Hydrodynamic effects in the discharge zone of the Motril-Salobreña coastal aquifer due to the drilling of artesian wells

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ABSTRACT

Flow patterns with vertical upward components are commonly present in discharge zones of coastal unconfined aquifers. Motril-Salobreña aquifer (Granada, south eastern Spain) shows this flow configuration confirmed by artesian wells, 300 m from the coast. The principal objective of this study is to explore how to simulate the observed flow patterns at the vicinity of these wells considering the uncertainties in the hydrogeological parameter values and the aquifer structure in the study area. A synthetic cross section with a numerical 3D density-dependent model has been developed in order to achieve the following: (a) find the optimal boundary conditions to represent the artesian wells located in the discharge zone either with drains or pumping wells, (b) explain the changes in saltwater-freshwater contact position and submarine groundwater discharge when wells are drilled in this location and (c) determine the modification of the flow pattern and salinity distribution in the discharge zone due to anisotropy, multilayer aquifer and configuration of the wells cased (distribution of the screened sections).

The model has been constructed with SEAWAT representing the artesian wells as pumping wells and also as a localized drainage point. The results were compared then with field observations considering a simple isotropic aquifer to a multilayered one and under different initial conditions, anisotropy ratios or cased configurations throughout the saturated thickness.

The results show that a drain boundary condition is representing more accurately the observations in the artesian well than a pumping well and the distribution of the screened sections has only a local affection on the dynamic of the flow. Higher anisotropy and hydraulic conductivity lead to higher vertical flow and a displacement seawards of the salt water intrusion. Hence, the consideration of a multilayer system with different hydraulic properties results in better adjustment between salinity observations and model data that indicates that Motril-Salobreña aquifer is layered in the proximity of the shore.

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