KEYNOTE LECTURE: Data Processing and 4D Inversion of ERT monitoring data

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Geoelectric monitoring has been widely used in environmental, hydrogeological and engineering problems. In these applications, we have frequently misinterpreted the ground condition changes due to the inversion artefacts and thus to the false anomalies in the difference images. To alleviate the problems, great care must be taken in every aspect of the ERT monitoring: 1) collection of high quality data, 2) careful data processing, and 3) appropriate inversion.

Since geophysical responses to temporal changes of subsurface properties are very weak, high quality data is prerequisite condition to a successful ERT monitoring. Careful examination and assessment of data reliability are also required since data are always contaminated by noise. Usual procedure of data processing relies on eye-inspection and and/or through inversions in a trial-and-error manner. This approach for enhancing the data quality is hard to be systematically applied, consumes great efforts and time, and occasionally filters out good data as well. In this presentation, processing of ERT monitoring data is discussed, where editing of data in the space and time domains, filtering of anomalous data, and evaluation of electrode status and electrode filtering are discussed. Especially, data reliabilities in this procedure can be used as weighting factors to the actual inversion to obtain reliable inversion results.

In the inversion of ERT monitoring data, there are many well-known studies to reconstruct time-lapse images of subsurface. One of the most rigorous approaches among them is the four dimensional (4D) inversion approach, where the subsurface model and the entire monitoring data sets are defined in a space–time domain. These definitions enable us to simultaneously invert multiple monitoring data sets measured at different times, and to introduce the regularizations in both space and time domains to effectively reduce inversion artefacts. Several successful case histories support the superiority of 4D inversion approach.