COMPARISON OF DIFFERENT APPROACHES TO MODEL TRANSPORT IN GROUNDWATER ON A VERY LARGE SCALE

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Abstract

Integrated water management on a river basin scale in areas where water supply is mainly based on groundwater such as southern Germany requires a detailed analysis and means of forecasting of groundwater quantity and quality related aspects. The latter are especially difficult to asses, since the changes of groundwater quality in space and time require the understanding of the three-dimensional movements of contaminants along with their alteration by decay, adsorption, reaction and related processes. On the very large scale (~100.000 km^2) fast and robust flow and transport models requiring a limited number of parameters are necessary to simulate the long term behaviour and fate of contaminates. The large scale also requires necessarily a coarse discretisation which, in turn, causes numerical problems such as numerical dispersion and oscillation. The aim of the present study was to find appropriate numerical schemes to fulfil the aforementioned tasks. From a previous study it could already be concluded, that simple finite difference (FD) approaches are not feasible to model transport. Therefore the choice of numerical schemes included advanced FD schemes and particle tracking approaches in particular. Five methods were applied to six simple flow models on three different grid sizes and compared to (if available) analytical solutions. Continuous contaminant injection at point sources was chosen as input. The relative errors where compared for breakthrough curves at observation points, the area affected by contamination, and the plume movement by using the zeroth and first spatial moments. This study was carried und within the framework of the German GLOWA research initiative.

Keywords: GLOWA-Danube; Transport; Numerical dispersion; Numerical schemes; Particle tracking