ASSESSING IMPACT OF CO2 LEAKAGE IN GROUNDWATER AQUIFERS IN THE PRESENCE OF DATA UNCERTAINTIES

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In this presentation we demonstrate a methodology for uncertainty quantification (UQ) and impact assessment for CO2 and brine leakage into a drinking water aquifer. Predicting the behavior of any natural system will result in a large degree of uncertainties in model outcomes due to the inherent heterogeneity, complexity and the imperfectly detailed nature of the system. W e address this applying the science of uncertainty quantification and high performance computing to better understand and communicate impacts by implementing a rigorous UQ approach to successively improve a systems understanding and capture uncertainty in the conceptual model and system parameters.

This approach is conducted iteratively, whereby model parameters are reduced, parameter bounds are decreased if appropriate, and model complexity is increased through successively model generations. Each generation consists of several hundred reactive transport models to simulate CO2 leakage and transport in a bi-modal permeability groundwater system using the NUFT code. Initial impact profiles are expected to have gross uncertainties since variables are poorly defined but the uncertainties are expected to decrease in sequential model generations. Initially, 16 parameters were identified, but those parameters that are most sensitive to the model outcomes such as the permeability values for sand and clay, leakage rate, material correlation lengths in the x and z directions, van Genuchten alpha parameter and the sand fraction are passed on to successive model generations as assessed through a Sobol-global sensitivity analysis.

Lastly, several high-resolution reduced order models for the risk profiles are developed to assess CO2 release risk for any potential storage site and to develop protocols to reduce risk. The reduced order models capture the parameter uncertainty of the physics-based models and they can assess the likelihood of receptor impacts and the potential for atmospheric release of CO2.

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