HYDROLOGY OF THE MALENŠČICA KARST SPRING AND ITS CATCHMENT

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The thesis deals with the hydrological analysis of the Malenščica karst spring and its catchment. The analysis comprises the results of a water balance method, hydrograph analyses, the basic descriptive statistics of different hydrological time series as well as of the correlation and multiple regression analysis of hydrological parameters. The principal methodological approach used in the research is the statistical analysis of the time series of daily and hourly hydrological data acquired and measured in the relevant hydrological years 1975, 2008 and in the sequence of five hydrological years 1997-2002, comprising an univariate and bivariate correlation and spectral analysis of data on discharges, precipitation and the physical-chemical characteristics of the discussed spring as well as other springs and watercourses in its catchment and its vicinity. Valuable additional information on water circulation in the catchment of the discussed spring was provided by a combined tracer test conducted in May 2008, when two different tracers were injected into the ponors of two contributing branches of the common catchment of the Unica and Malenščica karst springs (the Postojna Cave, the Mala Karlovica cave). An extensive analysis of different hydrological time series has shown that the size of a catchment area can influence the memory effect and the storage capacity of individual karst springs; typically, the storage capacity of larger karst systems is greater. A comparison of autocorrelation analysis results between separate hydrological years for the same measuring point shows important influence of recharge characteristics. The results of a cross-correlation analysis have further showed that the functioning of the complex hydrological system of the Malenščica karst spring is more or less homogeneous in its near catchment; individual watercourses respond to recharge almost simultaneously. Furthermore, the precipitation regime within the catchment is more or less homogeneous and thus the comparison of hydrogeological characteristics between individual springs and their catchments is more accurate, with less inaccuracies. The storage capacity of individual karst springs is also influenced by their recharge characteristics; in comparison with larger systems, the response of smaller karst springs to precipitation events is faster and more intense, however the duration of their pulse is shorter. The results have confirmed the importance of autogenic recharge in the observed spring and proved that the underground water connections from the direction of the Rak river ponor are better at the section leading towards the Unica karst spring, which is also confirmed by the results of a cross-correlation analysis of different hourly hydrological time series. The transfer of the temperature characteristics of water towards the Unica and Malenščica springs is better from the direction of Lake Cerknica. The maximum discharges of the Malenščica karst spring are reduced to some extent. Compared with the other springs and watercourses in its catchment and its vicinity, the spring shows a greater memory effect; if, however, compared with examples from elsewhere, its storage capacity can only be characterized as moderate. In comparison with the karst springs Vipava, Hubelj and Korentan, the examined spring has a greater storage capacity, which can not be assigned to the lower karstification degree of its catchment. The results of the above-mentioned tracer test have shown possible underground connection of the Pivka river, at its ponor into the Postojna cave, with the Malenščica spring, which has been proven for the first time. This opens new dimensions for the study of the common catchment of both the Unica and Malenščica karst springs as well as of effective methods to protect the examined spring. Methodologically, the tracer test results are in line with the results of the cross-correlation analysis of the electric conductivity parameter. Based on the results of the Malenščica karst spring study, the qualitative assessment of the applicability of time series analysis to karst hydrology has confirmed certain advantages of its application in relation to other methods. It has, however, also shown a number of disadvantages and limitations concerning its use in defining the hydrogeological characteristics of karst hydrological

systems as well as in explaining their functioning. Therefore it is essential that the results of time series analysis be interpreted together with the results of other methods used in karst hydrology.

Key words: Malenščica karst spring, karst hydrology, karst aquifer, time series analysis, autocorrelation, cross-correlation, spectral density function, water balance, tracer test

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