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Field and laboratory ad hoc calibrations of Virrib and ThetaProbe dielectric sensors for soil moisture measurements

F. Doležal, T. Litschmann, J. Kučera, J. Peterková, J. Zavadil, J. Vacek, P. Pražák, E. Pilná, T. Bayer, M. Nechvátal

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For the research of irrigation optimization and nitrate leaching it is important to know the short-term soil moisture variation during percolation episodes as well as its seasonal pattern. Dielectric soil moisture sensors Virrib (AMET – Consortium) and ThetaProbe ML2x (Delta-T) were used for this purpose over several years for measuring soil moisture content at hourly intervals in Valečov (49°38' 40" N, 14°30' 25" E, 461 m a.s.l.), Czech Republic, in a deep loamy Stagnosol soil underlain by weathered paragneiss. One-point field calibration was made each spring at the time of sensor installation over three (for Virrirs) or two (for ThetaProbes) consecutive years by taking sensor readings and soil samples (at least one 100 cm³ core sample near to each sensor) in parallel. A supplementary check was then made in the laboratory by taking readings of individual sensors, inserted into pre-made loamy-sand mixtures with various moisture contents. During both the field calibration and the laboratory check, the readings were taken manually, using either the AMET hand-held meter or the EMS ModuLog datalogger. The results suggest that the average slope of the secondary Virrib calibration curve (defined as the plot of $y = \text{sensor readings in terms of moisture content vs. } x = \text{soil moisture content determined gravimetrically}$) is near to unity, but the offsets are quite large and vary from probe to probe. The axial zone of influence of the Virrib sensors is up to about 30 cm, as it follows from both laboratory and field observations. The results of the laboratory check of Virrirs were biased, because the volume of the soil was not large enough and the soil had different dry bulk densities at different moisture contents. The field secondary calibration curve of ThetaProbes appears to be roughly linear, in contrast to the laboratory calibration curve, because of absence of very low moisture contents in the field. If the same calibration line is applied to several different depths, then its slope is statistically significantly lower than unity, due to the dependence of ThetaProbe readings on the soil bulk density. The overall accuracy of the sensors and its components due to different factors is estimated from the statistics of repeated measurements.

Keywords:

Virrib; ThetaProbe; one-point; loam; loamy sand; zone of influence; bulk density; offset; FertOrgaNic

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