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Evaporation dynamics from wetted porous surfaces affected by internal drainage

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Land surface evaporation dynamics following periodic rainfall events is complicated by liquid phase redistribution and concurrent internal drainage. The maintenance of constant and high evaporation rates (stage 1 evaporation) is predicated on water supply to the surface via continuous capillary pathways up to a characteristic depth defined by porous media properties. The objective is to extend the description to realistic conditions where evaporation and internal drainage occur concurrently. Column experiments have shown that evaporative losses were drastically reduced when drainage takes place. For initially high water content (and hydraulic conductivity) drainage dominates and shortens opportunity for stage 1 evaporation. A range of intermediate results emerges in which transition to stage 2 evaporation depends on initial conditions and soil properties. We derived a new definition of evaporative characteristic length that links soil hydraulic properties and initial conditions with predicted evaporative losses from wetted land surface. Experiments and theoretical considerations confirm the existence of an optimal water content defining conditions for maximal evaporative losses during stage 1.