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Impact of climate change on mean groundwater residence time in several Mediterranean Spanish aquifers

David Pulido-Velazquez, Carlos Marín-Lechado, Sergio Martos-Rosillo, Antonio-Juan Collados-Lara, and Ana Ruíz-Constan

Geological Survey of Spain, Granada, Spain (d.pulido@igme.es,c.marin@igme.es, s.martos@igme.es, aj.collados@igme.es, a.ruiz@igme.es)

The mean residence time in an aquifer, also known as natural turnover time or renewable period, can be obtained as the relation (R / St) between its storage capacity (St) and its recharge (R). It is an excellent indicator of the aquifer response capacity to its exploitation. Aquifers in which R is close to St values are extremely vulnerable to exploitation, even when it is less than the average recharge. This is especially relevant in Mediterranean climate areas, where long and intensive drought periods appear and will be exacerbated in future scenarios of global change. The natural turnover time depends on the recharge and the Global Change can produce important changes on it in the future.

In this research we propose a method for a detailed estimation of natural turnover time by combining detailed 3D geological modelling of the case studies, estimated fields of specific yield for the aquifers (based on the analysis of multiple field sample), and rainfall-recharge models in several aquifer with different ratios of natural turnover time. These detailed 3D geological models have been defined by integrating information coming from seismic profiles, boreholes, magnetotelluric, electromagnetic and electrical sounding, digital elevation models, previous geological maps and new structural dates. They also allow us to deduce the reserve curve as a function of the elevation. On the other hand, different ensemble and downscaling techniques will be used to define potential future global climate change scenarios for the test-regions based on the data coming from simulations with different Regional Circulation Models (RCMs). These precipitation and temperature scenarios will be employed to feed the previously calibrated rainfall-recharge models in order to estimated future recharge and turnover time values.

The methodology applied in this work could be a tool of special interest to identify at regional level which aquifers are most vulnerable to exploitation considering hydrogeological and climate change aspects.

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