EarthDrone: National drone infrastructure for the Earth with cross-platform interoperablility

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SUMMARY

Land access to deploy EM equipment is often difficult, expensive and presents safety issues for field crew. Additionally, many areas of Australia, and globally, are culturally significant to indigenous communities with limited access. An alternative approach to using field vehicles is by drones, with remote deployment and recovery. There is no current commercial 'off-the-shelf' (COTS) drone technology that can be appropriated with the specification required of range, payload, and low user-involvement for deployment and recovery. So, the primary goal of the program has been to develop a platform to deploy a 1 kg geophysical instrument remotely over a range of ~10 km and being able to recover the instrument after some days of data acquisition.

Remote deployment of full MT systems is impractical due to the requirements for grounded dipoles. Instead, we have developed a small, low-cost, three-component fluxgate magnetometer that can log data at 1 s period for a week or more to obtain geomagnetic depth sounding (GDS) responses. Although there are several commercial airborne platforms that continuously measure variation of the vertical magnetic field (such as AFMAG, ZTEM and MobileMT), the bandwidth of 10000 – 30 Hz is too high to effectively penetrate regolith >100 m of 1-10 Ohm.m that covers much of Australia. The three-component fluxgate GDS magnetometer deployed on the ground for several days is typically limited to frequencies <0.1 Hz, but modelling studies show that the longer-period bandwidth has sensitivity to near-surface exploration targets. The lack of bandwidth resolution is also compensated by being able to acquire data at multiple sites with a swarm of drones.

In this paper, we demonstrate the utility of GDS measurements to delineate 2D structures (fault/shear zones) and 3D bodies beneath cover. The GDS approach is also simulated for 3D MT resistivity models of known mineral exploration targets in Australia to demonstrate the opportunity of using drones in future surveys. The drone platform could similarly be used for other geophysical deployments, passive seismics and gravity for example.

Keywords: Drone geophysics; geomagnetic depth sounding; mineral exploration.