Influence of Forest Cover on L-band Soil Moisture Retrieval from Heterogeneous Pixels

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Abstract

ESA's Soil Moisture and Ocean Salinity (SMOS) mission, planned for launch in 2008, will carry a multi-angle interferometric L-band (1.4 GHz) radiometer for monitoring soil moisture and ocean salinity at a global scale. Mission requirements include the retrieval of soil moisture with a precision of 4% by volume. Spatial resolution of the instrument is ~35 km at nadir view, which means that most pixels of the earth's surface will be heterogeneous. In the tropical, temperate and boreal zones, forests make up a large fraction of the land surface area and will therefore certainly contribute to the microwave emission at the pixel-resolution of SMOS. Modelling studies [1,2] concluded that ignoring the *a priori* knowledge of the forest cover fraction (α) gives large errors in soil moisture retrieval if $\alpha \geq 10\%$, but if α is known and $\leq 50\%$, soil moisture in the non-forested area can be determined with a precision better than 4%. To date, these results have never been validated by experimental studies.

The CoSMOS-2/NAFE'05 field campaign was conducted in the Goulburn River catchment in south-eastern Australia in November 2005 (see www.nafe.unimelb.edu.au). Several focus farms were selected within the catchment for intensive ground and aircraft monitoring of soil moisture. The 'Roscommon' farm was chosen as a focus area for this particular study of heterogeneity effects, as it combined areas of native grass (grazing) with tree-covered areas dominated by eucalypt species. Soils in the area were predominantly sandy, with medium to high rock fraction in the tree-covered areas. Over Roscommon, dual-polarisation airborne measurements at L-band were done twice-weekly by the NAFE aircraft (PLMR radiometer) and once, on 15th November, by the CoSMOS aircraft (EMIRAD radiometer). PLMR measurements were done at four different altitudes (3048, 1524, 762 and 190.5 m), thereby offering the possibility to investigate the effect of heterogeneity at various spatial resolutions. EMIRAD measurements were done at incidence angles of 0º and 40º while PLMR measurements were at angles of either 7º, 21.5º, or 38.5º. Ground measurements at Roscommon were done on the majority of the flight days and included soil and tree temperatures, top 5 cm soil and litter moisture content, and average LAI of the tree canopy.

In this study, the CoSMOS-2/NAFE ’05 data sets were used to investigate the influence of the percentage tree cover on soil moisture retrievals from heterogeneous pixels. This was done both with and without *a priori* knowledge of the surface cover type for various ground moisture conditions. The study aims to validate the modelling studies mentioned above [1,2] and to improve data analysis for mixed vegetation pixels containing forested areas. Soil moisture retrievals were performed by inversion modelling of the L-MEB τ-ω model [3], after which retrieved values were compared to field measurements.

KEYWORDS: Passive microwaves, forests, heterogeneity, soil moisture, SMOS, NAFE/CoSMOS-2

References

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