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Investigations on the risk of brine displacement during CO_2 injection into saline aquifers

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Carbon Capture and Storage (CCS) is one promising technology to reduce greenhouse gas emissions. A challenging task is to assess the risks, which could occur during CO_2 storage for the different storage sites. We focus on risk assessment for CO_2 storage in saline aquifers since throughout all possible geological formations, saline aquifers are considered to have the largest storage potential worldwide. The assessment of the possible risks is already important during the characterization and selection of suitable storage sites. Numerical simulations are essential for addressing this purpose.

The main risks, which have to be considered for CO_2 storage in saline aquifers, are CO_2 leakage through e.g. abandoned wells, fractures, or faults, brine displacement far away from the injection site and geomechanical failure of the caprock. The risk of brine displacement and infiltration into shallower water aquifers, far away from the actual injection site has not yet been systematically investigated. The injected CO_2 will be stored in pores, which are initially filled with water or in the case of saline aquifers with brine. The pore space required by the injected CO_2 is formed through the displacement of the brine and additionally through compression of the brine and the rock. The displaced brine could move through fractures and faults into shallower aquifers and could thus infiltrate into drinking water aquifers. For brine displacement, fractures, faults or seal weaknesses, which are far away from injection and will not be reached by the CO_2 have to be investigated. Accordingly, very large model domains are required.

This work is focused on investigations of the risk of brine displacement far away from the injection site. For this purpose, different scenarios are set up to evaluate the risk of brine infiltration into a water aquifer. To determine the risk of brine displacement, the amount of infiltrated brine into the shallower water aquifer is calculated. The influence of different geological features as for example fractures, faults or seal weaknesses on the amount of infiltrated brine into a shallower water aquifer is investigated. It is also important to determine how the distance of these geological features influences the risk of brine displacement in order to define the extent of the required model domain.

Additionally, the effect of reservoir parameters or parameters of the shallower layers between reservoir and water aquifer as the permeability or the caprock thickness is tested. The aim is to get a deeper understanding, which geological features and parameters are most relevant for assessing the risk of brine displacement in order to adapt the method to data from real storage sites.