Non-equilibrium water flow in multimodal soil porous system

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Soil hydraulic properties of various horizons of Haplic Luvisol were studied under the laboratory and field conditions. Multistep outflow experiments were performed in the laboratory, and tension disk and Guelph permeameter tests were carried out in the field. The dual-permeability flow model in HYDRUS-1D and HYDRUS-2D were used to estimate the soil hydraulic parameters of matrix and macropore domains from the laboratory and field transient flow data via numerical inversion. First, the laboratory experimental data were analyzed to obtain soil hydraulic properties of the one-dimensional (small column) dual-permeability system. Parameters obtained for the matrix domains were then used to analyze field transient flow data of both permeameters tests to estimate parameters of macropore domains in the radially symmetric dual-permeability system. Results showed impact of various pore fractions (gravitational and large capillary pores) and multimodality of soil porous system, which were previously documented by Kodesova et al. (2008) in the micromorphological images, on preferential flow occurrence in structured soils.