EFFECTS OF TOPOGRAPHY ON THE L-BAND EMISSION OF SOILS. ANALYSIS OF COSMOS-AUSTRALIA CAMPAIGN

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ABSTRACT

The Soil Moisture and Ocean Salinity (SMOS) mission will provide L-Band multi-angular measurements of the surface emission with a 2-D interferometric radiometer on a global basis [1]. Soil moisture will be retrieved from collected and simulated data using a minimization algorithm. The success of the process will partly depend on how accurate is the modelling of the surface radiation and the correction factors that are being considered [2]. Topography is an important issue that influences the emission of real surfaces. Varying slope and azimuth affect several parameters involved in the data processing algorithms [3], having a final impact on retrieved soil moisture accuracy.

In preparation for the SMOS mission, 0° and 40° EMIRAD radiometric data were collected during 31st October – 9th December 2005 at the Goulbourn River catchment in New South Wales (Australia) during the coSMOS-Australia airborne campaign [4]. The main objective was to assess the model conceived for the SMOS retrieval algorithm and to answer to open questions such as sun-glint effect, dew and water interception by the vegetation cover, and topography impact.

To process the available L-band data, an EMIRAD processor was developed covering the steps from pixel geo-location (on-ground gain paterrn projection and determination of incidence angle, solid angle and polarization rotation angle), brightness temperature simulation (H-pol, V-pol and Stokes parameters) and soil moisture inversion. Working methodology consisted in gridding each pixel into facets corresponding to the available catchment Digital Elevation Model (DEM) resolution of 25 metres. Thus, pixel geometrical and geophysical heterogeneity was considered at this resolution. From the available flights, two passes were selected for the study of topography effects: a high topography area without availability of ground measurements to study the intra-pixel impact of topography on geometrical parameters, and a smoother grazing grass area with measured soil moisture, surface temperature, vegetation water content, soil texture and roughness to analyse the impact on brightness temperature and soil moisture.

Intra-pixel topography effects were analyzed for the facets within a single pixel in the high topography area. Antenna gain, incidence angle, slope angle and polarization rotation angle grids were compared considering topography and neglecting it. A weighting function was used to modulate the contribution of each facet to the overall pixel emission. The effect on integrated pixel brightness temperature was analyzed for the selected grass area flightline. Comparison between EMIRAD measured and simulated data was presented for H and V channels and Stokes parameters, both in a completely flat scene and a DEM consideration one. Error contributions were assessed and correlated to errors in incidence and azimuth angle (slope angle) caused by topography and aircraft motion. Further, soil moisture was retrieved for the same flightline considering angular coverage of 0° and 40° for 96% of the pixels. Results were compared to measured soil moisture according to three different gridding interpolation approaches: nearest neighbour, linear interpolation and empirical orthogonal functions [5]. A flow accumulation map of the area was calculated and accumulation below the flightline related to changes in measured and simulated soil moisture. Finally, effect of topography on surface temperature was observed comparing measured Thermal Infrared (TIR) temperature available together with EMIRAD data with sunlight illumination at each flightline point.

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