Near surface soil moisture estimation from microwave measurements

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Abstract

Soil moisture, water potential, and bulk density measurements were performed on a 0.4 ha bare field (27.2% clay, 61.7% fine and coarse loam) concurrent with backscattering coefficient measurements: 17 different volumetric water content profiles from 0 to 10 cm were sampled including wet, intermediate, and dry conditions. Backscattering coefficients were measured using a 4.5 GHz frequency, HH polarization and 15–20° incidence angle microwave sensor configuration, in order to minimize the soil surface roughness effects. First, the statistical analysis of the data ("classical calibration procedure") exhibited satisfactory regression lines between the backscattering coefficient and the volumetric water content calculated over arbitrary soil depths, as described by many authors (correlation coefficients between 0.859 and 0.899). Furthermore, the same results were obtained when water potential data were considered (log scale). Second, taking into account the dependence between the water content profile and the microwave penetration depth, the experimental relationship between backscattering coefficient and volumetric water content became nonlinear and exhibited smaller residuals than the "classical regression line." Finally, a statistical procedure for predicting the mean and standard deviation of volumetric water content profiles from the soil surface to the microwave penetration depth is presented. Results showed that the proposed procedure is promising for obtaining near-surface water content estimates used as boundary conditions for "soil/atmosphere" water transport modeling.