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[76] CLIMATE CHANGE AND MEDITERRANEAN COASTAL KARST AQUIFERS: THE CASE OF SALENTO (SOUTHERN ITALY)

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Introduction

Second half of the 20th century was characterized by an increase of groundwater discharge. Numerous aquifers are overexploited in the world and in particular in the Mediterranean area. Problems tie to overexploitation, as piezometric decline and increase of seawater intrusion, are amplified in karst coastal aquifers where the whole effect could be a groundwater quality and quantity degradation.

Focusing on Mediterranean countries, most part of coastal aquifers of Spain, France, Portugal, Slovenia, Croatia, Greece, Albania, Turkey, and Italy are karstic and affected, to different degrees, by seawater intrusion due high pumping extraction rates and low recharge. (COST 2005; Polemio et al. 2010).

Climate change may particularly aggravate these requirements, especially in the Mediterranean areas, due to the combined effects of semiarid condition climate, or reduced recharge and consequent increase of discharge (Cotecchia et al. 2003; Polemio 2005; Polemio et al. 2009).

The general purpose of this paper is to prove the capability of large-scale numerical models in management of groundwater, in particular for achieve forecast scenarios to evaluate the impacts of climate change on groundwater resources of karst coastal aquifer of Salento (Southern Italy).

The computer codes selected for numerical groundwater modelling were MODFLOW and SEAWAT. Three forecast transient scenarios, referred to 2001-2020, 2021-2040 and 2041-2060, were implemented, on the basis of calibrated and validated model, with the aim to predicting the evolution of piezometric level and seawater intrusion. The scenarios were discussed considering the effects of climate change, sea level rise and change of sea salinity.

Numerical model of study area

The study area, located in the Southern Italy (Fig. 1), is a portion of Salento Peninsula (about 2300 km^2) discretized into 97,200 cells, each one of 0.6 km^2.

Vertically, to allow a good lithological and hydrogeological discretization, the area was divided into 16 layers, from 214 to -350 m a.s.l..

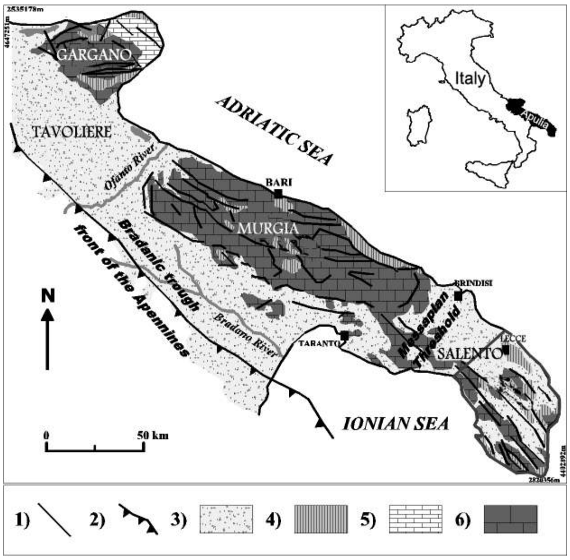

Fig. 1 – The study area.

Boundary conditions, thickness, and geometry of layers were defined on the basis of the aquifer conceptualization based on the 3D knowledge of hydrogeological complexes. (Fig. 2). The level of well discharge was almost low and negligible in thirties. A first simulation using data of thirties was done. This type simulation was defined on the basis of steady-state conditions to define natural conditions of flow and of seawater intrusion. Two new transient scenarios were done, from 1980-1989 and 1989-1989 periods also used to validate model. Model input data, calibration and validation phases are described in details by Romanazzi and Polemio (2013).

Climate changes and predict scenarios

In addition to overexploitation, in the next decades climate change may particularly aggravate these scenarios, due to these combined effects of temperature increasing and precipitation decreasing. Became so most important define new management tools, as numerical models, for a sustainable use of the groundwater resource. These models permit, for example, to test different recharge scenarios, on the basis of the effect of climate change, for a new sustainable groundwater management. Climate change hypotheses, referred to temperature and precipitation, were deifned on the basis of the model developed by Giorgi and

Lionello, called MGME, or Global Multi Model Ensemble, in relation to the defined scenario A1B (Giorgi and Lionello 2008). In the SEAWAT model also the variation of salinity and sea level rise were considered. An increase of salinity and sea level rise, respectively about 0.005 g/L and 0.05 meters for year, were implemented (Tsimplis et al. 2008). On the basis of annual step, transient piezometric and salinity scenarios of 2000-2020, 2021-2040, and 2041-2060 were elaborated. The results show a dramatic piezometric decrease and an important seawater intrusion increase. Figure 3 shows salinity variation map (layer -50 to -100 m a.s.l.) at 2060,referred to thirties (Fig. 3).

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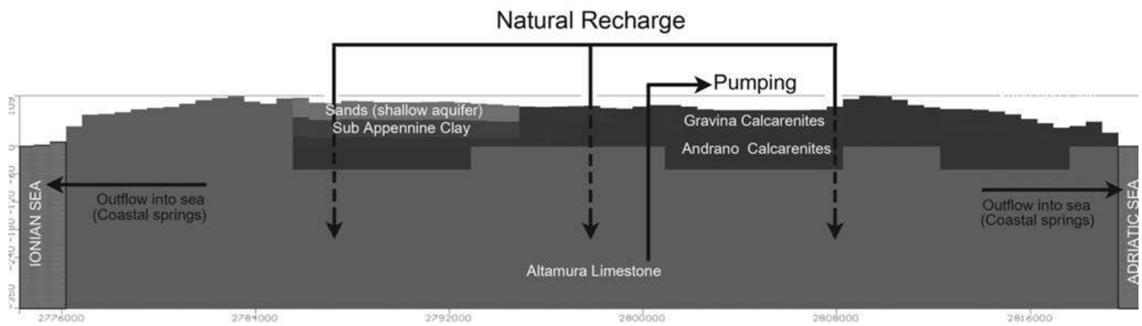

Fig. 2 - Conceptual model of Salento study area. Schematic generic section W-E.

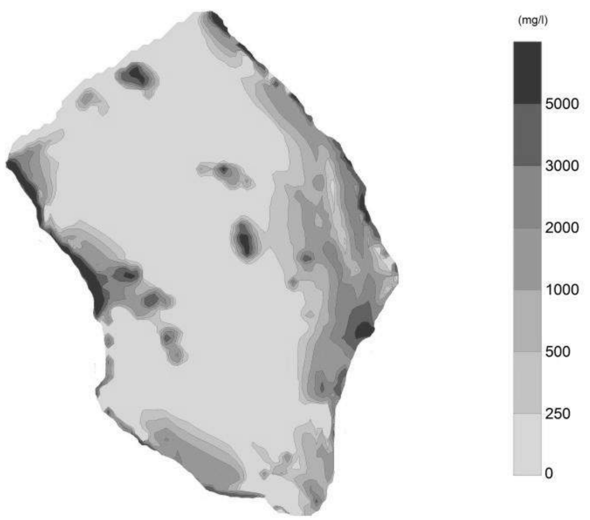

Fig. 3 - Salinity variation map (layer -50 to -100 m a.s.l.) at 2060 (referred to Thirties.