Analyzing Potential Improvements to a Semi-Analytical CO_2 Leakage Algorithm

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Abstract. A long history of using of fossil fuels has resulted in an increased atmospheric CO_2 concentration. This anthropogenic process has influenced global climate change. One possible way to retard this increasing atmospheric concentration is to geologically sequester CO_2 emissions. Successfully implementation of this technology requires a full understand of associated risks and detailed resource optimization. It is important to choose the appropriate level of complexity when selecting the type of computer model to apply to a problem. Many risk assessment and optimization tools require large numbers of simulations. In most cases, using a full scale numerical CO_2 leakage model for this process becomes prohibitively computationally expensive. Faster CO_2 leakage estimations are needed. An excellent semi-analytical multi-phase CO_2 leakage algorithm has been developed by Celia et al. (2011). Two possible improvements to this algorithm are proposed and explored. First, a Picard iteration scheme is applied to the global pressure solution with the intent of reducing computational expense. The need to solve large sets of linear equations is eliminated by using this iterative technique. Secondly, in an attempt to increase accuracy, aquifer pressure changes resulting from water leakages are determined using the Theis equation instead of the total flux method. CPU runtimes and differences between CO_2 leakage volumes are compared between the existing and modified algorithms.

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