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Numerical Simulations of CO_2 storage using Models of reduced geometry

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The complex geometry of a CO_2 storage reservoir can be described using geologic stratigraphy models based on detailed geophysical measurements. These geological models often result in very large simulation grids, which require considerable long computing times. One way to speed-up these simulations is to parallelize the simulation tool and perform the simulations on supercomputers (Wang, 2013). However, a complex description of the reservoir stratigraphy may be in conflict with the ability to sensor the dynamic flow and transport processes of the injected fluid. To select an appropriate model, the number of input parameters should be adequate to the availability of validation data. Otherwise, the numerical model may be over-determined.

In this work, we perform numerical simulations of the CO_2 storage application at the Ketzin test site in Germany. Instead of using a complex model grid based on interpretations of detailed geophysical analysis, we consider geometries with reduced complexity. These geometries range from 1D representations over axisymmetric 2D cross-sections to simplified 3D box models of the reservoirs. Material properties for these simplified reservoirs have been obtained by averaging of seismic measurements. For model validation purposes, we use observed pressures from the injection borehole as well breakthrough curves of CO_2-concentration at two observation wells. Using the Ketzin dataset as an example, we show that models of low complexity are sufficient to describe the observed system.