Using Wavelet Analysis to Determine Dominant Scales of Hydraulic Conductivity and Head Fields

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Abstract. Wavelet analysis involves an integral transform of, for example, a permeability data set, using wavelet as the kernel of the transform. A wavelet is a function that is non-zero only over a finite region; therefore the wavelet transform analyzes only a subset of the data set. The wavelet is shifted to analyze different subsets of the data set, and it is scaled to analyze different scales of the data set. Using wavelet analysis, the Global Wavelet Energy Spectrum (GWES) and therefore dominant scale of the permeability field can be identified in a statistically homogenous porous medium. We generate sets of bounded one dimensional permeability fields with exponential distributions and we run numerical flow simulations using these permeability fields. We use wavelet analysis to analyze the dominate scales in both the permeability fields and resulting head distributions. Using wavelet analysis, we explore the relationships between dominant scales in the permeability field and dominant scales in flow. We develop analytical solutions for the GWES to corroborate these relationships.