Geophysical Research Abstracts, Vol. 7, 07330, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07330

The dominant role of structure for transport in soil

H.-J. Vogel (1), I. Cousin (2) and O. Ippisch (3)

(1) Institute of Environmental Physics, University of Heidelberg, INF 229, D-69120 Heidelberg, Germany (hjvogel@iup.uni-heidelberg.de)
(2) INRA, Unité de Science du Sol, Avenue de la Pomme de Pin, BP 20619, 45166 Ardon, France
(3) Interdisciplinary Center of Scientific Computing, University of Heidelberg, Germany

A notorious problem in modeling solute transport in soil is the heterogeneous structure of the material. It is typically lumped into some effective parameters which cannot be measured independently. Hence, the predictive power of effective models is limited. The missing ingredient is the structure of the relevant material properties.

In this contribution we use information on the structure of a field soil to predict the translocation of the dye Brilliant Blue as measured in a field experiment. We combine three different approaches to represent the macroscopic structure of the specific situation: i) direct measurement of soil structure, ii) statistical description of heterogeneities and iii) a conceptual models of structure formation. The structure of soil layers was directly obtained from serial sections in the field. The subscale heterogeneity within the soil horizons was modeled through correlated random fields with estimated correlation lengths and anisotropy. Earth worm burrows came out to play a dominant role at the transition between the upper soil horizon and the subsoil. A model based on percolation theory is introduced that mimics the geometry of earthworm burrow systems. The hydraulic material properties of the different structural units are obtained by direct measurements where available and by a plausible guess otherwise. Given the hydraulic structure, the 3-dimensional velocity field of water was calculated by solving Richards' Equation. Subsequently solute transport was simulated assuming a convection-diffusion type of transport at the small scale.

The simulated tracer distribution compares reasonably well with the experimental data. We conclude that a rough representation of the structure and a rough representation of the hydraulic properties might be sufficient to predict flow and transport, but

both elements are indispensable to come up with such a prediction. Parameter estimation with one of them missing is futile.