Geophysical Research Abstracts
Vol. 21, EGU2019-4201, 2019
EGU General Assembly 2019

A simple solution for assessing the Breakthrough Curve uncertainty due to the finiteness of the solute plume size.

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Models and numerical simulations for solving transport in highly heterogeneous aquifers, primarily in terms of the mass arrival (the breakthrough curve BTC), were advanced in the last three decades. In all cases ergodicity, which allows to exchange the unknown BTC with the ensemble mean, was assumed to prevail for large plumes. The work investigates the uncertainty of the non-ergodic BTC due to the ?niteness of the plume size as compared to the correlation spatial scale of the hydraulic conductivity. The work develops a novel solution for assessing the BTC variability under non-ergodic transport. The solution is simple and it requires the knowledge of the expected value of the univariate travel time Cumulative Distribution Function (CDF), without the need to use the joint travel time distribution required in other approaches. The proposed solution depends in an analytical manner on the ?ow parameters as well as on the dimension of the initial plume relative to the integral scale of logconductivity covariance. The solution is applied to the analysis of the uncertainty of the plume spatial distribution of the MADE transport experiment. This was achieved by using the latest, recently published, analysis of the MADE aquifer conductivity data.