Using a self-consistent equivalent source layer interpolator in airborne natural source EM processing

A. Thiede, M. Becken and the DESMEX Working Group
University of Münster, Institute of Geophysics, athiede@uni-muenster.de

SUMMARY

Airborne natural source electromagnetics (EM) provides large-scale, spatially densely sampled magnetic field recordings. Data are analysed in terms of frequency-dependent inter-site transfer functions using horizontal ground site recordings as reference. Due to a very low signal-to-noise ratio in airborne data, a powerful robust processing approach is required. Our multi-site processing yields extremely densely gridded transfer function estimates which, despite using a robust multivariate approach, are still afflicted with noise. Conveniently, sounding point footprints enable much sparser gridding, allowing to exploit spatial constraints for robust averaging of transfer functions.

We present a self-consistent equivalent source layer interpolator implemented in an airborne natural source EM processing workflow. The scheme can be applied to data from airborne platforms outputting recordings in Earth-fixed coordinates. In addition to the well-known vertical magnetic transfer function (VMTF), for the first time we make use of the airborne horizontal magnetic tensor (HMT). It gives a linear relation of the horizontal magnetic field between airborne and reference site. By utilizing the HMT, we gain a complete EM field description, providing physically more reliable and robust input to the interpolator. The equivalent source layer interpolator yields physically consistent transfer function estimates in terms of Hilbert transform pairs.

We demonstrate the procedure on a large-scale field data set from Gobabis (Namibia). We find that transfer functions derived by using the equivalent source layer interpolator improve processing results when compared to purely statistically determined transfer function averages.

In addition, we propose a depiction of the HMT that is conceptually based on the tangential electric mode Poynting vector of the equivalent source layer, thus, representing the corresponding energy flux. The new depiction supports an intuitive understanding of subsurface conductivity gradients, hence, can serve as a tool for quick-look interpretation.

Keywords: Airborne natural source electromagnetics, Audio-frequency magnetics, Geomagnetic induction, Horizontal magnetic tensor, Equivalent thin sheet