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Comparing the Multistep-Outflow and Evaporation Method for Determining Soil Hydraulic Properties

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Accurate knowledge of the soil hydraulic properties is necessary to simulate water flow in unsaturated soils. Among the transient experimental methods which allow the quick and simultaneous determination of the water retention and hydraulic conductivity function in the laboratory, the multistep-outflow and evaporation methods have become the most popular. Despite great effort to improve the experimental setups and evaluation techniques, much less attention has been devoted to the investigation of the agreement of soil hydraulic properties obtained from different methods applied to the same soil. Therefore we analyzed different soil types in order to compare the hydraulic properties obtained by the multistep-outflow method and the simplified evaporation method by Schindler (1980), advanced by Peters and Durner (2008). We found that for soils, where all requirements for the validity of the Richards equation as water flow process description are sufficiently fulfilled, i.e. for homogeneous media with consolidated pore systems and in the absence of “dynamic effects”, the two methods gave very similar results. Problems arose for non-consolidated soils, where the evaporation process leads to a settling of the porous medium, or for swelling and shrinking soils. A particular problem was the establishment of identical initial conditions, when using the very same soil column for both experiments. Furthermore, dynamic effects, expressed by local non-equilibrium between water content and pressure head, and caused by limited gas-phase permeability or local heterogeneity, caused problems in the interpretation of the derived hydraulic properties.