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Environmental geophysics

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Developments in miniaturisation technology

Welcome readers to this issue's column on geophysics applied to the environment. This month I thought that I would highlight a few interesting developments in miniaturisation technology that are contributing to our ability to collect geophysical data using unconventional vehicles (drones and bikes) – of interest to most geophysicists, whether we are biased towards environmental geophysics or not.

My interest was piqued when I had a look through the March 2017 issue of *FastTimes* and found it dedicated to environmental geophysics – with quite a few interesting articles on a range of geophysical applications aimed at the environmental space. For those of you who don't know it, *FastTimes* is the scientific 'magazine', similar to *Preview*, published by the (American) Environmental and Engineering Geophysical Society (EEGS, see www.eegs.com for issues of *FastTimes*).

My attention was drawn especially to the Drone News column, a regular feature in *FastTimes*, that introduced a range of really interesting initiatives in the geophysics-applied-to-drones space. The now relatively 'common' use of drones to make base maps was mentioned (see this column in *Preview* 185) but much more was made of the ongoing miniaturisation of geophysical instruments that could be mounted on or hung under a drone. It looks as if Gem is leading the way on this for magnetometers (e.g. Figure 1), but Scintrex and others are not far behind. The magnetometer bird from Gem shown in Figure 1 weighs about 3.3 kg (although the article mentions a Gem system that weighs <1.8 kg – I couldn't find that one on their website). In those 3.3 kg they have mounted the magnetometer unit, a one hour battery, a GPS, a laser altimeter, an inertial movement unit (IMU), data storage, and a radio link for data transmission. Not bad at all. The *FastTimes* feature also mentions some applications that are a little more on the wild side. For example, they show some preliminary results from a drone-based GPR system that look potentially interesting.

I also ran into an interesting article in the 25 April online issue of *Eos*

Figure 1. *Sling-mounted magnetometer weighing ~3.3 kg hanging under various UAVs. The system's heart is the Gem GSMP 35U Potassium UAV magnetometer shown in the upper left (www.gemsys.ca/uavs-pathway-to-the-future/).*

(https://eos.org/project-updates/a-bike-built-for-magnetic-mapping) where a group of researchers in Israel have mounted a small magnetometer onto a mountain bike (Figure 2) and have achieved pretty good production rates (Figure 3) – in the 10s of kms per day (personally I would rather ride those kind of kms than walk them every day – terrain and vegetation permitting). The mag was a Gem Systems model GSM-19 (Overhauser style) mounted on a variation of the All-Terrain Bicycle Geomagnetic Mapping System developed by researchers at the SouthWest Research Institute in the US (http://bit.ly/ATBGMS). The system looks a little unwieldy, but I wonder what would happen if you used a smaller (developed for drones?) magnetometer mounted on a lighter frame. Would it be prohibitively expensive to use a mountain bike with minimal metal (e.g. I have seen bikes out there with carbon fibre spokes)? Probably, but that would allow the mag to be mounted closer to the bike…

I'm sure that this review is nowhere near complete; there must be a huge number of people out there who love their drones and are trying to figure out how to use their favourite 'toys' for more than just taking pictures and occasionally making basemaps. Obviously the key is to continue miniaturising the measuring devices that hang off of the drone. Anyone out there got some cool drone-based toys to show off?

Figure 2. *Uri Schattner from the University of Haifa testing the bike mounted magnetometer system. Picture courtesy of Eos/AGU.*

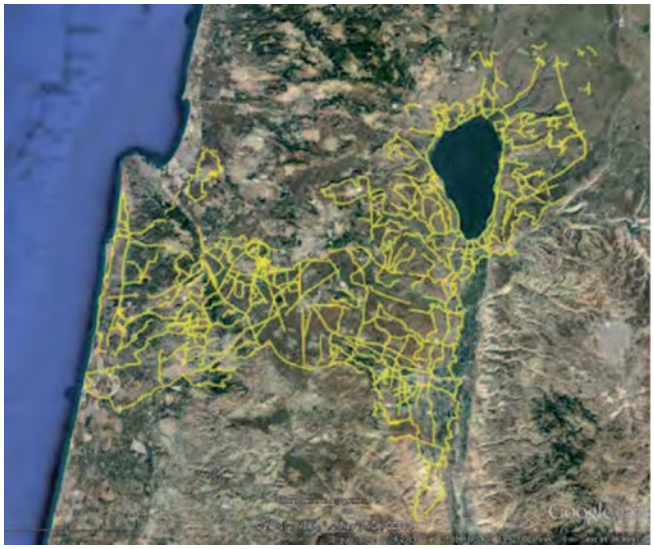

Figure 3. *Bike mag data collected for the Israeli study since April 2016 – about 2100 km. Photo courtesy of Eos/AGU.*