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A new approach to estimate the saturated hydraulic conductivity in soils affected by soil hydrophobic phenomenon

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Soil water repellency (SWR) or hydrophobicity is a phenomenon where a soil does not wet spontaneously when water is applied on the surface. This phenomenon gives infiltration curves with two markedly different slopes. While the first section (I) of the curve corresponds to the infiltration affected by SWR, with a very small sorptivity (S), the second one (II) is the infiltration once the SWR vanished. These types of curves do not allow that the standard methods to estimate the soil hydraulic properties can be used. This work presents a new procedure to estimate S and the hydraulic conductivity (K) of the soil from the analysis of an infiltration curve affected by SWR. To this end, the infiltration shape is considered as a bi-tension curve. The inputs are the initial and saturated volumetric water contents (theta_i and theta_s) and the infiltration curve measured at 0 cm of pressure head on a soil surface affected by SWR. Based on the assumption that under a very small S the water infiltration achieves rapidly the steady-state, the steady-state infiltration rate (qI) is measured from the last times of the infiltration curve affected by SWR (section I). Using the estimated qI, the values of KI and SI are estimated by combining the simplified transient and steady-state Haverkamp et al. (1994) equations. Next, by applying the Ankeny et al. (1991) method, the saturated K (KII) is calculated from KI and the qi measured on both sections of the infiltration curve (qI and qII), respectively. Finally, SII is obtained from qII, KII, theta_i and theta_s using the Haverkamp et al. (1994) model for steady-state water flow. The method, which was tested on several infiltration curves measured in different soils affected by SWR, gave coherent results.