Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05801, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05801
EGU General Assembly 2008

A simplified numerical model of 3-D subsurface flow and solute transport: model description and example verification

L. Lin(1), J.Z. Yang(2), B. Zhang(1)

Institute of soil science, Chinese academy of sciences, Nanjing, China,(2)State Key Laboratory of Water Resources and Hydropower Engineering, Wuhan University, Wuhan, China (llin@issas.ac.cn/+86-025-86881218)

Based on the integration of finite element method in the x-y plane and finite differential method along the z direction, 3-D water and solute balance element are analyzed in a simplified groundwater and solute transport numerical model. By simplifying 3-D water flow movement in large scale, the model redistributes 3-D finite element matrix equation and improves computation efficiency. Compared with the full 3-D model, the simplified model is easily to compile the source code, saves memory space, has an effective solution to discrete equation groups and depicts non-stationary situation of phreatic surface and solute plume. In this model, the seepage region is divided into several horizontal layers according to stratum properties. The algorithm of giving minimum thickness is successfully used to deal with transient station of water table, drying cells and rewetting problem. In the case of pumping and backwater of pump well, the comparison between the simplified model and Visual Modflow is presented, stressing the very small differences in results on the dynamic station of phreatic surface, the transient head of observing points, total head contour of horizontal section and that of vertical section. The simplified model is proved to be convergence and steady. Based on a non-point-source pollution example, the solute transport module is verified by comparing with MT3DMS and the concentration plume has a good coincidence. Influence of dispersion coefficients is analyzed. The conceptual model is proved to be innovative and computationally effective. When the imaginary case of NPS pollution is computed by a PC with the CPU of 2.8 GHz and the EMS memory of 512 MB,

the computation time of the simplified model is 27 min and that of Visual Modflow is 370 min. The maximum time step of the two models is 1 day. The reduction of computation time exceeds ten times and the efficiency is obvious with the simplified model. Applying the simplified model, the capability to predict non-stationary situation of phreatic surface and solute plume has been investigated. The simplified model is better than Visual Modflow at the aspects of treatment of free groundwater surface, dry cells, non-point source recharge and optimal selection of time steps. The following work can introduce into the modules of special boundary conditions in Visual Modflow, such as river, drain and wall boundaries.