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A simple screening model for selecting CO_2 sequestration sites using a semi-analytical model for calculating pressure buildup and phase front movement in thick and heterogeneous geologic settings

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A semi-analytical solution developed by Kumar et al. (2009) has been updated to include multiple rock layers, an expanding constant pressure boundary, and an updated phase front definition. The two phase fronts that are calculated include a dry zone region detailed by Noh et al. (2004) and a two phase region. The semi-analytical model calculates the well pressure needed to inject CO_2 at a constant rate at a specified time and the movement of the phase fronts. The updated semi-analytical model can be used for several applications; namely for complex sandstone layering formations, large storage reservoirs, and for quick and easy screening of potential CO_2 storage sites.

Numerical solutions require significant reservoir characterization effort and simulation time to complete. The updated semi-analytical model can be used with limited reservoir data to estimate well pressure expectations and phase front movements. The algorithm developed by Kumar et al. (2004) can be implemented with transient, steady-state, and pseudo-steady state flow equations. The updated model assumes early-transient flow equations for initialization and steady-state flow equations for later time with a constant pressure boundary.

The updated semi-analytical model has been applied to a simplified CO_2 storage reservoir and the results have been compared to a comparable TOUGH2 model. The pressure buildup results, defined as the difference between the well pressure and initial reservoir pressure, and two phase front movement and the dry zone front movement show reasonable agreement with some differences.