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Assessment of brine migration along vertical pathways due to CO_2 injection

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Global climate change, shortage of resources and the growing usage of renewable energy sources has lead to a growing demand for the utilization of subsurface systems which may create conflicts with essential public interests such as water supply from aquifers. For example, brine migration into potential drinking water aquifers due to the injection of CO_2 into deep saline aquifers is perceived as a potential threat resulting from the Carbon Capture and Storage Technology (CCS).

In this work, we focus on the large scale impacts of CO_2 storage on brine migration but the methodology and the obtained results may also apply to other fields like waste water disposal, where large amounts of fluid are injected into the subsurface.

We consider a realistic (but not real) on-shore site in the North German Basin with characteristic geological features. In contrast to modeling on the reservoir scale, the spatial scale in this work is much larger in both vertical and lateral direction, since the regional hydrogeology is considered as well. Structures such as fault zones, hydrogeological windows in the Rupelian clay or salt wall flanks are considered as potential pathways for displaced fluids into shallow systems and their influence needs to be taken into account. Simulations on this scale always require a compromise between the accuracy of the description of the relevant physical processes, data availability and computational resources.

Therefore, we test different model simplifications and discuss them with respect to the relevant physical processes and the expected data availability. The simplifications in the models are concerned with the role of salt-induced density differences on the flow, with injection of brine (into brine) instead of CO_2 into brine, and with simplifying the geometry of the site.