Geophysical Research Abstracts
Vol. 15, EGU2013-4061, 2013
EGU General Assembly 2013

Numerical model to support the management of groundwater resources of a coastal karstic aquifer (southern Italy)

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The main purpose of the research is to define management apporouches for a coastal karstic aquifer. The core of the tools uses numerical modelling, applied to groundwater resource of Salento (southern Italy) and criteria to reduce the quantitative and qualitative degradation risks. The computer codes selected for numerical groundwater modelling were MODFLOW and SEAWAT. The approach chosen was based on the concept of a equivalent homogeneous porous medium by which it is assumed that the real heterogeneous aquifer can be simulated as homogeneous porous media within cells or elements. The modelled aquifer portion extends for 2230 km2, and it was uniformly discretized into 97,200 cells, each one of 0.6 km2. Vertically, to allow a good lithological and hydrogeological discretization, the area was divided into 12 layers, from 214 to -350 m asl. Thickness and geometry of layers was defined on the basis of the aquifer conceptualisation based on the 3d knowledge of hydrogeological complexes.
For the boundary conditions, inactive cells were used along the boundary with the rest of Murgia-Salento aquifer, as conceptual underground watershed due to the absence of flow. About the sea boundary was used CHD boundary cells (Constant Head Boundary). Additional boundary conditions were used for SEAWAT modelling, as initial concentration and constant concentration, in the latter case for cells shaping the coastline. A mean annual net rainfall (recharge) was calculated in each cell with a GIS elaboration, ranged from 68 to 343 mm, 173 mm an average. The recharge or infiltration was calculated using an infiltration coefficient (IC) (defined as infiltration/net rainfall ratio) for each hydrogeological complex, assuming values equal to 1 inside endorheic areas. The mean annual recharge was equal to 150 mm. The model was implemented using MODFLOW and SEAWAT codes in steady-state conditions to obtain a starting point for following transient scenarios, using piezometric data of thirties as in that period the discharge level was negligeable. The model was calibrated through the use of PEST (Non-Linear Parameter Estimation) code, a standard in the geo-environmental modelling. The calibration was realised using data of 17 selected wells. The results of calibration can be summarised considering these control parameters: the correlation coefficient, equal to 0.92, the standard deviation, equal to 0.7, the mean square error, equal about to 0.65, and the absolute mean residue (RMS), equal to 12%.
The result emphasize the intrusion phenomena of seawater into aquifer with a important reduction of the quality of water and shown the importance of define management policies of groundwater extraction.