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Microwave radiometry experiments on a deciduous forest site

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Microwave radiometry at 1.4 GHz is one of the most promising remote sensing approaches to monitor areal near- surface soil moisture, with the advantages of being weather independent and using a protected frequency band. It is possible to interpret time series of radiometric measured emissivity of a bare soil site as an expression of the areal water regime.

However, additional investigations have to be performed for vegetated sites, where the radiative transfer is more complex. With this regard, we performed field experiments above a deciduous forest. An L- band and an X- band radiometer operating at 1.4 GHz and 11.4 GHz measured simultaneously.

In a first experiment performed during the defoliation period, the radiometers were oriented upward and mounted below the forest canopy. The recorded time series of brightness temperatures showed the downward emission and the transmissivity of the forest canopy at L- and X- band during the defoliation period. It was found that even the foliated forest canopy is semi- transparent at L- band, whereas at X- band the canopy is semi- transparent only in its defoliated state. From this it is concluded that the effect of the leaves on the radiation is significantly more pronounced at X- band that at L- band.

In a second experimental setup the radiometers were installed on a 100 m high tower allowing for observing the same forest site from above. Furthermore, the forest soil was covered with a metal foil within the -3 dB footprint of the radiometers. From the brightness temperatures measured during the shooting of the leaves with and without

the metal foil, we calculated the canopy transmissivity for L- and X- band using a simple non scattering radiative transfer model. Within the model uncertainties, the transmissivity was consistent with the results from the upward experiment.

In the third experiment, the forest soil was artificially irrigated for investigating the effect of a very moist forest soil on the brightness temperatures measured above the foliated forest. From these measurements we calculated the reflectivity, again using a simple non scattering radiative transfer model. It was found that the soil irrigation has a measurable effect on the soil reflectivity derived from the L- band measurements, which is consistent with the already observed semi- transparency of the canopy at L-band. The observed rapid drop of the forest ground reflectivity to value observed prior the irrigation is associated with the fast drainage process in the litter layer, indicating that the litter is not transparent and plays an important role for remote soil moisture detection.