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The influence of soil moisture on microwave emission under forest canopies

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Forests are important interfaces between soil and atmosphere as they play a significant role in the water and gas exchanges. Due to their capabilities in reducing evaporation from the surfaces and to intercept rainfalls, they are able to substantially modify the moisture behaviour of underneath soils. The capability of microwave radiometers of penetrating inside vegetation covers, especially at the lower frequencies, is well known, but only few studies have investigated quantitatively the attenuation of soil emission under forests. Actually, the importance of retrieving information soil conditions under forest cover is crucial for all the studies concerning global changes and carbon balance, since the soil moisture conditions influence the evapotranspiration and gas exchange mechanisms. During the past years, multi-frequency radiometric microwave measurements at L, C, X, Ku and Ka bands were carried out in Tuscany. The experiments were conducted in different seasons and therefore characterized by various soil moisture and plant water content. The obtained results pointed out that the influence of soil is clearly recognizable at L-band at steep incidence angles, for low values of biomass, whereas at the higher frequencies the changes in soil moisture basically do not influence microwave emission. At higher levels of biomass, instead, there is a threshold of L band sensitivity to soil moisture corresponding to a forest biomass of about 100 m^3/ha (roughly equivalent to 60-70 t/ha). The problem is also analyzed by using a discrete electromagnetic model, which considers vegetation as an ensemble of disks and cylinders over a soil surface. The model is based on the radiative transfer

theory and includes multiple scattering effects. The trends of forest emissivity as a function of soil moisture are simulated for various values of biomass, at L band, both polarization and various angles. Model outputs confirm the findings of the experiment and allow us to extend the prediction to a variety of forest covers.