Geophysical Research Abstracts
Vol. 17, EGU2015-1826, 2015
EGU General Assembly 2015

Reexamination of the field capacity concept in a Brazilian oxisol

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The most frequently cited soil physical quantity, “field capacity” is also the most ambiguous one. It is used for several purposes, among which irrigation management (where field capacity is the maximum recommended water content after an irrigation), estimation of plant available soil water (considered as the difference between field capacity and wilting point), maximum soil water storage (as used in so-called “tipping bucket models”), and others. The true assessment of field capacity involves an internal drainage experiment in the absence of evaporation and transpiration, together with the establishment of a drainage rate considered as negligible. Indirect ways of determining field capacity have been developed, and although theoretically unsustainable, correlation to a fixed value of pressure head is the most common practice. When soil hydraulic properties are known, simulation of internal drainage experiments by Richards equation based models can be used to assess field capacity. Twarakavi et al. (2008) performed a study with HYDRUS assuming homogeneous soil profiles. Using tensiometers and TDR-probes, we determined hydraulic properties from 5 depths of 46 locations on a 50 m transect in an oxisol from Brazil with a vertical texture gradient. We used the obtained data set in simulations of internal drainage scenarios with the SWAP model. We show that flux-based estimates of field capacity are highly correlated to the unsaturated hydraulic conductivity of the lower limit of the considered soil profile, with hydraulic gradients ranging from about 0.3 to almost 1. We demonstrate that this conclusion is in conflict with Assouline and Or (2014) whose proposal is not related with the flux- or time based concept of field capacity. In our data set, time or flux criteria to determine field capacity pressure head showed a similar reliability. Considering the 46 simulated locations, bottom flux varied over one order of magnitude at a fixed time, whereas the time to reach a predetermined bottom flux associated to field capacity also showed a variation of about an order of magnitude. Spatial aspects of the obtained values for field capacity will be discussed. By making hydraulic conductivity equal (or slightly higher to compensate for a smaller hydraulic gradient) to what is considered an acceptable “negligible” bottom flux and then inverting the K(h) or K(θ) relation, the pressure head or water content of field capacity can be assessed.