Geophysical Research Abstracts
Vol. 13, EGU2011-7985, 2011
EGU General Assembly 2011

Characteristic capillary pressures for air- and water-phase continuity

Peter Lehmann and Dani Or
ETH Zurich, Soil and Terrestrial Environmental Physics, Zurich, Switzerland (peter.lehmann@env.ethz.ch)

High and constant evaporation rates from porous media can be sustained by liquid flow from wet subsurface regions driven by pressure gradient between receding drying front and capillary pressure at the surface. While liquid network forming in pore spaces and crevices above a receding drying front remains sufficiently conductive to sustain required evaporation rate, stage-1 of evaporation persists. To predict duration and maximum drying front depth for stage-1, one needs to know values of capillary pressure (i) at the drying front, and (ii) required to drain smallest ('critical') pores in the hydraulically conductive network. The latter pressure corresponds to disconnection of the liquid phase, whereas the pressure at the front is related to emergence of continuous air-phase defined by air-entry value. Both limiting capillary pressures and related pore sizes can be linked by percolation theory based on critical path analysis: While the air-entry value is the smallest pore size of large pores forming a continuous air-filled network, the pore size controlling liquid phase continuity at the surface is the largest pore of a network of small water-filled pores. We will present experimental results revealing the existence of the two critical pressures and present remedies to deduce them from water retention curve and invasion percolation models.