Enhanced Analytical Simulation Tool for CO_2 Storage Capacity Estimate and Uncertainty Quantification

Award Number: DE-FE0009301

Project Summary:

This objective of this project was to develop an Enhanced Analytical Simulation Tool (EASiTool) for the development of simplified reservoir models to predict pressure impact on carbon dioxide (CO_2) injectivity and reservoir storage capacity of geologic formations. The EASiTool includes three major features: (1) an advanced closed-form analytical solution for pressure-buildup calculations that is used to estimate both injectivity and reservoir-scale pressure elevation in both closed- and open-boundary aquifers; (2) a simple geomechanical model coupled with a base model, which can account for rock deformation to evaluate and avoid the possibility of fracturing reservoir rocks during CO_2 injection operations; and (3) a net-present-value-based optimization algorithm to integrate the brine-management process so as to maximize stakeholders' profits, assuming carbon-storage credits. Development of improved reservoir modeling tools enable project developers to more confidently predict storage capacity and ensure storage efficiency and permanence, contributing to better storage technology and thus reducing CO_2 emissions to the atmosphere.

Prime Performer:
University of Texas at Austin

Key Performers:
C12 Energy

Principal Investigator:
Jean-Philippe Nicot

Project Duration:
5/1/2013 – 4/30/2018

Performer Location:
Austin, Texas

Program:
Carbon Storage

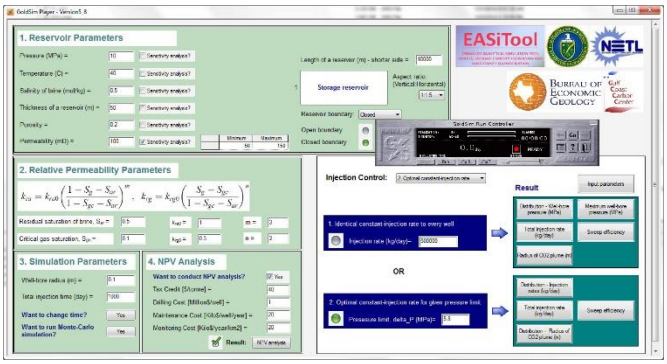

Figure 1: Screenshot of the EASiTool User Interface

Project Outcomes:

The project developed a simulator for rapid calculation of resultant bottom-hole pressure, pressure contours, plume extension, and net present value. EASiTool calculates the optimized injection rate for each well to minimize the pressure interference in the multi-well system. This tool is useful for carrying out analyses to support site selection early in the process of developing a storage project. Applications include: (1) assessing impacts of multiple reservoirs within the same basin on dynamic storage capacity; (2) assessing preliminary brine extraction and injector scenarios; and (3) estimating the number of wells and optimal rates necessary to achieve storage goals. A comparative study between the results of a conventional numerical simulator and EASiTool was performed for two deep saline systems (the Minnelusa Formation in the Powder River Basin, and the Qingshankou-Yaojia Formations in China) to investigate the effect of heterogeneity and formation structure on the dynamic storage capacity estimation. The EASiTool results, calculated in a few minutes, were within 30 percent of the numerical simulation results.

Presentations, Papers, and Publications

Final Report: ***Enhanced Analytical Simulation Tool (EASiTool) for CO_2 Storage Capacity Estimation and Uncertainty Quantification*** (April 2018) Seyyed A. Hosseini, Reza Ganjdanesh, Seunghee Kim