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Influence of vegetation on SMOS mission retrievals

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Abstract. Using the proposed Soil Moisture and Ocean Salinity (SMOS) mission as a case study, this paper investigates how the presence and nature of vegetation influence the values of geophysical variables retrieved from multi-angle microwave radiometer observations. Synthetic microwave brightness temperatures were generated using a model for the coherent propagation of electromagnetic radiation through a stratified medium applied to account simultaneously for the emission from both the soil and any vegetation canopy present. The synthetic data were calculated at the look-angles proposed for the SMOS mission for three different soil-moisture states (wet, medium wet and dry) and four different vegetation covers (nominally grass, crop, shrub and forest). A retrieval mimicking that proposed for SMOS was then used to retrieve soil moisture, vegetation water content and effective temperature for each set of synthetic observations. For the case of a bare soil with a uniform profile, the simpler Fresnel model proposed for use with SMOS gave identical estimates of brightness temperatures to the coherent model. However, to retrieve accurate geophysical parameters in the presence of vegetation, the opacity coefficient (one of two parameters used to describe the effect of vegetation on emission from the soil surface) used within the SMOS retrieval algorithm needed to be a function of look-angle, soil-moisture status, and vegetation cover. The effect of errors in the initial specification of the vegetation parameters within the coherent model was explored by imposing random errors in the values of these parameters before generating synthetic data and evaluating the errors in the geophysical parameters retrieved. Random errors of 10% result in systematic errors (up to 0.5°K, 3%, and ~0.2 kg m^{-2} for temperature, soil moisture, and vegetation content, respectively) and random errors (up to ~2°K, ~8%, and ~2 kg m^{-2} for temperature, soil moisture and vegetation content, respectively) that depend on vegetation cover and soil-moisture status.

Keywords: passive microwave, soil moisture, vegetation, SMOS, retrieval

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