Ensemble Solute Transport in 2-D Operator Stable Random Hydraulic Conductivity Fields

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Abstract. Motivated by field measurements of aquifer hydraulic conductivity (*K*), recent techniques were developed to construct anisotropic fractal random fields, in which the scaling, or self-similarity parameter, is defined by a matrix. Ensemble numerical results are analyzed for solute transport through these 2-D "operator-stable" fractional Brownian motion (fBm) *K* fields. Both the longitudinal and transverse Hurst coefficients, as well as the "unit circle radius" are important to both plume growth rates and the timing and duration of breakthrough. It is possible to create osfBm fields that have more "continuity" or stratification in the direction of transport. The effects on a conservative solute plume are 1) continually faster-than-Fickian growth rates, 2) highly non-Gaussian shapes, and 3) a heavier tail early in the breakthrough curve. Contrary to some analytic stochastic theories for monofractal *K* fields, the plume growth rates never exceed *Mercado's* [1967] rate of apparent dispersivity growth proportional to mean distance in a purely stratified aquifer. Apparent super-Mercado growth must be the result of other demonstrable factors, such as initial plume size.

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