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Assessment of the viability of worldwide application of  
the WSL Monoplotting Tool in reconstruction of past  
glacier stands

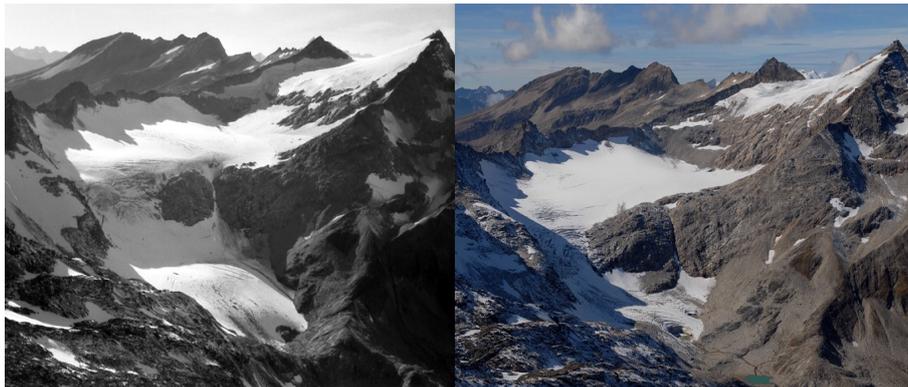
*A set of trials using historical images of the  
Goldbergkees glacier (Austria) dating back to 1969*

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By

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## ABSTRACT

Uncertainty regarding changes in the earth's ice cover in future has created a demand for accurate data from all over the world on past and present glacier fluctuations in order to predict future global glacier fluctuations. So far, all the methods employed for reconstructing past glacier fluctuations have been limited both spatially and temporally. The main objective of this thesis was to assess the global applicability of a promising new method for glacier reconstruction which could offer a solution to this problem. This new method - the WSL Monoplotting software tool developed by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL)-uses monoplotting technology to georeference historical oblique images. Its basic input requirements are simply a digital version of the historical image, a DEM, an orthophoto of the area under study, and at least five control points.

In order to evaluate the global applicability of the WSL tool, three historical images dating from 2009, 1992, and 1969, of the Goldbergkees glacier in Carinthia, Austria were repeatedly georeferenced with DEMs and orthophotos of a quality (i.e. of a resolution) which is available globally. To check the accuracy of the georeferencing results obtained in this way, all the digitalised glacier tongues were compared with reference data. The glacier tongue outlines thus reconstructed display an accuracy range of 4m-10m in a 2D world space. The resulting georeferencing quality is highly dependent both on the accuracy and attributes of the GDEM and orthophoto used and also on having a suitable distribution of control points.

A further research objective of this thesis was to assess the effect of two different camera calibration procedures on the georeferencing results within the WSL Monoplotting Tool. These two calibration procedures differ in terms of control point settings. While the "recommended calibration procedure" features well distributed control points over the entire historical image, the "adjusted calibration procedure", uses a sequence of globally available data attributes and therefore does not have well-distributed control points. The digitalised glacier tongues as obtained from each of these calibration procedures were compared with reference data. The reconstructed glacier tongue outlines from the "recommended calibration procedure" show an accuracy range of 7m-23m, which is much higher than the 6m-14m accuracy range of the "adjusted calibration procedure".

The present thesis has not only succeeded in demonstrating the global applicability of the WSL Monoplotting Tool, but has also shown which camera calibration process leads to the more accurate result when globally available input data are being used. This represents an enormous benefit for the field of glaciology because this enables us to make accurate reconstructions of global glacier fluctuations that go further back in time than any other currently available glacier reconstruction method.

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