POTENTIAL OF MAPPING SOIL MOISTURE BY COMBINING POLSAR DECOMPOSITION AND RADAR BACKSCATTER MODEL

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1. ABSTRACT

Experiments undertaken in the 1970s demonstrated the sensitivity of radar backscatter to soil moisture conditions [1]. More recent advances in active microwave remote sensing have confirmed the potential for using current satellite data for the generation of soil moisture maps at different scales [2,3]. However, in addition to its strong sensitivity to the soil water content, radar backscatter is also affected by the presence of vegetation and by soil roughness, factors which present a major difficulty in the development of soil water retrieval algorithms [4,5,6]. Previous studies have shown that the inversion of radar backscatter models for the retrieval of surface parameters such as soil water leads to promising results, but with higher than acceptable errors [7,8]. Within this context, the purpose of this study is to evaluate the capability of the Oh surface radar semi-empirical backscattering model [9] to estimate soil moisture over agricultural fields from fully polarimetric RADARSAT-2 C-band SAR responses. For validation purposes, ground measurements over sampling sites in Eastern Ontario-Canada were carried out in the fall of 2009 simultaneous with satellite data acquisitions. Discrepancies between measured radar backscatter coefficients and those predicted by the Oh model were previously reported, requiring correction factors to reduce biases associated with this approach.

Initially, soil moisture multi-polarization retrieval was accomplished by using a look-up table (LUT) approach applied to the model. Two approaches were considered: the multi-polarization method where only measured backscatter coefficients were used within the inversion routine, and the one-unknown method where roughness rms heights and image-derived backscatter coefficients were used as inputs. Of the two inversion configurations, results showed that the cross-polarization (HH-HV) inversion scheme provided the best estimates.

In the second phase of this research, the potential of using Freeman Durden polarimetric SAR decomposition [10] in combination with the Oh backscattering model for the estimation of soil moisture is investigated. The main advantage of the proposed inversion model is the straightforward separation of different scattering mechanisms. Therefore, the conceptual approach for retrieving soil moisture using the surface scattering component of the total power was implemented in a LUT inversion routine. The direct search algorithm attempts to minimize a scalar value representing the difference between measured single scattering power obtained by applying Freeman Durden decomposition on SAR data and simulated total power using Oh model formulation. When compared with the multi-polarization approach, this polarimetry-based method improves soil moisture estimation in terms of error magnitude. These results suggest that backscatter models could be used in an inversion scheme making use of the phase and the multiple polarization information available from the quad-pol mode of RADARSAT-2 to retrieve surface moisture.

2. REFERENCES

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