Influence of surface heterogeneity on L-band (1.4 GHz) measurements at various spatial resolutions; some preliminary results of the CoSMOS/NAFE’05 field campaign

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BACKGROUND:
In order to understand the influence of forested areas on the soil moisture retrieval ofinhomogeneous pixels, further research is necessary, especially based on experimental data. Almost all existing knowledge of this subject at the moment is based on modelling studies and represents rather optimistic cases in terms of retrieval and error. In these studies (e.g. Van de Griend et al., 2004) it was concluded that ignoring the a priori knowledge of the forest cover fraction (α) gives large errors in soil moisture retrieval if α ≥ 10%, but if α is known and ≤50%, soil moisture in the non-forested area can be determined with a precision better than 4%. Results of the CoSMOS/NAFE’05 field campaign will be used to validate these findings, and to try to improve data analysis for mixed vegetation pixels.

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OBJECTIVE:
To compare modeled values of emissivity with airborne measurements over heterogeneous tree-covered areas, in order to give an idea of the influence of vegetation heterogeneity by showing errors in emissivity for different % cover situations.

SITE: ‘Roscommon’ farm:
Vegetation:
Open-forest formation: Box, Ironbark & Black Cypress pine.
Open-heath understory: Sifton bush
Sandy soils, high % rock cover
Litter:
average layer height 0.5 cm
average dry bulk density 0.15 ± 0.05 g/cm²

FLIGHT LINES ABOVE ROSCOMMON FARM

MATERIALS:
L-band dual-polarized radiometers:
- EMIRAD: simultaneous measurements at 0° & 45° (~800m resolution)
- PLMR: measurements at high (~62.5m) & medium (~250m resolution)

Models:
- Wang-Schmugge dielectric model
- L-MEB (L-band Microwave Emission of the Biosphere, Wigneron et al., 2006), based on ‘tau-omega’ model:

Ground measurements:
- Soil moisture & temperature (top 5 cm) - Hydraphone
- Litter moisture - grab samples
- LAI - fish-eye photographs
- Temperatures of a tree (canopy, trunk) and soil (0, -2, -4 and -50 cm)

RESULTS:

DISCUSSION:
Expected from the literature (Van de Griend et al., 2003):
(1) larger mean error for mixed pixels
(2) larger standard deviation for wet soils (smaller soil contribution ⇒ sensitivity to ground characteristics weaker)
(3) errors have general order of magnitude 0-0.06

Further analysis:
- also with a priori knowledge of cover fraction
- effect of litter layer
- optimize more realistic values of tau from EMIRAD dual-angle data

References:
- Van de Griend et al. (2004). Soil Moisture Retrieval from Heterogeneous Surfaces by 1.4 GHz Multi-Angle SMOS Observations using a Prior Knowledge of Surface Cover Fraction. 4GARSIS 2004
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