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An Integrated Model for Basin-Scale and Plume-Scale Processes Related to Full-Scale Employment of CO_2 Storage: The Illinois Basin as an Example

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If employed at the scale necessary to help mitigate climate change, geologic carbon sequestration (GCS) needs to be conducted at multiple storage sites in large sedimentary basins. Such full-scale deployment of CO_2 storage will cause basin-scale fluid pressurization and migration of native brines, which may affect valuable groundwater resources overlying the deep sequestration reservoirs. Assessment of GCS-induced flow and transport processes at the basin scale, with possible interference between individual storage sites, will thus become important, in addition to the transport processes of stored, contained, and potentially leaking CO_2 at the plume scale. In this abstract, we describe development of an integrated high-performance model of basin- and plume-scale transport processes and its application to a hypothetical GCS scenario with CO_2 injection and storage in the extensive Mt. Simon formation in the Illinois Basin. A three-dimensional unstructured mesh was generated with grid resolution adequate for detailed modeling of multiscale transport processes. Local mesh refinement was achieved around 20 hypothetical injection sites, approximately 30 km spaced in the center of the basin. A total annual CO_2 injection rate of 100 million metric tonnes (corresponding to one third current stationary emissions in the region) over 50 years was employed.