Using geophysical data to build more realistic saltwater intrusion models

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ABSTRACT

Saltwater intrusion (SWI) results from a number of mechanisms interacting under conditions that include complex lithological heterogeneity and variable boundary conditions. Characterizing lithological heterogeneity and representing it appropriately in SWI models is a challenging aspect of studying and predicting SWI. The accuracy of numerical SWI simulations depends on a realistic representation of the subsurface. Geophysical methods can aid the study and prediction of SWI by offering continuous images of subsurface properties, which can be used to build realistic models. We present geophysical data from a recent airborne electromagnetic (AEM) survey, which will be used to develop realistic numerical models for studying and predicting SWI in Monterey Bay, California, U.S.A.. The study area constituted 200 km^2 in the Salinas Valley, from the coast to the city of Salinas, where 635 line-km of AEM data were collected. The AEM data were inverted to provide images of the electrical resistivity of the study area, extending from the surface to between 50 mbgs and 300 mbgs. These data offer a 3-dimensional view into the distribution of saltwater in the study area, and illuminate the differences in aquifer structure between the southern and northern regions. Furthermore, the existing understanding of the aquifer system is challenged by the AEM data. Currently, the two confined aquifers in the study area, the 180-Foot Aquifer and the 400-Foot Aquifer, are considered by publicly available numerical SWI models to be completely separated by an aquitard. Our data suggest the existence of vertical conduits between these two aquifers where the aquitard thins out, allowing saltwater to intrude as isolated plumes from the 180-Foot Aquifer into the 400-Foot Aquifer. Recent groundwater sampling in the study area shows that isolated plumes of saline water are growing in the 400-Foot Aquifer, substantiating the existence of these vertical conduits. These conduits are not integrated into existing numerical SWI models of the study area, but should be considered for accurate predictions of SWI. The collected AEM data indicate the significant value in the use of this type of data for predicting and studying SWI.

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