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CO2-PENS: Development of a Spatially Coherent System-Level Modeling Tool for Performance Assessment of Geologic Carbon Dioxide Sequestration

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We present new developments in a system-level modeling tool that is being designed to generate performance and risk assessment calculations for the geologic sequestration of carbon dioxide. Our approach follows Systems Analysis logic and includes estimates of uncertainty in model parameters and Monte-Carlo simulations that lead to probabilistic results. Probabilistic results provide decision makers with a range in the likelihood of different outcomes. Our current research builds on work that integrates science-based processes level models into a larger system model through both model abstraction and reduction of complexity. Previously, we have demonstrated the usefulness of this approach in comparing the number of wells and associated costs for two injection scenarios (Stauffer et al., Env. Sci. and Technology, Feb 1, 2009). We present results from a new approach that captures site-specific spatially coherent details such as topography on the reservoir/cap-rock interface, evolution of saturation and pressure during injection, and dip on overlying aquifers that may be impacted by leakage upward through wellbores and faults. The figure below shows model output of mean brine leakage from an injection reservoir into an overlying aquifer through wellbores for 1000 realizations using distributions for the most important model parameters. Model output can be used to guide decisions on locating monitoring equipment to detect potential leaks. We believe that maintaining site-specific details will be crucial in future performance and risk assessments and will help garner public support for geologic sequestration.