

Calibration of Time Domain Reflectometry for Water Content Measurement Using a Composite Dielectric Approach

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Time domain reflectometry (TDR) has been developed to an operational level for the measurement of soil water content during the past decade. Because it is able to provide fast, precise and nondestructive in situ measurements, it has become an alternative to the neutron scattering method, in particular for monitoring water content under field conditions. One of the major disadvantages of the neutron scattering technique is that, due to the relatively high sensitivity of the signal to factors other than water content, site-specific calibration is usually required. In this paper a calibration curve for the TDR method is presented which is not restricted to specific soil conditions. The calibration is based on the dielectric mixing model of Dobson et al. (1985). Measurements of volumetric water content and dielectric number at eleven different field sites representing a wide range of soil types were used to determine the parameter of the model by weighted nonlinear regression. The uncertainty (root mean square error) of water content values calculated with the optimized calibration curve was estimated not to exceed $0.013 \text{ cm}^3/\text{cm}^3$. This value is comparable to the precision of the thermogravimetric method. From a sensitivity analysis it was determined that the temperature dependence of the TDR signal may have to be corrected to obtain optimum accuracy.