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Comparison of soil moisture retention characteristics obtained by the extended evaporation method and the pressure plate/sand box apparatus

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The water retention curve (WRC) characterizes the capacity of soil to hold water at specified soil matric potentials. It is a key property in any soil hydrologic application. To determine water retention data accurately and in turn use them to draw the whole curve by optimizing parameters of a proper soil hydraulic equation, it is of crucial importance to choose a suitable measurement procedure. For many years, the sand box-pressure plate apparatus are widely accepted as a reference laboratory procedure. To overcome shortcomings of the pressure plate, the evaporation method was introduced, besides many others. The method is not dependent on hydrostatic equilibrium conditions, thus allowing much quicker measurements, and yields the WRC in very high resolution. The method furthermore enables to quantify the unsaturated hydraulic conductivity function. We investigated a set of 40 fine-textured soils with both methods. The samples were packed from aggregated, dried and sieved material. Eight (-5, -10, -33, -100, -400, -700,-1000 and -1500kPa) water retention data points were obtained from sand box-pressure plate apparatus. Evaporation measurements were performed with the commercial apparatus HYPROP by UMS GmbH, Munich, applying the extended method, which yields water retention data in the range from 0 to -500kPa. We found that the sand box-pressure plate method lead to immediate drainage of water, whereas in HYPROP water started to drain only after reaching an air-entry point of pF 1.2-1.3. Accordingly, HYPROP gave higher water contents until pF 2, compared to the sand box/pressure plate apparatus, but from this point on both curves begin to be close and around the field capacity (pF 2.5) they overlap. Both methods show that the textural pore system starts to drain much later, around pF 3.5. We hypothesize that the reason for the different drainage behaviour of the interaggrate pore system lies in the saturation procedure. For HYPROP, samples were saturated under vacuum, yielding 100% saturation, whereas for the traditional method saturation took place by capillary uptake.