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Testing a new comprehensive model for single ring infiltration data

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The objective of this investigation is to evaluate a recently proposed model for three-dimensional single-ring infiltration with data from four different soils. A total of fourteen different scenarios were considered to estimate field-saturated soil hydraulic conductivity, K_{fs}, values. Those scenarios differed by: i) the way they constrain the macroscopic capillary length, λ, and the initial and saturated soil water content, θ_i and θ_s, ii) the use of transient or steady-state data, and iii) the fitting methods applied to transient data. For comparative purposes, the SSBI method (Steady version of the Simplified method based on a Beerkan Infiltration run) was also applied. The reliability of K_{fs} data was firstly checked though a comparison with unsaturated hydraulic conductivity, K_0, values measured in laboratory on extracted soil cores, in order to discriminate between theoretically possible ($K_{fs} > K_0$) and impossible ($K_{fs} \leq K_0$) situations. Physically possible K_{fs} values were always obtained with the exception of the crusted soil, where $K_{fs} < K_0$ situations suggested that the role of the crust layer was effective in reducing water flow during ponding experiments in the field. Then, K_{fs} data estimated from the different scenarios were compared for validation purpose with those values obtained by numerical inverse modeling with HYDRUS-2D/3D. This comparison identified Approaches 1 and 3, which estimate K_{fs} via optimization and using analytical expressions, respectively, as more accurate methods. The steady-state scenario of Approach 4 and the SSBI method, both of which use a λ value of first approximation, appeared preferable for field campaigns aimed to sample remote or large areas, given that they do not need additional data and still provide acceptable estimates. The model tested in this study could represent a valuable tool for analyzing both transient and steady-state infiltration data or experiments carried out with different set up, i.e., different ponding depth of water, ring size and ring insertion depth.