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Analysis of Large ERT Monitoring Datasets with a Time Series Perspective

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Imaging temporal variations is the key motivation for setting up a permanent ERT monitoring system. Running such a system over long periods generates large datasets that generally consist in repeated surveys at regular intervals. Conventional processing approaches are based on separate data filtering of each survey followed by inversion strategies such as difference of separately inverted surveys, difference inversion, time-lapse inversion or, more recently, 4D inversion. Here we propose an approach of data processing that focuses on the temporal nature of the dataset.
Depending on the phenomenon of interest, erratic events and short or long period phenomena may obliterate the targeted variations. Using time series analysis methods on measured data and inverted sections we tried to improve the imaging the monitored area of the targeted with respect to targeted variations. This approach allows including external time series such as additionally monitored environmental parameters (e.g. effective rainfall, soil humidity, temperature) in the analysis. As this processing includes modelling temporal variations of measures it may also be used to fill gaps associated to instrumental maintenance or breakdowns.
Handling large datasets in this way requires efficient storage and retrieval structures as well as semi-automated (or fully automated) processing workflows. For data management, we use a hierarchically formatted file structure allowing efficient data storage, append and retrieval. This allows to efficiently manipulate the dataset as successive surveys but also as multivariate time series. Python routines have been developed to integrate all the steps prior inversion: data acquisition, append of the hierarchically formatted file, standard filtering and time series pre-processing. Datasets are then generated for inversion program such as BERT. After inversion, results are appended in a hierarchically formatted file for further time series processing.
This approach was both applied to synthetic datasets and to field data from the daily hydrogeophysical monitoring of the vadose zone at the Rochefort Cave Laboratory. A comparison of results with and without applying the present approach is proposed.