



A comparative modelling study of a dual tracer experiment in a large lysimeter under natural boundary conditions

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Five model approaches with different physical and mathematical concepts varying in their model complexity and requirements were applied to describe transport processes in the unsaturated zone. The applicability of these model approaches were compared and evaluated investigating two tracer breakthrough curves (bromide, deuterium) in a cropped, free-draining lysimeter experiment under natural atmospheric boundary conditions. The data set consisted of time series of water balance, depth resolved water contents, pressure heads and resident concentrations measured during 800 days. Due to the available spatial distributed data, water flow and solute transport was described as much detailed as possible with a deterministic approach using multi-layered bimodal retention characteristics. The identified transport parameters were compared to those from four other models which include a simplified flux (mean water content model), a stochastic (stream tube model) and two lumped parameter (multi flow dispersion model, variable flow dispersion model) approaches. All model approaches were able to fit the tracer breakthrough curves. However, accurate simulations could only be performed using different dispersion parameters for bromide and deuterium, respectively.

Despite the differing physical and mathematical concepts the resulting parameters (mean water contents, mean water flux, dispersivities) of the five model approaches were all in the same range. The physical based deterministic approach, which is nec-

essary to investigate reactive transport processes, needed information about soil hydraulic properties. The other approaches yielded fitting parameters that partly were pure fit or apparent parameters with physical indistinct meaning. Here, the transferability to other field sites can only be possible if seepage fluxes are available. Nevertheless, due to high fitting accuracy and parameter similarity all model approaches indicated reliable results.