



Mapping of proglacial areas using low-cost unmanned aerial vehicles and structure-from-motion – operational framework

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This study presents the operational framework for rapid, very-high-resolution mapping of glacial geomorphology, with the use of budget Unmanned Aerial Vehicles (UAVs) and a structure-from-motion approach. Operational procedures were developed based on several years of application of different types of consumer-grade UAVs over a wide range of case studies representing ice margins of glaciers in Svalbard, Iceland, and Peru. The proposed workflow comprises seven stages: (1) Preparation and selection of the appropriate platform; (2) transport; (3) preliminary on-site activities (including optional ground-control-point collection); (4) pre-flight setup and checks; (5) conducting the mission; (6) data processing; and (7) mapping and change detection.

The application of the proposed framework has been illustrated by a mapping case study on the glacial foreland of Hørbyebreen, Svalbard, Norway. A consumer-grade quadcopter (DJI Phantom) was used to collect the data, while images were processed using the structure-from-motion approach. The resultant orthomosaic (1.9 cm ground sampling distance—GSD) and digital elevation model (7.9 cm GSD) were used to map the glacial-related landforms in detail. It demonstrated the applicability of the proposed framework to map and potentially monitor detailed changes in a rapidly evolving proglacial environment, using a low-cost approach. Our approach covers multiple technical and organisational aspects ensuring that the proposed framework is universal and can be applied in a broader range of settings.

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