Magnetic signature over the epicenter area of Tunguska

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Introduction: Yet an unexplained large explosion happened on 30. June 1908 deep in Siberia, Russia. Known as Tunguska Event this phenomenon has been tested by many hypotheses so far. Native people described long-lasting thunder and long-lasting bright glow from the direction of the epicenter of the event. A large area of damaged forests with trees fallen down was found later. Many expeditions were done to the epicenter during the last decades. The site is in a remote location, deep in Siberia, where are dense forests, large swamps, extreme temperatures, and wild animals. Any geophysical measurements and fieldwork are though in such an environment.

We decided to carry out a magnetometer survey of the Tunguska Event epicenter. Satellite-based magnetometer data are available worldwide. A detailed magnetometer survey hasn't been done yet in this area. Magnetic anomalies in epicenter and deviations from anomalies driven by geology could reveal the mechanism or cause of the explosion in Tunguska. The conventional method of magnetometer survey is nearly impossible at this site due to rough terrain and large swamps. Our survey is UAV based magnetometer survey so we were able to measure a large number of points in a relatively short time period and regardless of the terrain difficulty. Using UAVs (drones) we were able to collect a significant amount of data. We programmed drones to fly profiles autonomously in the north to south loop pattern. This way we measured area 8.5km x 4km with 100m line spacing. We were flying fixed altitude at 110m above our home point. The vertical speed was 13m/s. Magnetometer data were collected automatically at 62.5samples/s. UAV with magnetometer collects X,Y,Z components of the magnetic vector. Position, altitude and sensor temperature is recorded along with magnetic data. Total magnetic intensity is later computed from the data and corrected with altitude data and with temperature data eventually. We plotted the data to map of magnetic anomalies. Most of the anomalies which we recorded over the epicenter correspond with the known geological situation of the area.

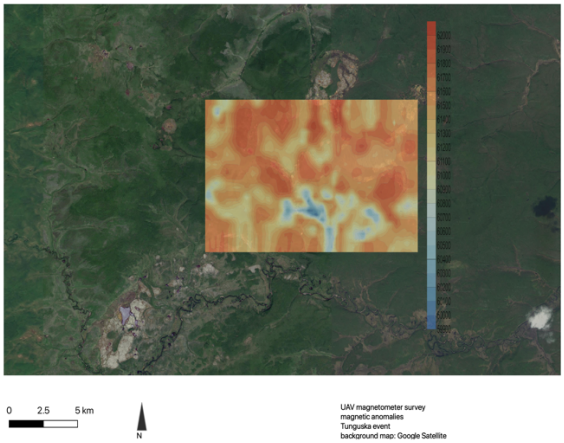

Fig. 1, Magnetic anomalies(nT) over the Tunguska Event epicenter.

Material and Instruments: We used two unique magnetometers that have total weight less than 350g each, including battery and GPS datalogger. One magnetometer was attached to the UAV (unmanned aerial vehicle-drone) and the second, identical magnetometer, was used as a base station. Both magnetometers are three-axis vector fluxgate magnetometers with flat-ring cores and were built to be used primarily for UAV based magnetometer survey. A similar device would be used on Mars. Magnetometer data were collected with two parallel magnetometers where one served as a ground station and one was part of the autonomous drone. We used four light and portable UAV's and systematically switched magnetometer between them so continuous measurement workflow was possible. Due to the remote location of the site was important to solve the charging needs of the instruments and drones. A portable petrol AC generator was used and moved along the site to provide continuous availability of electric power to charge drones and magnetometers.

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