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Groundwater circulation and utilisation in an unconfined carbonate system – revealing the potential effect of climate change and humankind activities

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Characteristics of gravitational groundwater flow systems in carbonate regions were presented by Mádl-Szőnyi & Tóth (2015) based on theoretical considerations, identification and classification of groundwater flow-related field phenomena and numerical simulation. It was revealed that the changes of flow pattern in carbonate framework attributed to groundwater utilization and/or climate change are more apparent due to the effective hydraulic conductivity of carbonates. Consequently, natural or artificial disturbances of water level propagate farther, deeper and faster in carbonates than in siliciclastic basins. These changes could result in degradation and reorganization of hierarchical flow systems, modification of recharge and discharge areas and even alteration of physicochemical parameters (Mádl-Szőnyi & Tóth, 2015).

This paper presents the application of the gravity-driven regional groundwater flow concept to the hydrogeologically complex thick carbonate system of the Transdanubian Range, Hungary, depicting the flow pattern of the area and to a practical problem of a local study area, conflicts of interest of water supply and water use of a golf course. The question is how will the natural discharge on the golf course be influenced by the planned karst drinking water production well. In addition, the effects of climate change on this conflict were evaluated.

We demonstrate the importance of the understanding the appropriate scale in karst studies and illustrate how the gravity-driven regional groundwater flow concept can help to determine it. For this purpose, the hydrogeological conditions of the study site were examined at different scales. The goals were to define the appropriate scale and reveal the effects of tectonic structures; and give prognoses for the possible impact of a planned drinking water well and climate change on the golf course based on numerical simulation. The study also showed the low geothermal potential of the area.