



Geomorphic change detection in proglacial areas using repetitive unmanned aerial vehicle (UAV) surveys

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Glacial forelands exposed due to the glacier recession are one of the most dynamically transformed landscapes in Polar and mountainous areas. These areas are supposed to be intensively changed by various geomorphological processes related to the glacial retreat and meltwater activity, as well as paraglacial adjustment of topography.

This study deals with landscape transformation in an annual time-scale in the foreland of Hørbyebreen and Rieperbreen (Svalbard) and Fjallsjökull and Kviárjökull (Iceland) to assess landscape changes in 2014-2016 period. The main aim of this study is to map and quantify landforms development in detailed spatial scale to provide an insight into geomorphological processes which occurred shortly after the retreat of the ice margin.

Low-altitude aerial photographs were taken using small quadcopter equipped with 12 MP camera. Images were acquired at an elevation between 40 and 60 m above the ground level. The images were subsequently processed using structure-from-motion approach to produce orthomosaics (~3 cm cell size) and digital elevation models (DEMs) with 5-10 cm cell size. Subtracting DEMs from subsequent time periods created DEMs of Differences — which enabled us to calculate the amount of material loss or deposition. Accuracy of the orthophotos and DEMs was improved using ground control points measured with dGPS.

Over the 2014-2016 period repetitive UAV-based surveys revealed and quantify changes in landscape including: (1) glacier thinning; (2) ice-cored moraines degradation; (3) development of terminoglacial and supraglacial lakes; (4) debris flow activity. Short-time dynamics of different components showed very high variability over time and space illustrating relative importance of ice backwasting and downwasting as well as glacialfluvial processes for studied forelands

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