Geophysical Research Abstracts
Vol. 13, EGU2011-4918, 2011
EGU General Assembly 2011

Interfacial processes controlling evaporation rates from porous media

Dani Or (1), Ebrahim Shahraeeni (1), Nima Shokri (2), and Peter Lehmann (1)
(1) Swiss Federal Institue of Technology, ETH Zurich, Zurich Switzerland (dani.or@env.ethz.ch), (2) Department of Earth Sciences, Boston University, Boston, USA

Evaporation rate from porous media surfaces reflects interactions between internal liquid and vapor transport, energy input for phase change at vaporization plane, and mass transfer across air boundary layer. In this presentation we highlight the roles of three interfaces controlling evaporation rates from porous media – surface wetness pattern, drying front depth, and new vaporization plane forming at onset of stage-2 evaporation. Typically, for moderate atmospheric demand (<6 mm/day) the evaporation rate remains nearly constant (stage-1) while evaporative flux is supplied by capillary flow from a receding drying front. Interestingly, higher atmospheric demand results in a gradual decrease in evaporation rate under similar capillary supply regime (stage-1). We quantified theoretically and experimentally the interplay between surface evaporation sites patterns (wetness) and vapor exchange across the sub-viscous boundary layer above (its thickness varies with wind speed). Drying front depth is another important fluid interface affecting evaporation rate dynamics. We show that for a given porous medium, a predictable critical drying front depth results in disruption of hydraulic continuity supplying surface evaporation marking end of stage-1 and transition to diffusion controlled stage-2 evaporation. Recently, Shokri and Or (2011) have shown based on percolation theory arguments, the existence of a relatively abrupt jump in vaporization plane at end of stage-1 that reforms at a depth below the surface. The depth is scaled by the Bond number and thus enabling prediction of evaporation rates at onset of the diffusion controlled stage-2 (based on diffusion path length). These three interfaces not only affect evaporation rates, but also play an important role in patterns of salt deposition at vaporization planes.