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# Modeling hydrostratigraphy and groundwater flow of a karst aquifer in a Mediterranean basin (Salento peninsula, Southeastern Italy)

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Hydrostratigraphic architecture and deep groundwater flow of the Salento peninsula (about 5000 km2 in Southern Italy) have been modelled at regional scale. Salento is a typical Mediterranean area at risk of desertification, where the main aquifer is hosted in carbonatic Cretaceous rocks (Altamura Limestone Formation) with complex relationships with the sea and a poor recharge because of the coverage of more recent sediments with low permeability.

The hydrostratigrahic model is supported by lithologic data analysis, descriptions of geologic formations and of their physical properties that reveal the nature of subsurface rocks, sediment types and contained fluids. The model is obtained by processing and correlation of surface and subsurface data. In particular archival and observed borehole log data relative to more than 515 wells were interpreted and reclassified into a 3D geographic information system, in order to fit the conceptual hydrostratigraphic framework for the study area, which includes Oligocene, Miocene, Pliocene and Pleistocene, mostly impermeable, units overlying the thick Cretaceous fractured and karst bedrock. Miocenic and Pliocene rocks and Upper-Pleistocene terrace deposits host local, respectively fractured or porous, aquifers which are of minor importance at the regional scale and therefore are not modeled in this study. The digital data base permitted us to easily join the subsurface data with geological maps, with additional control points from shallow wells that do not reach the bedrock and with observations of sedimentary structures outcropping in quarries and other areas excavated for infrastructures and buildings (about 750 data). The surfaces that delimit each hydrostratigraphic unit were obtained through interpolation of the point data, cross-checking the results and validating them also with the aid of several 2D geological sections.

The 3D hydrostratigraphic model plays a key role not only to determine the top of the Cretaceous aquifer, but also to estimate the aquifer recharge, together with a map of the distribution of the precipitations over the area. These data were completed with information about the soil use to estimate water abstraction for irrigation and literature data to estimate the water abstraction for drinking purposes. The piezometric head is unfortunately not properly monitored but is evaluated from the data collected during well drilling. Different boundary conditions are applied along the coastline, in order to model sea-aquifer interaction either when the top of the Altamura Limestone lies above the sea level, when the aquifer is phreatic and fresh water is drained, or below the sea level, so that the aquifer is under pressure and the contact with sea occurs off-shore. The characteristics of the numerical simulation model are fixed on the basis of the final goal of this work which is to estimate the terms of the water balance at the regional scale. Therefore a classical conservative finite-difference scheme is used to model 2D stationary flow, with a grid spacing of 500 m. The model is based on the approximation that the karst and fracture network is spread over each discretization cell, so that a discrete Dary's law can be applied. The base of the fresh water aquifer is obtained with the Ghyben-Herzberg approach. The first attempts of model calibration suggest that the aquifer is a highly heterogeneous system, with a vertically averaged hydraulic conductivity which vary by some orders of magnitude. As a positive outcome of this preliminary calibration, the model correctly predicts the areas where the aquifer is filled with salt water, despite the uncertainty on the input data.