Geophysical Research Abstracts, Vol. 7, 05898, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05898

Upscaling unsaturated hydraulic parameters for flow through heterogeneous anisotropic sediments: A comparison of two methods

A. Ward, and Z. Zhang

Pacific Northwest National Laboratory, Washington, USA. (andy.ward@pnl.gov / Fax: +1 509 372-6089 / Phone: +1 509 372-6114)

We compare two methods for determining the upscaled water characteristics and saturation-dependent anisotropy in unsaturated hydraulic conductivity. In both approaches an effective medium approximation is used to reduce a porous medium of M textures to an equivalent homogenous medium. In the first approach the moisture-based Richards' equation is treated like the convective-dispersive equation and parameters are derived from the spatial moments of the infiltrating water plume. The gravity term, $dK_z(\theta)/d(\theta)$, which is analogous to the vertical convective velocity, is inferred from the temporal evolution of the plume centroid along the vertical coordinate allowing calculation of an upscaled $K_z(\theta)$. As with the dispersion tensor, the rate of change of the second spatial moment in 3D space is used to calculate the water diffusivity tensor, $\mathbf{D}(\theta)$, from which an upscaled $\mathbf{K}(\theta)$ is calculated. In the second approach, parameter scaling is used first to reduce the number of parameters to be estimated by a factor M. Upscaled parameters are then optimized by inverse modeling of a field-scale injection test to produce an upscaled $\mathbf{K}(\theta)$ characterized by a pore connectivity tensor, $\mathbf{L}$. Parameters for individual textures are finally determined from the optimized parameters by inverse scaling using scale factors determined *a priori*. Parameter scaling reduced the inversion time by a factor of M^2. In both methods, the upscaled $\mathbf{K}(\theta)$ showed saturation dependent anisotropy. Flow predictions with the STOMP simulator, parameterized with local-scale and upscaled parameters, were compared with field observations. Predictions based on the first method were only able to capture the mean plume behavior. The second method captured the effects of heterogeneity and anisotropy and reduced the mean squared residual by nearly 90% compared to local-scale and upscaled parameters from the first method. The Pacific Northwest National

Laboratory is operated for the U.S. Department of Energy by Battelle under Contract DE-AC05-76RL01830.