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Field Evidence Model: A hierarchical heterogeneous structure for subsurface transport modeling

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Contaminant transport in highly heterogeneous aquifers is challenging due to non-symmetric but highly skewed tracer plume shapes. Predicting such transport behavior deterministically is associated to a resolution of heterogeneity which requires a dense measurement network. This is in contrast to the available information for most aquifers.
A new hierarchical stochastic aquifer structure model is presented which combines large-scale deterministic information and simple stochastic approaches for incorporating heterogeneity. The model is constructed step by step following field evidence of observations, in the same time making use of as few data as possible. The model consists of deterministic blocks for areas which have different mean hydraulic conductivity as potentially indicated by pumping tests. A sub-scale heterogeneity is introduced within every block consisting of a simple bimodal structure requiring few observations to determine the structural parameter, for instance by flow meter measurements. The model can be applied to predict transport purely on structural parameter of the aquifer and the initial conditions of the transport event.
A successful implementation of the model for the MADE site, Mississippi is presented. Furthermore, the impact of input parameters, structure and conductivity contrasts is investigated in a systematic manor.
The conceptual model is an example for a goal-oriented site specific transport analysis. It allows to reproduce highly skewed tracer plume by incorporating deterministic contrasts and effects of connectivity instead of using unimodal heterogeneity models with high variances. Thereby the investigation effort can be reduced to few observations making the conceptual model appealing for less well investigated sites.