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Assessing the performance of different model-based techniques to estimate water content in the upper soil layer

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The knowledge of soil water content (SWC) of the upper soil layer is important for most hydrological processes occurring over vegetated areas and under dry climate. Because direct field measurements of SWC are difficult, the use of different type of sensors and model-based approaches have been proposed and extensively used during the last decade.
The main objective of this work is to assess the performance of two models estimating SWC of the upper soil layer: the transient line heat source method and the physically based Hydrus-1D model. The models' performance is assessed using field measurements acquired through a Time Domain Reflectometer (TDR).
The experiment was carried out on an olive orchard located near the town of Castelvetrano (South-West of Sicily - latitude 37.6429°, longitude 12.8471°). The temporal dynamic of topsoil water content was investigated in two samplers, under wet and dry conditions. The samplers were opened at the upper boundary and inserted into the soil to ensure the continuity of the soil surface.
A K2D Pro sensor allowed to measure the soil thermal properties allowing to estimate soil thermal inertia and then SWC. The physically based Hydrus-1D model was also used to estimate SWC of both samples. Hourly records of soil water contents, acquired by a TDR100 probe, were used to validate both the considered models. The comparison between SWCs simulated by Hydrus-1D and the corresponding values measured by the TDR method evidenced a good agreement. Similarly, even SWCs derived from the thermal diffusion model resulted fairly close to those measured with the TDR.