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Estimation of Effective Soil Hydraulic Properties Using Data From High Resolution Gamma Densiometry and Tensiometers of Multi-Step-Outflow Experiments

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Dynamic Multi Step Outflow (MSO) experiments serve for the estimation of the parameters from soil hydraulic functions like e.g. the Mualem van Genuchten model. The soil hydraulic parameters are derived from outflow records and corresponding matric potential measurements from commonly a single tensiometer using inverse modeling techniques. We modified the experimental set up allowing for simultaneous measurements of the matric potential with three tensiometers and the water content using a high-resolution gamma-ray densiometry measurement system (Bieberle et al., 2007, Hampel et al., 2007).
Different combinations of the measured time series were used for the estimation of effective soil hydraulic properties, representing different degrees of information of the "hydraulic reality" of the sample. The inverse modeling task was solved with the multimethod search algorithm AMALGAM (Vrugt et al., 2007) in combination with the Hydrus1D model (Šimúnek et al., 2008). Subsequently, the resulting effective soil hydraulic parameters allow the simulation of the MSO experiment and the comparison of model results with observations.
The results show that the information of a single tensiometer together with the outflow record result in a set of effective soil hydraulic parameters producing an overall good agreement between the simulation and the observation for the location of the tensiometer. Significantly deviating results are obtained for the other tensiometer positions using this parameter set. Inclusion of more information, such as additional matric potential measurements with the according water contents within the optimization procedure lead to different, more representative hydraulic parameters which improved the overall agreement significantly. These findings indicate that more information about the soil hydraulic state variables in space and time are necessary to obtain effective soil hydraulic properties of soil core samples.

Bieberle, A., Kronenberg, J., Schleicher, E., Hampel, U., 2007: Design of a high resolution gamma ray detector module for tomography applications, Nuclear Instruments And Methods in Physics Research A, Vol. 572, pp. 668-675.

Hampel, U., Bieberle, A., Hoppe, D., Kronenberg, J., Schleicher, E., Sühnel, T., Zimmermann, F., Zippe, C., 2007: High resolution gamma ray tomography scanner for flow measurement and non-destructive testing applications, Review of Scientific Instruments, Vol. 78, 103704.

Šimúnek, J., Šejna, M., Saito, H., Sakai, M. & van Genuchten, M. Th., 2008: The Hydrus-1D Software Package for Simulating the Movement of Water, Heat, and Multiple Solutes in Variably Saturated Media, Version 4.0, HYDRUS Software Series 3, Department of Environmental Sciences, University of California Riverside, Riverside, California, USA, pp. 315.

Vrugt, J.A. and Robinson, B.A. 2007: Improved evolutionary optimization from genetically adaptive multimethod search, Proc. Nat. Acad. Sci. USA, 104, 708 - 711.