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In situ soil water retention measurements with TDR and polymer tensiometers and comparison with computed water retention relations

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The soil water retention relation is of widespread interest in unsaturated zone hydrology. The standard procedure for determining this relation is to take soil cores, subject these cores to predetermined pressures and record the subsequent soil water contents. A disadvantage of this method is that it needs to be determined in the laboratory, and is often the main drying curve is considered. However, the water retention relationship's nature is hysteretic, and field soils will often go through multiple cycles of drying and wetting. To fully understand unsaturated processes in dry soils it is highly desirable to measure in situ soil water retention relations. Combining measurements of polymer tensiometers and TDR-probes it is possible to determine an in situ soil water retention relation until a matric potential of -1.6 MPa (pF=4.2).
In an experimental setup polymer tensiometers were paired to TDR probes in a setup of two evaporation boxes, one containing sand (97.6% sand, 1.6% silt, 0.8% clay), and one containing loam (42.8% sand, 38.8% silt, 18.4% clay). Results were compared with laboratory determined water retention relations, and frequently used water retention models.
Some water retention models may implicitly assume the averaged value of the matric pressure over a soil sample, a point that was illuminated by Liu and Dane (1995). As polymer tensiometers measure a more local value of the matric pressure within the soil, the use of such models on in situ determined water relations may lead to extreme parameter values.

Liu, H.H. and J.H. Dane. 1995. Improved computational procedure for water retention relations of immicible fluids using pressure cells.

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