Estimation of electrode positions from sparsely distributed reference points for long term geoelectric monitoring of an active landslide

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Recent improvements in the capabilities of electrical resistivity tomography (ERT) in ground imaging have resulted in an increased application of this technique to the characterisation of landslides. Time-lapse ERT offers the possibility to image changes in the resistivity distribution over time, which may indicate hydrological processes triggering landslide movement. However, these measurements depend on knowing the exact locations of the electrodes, which, especially on landslides, are changing over time.

We present and compare three different methods to estimate electrode positions from known locations of sparsely distributed reference points (RP). These methods include techniques estimating the electrode positions by the directional movement of the RP, by the deformation of a local plane that is described by 3 RP, and a more geostatistical approach, kriging.

To validate these techniques we present a synthetic example, in which the true electrode positions can be recovered within the numerical accuracy. Moreover, we present a real data example of a natural, slow moving landslide to which we applied the different techniques. By estimating the electrode positions with the introduced techniques we were able to recover the electrode positions to about 10% of the initial electrode spacing. Additionally, we justify the need for the estimation of electrode positions by showing artefacts in the inverted resistivity models which are caused by incorrect electrode positions and how they disappear if the estimated electrode positions are used.