EGU2020-6922
https://doi.org/10.5194/egusphere-egu2020-6922
EGU General Assembly 2020

Automating the pre-processing of time-domain induced polarization data using machine learning

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Exploring and studying the earth system is becoming increasingly important as the slow depletion of natural resources ensues. An important data source is geophysical data, collected worldwide. After gathering data, it goes through vigorous quality control, pre-processing, and inverse modelling procedures. Such procedures often have manual components, and require a trained geophysicist who understands the data, in order to translate it into useful information regarding the earth system. The sheer amounts of geophysical data collected today makes manual approaches impractical. Therefore, automating as much of the workflow related to geophysical data as possible, would allow novel opportunities such as fully automated geophysical monitoring systems, real-time modeling during data collection, larger geophysical data sets, etc.

Machine learning has been proposed as a tool for automating workflows related to geophysical data. The field of machine learning encompasses multiple tools, which can be applied in a wide range of geophysical workflows, such as pre-processing, inverse modeling, data exploration etc.

We present a study where machine learning is applied to automate the time domain induced polarization geophysical workflow. Such induced polarization data requires pre-processing, which is manual in nature. One of the pre-processing steps is that a trained geophysicist inspects the data, and removes so-called non-geologic signals, i.e. noise, which does not represent geological variance. Specifically, a real-world case from Grindsted Denmark is presented. Here, a time domain induced polarization survey was conducted containing seven profiles. Two lines were manually processed and used for supervised training of an artificial neural network. The neural net then automatically processed the remaining profiles of the survey, with satisfactory results. Afterwards, the processed data was inverted, yielding the induced polarization parameters respective to the Cole-Cole model. We discuss the limitations and optimization steps related to training such a classification network.