Towards a AFMAG-capable airborne EM Sensor Platform - Identification of Noise Sources

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SUMMARY

Airborne electromagnetic (EM) measurements using natural signal provide a dense data coverage of large areas in short time and with small effort. The audio-magnetotelluric signal is much weaker than the signal of a nearby artificial transmitter. Hence, airborne systems require an extremely low noise level for purely passive measurements.
The strongest noise source of airborne EM data is motion noise due to sensor movements in the Earth's magnetic field. As part of the DESMEX II project, we aim to optimize the DESMEX induction coil airborne system to meet passive EM requirements and improve semi-airborne EM data quality aspiring to penetration depths of > 1000 m. We use an Inertial Navigation System (INS) to measure sensor movements and predict the signal input caused by motion. The INS samples with 400 Hz, thus allows for low frequency corrections.
However, the "cleaned" data recorded with undamped sensors are still afflicted with remaining motion noise and the resulting signal-to-noise ratio is insufficient for natural signal analysis. To reduce the noise level, we built a damped sensor platform using vibration-insulating foam material. Damping characteristics were tested on the ground and under flight conditions.
The vibration-insulated sensor platform reduces motion noise on all components with a factor of more than 10 at high frequencies (> 50 Hz). Passive airborne EM using the DESMEX induction coil system seems to be feasible in a limited frequency range. Accessing lower frequencies is essential for greater penetration depth hence further improvement is necessary. We identified internal EM and further motion noise sources affecting airborne EM data quality. Ongoing work focuses on the removal of noise sources and the design of an optimized sensor platform.

Keywords: Audio-frequency Magnetics; semi-airborne Electromagnetics; Airborne Sensor Platform; Motion Noise