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The role of layering induced by tillage on preferential flow in a structured soil

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In this work an approach is discussed for characterizing the hydrological behavior of heterogeneous soils, in the presence of structural inter-aggregate macropores or even cracks. Accordingly, special emphasis is given to the effect of micro-macro-heterogeneity and soil structure on water flow processes at local scale. The discussion is limited to a mechanistic approach. Theoretical discussion and experimental evidence of the structural effects on the hydrological behavior of soils are provided.
The main objective of the work will be to select the proper interpretative model for hydraulic functions for the soil investigated. A single-permeability model with bimodal hydraulic functions and, alternatively, a dual permeability model, will be used, both based on Richards equation. Specifically, we will analyze how sensitive this selection is to (i) the type of measurements (water retention, hydraulic conductivity) and (ii) the ranges of measurement (close to saturation and/or dry). Then, we will investigate whether and how well ensemble hydraulic characteristics obtained in a Monte Carlo framework, under the assumption of either single-permeability or double permeability, produce effective soil water contents at three control depths, closely representing those measured in the structured soil investigated. Measured water content were obtained in this study by calculating for each time the average at a given depth z of the volumetric water contents measured over time in 12 sites in the experimental field by TDR and neutron probes. We aim to investigate how allowing, or not, for the crucial effects of the structure in the hydraulic functions influences the prediction of field-scale soil hydrological behavior.