

## Application of structure from motion to digitized historical airphotos to document geomorphic change over the past century

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Topographic modeling is becoming more accessible due to the development of structure from motion (SFM), and multi-view stereo (MVS) image matching algorithms in digital photogrammetry. Many studies are utilizing SFM-MVS with either UAV or hand-held consumer-grade digital cameras. However, little work has been done in using SFM-MVS with digitized historical air photos. Large databases of historical airphotos are available in university, public, and government libraries, commonly as paper copies. In many instances, the photos are in poor condition (i.e. deformed by humidity, scratched, or annotated). In addition, the negatives, as well as metadata on the camera and the flight mission, may be missing. Processing such photos using classic stereo-photogrammetry is difficult and in many instances impossible. Yet these photos can provide a valuable archive of geomorphic changes. In this study, we digitized over 1000 vertical air photos of the Mount Meager massif (British Columbia, Canada), acquired during flights between 1947 and 2006. We processed the scans using the commercial SFM-MVS software package PhotoScan. PhotoScan provided high-quality orthophotos (0.42-1.13 m/pixel) and DTMs (1-5 m/pixel). We used the orthophotos to document glacier retreat and deep-seated gravitational deformation over the 60-year photo period. Notably, we reconstructed geomorphic changes that led to the very large ( $\sim 50 \times 10^6 \text{ m}^3$ ) 2010 failure of the south flank of Meager Peak and also documented other unstable areas that might fail catastrophically in the future. This technique can be applied to other photosets to provide rapid high-quality cartographic products that allow researchers to track landscape changes over large areas over the past century.