Inversion of multi-temporal geoelectrical data sets: insights from several case studies

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Abstract

Time-lapse inversion of geoelectrical data is increasingly growing as remote monitoring systems are being used in more applications such as seawater intrusions, landslides, bioremediation of contaminated sites, landfill operations, shallow geothermal systems, or water resources. To date, several inversion strategies exist for taking into account the temporal dimension of the data. Among the most used ones are the independent inversion of multi-temporal data sets, the difference inversion, the temporally-constrained inversion, and the more recent process-based inversion. The success of a particular time-lapse inversion scheme depends on the validity of several assumptions made by these inversion schemes. Difference inversion schemes generally assume that part of the noise contained in the data cancels out when working with temporal data differences. Process-based inversion requires a more advanced knowledge of the system prior the inversion. Temporally-constrained inversion on the other hand assumes that the changes are localized and minor. We show in this paper using data sets with different time and spatial scales, and with different degrees of geological complexity and resistivity contrasts, that the particular success of a time-lapse inversion scheme is highly dependent on the temporal behaviour of the noise estimation in the time-lapse data set and of the model-dependent resolution pattern of the survey. We attempt to provide guidelines for successful quantitative interpretation of time-lapse data sets whenever possible.