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Evidence of subsurface flow through macropores in agricultural soils: field investigations and modeling

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It has been recognized that heterogeneity of soil controls the soil hydraulic behavior at all spatial scales. Beside the development of various experimental approaches to determine hydraulic properties directly, pedotransfer functions (PTFs) have been introduced and widely used to calculate soil hydraulic properties based on readily available soil properties. However, most pedotransfer functions, in particular those that predict hydraulic conductivity, have been reported to be associated with low accuracy, probably as a result of ignoring the influence of structural properties such as aggregation and macroporosity in the wet range of soil moisture conditions. Using field data from a loamy agricultural field, where an automated system has been setup for monitoring surface runoff, subsurface soil pore water in terms of soil moisture and water potential, and solute concentration, we evaluated the applicability of PTFs for estimating parameters used for modeling flow processes. With a glassfibre wick sampling system, we observed substantial subsurface flow above the less permeable plough sole located at a depth of about 30-35 cm. The presence of abundant pores with diameter ranging between 0.2-0.6 cm on the soil surface after several rainfall events, could indicate that the observed lateral subsurface flow was mainly associated with macropore pathways. The prediction of changes in water potential with depth, using the van Genuchten soil-water retention parameters θr, θs, α and n, and *Ks* estimated from soil texture and bulk density with Rosetta PTF model, did not agree with the field measurements using tensiometers and TDR probes. The predicted values of saturated conductivity were also much higher than those determined on ring soil samples using a permeameter. Inverse solutions using field measurements can render better estimations of the parameters characterizing the hydraulic properties in the high water content range and further efforts are needed to better describe the water flow when macropore flow network develops in the high water content range.