EGU22-11258
https://doi.org/10.5194/egusphere-egu22-11258
EGU General Assembly 2022

Collecting and calibrating magnetic data from surveys with Uncrewed Aerial Systems (UAS) and an approach for regions with strong magnetic gradients

Leon Kaub[1], Claire Bouligand[2], and Jonathan M.G. Glen[3]
[1]Ludwig-Maximilians-University Munich, Geophysics, München, Germany (lkaub@geophysik.uni-muenchen.de)
[2]University of Grenoble Alpes, Univ. Savoie Mont Blanc, CNRS, IRD, IFSTTAR, ISTerre, Grenoble, France
[3]U.S. Geological Survey, Moffett Field, CA, USA

Magnetic surveys employing Uncrewed Aerial Systems (UAS) allow a fast and affordable acquisition of high-resolution data. We developed a self-built carbon-fiber frame which can be used to attach magnetometers 0.5 m below an UAS. In order to remove undesired signals from the magnetic recordings that originate from the aircraft and that can cause strong heading errors, we apply calibration processes often referred to as magnetic compensation. These processes are usually applied for manned aerial surveys for both scalar and vector magnetometer data and require flying a calibration pattern prior to a survey. We recently published open-source software written in Python to process data and compute compensations for both scalar and vector magnetometers. We tested our method with two commercially available magnetometer systems (scalar and vector) by flying dense grid patterns over a test site using different suspension methods (magnetometer system attached to 2.8 m long tethers, fixed on the landing gear of the UAS, and fixed on our frame configuration). The accuracy of the magnetic recordings was assessed using both standard deviations of the calibration pattern and tie-line cross-over differences from the grid survey. Our frame configuration resulted after magnetic compensation in the highest accuracy of all configurations tested. The frame also allows for the acquisition of aeromagnetic data under a wide range of flight conditions. This is of great advantage compared to the often-used tethered solutions to avoid recording the aircraft's signals. Since tethered payloads are prone to rotations and swing motions, they require skilled pilots and can be difficult to fly safely. In contrast to that, our system is easy to use and due to its high in-flight stability, even fully autonomous flights are possible. Since the calibration flights that are required for magnetic compensation need to be collected in areas with low magnetic gradients, it can be difficult to find suitable locations in areas with strong magnetic gradients – such as in volcanic and geothermally active regions. However, a survey collected at the location of the calibration site can be used to evaluate the geological magnetic signal. The compensation process involves then two successive evaluations of the compensation parameters. First, an approximate evaluation of the compensation parameters is done assuming a constant value of the magnetic field at the calibration site. The resulting compensation parameters are then used to compensate the survey data collected over the calibration site and evaluate the magnetic field along the calibration pattern trajectory. Second, the compensation parameters are reevaluated taking the magnetic field variations into account. We tested this double calibration scheme on recordings that were collected over the Krafla geothermal area in the Northern Volcanic Zone of Iceland. The double calibrated data resulted in higher accuracy than a single calibration showing that this method can improve magnetic compensation in magnetically high-gradient areas.