moisture Active Passive (SMAP) Mission - Algorithm and Cal/Val Activities and Synergies with SMOS and Other L-band Missions

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ABSTRACT

NASA's Soil Moisture Active Passive (SMAP) mission, planned for launch in late 2014, has as its key measurement objective the frequent, global mapping of near-surface soil moisture and its freeze-thaw state. SMAP soil moisture and freeze/thaw measurements at 10 km and 3 km resolutions respectively, would enable significantly improved estimates of water, energy and carbon transfers between the land and atmosphere. Soil moisture control of these fluxes is a key factor in the performance of atmospheric models used for weather forecasts and climate projections. Soil moisture measurements are also of great importance in assessing floods and for monitoring drought. In addition, observations of soil moisture and freeze/thaw timing over the boreal latitudes can help reduce uncertainties in quantifying the global carbon balance.

The SMAP measurement concept utilizes an L-band radar and radiometer sharing a rotating 6-meter mesh reflector antenna. The SMAP radiometer and radar flight hardware and ground processing designs are incorporating approaches to identify and mitigate potential terrestrial radio frequency interference (RFI). The radar and radiometer instruments are planned to operate in a 680 km polar orbit, viewing the surface at a constant 40-degree incidence angle with a 1000-km swath width, providing 3-day global coverage. Data from the instruments would yield global maps of soil moisture and freeze/thaw state to be provided at 10 km and 3 km resolutions respectively, every two to three days. Plans are to provide also a radiometer-only soil moisture product at 40-km spatial resolution. This product and the underlying brightness temperatures have characteristics similar to those provided by the Soil Moisture and Ocean Salinity (SMOS) mission. As a result, there are unique opportunities for common data product development and continuity between the two missions. SMAP also has commonalities with other satellite missions having L-band radiometer and/or radar sensors applicable to soil moisture measurement, such as Aquarius, SAOCOM, and ALOS-2.

The algorithms and data products for SMAP are being developed in the SMAP Science Data System (SDS) Testbed. The algorithms are developed and evaluated in the SDS Testbed using simulated SMAP observations as well as observational data from current airborne and spaceborne L-band sensors including SMOS. The SMAP project is developing a Calibration and Validation (Cal/Val) Plan that is designed to support algorithm development (pre-launch) and data product validation (post-launch). A key component of the Cal/Val Plan is the identification, characterization, and instrumentation of sites that can be used to calibrate and validate the sensor data (Level 1) and derived geophysical products (Level 2 and higher). In this presentation we report on the development status of the SMAP data product algorithms, and the planning and implementation of the SMAP Cal/Val program. Several components of the SMAP algorithm development and Cal/Val plans have commonality with those of SMOS, and for this reason there are shared activities and resources that can be utilized between the missions, including in situ networks, ancillary data sets, and long-term monitoring sites.

This work was carried out in part at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

The SMAP mission has not been formally approved by NASA. The decision to proceed with the mission will not occur until the completion of the National Environmental Policy Act (NEPA) process. Material in this document related to SMAP is for information purposes only.