Springer

Acta Geophysica
vol. 65, no. 2, 2017, pp. 353-361
DOI 10.1007/s11600-017-0035-8

Solution of one-dimensional space- and time-fractional advection–dispersion equation by homotopy perturbation method

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Abstract

This study develops solution of one-dimensional space–time fractional advection–dispersion equation (FADE). Various forms of dispersion and velocity profiles (i.e. space dependent and both space–time dependent) are considered throughout the study. Homotopy perturbation method (HPM) is used to solve the problem semi-analytically. The advantage of HPM is that it does not require much information about the boundary of the aquifer. The initial condition may be measured for an aquifer, but sometimes it is very difficult to specify the boundary conditions. The FADE is employed for modeling the fate of contaminants in both homogeneous and heterogeneous porous formations subject to an increasing spatially dependent source condition. It is found that the contaminant concentration changes with the order of FADE as fractional-order derivative contains the memory of the system, i.e. how the system changes from one integer order to another integer order. FADEs are used to model the non-local system, hence this study helps understand the physical meaning of parameters involved in the velocity and dispersion.

Key words: space–time dependent FADE, dispersion, velocity, HPM.

Full text is available at
https://link.springer.com/article/10.1007/s11600-017-0035-8