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Use of drones for aeromagnetic surveys; an overview

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Drone-based magnetic surveys seems to have a high potential for an improved earth surface mapping. Compared to manned aeroplanes they can be performed at lower distance to ground and thus enable much higher definition and sensitivity of magnetic anomalies related to surface rocks and significantly lower costs. And compared to traditional on-ground mapping they provide higher productivity and thus, more data, since they can be performed on more extended areas, even if their access is very difficult (e.g. forest, sharp slopes, etc).

To have such good performance, drone-based magnetometry needs:
1) An optimum navigation in the sense of track and altitude control, and, in the case of vector measurements, 3D-orientation determination and actuation at a speed consistent with the sample acquisition ratio of the instrumentation.
2) A well-defined data positioning respect to the mapped area derived from the flight parameters.
3) A magnetic cleanliness control and noise reduction system either based on magnetometer deployment respect to the platform, gradiometric measurements or magnetic signature shielding.

Due to the initial stage of drone flights, up to now still very few magnetic surveys have been performed compared to other GIS observations devoted mainly to terrains micromorphology (camera, radar, LIDAR).

Another issue is that these surveys are often driven by commercial purposes and therefore, most of the recent studies are only presented in the Internet as part of the enterprises and scientific groups marketing. And there is a lack of peer-reviewed scientific papers, restricted up to now to only one paper [1] in an international journal.

Therefore in all these showcases the information is superficial and there is not a deep discussion on the scientific and technical aspects. For example, comparisons with on ground studies and magnetic properties of surface rocks are not shown, and the details concerning a noise correction are missing in the available information.

In this forum we would like to summarize existing case studies critical reviewing the methodology and results obtained. Some of the presented discussion will be on the pros and cons of the different used platforms since they include multicopters and aeroplanes of most distinct technical properties. In particular we will focus on the flight altitudes for the surveys.

Another point of the discussion will be the advantages of the different magnetometers. Among the different aspect the resolution is directly linked with the magnetic cleanliness and noise. Also, despite

the fact that used instruments comprise both scalar (Potassium and Cesium) and vector magnetometers (fluxgate). It has not been reported any study with well oriented vector data.

Finally, we analyze the potential of drone-based measurements as complementary of either aeroplane and on ground surveys for a more complete characterization of exposed and non-exposed rocks at different depths, as well as a more detailed information concerning the magnetic mineralogy, tectonic structures and, if possible, paleomagnetics.

References:
[1] Koyama et al. (2013) Earth Planets Space, **65**, 657–666.