

Optimization of the processing of images from unmanned aerial vehicles for the analysis of land surface dynamics in glacial geomorphology

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This doctoral dissertation integrates the application of unmanned aerial vehicles in glacial geomorphology with the challenges of efficient processing of high-resolution images in photogrammetric software. The literature review revealed significant gaps in describing image processing methodologies in numerous scientific publications related to the application of digital elevation models and orthomosaics in glacial geomorphology. Errors or lack of knowledge at this stage can have a considerable impact on the accuracy of photogrammetric products and, consequently, on the results of further geomorphological analyses and interpretations. As part of the doctoral research, to address this identified gap, experiments were conducted using Agisoft Metashape software. The aim was to develop optimal procedures and settings depending on the desired outcomes: either reducing computation time or achieving minimal errors in digital elevation models. The outcome of these efforts resulted in three Python scripts, significantly facilitating work within the software, and supporting effective management of multiple projects simultaneously, for example, through using of multi-threaded computing clusters. The final part of the dissertation involved applying the knowledge from the literature review along with the developed scripts to analyze the dynamics of the terrain in front of the Kvíár glacier in Iceland. Quantification of changes in landforms was carried out based on images acquired from unmanned aerial vehicles between 2014 and 2022. The conducted research confirmed the usefulness of the developed scripts for working with extensive datasets, documented high dynamics of landforms in front of the glacier primarily associated with the degradation of ice cores, and indicated certain limitations of the Structure-from-Motion method. The entire work constitutes a significant contribution to the development of image processing methodologies in glacial geomorphology research, and the developed scripts may be valuable for other researchers working with similar data.

Keywords: Structure-from-Motion, unmanned aerial vehicle, glacial geomorphology, change detection, photogrammetry, Agisoft Metashape