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TDR-Lab V.1.0: New TDR software for water content and electrical conductivity measurements

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Time Domain Reflectometry (TDR) is a useful technique that allows real time and simultaneous estimation of the apparent permittivity (ε_a), which is related to the volumetric soil water content (θ), and the soil bulk electrical conductivity (σ_a). These parameters are typically calculated using specific TDR software by graphical analysis or numerical modelling of the TDR waveforms. This work presents the TDR-Lab V.1.0 software that, compatible with Tektronics 1502C, TDR-100 Campbell Sci. and TRASE Soil-moisture Equipment Corp. cable testers, allows estimation of θ and σ_a by using different TDR waveform analysis. The software, which has a user friendly graphical interface, includes scheduling automated readings and automated waveform analysis applications, connection to multiplexors SDMX50 and datalogger CR1000 (Campbell Sci.) and two different types of TDR probe geometries (coaxial and three-wire TDR probes). Four different methods of TDR waveform analysis for water content estimation have been included: (i) manual method, where the user fixes the first peak and second reflection point of the TDR waveform, (ii) the graphical "tangent method", useful for fast and accurate TDR waveforms analysis of long TDR probes (i.e. probes longer than 10 cm); (iii) the graphical method of the "maximums", that analyses the derivative of the TDR waveform and is appropriate for homogeneous media, and (iv) a TDR signal numerical modelling method for homogeneous media, that allows accurate estimations of water content using extremely short TDR probes (between 0.7 and 3 cm length). The new software also includes estimations of the soil bulk electrical conductivity either by graphical or numerical analysis of the TDR signal.