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# Modeling CO2 storage into large scale heterogeneous geological media

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The modeling of large scale (reservoir or basin scale) heterogeneous media remains a challenging issue considering the lack of data available for modeling calibration and the difficulty to handle such large size models with actual computing facilities. We propose the presentation of three case studies covering different geological context and storage scenarios. All simulations are performed using the code TOUGH2 with the parallel version (TOUGH2-MP for Massive Parallel).

The first case is a very complex heterogeneous model developed by the Tenth SPE (Society of Petroleum Engineering) Comparative Solution Project (Model 2) originally designed to compare the ability of up-scaling approaches to predict the performance of waterflood technique (Christie and Blunt 2001). This fine-scale geological model contains 1.1 million cells (60x220x85) with a top part representative of a prograding near shore environment while the lower part is fluvial. The grid is a Cartesian regular mesh. Simulation of injection of the CO2 has been conducted considering the possibility of water re-injection to maintain the overpressure below the fracture pressure.

The second case has been developed using the French Paris Basin geological context (Gabalda, 2010). The area covers a 100 km by 100 km domain (South East of Paris) in which data from about 70 wells and seismic grid have been used to build a 3D grid containing the Dogger carbonate formation as well as the lower part of the Oxfordian clay formation (the caprock) and the upper part of the Aalenian (below the Dogger). Major faults of the geological system have also been incorporated in the structural scheme. Petrophysical properties have been generated using stochastic approach. Porosity variability is simulated for each facies and correlated to permeability. Injection point has been selected in order to avoid fault reactivation. Sensitivity analysis has been conducted on transport properties to assess the storage capacity of such geological formation.

The last case is a representative of the Trias geological formation in France. The 3D regular Cartesian grid contains facies variability built using process based method to represent fluvial deposit architecture (Lopez, 2003). Thanks to its high geothermal gradient this geological formation is envisaged for geothermal production. In the context of CO2 geological storage simulation have been conducted to evaluate the mass flow and heat extraction rates from enhanced geothermal injection-production systems using CO2 as heat transmission fluid (Pruess 2006). All these three models contain high heterogeneous properties that may affect both the capacity of injection and the overpressure generated during the injection. Using the simulations results the role of these heterogeneities on the CO2 storage performance and security is discussed and analyzed.

References:

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