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Comparison of two sampling methods to characterize the fate of two herbicides under field conditions.

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Leaching studies in lysimeters are one requirement for the registration of pesticides in Germany. However, the crucial question is to which extent information on the temporal evolution of the breakthrough curve reflects the transport behaviour in a field soil, where pesticides will eventually be applied. Or vice versa, can pesticide concentration profiles obtained from soil coring be used to predict pesticide fluxes at a certain depth? Hardly any experimental study exists that addresses this topic. In this study we applied bromide and two herbicides as a short pulse to the bare soil surface (Orthic Luvisol) of six 1.2 m high lysimeters and over a 100 $\times$ 100 m area in the field. The experiment was run for three years under natural weather conditions. Leachate was regularly collected from the lysimeters and six soil coring campaigns were carried out in the field. The samples were analyzed for bromide, the herbicides and their main metabolites. In the field we found half-live values of 800 and 27 days for the two herbicides, and a large retardation $R > 10$. Less than 0.06% of the applied mass of the herbicides were detected below the 0.4 m depth after one year. This contradicted to the observed herbicide fate in the lysimeters, where up to 1% of the applied mass was collected in the leachate at 1.2 m depth after one year. Both the convection–dispersion model (CDE) and the convective log-normal transfer function (CLT) were able to describe the observed breakthrough curves and concentration profiles for bromide separately. However, none of the models were able to predict the concentration profiles at the various times correctly using the parameterization from the lysimeters, probably because the constraints of mainly downward flow and a constant transport volume are violated under transient flow conditions. The fast transport of small amounts of herbicides in the lysimeters could not be predicted based on the retardation and degradation parameters obtained from the concentration profiles in the field. For organic compounds in general, the lysimeter is a sampling system that is susceptible to detect low chemical

loads, which occur during preferential flow events, whereas the soil coring method will provide information on the bulk transport through the matrix. Thus, both measuring devices emphasize the occurrence of different flow regimes.