



Vulnerability assessment of karst aquifer feeding Pertuso Spring (Central Italy): comparison between different applications of COP method

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Vulnerability assessment of karst aquifers and vulnerability mapping are important tools for improved sustainable management and protection of karst groundwater resources.

In this paper, to estimate the vulnerability degree of the karst aquifer feeding Pertuso Spring in Central Italy, two different implementations of COP method, supported by an open source GIS, were tested and a comparison of the vulnerability maps is proposed.

The study area is a highly karstified carbonate aquifer located in the Upper Valley of the Aniene River, in the south-east part of Latium Region. The hydrogeological basin covers about 50 km² and the karst aquifer provides a water supply of about 120.000 m³d⁻¹.

The well-developed karst features in this hydrogeological system is responsible of the fast infiltration of rainfall in the saturated zone and, consequently, of the high discharge rate of Pertuso Spring (up to 3 m³/s). Thus, in the aim of emphasizing the presence of these karst features, due to which, there are limited attenuation processes in the unsaturated zone, in this work COP method has been applied by the implementation of a new discretization methodology of the hydrogeological basin using polygonal layer. Therefore, the hydrogeological catchment basin has been divided into 52 polygonal layer, representative of outcropping lithology and karst features, to which COP method has been applied. The intrinsic vulnerability maps, produced using a GIS approach, has been examined and compared with the maps obtained using traditional vulnerability assessment method, which provides the discretization of the study area generating a grid map to which associate the Vulnerability Indexes.

The results of this study highlight vulnerability from low to very high. The maximum vulnerability degree is due to karstic features responsible of high recharge and high hydraulic conductivity.

The new proposed discretization of the hydrogeological basin using polygonal layer raise four vulnerability classes, ranging from low to very high, and provide different results for high and very high vulnerability areas whit respect to the traditional grid approach. The traditional implementation of COP method assigns to most of the study area very high vulnerability degree, while the polygon discretization shows the dominance of high vulnerability classes assessing very high vulnerability only to karst features. These results seem to be more realistic because they better consider the role of the highly developed epikarst, which minimizes the protective function of the unsaturated zone.

Comparing the vulnerability maps obtained by both methodologies shows that the traditional discretization approach seems to overestimate the vulnerability of the karst aquifer feeding Pertuso Spring and to provide a low sensitivity to the spatial variation of the hydrogeological parameters.

Between the two different approaches of COP method, the proposed polygon discretization of the hydrogeological basin seems to be more accurate and flexible than the traditional grid mapping.