Geophysical Research Abstracts
Vol. 12, EGU2010-3930, 2010
EGU General Assembly 2010

Impact of uncertainty of grain size distributions and associated attributes on interpretations of tracer tests

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We assess the importance of selecting two different methodologies for the determination of hydraulic conductivity from available grain-size distributions on the stochastic modeling of the depth-averaged breakthrough curve observed during a forced-gradient tracer test experiment, which was performed in the Lauswiesen alluvial aquifer, located near the city of Tübingen, Germany. In the absence of direct measurements of porosity, we consider: (a) the model used by Riva et al. (2006, 2008), which relates the natural logarithms of effective porosity and conductivity through an empirical, experimentally-based, linear relationship derived for a nearby experimental site; and (b) a model based on a commonly used relationship linking the total porosity to the coefficient of uniformity of grain size distributions. Transport is described in terms of a purely advective process and/or by including mass exchange processes between mobile and immobile regions. Modeling of flow and transport is performed within a Monte Carlo framework. Our results indicate that the model adopted to describe the correlation between conductivity and porosity and the way grain-sieve information are assimilated to describe the spatial variability of hydraulic conductivity can have relevant effects in the interpretation of the data at the site. All the conceptual models employed to describe the structural heterogeneity of the system and transport features can reasonably reproduce the global characteristics of the experimental depth-averaged breakthrough curve. The best prediction of the late-time behavior of the measured breakthrough curves, in terms of the observed heavy tailing, is offered by directly linking porosity distribution to the spatial variability of particle size information.