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Determination of hydraulic parameters of Planosol using dual-permeability model

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Forward and inverse modeling of water flow help to address the question of reliable hydraulic properties of natural porous medium. The soil hydraulic behavior at Valecov experimental station (located in Bohemo-Moravian highland region) is closely examined. Three types of different measurements were used to estimate soil hydraulic parameters of the heterogeneous porous system at Valecov. Watermark probes and tensiometers provided soil water pressure data; Virib probes measured volumetric water content. The dual-permeability model of soil water flow was utilized to simulate the soil water dynamics in a one-dimensional vertical soil profile. The inverse modeling involved the estimation of scaling factors. Resulting sets of hydraulic parameters (scaling factors) for all sensor nests were evaluated. A similar trend in optimized hydraulic conductivity scaling factors for all three types of sensors was obtained indicating that the saturated hydraulic conductivity significantly decreases with depth in the soil profile. The pressure head scaling factors, estimated from water content and suction data, exhibit similar tendency as the hydraulic conductivity scaling factors. Relatively low objective function values were reached when the pressure head boundary condition (h = 0 cm) instead of the free drainage boundary condition was imposed at the bottom of the soil profile. However, forward simulations using the pressure head bottom boundary condition resulted in low correlation between the measured and observed values and to considerably deteriorated sensor responses. In our particular case study, both forward and inverse simulations suggest substantial reduction of the saturated hydraulic conductivity of the soil matrix with depth. This research has been supported by the Grant Agency of the Czech Republic, project no. 103/04/0663.