Geophysical Research Abstracts
Vol. 21, EGU2019-17813, 2019
EGU General Assembly 2019

Solute Transport in Generalized Sub-Gaussian Hydraulic Conductivity distributions

Daniel Fernandez-Garcia (1,2), Guillem Sole-Mari (1,2), Monica Riva (3), Alberto Guadagnini (3), Xavier Sanchez-Vila (1,2)

(1) Universitat Politecnica de Catalunya, Enginyeria del Terreny, Enginyeria Civil i Ambiental, Barcelona, Spain (daniel.fernandez.g@upc.edu), (2) Associated Unit: Hydrogeology Group (UPC-CSIC), (3) Politécnico di Milano, Ingegneria Civile e Ambientale, Italy (monica.riva@polimi.it)

Evidence shows that probability density distributions of hydrogeological properties, such as the hydraulic conductivity in aquifers, tend to be non-Gaussian. In these distributions, the spatial increments of the log-conductivity Y between two locations separated by a distance s present distributions with peaks that grow sharper and tails that become heavier as the lag s decreases. Recently, the Generalized Sub-Gaussian (GSG) model has been introduced. This model captures the main features that characterize the behavior of non-Gaussian variables. Here, we present the results of a numerical study to evaluate the implications on solute transport of GSG log-conductivity fields. The spatial and temporal evolution of a solute plume in a three-dimensional saturated column is compared for GSG log-conductivity distributions with differing degrees of “non-Gaussianity”, i.e. of departure from the Gaussian behavior. The results show that, after a few integral scales, the evolution of the second spatial moment of the concentrations in a GSG field coincides with that associated with a Gaussian field with a lower log-conductivity variance. Although the evolution of higher-order moments of solute plumes in GSG fields differs from what can be found in Gaussian settings, these differences become small after the solute travels across a few integral scales. Hence, these discrepancies might be extremely hard to detect so that it would be difficult to differentiate between Gaussian and non-Gaussian fields by relying on these types of observations. Moreover, local-scale dispersion can also affect transport, its contribution being intimately intertwined with that of Y heterogeneity. Another signature of the GSG conductivity field is the emergence of power-law tailing of solute breakthrough curves where it would not be expected in the presence of Gaussian log-conductivities. We found that GSG fields, due to their higher degree of spatial disorder, tend to enhance the stretching of an initially regular interface between two solutions when compared to Gaussian fields. This can be relevant in the context of reactive transport scenarios, as it may yield enhanced rates of mixing and reaction.