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Unmanned aerial survey in East Antarctica for modelling glacier topography

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We conducted an unmanned aerial surveying of several territories around the Molodezhnaya and Progress Stations, East Antarctica, including the Thala and Larsemann Hills, the Dålk Glacier, and an initial section of the sledge route from the Progress to Vostok Stations. The surveying was performed by Geoscan 201, a flying-wing unmanned aerial system, with a wingspan of 2.3 m and a takeoff weight of 8 kg, launching by catapult and landing with parachute [2]. Geoscan 201 has an electric motor; the flight duration is up to 2.5 hrs with a cruising speed of 110 km/h. On board there are (1) modem for the telemetry communication with a laptop ground control station; (2) visible-band digital camera Sony DSC-RX1 equipped with a Carl Zeiss Vario Sonnar T lens (a central shutter; a 35 mm focal length) and a 35.8 x 23.9 mm sensor (a matrix of 6000 x 4000 pixels with pixel sizes of 6 x 6 μm); and (3) GNSS receiver Topcon used for high-precision determination of image projection centres. A ground GNSS base station includes a receiver Topcon HiPer V.

The total area surveyed was about 300 sq km. The aerial surveying was conducted in January and February 2017 under different meteorological conditions including clear sunny weather as well as partly, low, and high cloudiness. The air temperature ranged from 3 °C to –17 °C. The hourly wind speed varied from 1 m/s to 24 m/s at the flight altitude (300 m above ground level). The total time required to complete the survey was about 80 hrs. As a result, we obtained about 59,000 aerial photographs with the average resolution of 5.5 cm; forward and side overlaps were about 70 % and 50 %, correspondingly.

On January 30, 2017, a rare natural catastrophic phenomenon occurred: a wide collapsed depression was formed in the western part of the Dålk Glacier [3]. This area was surveyed two times: before and after the glacier's collapse.

For the photogrammetric processing of aerial imagery, we applied software Agisoft PhotoScan Professional 1.3.2. Using about 38,000 aerial photographs, we generated digital elevation models (DEMs) of glacier topography for surveyed territories. For the Dålk Glacier, we derived two DEMs related to the pre- and post-collapsed glacier surface. The DEMs have the resolution of 25 cm. Further analysis of the DEMs will be performed by methods of geomorphometry [1]. The focus of the study will be on the revealing of glacier crevasses.

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References

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