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Laboratory calibration of different soil moisture sensors in various soil types

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Measurements of soil water content are particularly useful for irrigation scheduling. In optimal conditions, field data are obtained through a dense grid of soil moisture sensors. Most of the currently used sensors for soil water content measurements, measure relative permittivity, a variable which is mostly dependant on water content in the soil. Spatial variability of soil characteristics, such as soil texture and mineralogy, organic matter content, dry soil bulk density and electric conductivity can also alter measurements with dielectric sensors. So the question arises, whether there is a need for a soil specific calibration of such sensors and is it dependant on the type of sensor? This study evaluated the performance of three soil water content sensors (SM150T, Delta-T Devices Ltd, UK; TRIME-Pico 32, IMKO micromodultechnik GmbH, DE; MVZ 100, Eltratec trade, production and services d.o.o., SI) in nine different soil types in laboratory conditions. Our calibration approach was based on calibration procedure developed for undisturbed soil samples (Holzman et al., 2017). Due to possible micro location variability of soil properties, we used disturbed and homogenized soil samples, which were packed to its original dry soil bulk density. We developed soil specific calibration functions for each sensor and soil type. They ranged from linear to 5th order polynomial. We calculated relative and actual differences in sensor derived and gravimetrically determined volumetric soil water content, to evaluate the errors of soil water content measured by sensors which were not calibrated for soil specific characteristics. We observed differences in performance of different sensor types in various soil types. Our results showed measurements conducted with SM150T sensors were within the range of manufacturer specified measuring error in three soil types for which calibration is not necessary but still advisable for improving data quality. In all other cases, soil specific calibration is required to obtain relevant soil moisture data in the field.