Comparison of TDIP and SIP measurements in the field scale

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The frequency-dependence of the induced polarization effect (IP), in the so-called spectral IP (SIP), has been demonstrated to be strongly correlated to important parameters in hydrogeological and environmental investigations. This has prompted the development of measuring instruments and modelling techniques towards the collection of laboratory and field data with enhanced accuracy and at a broader frequency bandwidth. Although SIP datasets were traditionally collected in the frequency-domain (FDIP), recent developments have demonstrated the capabilities to solve for the frequency-dependence of the complex conductivity through the inversion of measurements collected in the time-domain (TDIP).

In recent years comparison of both methods has been conducted in a few studies; however, mostly related to the imaging results and not the actual signal-strength and sources of error affecting TDIP and FDIP. In particular, the EM-coupling is a limiting factor for the application of petrophysical models (observed in laboratory) in field in both FDIP and TDIP. Hence, the aim of our investigations is comparison of the resulting frequency-dependence parameter at a broad frequency range resolved through FDIP and TDIP. Furthermore, a detailed discussion on the different sources of error effecting the IP data readings. To provide as fair comparison as practically possible for TDIP and FDIP measurements, we conducted measurements with different instruments. For FDIP we deployed measurements with the Radic-Research SIP 256C and MPT DAS-1; whereas ABEM Terrameter LS and IRIS Syscal Switch Pro were used for TDIP. We present our results regarding the analysis of data errors, performed through statistical analysis of the misfit between normal and reciprocals. Analyses of signal strength are evaluated through comparison of data collected at different electrode separation. Additionally, we present a comparison of the inversion results as obtained by different algorithms.