Saltwater intrusion in the Crau coastal aquifer (South of France): validation of variable density modeling using geophysical and geochemical data

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ABSTRACT

The research focus on the effect of variable groundwater density on the modeling of seawater intrusion in coastal aquifers. In this setting, the concomitant presence of freshwater and saltwater alters flow patterns typically represented by the Darcy equation. Models of ground water subjects to density changes suffer of several difficulties: 12) The change on the aquifer permeability due to the one of salinity is difficult to take into account during simulation and generates instability. 3) Influences of heterogeneity in this context are more important than in other setting having constant density. 4) Data set must be detailed in order to get a reliable model results. 5) In general, the results of modeling are less robust.

To address and discuss these problems, we set up a variable density groundwater model using FEFLOW. The studied area is the Crau aquifer, in the Mediterranean region of Southern France. It has been chosen because of the long term records of hydrogeological and climatic data (salinity, piezometric levels, water geochemistry, rainfall, irrigation seepages and exploitation).

The first results indicate that the interface between freshwater and saltwater is very influenced by the heterogeneities in aquifer properties and the effects of irrigation and groundwater withdrawal. To better constraint the data set for the variable-density flow model, geophysical acquisitions have been carried out using Electrical Resistivity Tomography (ERT) and Electromagnetic surveys (EM). This has provided subsurface information on vertical salinity and lithology distribution. Furthermore, Radon-222 activity in groundwater has been used to estimate independently the groundwater velocity following the method of Schubert et al 2011. Radon-based groundwater velocity results of the same order of magnitude as the velocity estimated with FEFLOW. Groundwater discharges into ponds surrounding the Crau area, will also be assessed during the course of this study by using Radon mass balance between ponds and groundwater, as well as salinity data.

Keywords: saltwater intrusion, Crau aquifer, FEFLOW, EM-34, ERT, Radon-222