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Applied dual porosity concept for large karst basins in the east Mediterranean

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One of the most problematic aspects of modeling karst hydrology is the "system identification", which is the conceptual structure of flow within a karstic system. In this study we simulate the conceptual flow system of two large karstic springs, which originate in the karstic region of the Hermon Mountain (Northern Israel). These springs contribute 300 million m^3 annually, nearly $\sim$70% of the flow to the Upper Catchment of the Jordan River. Our findings are supported by daily measurements of spring discharge and weekly measurements of geochemical components over 35 years.

The model couples the groundwater flows of these springs with mixing equations, and applied them simultaneously to both spring discharges and to three different solute concentrations. The conceptual karstic groundwater routine includes two small and fast-reacting reservoirs representing the springs' conduit systems, and one large and slow-reacting reservoir representing the fissured-porous system (dual porosity concept). Both conduit reservoirs exchange flow with the fissured-porous system, which is linearly dependent on their difference in hydraulic potential. Thus flow between the conduit reservoirs and the fissured-porous reservoir is possible in both directions. Moreover, based on the real hydrological system, it was assumed that one conduit reservoir was located significantly higher than the conduit reservoir of the other. The model enabled the simultaneous solution of the spring flows and concentration of Nitrate [NO_3^-], Chloride [Cl^-] and Sulfate [SO_4^{2-}]. The multiple-response validation indicated that it is most probable that the new model structure now considers the significant and major processes taking place in the karst hydrological system of Mount Hermon.

The successful application of the dual porosity concept suggests that the contributing fissured-porous aquifer of both springs is the same, despite the obvious differences between the nature of spring discharge, and some differences in their geochemistry.

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