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B. Andreo · F. Carrasco · J.J. Durán
J.W. LaMoreaux (Eds.)

Advances in Research in Karst Media

 Springer

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First Outcomes from New Approach in Assessing Recharge of Highly Karstified Terrains – Cases Examples from Montenegro

Milan Radulovic, Z. Stevanovic, and Micko Radulovic

Abstract The recharge of a karst aquifer, in terms of its quantity and spatial distribution depends on various natural factors, such as: climate, topography, vegetation, soil, geology etc. Selection of adequate method for assessing recharge in karst often represents matter of dispute. Multi-parameter methods using GIS tools have been recently successfully developed and applied in karstic terrains of Spain (Andreo et al. 2008) and Lebanon (Shaban et al. 2005). Specific local conditions as highly karstified terrains could additionally complicate such an assessment. The Montenegro karstified terrain, as southern part of External Dinarides, is characterized by very high precipitation rate, irregular seasonal distribution and absence of surface waters (high infiltration capacity of karst). Considering such conditions, an attempt to adapt existing knowledge and experiences and develop appropriate multi-parameter method for assessing spatial distribution of autogenous recharge has been made. Method KARSTLOP has been developed, applied and calibrated at catchments of several large karst springs of Montenegro. Obtained results in tested catchment areas indicate that with some further improvements the KARSTLOP method can support research of karstic aquifer in similar highly karstified terrains.

1 Introduction

Montenegro is situated in the southeastern part of Europe (Fig. 1). Its entire territory belongs to Alpine geo structure, to the Dinarides branch. The largest part of its

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Time Series Analysis of Saraw Springs – SE of Sulaimaniya, Iraqi Kurdistan Region

S.S. Ali and Z. Stevanovic

Abstract Saraw Springs are located 45 km southeast of Sulaimaniya city of the Iraqi Kurdistan Region. This group of three vaclusian springs is recharged by infiltration through Cretaceous and Jurassic limestone outcrops. During three years of drought (1999–2001), one of the springs located at a few meters higher elevation than the others dried up. It became again active after the heavy rains at the end of December 2001. Based on the daily discharges measurements from October 2004 until the end of June 2006, a high correlation between discharge rates of the springs has been observed which indicates the prevailing role of long term reserves. The gentle declining of the auto-correlogram with no inter-subsistence of any peaks during that period indicates a type of homogeneity in the fissured systems, with no significant double porosity. The cross-correlogram shows that the stochastic connection between precipitation and discharge rate is weakly synchronized. This confirms dominant discharge through small fissures of the aquifer. The late reactions of the bigger channels can be forecasted according to the highly significant correlation of the first two days. In accordance with the obtained recession coefficients the average total dynamic reserves for the three springs equals $22 \times 10^6 \text{ m}^3$ per 277 days.

1 Introduction

Karst springs represent imperative potential resources for water supply and irrigation in Iraqi Kurdistan Region. Sharazoor-Piramaqroon basin as one of the most important hydrogeological basins in the northeastern part of Iraq is characterized by the existence of a number of karstic and karstic-fissured springs with appre-

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