Geophysical Research Abstracts,
Vol. 10, EGU2008-A-10433, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-10433
EGU General Assembly 2008

Quantitative assessment of well vulnerability by an efficient 2-D backward transport model

K. Mazi and **A.D. Koussis**

Institute for Environmental Research and Sustainable Development, The National Observatory of Athens, Greece (akoussis@env.meteo.noa.gr / Fax: +30 210-8103236 / Phone: +30 210-8109125

We present a quantitative approach for assessing well vulnerability based on the source-pathway-receptor and the multiple-barrier concept as alternative to the conventional concept of the wellhead protection area. Our work concerns the *pathway* part of the *multiple-barrier* concept. It uses a backward transport model to estimate the potential impact on a receptor of a contaminant source operating in the well capture zone and thus allows a process-based, objective assessment of aquifer vulnerability, as opposed to the results of so-called index methods such as DRASTIC.

In our implementation, backward transport (adjoint solution of the transport problem) is computed along the curvilinear principal directions of transport (streamlines of a steady flow field and their normals) within a locally one-dimensional framework (Syriopoulou & Koussis, 1991). In the longitudinal transport step, the model integrates along streamlines, using an explicit scheme of the pseudo-viscosity type (matching the numerical diffusion of a scheme solving the pure advection equation to the longitudinal dispersion); the transverse transport step, computes pure dispersion via the Thomas algorithm. Due to the explicit pseudo-viscosity scheme, the model handles advection-dominated transport readily (computes sharp fronts with mild grid constraints), and also determines the edge of the plume, so that the transverse dispersion calculation extends only over the effective plume area. These arrangements, in connection with the use of the principal directions form of the transport equation, ensure great efficiency.

We demonstrate applications of quantitative assessment of well vulnerability with the 2-D backward transport model in a series of example cases. The results concern maximum concentration C_{max}, time to reach C_{max} at the receptor, time to break threshold value relative to source concentration and exposure time to concentration above threshold value.

Syriopoulou, D. and A. D. Koussis, 2-D Modeling of Advection-Dominated Solute Transport in Groundwater by the Matched Artificial Dispersivity Method, Water Resources Research, 27(5), 865-872, 1991.