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Estimation of hydraulic parameters for heterogeneous coastal aquifer systems from pumping test analysis and tidal response

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Understanding the effects of heterogeneity in the hydraulic conductivity field on the 3D dynamics of seawater intrusion in coastal aquifers is fundamental for the design of water-resources management schemes and environmental remediation strategies. In most applications, the medium and thus the flow field are highly heterogeneous and mixing is strongly influenced by small-scale permeability variations. In addition, the fluid density varies as a function of solute concentration. Therefore, evaluating and dealing with seawater intrusion in real aquifers remains a challenge due to the complexity, variability, and uncertainty inherent to natural flow and transport systems. The strategic objective of this study is to obtain adequate and reliable estimates of aquifer parameters in coastal aquifers taking into account the impact of heterogeneity and density effects. This goal will be approached using a stochastic approach. This implies generating several sets of heterogeneous hydraulic conductivity realizations. Three-dimensional simulations of density dependent flow and solute transport are carried out on each of these hydraulic conductivity fields to evaluate hydraulic parameters such as hydraulic diffusivity as well as connectivity from aquifer response to sea level fluctuations and pumping tests. The quantification of these parameters at regional scale is essential for the prediction of contaminant transport and thus of central importance for achieving ground-water sustainability.

Keywords: coastal aquifers, heterogeneity, density-dependent flow, pumping test, tidal response.