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3D modelling of a hydrological structure combining spatial data science and geophysics: Application to a coastal aquifer system in the island of Crete, Greece

Emmanouil Varouchakis[1], Leonardo Azevedo[2], João L. Pereira[2], Ioannis Trichakis[3], George P. Karatzas[1], Seifeddine Jomaa[4], and Pantelis Soupios[5]

[1]Technical University of Crete, School of Environmental Engineering, Chania, Greece (evarouchakis@isc.tuc.gr)
[2]CERENA, DECivil, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisbon, Portugal
[3]European Commission, Joint Research Centre (JRC), Italy
[4]Department of Aquatic Ecosystem Analysis and Management, Helmholtz Centre for Environment Research - UFZ, Magdeburg, Germany
[5]Department of Geosciences, College of Petroleum Engineering & Geosciences, King Fahd University of Petroleum and Minerals – KFUPM, Saudi Arabia

Groundwater resources in Mediterranean coastal aquifers are under threat due to overexploitation and climate change impacts, resulting in saltwater intrusion. This situation is deteriorated by the absence of sustainable groundwater resources management plans. Efficient management and monitoring of groundwater systems requires interpreting all sources of available data. This work aims at the development of a set of plausible 3D geological models combining 2D geophysical profiles, spatial data analytics and geostatistical simulation techniques. The resulting set of models represents possible scenarios of the structure of the coastal aquifer system under investigation. Inverted resistivity profiles, along with borehole data, are explored using spatial data science techniques to identify regions associated with higher uncertainty. Relevant parts of the profiles will be used to generate 3D models after detailed Anisotropy and variogram analysis. Multidimensional statistical techniques are then used to select representative models of the true subsurface while exploring the uncertainty space. The resulting models will help to identify primary gaps in existing knowledge about the groundwater system and to optimize the groundwater monitoring network. A comparison with a numerical groundwater flow model will identify similarities and differences and it will be used to develop a typical hydrogeological model, which will aid the management and monitoring of the area's groundwater resources. This work will help the development of a reliable groundwater flow model to investigate future groundwater level fluctuations at the study area under climate change scenarios.

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