Weak Airborne Induced Polarization Effects Visible in Airborne Electromagnetic Models While Nearly Undetectable in the Soundings

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# Abstract

The existing literature on airborne induced polarization (AIP) concentrates on field cases where AIP effects are observed as negative transients. Where weaker AIP and/or stronger inductive response exists and there is an entirely positive decay, the decay curves are only steepened in the late time. In various datasets, such as the airborne electromagnetic (AEM) surveys in southern Wisconsin (2022) and in Delaware Bay (2023), model anomalies are observed in locations where the flight path crosses kettle lakes or saline, meandering river corridors, respectively. The anomalous structure observed is an unrealistically high resistivity beneath the conductive surficial layer, which is geologically unreasonable. However, there is neither negative transients nor steepened late decay curves in the data, only an effect in the model-space. Thus, we posit this is a “weak AIP” effect. We incorporated IP parameters in the inversion using the Cole-Cole model, and the reparameterization (Fiandaca et al., 2018) into the maximum phase angle (MPA) model, both executed with AarhusInv (Auken et al., 2015). Although these IP inversions do not totally eliminate the vertically elongated, overly resistive anomalous features, we were using more typical IP parameter values. It is possible that the weak AIP effect is happening with suspended sediment in the water column. The grain polarization mechanism is suggested to have an atypically high time constant (tau of ~0.038 s as opposed to ~10-3 – 10-5 s) (Niu, 2023). The possibility that this is an artifact of 1D inversions, as opposed to 3D, needs to be ruled out as well, which forward modeling in SimPEG (Cockett et al., 2015) would illuminate. Both IP inversions and 3D inversions are computationally intensive compared to laterally or spatially constrained 1D, resistivity only inversions, and classifying regions that would benefit from more complex inversion methods for more geologically realistic models would still be beneficial. A clustering algorithm on the resistivity only 1D models has shown some promise in identifying areas with weak AIP effects.