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Model simulations of solute and pesticide transport in soils with preferential flow paths: a review

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The past two decades have seen a growing number of studies dealing with model simulations of solute and pesticide transport in soils with preferential flow paths. For such soils, increasingly complex models have been developed to describe solute and multi-process pesticide transport, the latter involving both physical non-equilibrium and (bio)chemical processes. This presentation seeks to give an overview over the current state-of-the art in this field of model application. Problems at different spatial scales are addressed, typically ranging from the laboratory soil column to the field, but sometimes extending to the watershed or even larger scales using integrated modelling tools. The difficult problem of parameterizing non-equilibrium transport models in most studies involves some combination of direct measurement, estimation, and inverse identification. Representation of soil structure in the model applications and model parameter ranges as obtained for different soils and scales are compared. Furthermore, the use of inverse parameter identification and the resulting parameter uncertainty are reviewed. Challenges in preferential solute and pesticide transport simulation are discussed.