



## Mass Balance Threshold Matching of Geoelectric and Seismic Data – A case study from Ketzin

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Seismic and geoelectric/electro-magnetic methods are used as complementary tools for the identification of fluid/gas effects in underground storage and production scenarios. Both methods generally have very different resolution. Seismic tends to be acquired by much more dense geometrical layouts and the geoelectric or electro-magnetic acquisition being a potential field method shows information integrated over spatial distances. These inherent scale and design dependent differences require spatial tuning in joint inversion approaches and careful matching in independent interpretations of both methods. We present results matching seismic and electrical resistivity tomography (ERT) results from two repeat surveys acquired during CO<sub>2</sub> storage operations at the Ketzin pilot site in Germany. The approach is based on data acquired in 2009 and 2012, at different stages of total injected CO<sub>2</sub> volume. Volumes of injected mass are obtained from the averaged acoustic impedance change (seismic) in the vicinity of the injection well and compared to volumes inferred from the ERT cross-well acquisition. The results are compared radially with increasing distances from the injection location. Seismically derived masses of injected CO<sub>2</sub> are used as a benchmark for a threshold-driven workflow analyzing the electric resistivity model. The cross-well ERT results have been obtained in a quadrant of the seismic survey acquisitions. Assuming radial symmetry for the ERT makes it possible to compare individual mass balances in the near-vicinity of the injection well. Archie's equation is used to obtain saturations from the tomographic geoelectric models. The sensitivities of parameters relevant in determining the mass of injected CO<sub>2</sub> is analyzed. Variations in saturation exponent  $n$ , baseline resistivity  $R_0$ , and porosity  $\Phi$  enable specifying applicable ranges of the parameters and determining the investigation radii compared to the seismic derived benchmark. This is done for individual threshold levels for saturations derived from the ERT field data. Seismically and ERT obtained masses match comparatively well and subtle variations of the sensitive parameters are capable in explaining differences for individual investigation volumes. Applicable investigation radii lie between 20-100 m. A 10% in- or decrease of the mean parameters is able to match the seismic derived mass in this range. Above a threshold of 10% for the saturations, the derived mass decreases more rapidly showing a larger deviation from the seismic derived mass. Both methods underestimate the total injected mass. This is not surprising as there are both fluid related processes and structural heterogeneities not accounted for in either. Results of surface-downhole measurements support the findings and show applicability of the developed approach. The

threshold-based approach may support the monitoring concept of a CO<sub>2</sub> storage site and provides a basis for quantitative evaluation of its containment, as investigated in the frame of the EU project SECURE.