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Soil Hydraulic Parameter Estimation and Analysis of Flow Paths under Evaporation in undisturbed Soil Columns

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In general, spatial heterogeneity has an important impact on the local and effective soil hydraulic properties. Hence, one of the objectives of this study was to determine the effective soil hydraulic parameters of a highly heterogeneous, undisturbed soil sample using the evaporation method in combination with inverse modeling. Therefore, pressure heads, water contents, and the weight loss of an undisturbed soil column in course of an evaporation experiment were measured. The inverse estimation of the soil hydraulic parameters was performed using the HYDRUS-1D software package in combination with a global optimization algorithm SCE-UA. Most reported studies for soil hydraulic parameter estimation in soil column experiments used either pressure heads or water contents in the inverse routine. In this study, three scenarios were performed. Initially, only the pressure heads were used in the objective function, in the second scenario only the water content measurements were used to constrain the optimization, and in the third scenario both information from water content and pressure head readings were considered. As result three different soil hydraulic parameter sets were obtained which show strong differences. Including only pressure head or water content data would yield in serious misinterpretation of the effective soil hydraulic parameters of the soil monolith. The second objective of this study was to mark the flow paths of a Brilliant Blue solution in a heterogeneous soil monolith under evaporation conditions. As a result the Brilliant Blue solution preferentially flowed upwards close to the column wall. According to the fact that tracer experiments under evaporation conditions were rarely performed, this study shows that border effects have to be considered in further research.