Evaluation of Instability of a Low-salinity Density-dependent Flow in a Porous Medium

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Abstract

Seawater intrusion into coastal aquifers is usually modeled by using transport models that include account for the effect of variable-density on flow. Variable-density models can be validated with the Henry and Elder benchmark problems. However, when mixed convective flow is simulated under variable density conditions, it is susceptible to physical and numerical instabilities. The purpose of this work is to explore the development of physical instability during the migration of a NaCl plume in a homogeneous medium that is initially saturated with freshwater. This will be done by varying the Peclet (Pe) and Rayleigh (Ra) numbers to represent different discretization and density contrasts, while selecting a Courant number that gives numerical stability. The Subsurface Flow Module of COMSOL Multiphysics® will be used to model concentration distribution of the NaCl plume and sensitivity of the output to expected ranges of Pe and Ra numbers will be evaluated. Results are expected to be consistent with published analyses that used the models SUTRA and PHWAT.

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