Considerations regarding surface to borehole ERT

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We developed a geoelectrical borehole tool for near-surface measurements, allowing for highly resolved tomographic resistivity distributions in soils. They can be used as an indicator for the water distribution on a small scale and help identifying thin hydraulic barriers. The tool consists of 20 ring electrodes distributed over one meter on a plastic rod and is pushed into the ground ensuring good electrical contact. It is operated in combination with surface electrodes whenever possible for recovering 2D structures, while the whole setup is characterized by its small electrode distances.

This feature, allowing for a high resolution, also poses a challenge in terms of data processing and modeling, as the spatial extent of the electrodes is no longer negligible.

We verify that the ring electrodes (and even the surface electrodes) can not be represented by dimensionless point electrodes as they are usually assumed in standard ERT inversion codes. We utilize another way of representing electrodes with a finite spatial extent, the conductive cell model, in a 3D inversion. This allows for an exact replication of the actual data acquisition conditions, as the whole electrode surface is involved in the measurement. The accuracy of the approach is evaluated for a couple of artificial model cases using a crossed-bipoles configuration. Moreover, we apply the approach to laboratory data from a well-defined layered box model, using only the borehole tool.\\

The developed inversion procedure reconstructs the artificial model cases quite accurately and recovers the laboratory model realistically.