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Redefining field capacity: intrinsic criteria for soil internal drainage dynamics

Shmuel Assouline (1) and Dani Or (2)

(1) A.R.O - Volcani Center, Soil and Water, Bet Dagan, Israel (vwshmuel@agri.gov.il), (2) 2. The Department of Environmental Systems Science (D-USYS), Swiss Federal Institute of Technology (ETH), Zurich, Switzerland

Across many soil types and conditions, soil internal drainage exhibits predictable dynamics that converge to a stable hydration state termed "field capacity" (FC). Notwithstanding the usefulness of this natural state as a hydrologic benchmark for modeling and for estimation of plant available soil water, FC had been fraught with ambiguities and inconsistencies since its inception. We propose using a soil intrinsic characteristic length (derived from drainable soil pore size distribution) to mark conditions for loss of hydraulic continuity linked with attainment of FC. This static criterion for FC was extended to define a general and self-consistent dynamic criterion for internal drainage dynamics. A systematic evaluation of the proposed FC definitions using a numerical model and experimental data reveals remarkable consistency and predictability across a wide range of soil types. The new intrinsic metrics provide the necessary definitiveness for this useful concept relevant to a broad range of agronomic, hydrologic, ecological and climatic applications. The consistency of FC hydration state must have played an important role in shaping life in soil not only in terms of plant available water, but also in the aquatic habitats it defines for soil biota.