EGU21-1746
https://doi.org/10.5194/egusphere-egu21-1746
EGU General Assembly 2021

Scale-dependent dispersion for solute transport in bounded formations

Qinzhuo Liao[1], Gang Lei[1], Dongxiao Zhang[2], and Shirish Patil[1]
[1]Petroleum Engineering, CPG, King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia
[2]School of Environmental Science and Engineering, Southern University of Science and Technology, Shenzhen, China

We present a new method to estimate the displacement covariance and macrodispersivity for solute transport in bounded formations. Here we use circulant embedding, which is based on the fast Fourier transform and is much more efficient than eigen-decomposition for the factorization of random spatial fields. We compute the displacement covariances using the analysis of variance approach and introduce an interpolation process to significantly reduce the number of forward simulations. Once the effect of each eigenvector on the displacement covariance is obtained, it is unnecessary to rerun the simulator for different spatial covariance functions or anisotropy ratios, which saves a large amount of computational effort. The proposed method is validated in various tests in two-dimensional and three-dimensional examples and accurately matches the results from the Monte Carlo simulation. It is found that the longitudinal dispersivity is not sensitive to the boundaries, while the transverse and vertical dispersivities are greatly affected. The method is applied to the Borden site and provides a better explanation of the observed data after considering the effect of vertical boundaries. These results show that our method could serve as a promising tool for studying and predicting the characteristics of solute transport in heterogeneous media.