GC8-Hydro-89, updated on 24 Apr 2024
https://doi.org/10.5194/egusphere-gc8-hydro-89
A European vision for hydrological observations and experimentation

Temperature-corrected calibration of GS3 dielectric sensors

Paolo Nasta[1], Heye Bogena[2], Alexander Huisman[2], Benedetto Sica[1], Carolina Allocca[1], Ugo Lazzaro[1], Caterina Mazzitelli[1], Harry Vereecken[2], and Nunzio Romano[1]

[1]University of Napoli, Portici, Italy (paolo.nasta@unina.it)

[2]Agrosphere Institute, Forschungszentrum Jülich GmbH, Jülich 52425, Germany

In the Upper Alento River Catchment (UARC; southern Italy), two test sites, having different physiographic and soil features, were instrumented with SoilNet wireless sensor networks controlling GS3 (METER Group, Inc. USA) capacitance sensors deployed at soil depths of 15 and 30 cm at twenty locations to monitor soil permittivity, soil temperature, and apparent electrical conductivity. The conversion of soil permittivity into soil water content is challenging given the high clay content of the soil. Therefore, the both factory and Topp's calibration functions are compromising soil water content dynamics with underestimated dynamics during dry periods and overestimations in the wet season. In addition, the soil moisture measurements is influenced by the very strong soil temperature variations. In this study we combined a laboratory calibration with in-situ intensive validation campaigns. The laboratory calibration of GS3 electromagnetic sensors was carried out on repacked soil samples by simultaneously measuring soil permittivity and soil water content at prescribed temperature steps within the range observed in the field (from 4.5 °C and 31.9 °C). A new empirical regression-based calibration law was developed for the two study areas to relax the impact of soil temperature on the measurement of soil permittivity. The temperature-corrected approach was validated in the field by taking thermo-gravimetric measurements of soil water content using a stainless steel soil core sampler over five field campaigns at soil depths of 15 and 30 cm. Our results demonstrated that the proposed site-specific calibrations properly reflect the seasonal dynamics of observed soil water content and outperform both factory and Topp's calibration functions.