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Inverse Simulation of Field Infiltration Experiment Counting Preferential Flow

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The field tension and ponded infiltration experiments were conducted to monitor and describe irregularities of moisture propagation and to estimate the soil hydraulic properties (Distric Cambisol, Korkusova Hut, Sumava). On these soils the preferential pathways have been observed in several scales with the use of dye tracers, MRI and CT imaging. Preferential behavior was detected also during laboratory infiltration experiments. The flow irregularities are credited to variable air entrapment at the beginning of infiltrations. The field infiltration experiment was carried out in a shallow pit for a period of one day. The upper boundary condition was controlled by the tension disk infiltrometer, the propagation of a water front was monitored by two tensiometers installed in two depths below the infiltration disk. The propagation of saline solution front during ponded infiltration was visualized with high resolution electrical resistivity tomography (ERT). Infiltration experiments were monitored with TDR probes, tensiometers and ERT. Zones of preferential flow were determined through analyses of photographs taken during laboratory dye tracer infiltration experiments performed on undisturbed soil samples. Connectivity, volumetric ratio and spatial development of preferential pathways were evaluated as the necessary information for numerical simulations of flow using dual-permeability approach. 2D axisymetric numerical simulations were conducted to evaluate the results of the experiment. The parameter estimator PEST coupled with the simulation code S2D_DUAL (Vogel et al., 2000) were employed. Two different approaches were used: 1. Single-domain approach based on Richards' equation. 2. Dual-permeability approach based on two interacting water flow domains (matrix and preferential domains), each governed by one Richards' equation. Concerning the existence of preferential flow on investigated soil, the dual-permeability model gives a better picture of the flow regime. The research has been carried out within the projects VZ03 CEZ MSM 6840770005 and GACR 103/08/1552.