Groundwater modeling: solute transport simulation

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Summary

The first part of the slide show consists of reminders about the basic concepts and equations of saturated solute transport processes. Then, the boundary conditions (BCs) are discussed and the different possibilities are illustrated.

The most common numerical techniques used to solve solute transport are described based on the Finite Difference method. Particular attention is given to advection-dominated problems, as this is the case mostly in aquifers. Specific methods are described, such as Eulerian or grid-based methods with upwind or upstream weighting, TVD methods, Eulerian-Lagrangian methods combining a method of characteristics with traditional FD or FE methods. Peclet and Courant numerical dimensionless numbers help the user to detect the actual numerical conditions, adapt time steps, and to choose which specific method should be adopted. Multi-species reactive transport is a coupled problem that can be simulated sequentially or in parallel.

The following long list of references is provided in order to allow the student/researcher to go into more detail on the subject. The references are used and accordingly cited in the associated slide show. Specifically for BCs discussion, a list of provided references from the author and his research team allows finding practical examples of BCs choices in various practical cases.

Key words

Deterministic model, solute transport, saturated conditions, equations, boundary conditions, Finite Difference Method (FDM), numerical Peclet number, numerical Courant number, numerical oscillations, numerical dispersion, upwind methods, upstream methods, total variation diminishing method (TVD), Eulerian-Lagrangian methods, method of characteristic, MOC, HMOC, MMOC, reactive transport modeling.

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