



Consecutive combination of multistep outflow and evaporation method to determine soil hydraulic properties over a wide pressure head range

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Simulation of water flow in unsaturated soils requires accurate knowledge of the soil hydraulic properties. The two standard methods for the simultaneous determination of the water retention and hydraulic conductivity function in the laboratory are the multistep outflow and the evaporation method. The multistep outflow method provides data only in the pressure head range corresponding to relatively moist conditions, whereas the evaporation method has its highest information content in the medium to dry range. A comparison of both methods showed very similar results in the pressure head region where both provide reliable information on the soil hydraulic properties, but distinct differences become evident if results are extrapolated beyond this range. To obtain reliable estimates of soil hydraulic properties in a wider range of soil moisture, we propose to combine both methods in a consecutive manner. The combined experiment we present starts with a multistep outflow experiment which is directly followed by an evaporation experiment. We test this experimental design with both synthetic data and real laboratory experiments. In the evaluation of the combined experiment, data points for the retention and conductivity functions are calculated from the evaporation experiment and included into the objective function for the inverse simulation of the multistep outflow experiment. The combined evaluation leads to a greatly improved estimate of the hydraulic properties in a wide moisture range, circumvents the unreliable extrapolation beyond the different pressure head ranges of the separate experiments and significantly reduces the model error induced by such extrapolations.