Geophysical Research Abstracts
Vol. 15, EGU2013-5328, 2013
EGU General Assembly 2013

3D inversion of land-based CSEM data from the Ketzin CO_2 storage formation

Alexander Grayver (1), Rita Streich (2), and Oliver Ritter (3)

(1) GFZ German Research Centre for Geosciences, Potsdam, Germany (agrayver@gfz-potsdam.de), (2) GFZ German Research Centre for Geosciences, Potsdam, Germany; Now at Shell Global Solutions International Rijswijk, Netherlands (rstreich@gfz-potsdam.de), (3) GFZ German Research Centre for Geosciences, Potsdam, Germany (oritter@gfz-potsdam.de)

We present 3D inversion of land controlled-source electromagnetic (CSEM) data collected across the CO_2 storage test site at Ketzin, Germany. The CSEM data were generated by injecting currents into the earth at eight locations using a newly developed transmitter equipped with three grounded electrodes. Electric and magnetic field responses were recorded by 39 receivers along a line approximately perpendicular to the main geological trend. The survey aimed at imaging large-scale resistivity structure beyond the near-well region monitored by higher-resolution electrical techniques. Infrastructure present in the survey area, such as pipelines with impressed-current cathodic protection systems, power lines, and wind power plants cause strong noise in the data. The noise is effectively suppressed by adopting statistically robust processing techniques known from passive magnetotellurics.
A newly developed Gauss-Newton type parallel distributed inversion scheme, which is based on a direct forward solver and explicitly calculates the full sensitivity matrix, is applied to recover subsurface conductivity images. As 3D inversion is demanding on computer time and memory, we run inversions on parallel distributed machines. We achieve good scalability by distributing computations and memory uniformly among the processes involved.
We carry out cumulative sensitivity and resolution analyses for the sparse CSEM acquisition geometry. These studies indicate reasonable spatial coverage along the main survey line. Synthetic studies calculated for the real survey layout and representative conductivity models indicate that the magnetic field components are practically insensitive to resistive structures, whereas the electric field components resolve resistors and conductors similarly well. Because the magnetic field contributes little subsurface information, we concentrate on inverting the electric field, which is also more computer-efficient than inverting all components.
We test different starting models and approaches to avoid numerical singularities resulting from the grounded sources located within the inversion domain. Different regularization techniques are able to fit the data to a reasonable level for most of the receivers. This clearly demonstrates the non-unique nature of the inverse problem and motivates further investigation of the model space. Although we have not yet included geological a priori information into the inversion, the principal features in the obtained 3D resistivity model are robust against the inversion parameterization and correlate well with the main geological units. This demonstrates the potential of land CSEM surveying for subsurface characterization.