Karst Hydrology (Proceedings of Workshop W2 held at Rabat, Morocco, April–May 1997). IAHS Publ. no. 247, 1998.

Summary of the discussion on "Vulnerability and carrying capacity of karst water systems"

TORSTEN CLEMENS (rapporteur) and the convenors

There is little knowledge on the transport processes and dynamics of sanitary bacteria within karst aquifer systems and there is a need for more research in this area. In most cases pollutants entering via point and linear sources (dolines, sinking streams and loosing streams) are the main threat to the underground waters stored in karst aquifers. To incorporate them into a GIS is not a trivial task. In a first, very general, appraisal point and linear features can be linked to surface morphology. Most of the available GIS software offers procedures to calculate catchment areas for point or linear data. However, this approach does not include the complex underground flow system in karst aquifers.

For future studies flow models should be incorporated into the GIS investigations of karst areas. Then raster based data layers derived for example by remote sensing techniques can be combined with linear flow networks. A more reliable assessment of risks and the vulnerability in karst regions will then be possible. Three-dimensional geographic information systems are being developed and seem to be especially suitable to describe the spatial heterogeneity of karst systems. However the requirement for large amounts of high quality data input will limit their application.

Vulnerability maps provided by GIS tools can be combined with maps showing the confidence defined as a confidence index. The two maps are useful in order to determine the quality of data and where more information is necessary. This approach can be improved if the distribution of the pollution load is included. However a proper picture of vulnerability can only be obtained if the vulnerability map is combined with a numerical recharge and flow model. In mature karst aquifers where flow is characterized by conduits with diameters of 1 m to 10 m no numerical model is applicable. Single or double continuum models use the REV (Representative Elementary Volume) approach which is not a physically meaningful description of the large conduits. On the other hand numerical models using a discrete description of the karst conduits require information about geometry and location of these conduits.

The authors of papers presented in this workshop were asked to provide practical information on how to implement intrinsic vulnerability maps in karstic environments. Reference was made to ILWIS, the Integrated Land–Water Information System, which uses both raster and vector systems.

The discussion showed a principle difference of opinions concerning the value of vulnerability maps. Some participants deny the physical consistence of such vulnerability maps because all the processes of weighted coefficients are really empirical. For them, vulnerability must be studied only on the base of the actual hydraulic behaviour of the aquifer and physically-based laws should be used. Of

course these laws are very complex especially in the karstic aquifers and uncertainty on the physical parameters remains. This first direction stands in opposition to the trend to estimate aquifer vulnerability by means of evaluation of the specific vulnerability where physical based laws are not always applicable. However, the participants agreed that it is necessary to use integrated approaches. Such approaches are well known in hydrology and were partially presented during the respective session.