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Identification and parameterisation of 1-D transport models using multi-dimensional flow and transport simulations

J. Vanderborght (1), H. Vereecken (1)

(1) Agrosphere ICG-4, Forschungszentrum Jülich, Germany (j.vanderborght@fz-juelich.de)

To assess the impact of diffuse pollution at the soil surface on groundwater quality due to contaminant leaching through the vadose zone, a one-dimensional convection dispersion equation is often used. Since the implicit assumptions about the transport process in this model do not hold for natural soils, its parameterisation depends on the scale of the transport process. A review of dispersivities (Vanderborght and Vereecken, 2007) demonstrated that the dispersivity generally increases with travel distance. A well accepted explanation for this observed phenomenon is the heterogeneity of local flow and transport velocities which extend over macroscopic scales. Although the impact of these heterogeneities on transport of inert substances is relatively well understood, its influence on transport of reactive substances undergoing decay and sorption is wrongly assessed when a convection dispersion model with additional terms for sorption and decay is used. We postulate that transport simulations considering these heterogeneities in detail are required to identify and parameterize simpler transport models. This hypothesis is demonstrated for two cases. The first treats transport of non-linearly sorbing substances and the second considers leaching through a soil profile with depth dependent sorption and decay parameters. The impact of soil heterogeneity is assessed by simulating multi-dimensional flow and transport. From a comparison of averaged concentrations and solute fluxes in the multi-dimensional model with one-dimensional model simulations suitable simplified models and model parameters are identified.

Vanderborght, J., and H. Vereecken. 2007. Review of Dispersivity Lengths for Transport Modeling in Soils. Vadose Zone J.:(in press).