Geophysical Research Abstracts
Vol. 16, EGU2014-15172, 2014
EGU General Assembly 2014

Disorder versus correlation controlled non-Fickian transport in heterogeneous porous media: a correlated continuous time random walk approach

Marco Dentz (1), Tanguy Le Borgne (2), Peter Kang (3), and Diogo Bolster (4)

(1) Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Department of Geosciences, Barcelona, Spain (marco.dentz@gmail.com), (2) Université de Rennes 1, CNRS, Geoscience Rennes, UMR 6118, Rennes, France, (3) Massachusetts Institute of Technology, Department of Civil and Environmental Engineering, Cambridge, MA, USA , (4) Environmental Fluid Dynamics Laboratories, Department of Civil Engineering and Geological Sciences, University of Notre Dame, Indiana 46556, USA

Medium and flow heterogeneities lead to global transport patterns such as early and late solute and particle arrivals, and non-linear dispersion which cannot be captured by large scale models based on Fickian transport mechanisms. Such behaviors can be modeled by non-Fickian approaches that are based on time and/or space non-local conservation equations. A key question concerns the identification and quantification of the heterogeneity controls on global non-Fickian transport patterns. Anomalous transport can be viewed as a collective phenomenon generated by the complex interaction of small scale fluctuations and mass transfer processes. Here, we focus on the roles of broad heterogeneity distribution, and heterogeneity and flow correlation on global non-Fickian transport. We identify the signatures of disorder and correlation dominated large scale transport in the distributions of solute arrival times, solute dispersion and spatial solute distributions. Starting from well-defined small scale stochastic flow and transport descriptions, we quantify large scale transport by ensemble averaging over the Lagrangian particle dynamics, which leads to a global transport model that is given by a coupled continuous time random walk (CTRW) characterized by correlated particle velocities. We formalize this correlated CTRW in terms of an evolution equation for the global particle distribution, and discuss the impact of the correlation of subsequent particle velocities on the transport behavior, as well as the limits of perfect and no correlation.