Recent Developments in the MT3DMS Family of Groundwater Transport Modeling Tools

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MT3DMS is a solute transport model based on a modular structure to permit simulation of transport components independently or jointly. MT3DMS interfaces directly with the U.S. Geological Survey finite-difference groundwater flow model, MODFLOW, for the flow solution, and supports all the hydrologic and discretization features of MODFLOW. MT3DMS has been widely applied in research projects and field-scale modeling studies. MT3DMS is unique in that it includes a comprehensive set of transport solution options, including the fully implicit finite-difference method (FDM), the particle-tracking based Method of Characteristics (MOC) and its variants, and a third-order total-variation-diminishing (TVD) scheme that is mass conservative and minimizes numerical dispersion and artificial oscillation.

Recently, the simulation capabilities of MT3DMS have been significantly extended through MT3DMS-based modeling tools. These include 1) coupling of MT3DMS with the advanced geochemical modeling program PHREEQC-2 for simulation of complex multicomponent reactive transport processes, 2) combining of MODFLOW and MT3DMS into a single code for variable-density flow and transport modeling of seawater intrusion and density-dependent problems, 3) direct simulation of groundwater ages through a zero-order kinetics added to MT3DMS, and 4) coupling of MT3DMS with global optimization techniques for groundwater remediation design, sustainable resource management, and monitoring network design. This presentation will provide an overview of each of these new developments and present examples for applying these newly developed tools to solve complex, real-world problems.