Geophysical Research Abstracts
Vol. 20, EGU2018-15673, 2018
EGU General Assembly 2018

Modeling macrodispersive behaviors of solute in a heterogeneous alluvial aquifer with spatial Markov models for velocities

Vivien Hakoun (1), Alessandro Comolli (1,2,3), and Marco Dentz (1)

(1) Institute of Environmental Assessment and Water Research (IDÆA), CSIC, Barcelona, Spain, (2) Associated Unit: Hydrogeology Group (UPC-CSIC), Barcelona, Spain, (3) Department of Geotechnical Engineering and Geosciences - Technical University of Catalonia (UPC), Barcelona, Spain

Performing accurate predictions of solute transport in heterogeneous alluvial aquifers, such as the Columbus aquifer (Mississippi), is a challenge because the variability of hydraulic properties impacts the flow field and the transport behavior. The two macrodispersion experiments (MADE 1 and 2) performed in the heterogeneous Columbus aquifer ($\sigma^2_{\ln K} \approx 4$) reveal a non-Fickian transport behavior. Unlike in a homogeneous medium where they would be symmetric, in this aquifer the spatial distributions of conservative tracers are skewed. The tracer front extend downgradient the injection zone and the peak of solute concentration remains close to the injection site, where the hydraulic conductivity and groundwater velocity are small. It implies that initially, tracer advection is slow. Then when the front of the plume reaches an area with higher hydraulic conductivity, tracer advection is faster and the plume becomes skewed. This behavior illustrates a need for a stochastic approach that allows for conditioning on the initial distribution of velocities. This is accomplished by employing spatial Markov models for the velocities of solute particles which allow for the evolution of Lagrangian velocities between an arbitraty initial velocity distribution and a steady-state velocity distribution. We use two stochastic relaxation approaches based on a Bernoulli and an Ornstein-Uhlenbeck process, which are parsimonious in that the single parameter is an effective correlation length for the velocities. The resulting model for particle transport can be seen as a continuous time random walk, or time domain random walk (TDRW). This approach is used to reproduce the skewed spatial distribution of tracers of the MADE experiments. We show how the TDRW model can be parametrized based on few field data (correlation length of the K-field, point K distribution and velocity distributions). We find good agreement between field data and model predictions. The few input data required for parametrization suggest that the approach could be applied to study sites where characterization is scarce.