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Investigation of time-saving monitoring techniques to detect possible brine migration into shallow aquifers as an impact of geological CO_2 storage

Möller Marcus[1], Schmidt-Hattenberger Cornelia[1]

[1]*Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany*

Carbon capture and storage (CCS) is to be considered as a promising technique to realise climate change mitigation solutions. The preferential objective of this approach is to reduce the anthropogenic greenhouse gas emissions by a long-term storage in underground reservoirs. Induced by pressure propagation during the CO_2 injection, the reservoir saltwater could be displaced into shallow freshwater layers along leakage pathways. In order to ensure a safe storage operation, an adequate geophysical monitoring system is essential.

We will present the electrical resistivity tomography (ERT) as one module of an integrated geoelectrical/electromagnetical monitoring system. With its relatively high resolution on the scale of some tens of meters it is preferentially used in boreholes and near subsurface surveys. Based on modelled CO_2- and brine migration scenarios, different electrode configurations and analysis methods were investigated, in order to find an optimised monitoring workflow.

The modelling study simulates a saltwater intrusion into a freshwater aquifer complex as a worst-case scenario on a real potential storage site. In most cases, the number of the boreholes and consequently the number of the electrodes is limited due to costs and technical constraints. Therefore, one focus of the study concentrates on the irregular adaptive positioning of a few electrodes along the wellbore. Thus, both the large-scale background resistivity and the small-scale resistivity changes at critical points are covered. The second focus is directed on the assessment of fast and sufficient detection methods for the salinisation process.