COMBINED PASSIVE AND ACTIVE MICROWAVE OBSERVATIONS OF SOIL MOISTURE DURING SMAPVEX08

Rajat Bindlish[1], Thomas Jackson[1], Michael Cosh[1], Simon Yueh[2], Steve Dinardo[2]

[1]USDA ARS Hydrology and Remote Sensing Lab, Beltsville, MD
[2]Jet Propulsion Lab, Pasadena, CA

1. INTRODUCTION

An important research direction in advancing higher spatial resolution and better accuracy in soil moisture remote sensing is the integration of active and passive observations. The Soil Moisture Active Passive Mission (SMAP) is currently addressing issues related to the development and selection of soil moisture retrieval algorithms designed to achieve these goals. A series of aircraft-based flights (SMAP Validation Experiment 2008-SMAPVEX08) was designed to address some of the issues related to these algorithms. The experiment was conducted on the Eastern Shore of Maryland and Delaware over a two week period. The objectives of SMAPVEX08 included: (1) development and evaluation of new radio frequency interference (RFI) suppression techniques under consideration for SMAP, (2) providing more robust sets of concurrent passive and active L-band observational data, (3) evaluating the impact of azimuthal orientation on alternative radar retrieval algorithms, and (4) understanding the scaling of high resolution synthetic aperture radar (SAR) to the lower resolution of SMAP. Soil moisture retrieval results using passive and active L-band microwave observations from the SMAPVEX08 experiment will be presented.

2. MICROWAVE OBSERVATIONS DURING SMAPVEX08

SMAPVEX08 was preceded by an extended precipitation event that resulted in moderately wet soil conditions. Cloud cover and cooler fall temperatures resulted in a relatively slow but consistent drydown of the surface soil. A series of seven aircraft flights was conducted over two weeks that tracked this drydown. The key instrument in SMAPVEX08 was the Passive Active L-band Sensor (PALS) [1], which simulates SMAP observations. PALS observations provide a valuable active-passive data set for the development of passive and active L-band soil moisture estimates over heterogeneous land surface conditions. In situ soil moisture and soil temperature measurements were made at each sampling site concurrent with the PALS observations. Individual fields in the Choptank watershed are smaller than the size of the PALS footprint. A group of fields within an area of ~10 km^2 were sampled to represent a single sampling site. Soil moisture measurements from all the fields were averaged to obtain a site average. Vegetation water content measurements were also made during the experiment. The resulting brightness temperature images were consistent with observed land surface conditions. Over the forested areas, L-band brightness temperatures showed little variability throughout the duration of the experiment.

3. RADIOMETER BASED RETRIEVALS

Individual PALS footprint observations were used in a soil moisture retrieval algorithm [2]. Soil moisture estimates from all PALS footprints within each sampling area were averaged to obtain a site average. The standard error of estimate for soil moisture over the Choptank watershed study area using only the radiometer observations was 0.039 m^3/m^3. The bias between the estimated and observed soil moisture was 0.016 m^3/m^3. Over the duration of the field experiment, some of the sampling fields underwent significant changes. Some senescent corn fields were harvested and tilled. These changes in the land surface could be contributing to the bias found in the estimates.

4. RADAR BASED RETRIEVALS

Vegetation canopies complicate the retrieval of moisture in the underlying soil, because the canopies also contain water. Due to scattering effects, the interaction between the two contributions is highly nonlinear. In order to account for these problems, an approach, based on the water-cloud model, was developed by Attema and Ulaby [3]. They proposed to represent the canopy in a radiative transfer model as a uniform cloud whose spherical droplets are held in place structurally by dry matter. Despite its simplicity, the water-cloud model has been shown to provide fair to good agreement with experimental data [4, 5]. Here, the soil surface backscattering coefficient was computed using the Dubois model [6]. Soil moisture algorithms using PALS radar observations are currently being developed.

5. REFERENCES

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