Geophysical Research Abstracts, Vol. 9, 01260, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-01260

Intrinsic vulnerability assessment in karst areas: a numerical modeling approach

C. Butscher, P. Huggenberger

Institute of Geology and Paleontology, Applied and Environmental Geology, Department of Environmental Sciences, University of Basel, Switzerland (contact: christoph.butscher@unibas.ch)

Karst springs are a valuable resource for drinking water supply. Their catchments may cover very large areas and their aquifers are extremely heterogeneous and anisotropic. These specific characteristics make them particularly vulnerable to contamination. The assessment of vulnerability is an important aspect of groundwater protection in karst areas. In Europe, mapping methods are the primary tool for vulnerability assessment. However, these methods have some drawbacks. First of all, mapping approaches disregard the dynamics of vulnerability. They assume that some places within the catchment area are more vulnerable to contamination than others, but they don't consider that a place may sometimes be more vulnerable than the same place at another time depending on the hydrological situation. Secondly, the indices used for vulnerability mapping are rather conceptual and may depend on the subjective estimation of the mapping hydrogeologist. Therefore, the European COST action 620 on vulnerability and risk mapping for the protection of carbonate (karst) aquifers (European Commission, 2003) suggests using calibrated numerical models for the validation of vulnerability maps. Acting on this suggestion, the main objective of this study was to develop a modeling method, which allows quantifying the intrinsic vulnerability of karst springs. The method should include the hydrological dynamics of karst systems and should be applicable to complex karst settings, which cannot be spatially resolved. To fulfill these requirements, we have chosen a lumped parameter approach modeling the discharge of a karst spring. First, we set up a basis model and four extended versions to include different flow processes or flow paths which could affect the vulnerability of the system. All these model setups consider, beside recharge (soil and epikarst system), the conduit and diffuse flow system as the main characteristics of

the karst aquifer. The extended setups additionally account for surface runoff, an intermediate flow system, exchange flow between the conduit and the diffuse system and, respectively, a seasonal variation of the water storage capacity of the recharge system. Second, we make suggestions how to use the calibrated models to quantify the intrinsic vulnerability of karst springs. The suggestions are based (1) on the temporally changing contributions of the conduit and diffuse flow system to spring discharge, and (2) on modeled breakthrough curves resulting from a standardized contaminant input into the karst system.