



On the Necessity of an Entry Pressure in the Mualem Model

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The calculation of the relative hydraulic conductivity function based on water retention data is an attractive and widely used approach, since direct measurements of unsaturated conductivities are difficult. We show theoretically under which conditions an air entry pressure for water retention data is definitely required when using the statistical approach of Mualem. Moreover we rigorously specify the conditions for which the classical van Genuchten-Mualem model leads to wrong predictions of relative hydraulic conductivity near water saturation and, hence, an alternative formulation including an air entry pressure should be used. Significant consequences are demonstrated for the inverse parameter estimation based on multistep outflow experiments. Furthermore, it is shown that the numerical simulation of water dynamics is greatly facilitated when using the physically correct formulation of the water retention curve including an air entry pressure and the derived hydraulic conductivity function.