Electrical Resistivity Tomography (ERT) measurements in inclined boreholes

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ABSTRACT

Electrical resistivity tomography (ERT) is a widely applied geophysical method that seeks to determine the subsurface through measuring and mapping its electrical properties. The data acquisition is commonly realized by employing electrodes on the surface of the ground. But due to further advances in this field, other techniques are also applied including cross-hole measurements, where the electrodes are placed in boreholes, or between the borehole and the surface. The location of electrodes inside existing boreholes can increase the resolving capabilities of the reconstructed images, since they are closer to the targeted area. This research focuses especially on surface-to-borehole and cross-hole measurements, assuming vertical and inclined boreholes. Applying the traditional resistivity arrays to these arrangements and implementing some restrictions to the candidate measurements, an optimized dataset is proposed, in addition to a comprehensive dataset. The optimized protocol consists of measurements that result in comparable resolution with the comprehensive dataset and given its reduced measurements, the field data acquisition and subsequent processing is less time consuming. The evaluation of the resolving power of the optimized datasets is based on synthetic models and an application on field surface-to-borehole measurements acquired in the walls of the Rotunda church monument, in Thessaloniki. The synthetic models proved to be a valuable tool in the initial stages of the survey, since they can be used for the determination of the trusted area of each geometry and even during the processing stage, where they can be used to further validate the results. Furthermore, the field data acquisition was successful and managed to reveal the internal structure of the monument.