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Direct measurement and indirect estimation of unsaturated soil hydraulic properties in Tunisian soils.

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Abstract

The hydrological cycle is strongly affected by climate changes causing extreme weather events with long drought periods and intense rainfall events. To predict the hydrological functioning of Tunisians catchments, modelling is an essential tool to estimate the consequences on water resources and to test the sustainability of the different land uses. Soil physical properties describing water flow, are therefore essential to feed the models and need to be determined all over the watershed.

In order to complete this task, lightweight, cost effective but robust methods are needed. In the present study, both physically based and empirical models or pedo-transfer functions (PTF) have been used to estimate unsaturated soil hydraulic properties based on particles size distribution (PSD), and straightforward in-situ infiltration experiments.

The specific Pedo-Transfer Functions (PTFs) embedded within the Rosetta model, the physically grounded Arya-Paris model, and the Beerkan Estimation of Soil Transfer parameters (BEST) have been specifically developed to gauge soil hydraulic parameters based on soil texture, bulk density, and, eventually, outcomes from single-ring infiltration experiments. These models were applied to a diverse array of soil types from both Northern and Central Tunisia, with a subsequent comparative analysis aimed at evaluating their potential applicability and individual performances.

Consequently, the estimated parameters derived from these models were incorporated into Hydrus to compute water flow in the vadose zone under the actual weather conditions prevailing in Tunisia. The resultant effects on the calculated water balance, encompassing infiltration, drainage, and runoff, were systematically compared for a comprehensive understanding of their implications.

Results show that soil hydraulic parameters determined with different techniques are significantly different. The results for simulated water balance over 3 years, show also differences especially for intense rainfall events. It seems that the BEST method is a valuable technique for estimating soil hydraulic parameters, offering a cost-effective and practical alternative to traditional methods, especially as it leverages on experimental infiltration data.