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Collapse of Capillary Potential behind Wetting and Poiseuille-Flow in Soils

P. Germann, A. Helbling, T. Vadilonga

Soil Science Section, Department of Geography, University of Bern, Switzerland

germann@giub.unibe.ch

The Richards Equation (RE) is usually applied to flow in unsaturated porous media. It is based on the assumption that the tension in the water surfaces of the menisci is a function of soil moisture and that it is always at a relative minimum, including during infiltration. On the other hand, Poiseuille Flow (PF) follows the paths of the least momentum dissipation.

Immediately behind wetting the capillary potentials collapsed repeatedly to close to atmospheric pressure. The observations contradict RE, and PF is assumed. We calculated the *equivalent Poiseuille pore (ePp)* diameters from the velocity of wetting, and the number of pores per diameter class followed from the temporal increase of soil moisture during infiltration. The frequency distributions of the *ePp*-diameters indicate flow primarily in the pore space that was air filled prior to infiltration. Antecedent soil moisture was found to be the major factor impacting the advancement of wetting: The higher it is the narrower is the frequency distribution and the wider get the *ePp*-diameters. Rain fall intensity is the second important parameter governing the flow path dimensions. From all flow geometries a cylinder exerts the least momentum dissipation on the moving water. The total sum of the inner wall surfaces of the *ePp* thus represents the maximum surface area per unit volume of soil to which momentum dissipates during flow. Still, the sums of the surface areas compare reasonably well with those found from analyzing infiltration with kinematic wave theory.