



On the Equifinality of Van Genuchten Parameter Sets as obtained from a Sand Lysimeter under Finger Flow Conditions

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In various field and lysimeter investigations it has been shown that the formation of flow fingers is dominating the flux field of the vadose zone in sandy soils. In this study an undisturbed 0.78 m³ sand lysimeter was equipped with several soil hydraulic probes aiming at deriving spatially differentiated Van Genuchten parameter sets in order (i) to assess the goodness of obtained parameter sets for the depiction of soil hydraulic state variables and (ii) to determine possible spatial differences in soil hydraulic properties within the lysimeter.

Van Genuchten parameter sets were obtained from simple fitting procedures using measured time series from 36 tensiometer and 16 TDR probes as resulting from infiltration experiments at three different irrigation intensities. Different parameter optimization strategies yielded altogether 108 parameter sets; parameter values – especially for Van Genuchten's α and n - exhibited pronounced variability. The analysis of all parameter sets revealed that the lysimeters' discharge could be reproduced with high accuracy from over 90% of all parameter sets. In opposite, the layer-wise depiction of the average soil water tension was less successful and the calculation of the average volumetric soil water content failed in almost all cases.

Calculation of the matrix-flux-potential, as an integrative measure for the soil hydraulic properties at given spatial locations, showed that the soil monolith was almost unstructured both layer-wise and vertical-section-wise. The experimentally observed finger-flow-scenario could not be confirmed from the spatial structure of the

lysimeters' hydraulic properties. It is concluded that especially in coarse-textured single grained substrates which possess material functions that are characterized by a steep increase in hydraulic conductivity in the near-saturation range, the resolution of measurements might be insufficient to detect minor variations in soil water pressure and soil water content that cause large differences in flow and transport. Under these conditions Van Genuchten parameter values might be ambiguous.