

Photogrammetric recognition of subglacial drainage channels during glacier lake outburst events

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ABSTRACT:

In recent years, many glaciers all over the world have been distinctly retreating and thinning. One of the consequences of this is the increase of so called glacier lake outburst flood events (GLOFs): Lakes that have been dammed by a glacier spontaneously start to drain through a subglacial channel underneath the glacier due to their outweighing hydrostatic pressure. In a short period of time, the lake water drains under the glacier and causes floods in downstream valleys. In many cases the latter become hazardous for people and their property. Due to glacier movement, the tunnel will soon collapse, and the glacier lake refills, thus starting a new GLOF cycle.

The mechanisms ruling GLOF events are yet still not fully understood by glaciologists. Thus, there is a demand for data and measurement values that can help to understand and model the phenomena. In view of the above, we will show how photogrammetric image sequence analysis can be used to collect data which allows for drawing conclusions about the location and development of a subglacial channel. The work is a follow-up on earlier work on a photogrammetric GLOF early warning system (Mulsow et. al., 2013).

For the purpose of detecting the subglacial tunnel, a camera has been installed in a pilot study to observe the area of the Colonia glacier (Northern Patagonian ice field) where it dams the lake Lago Cachet II. To verify the hypothesis, that the course of the subglacial tunnel is indicated by irregular surface motion patterns during its collapse, the camera acquired image sequences of the glacier surface during several GLOF events. Applying LSM-based tracking techniques to these image sequences, surface feature motion trajectories could be obtained for a dense raster of glacier points. Since only a single camera has been used for image sequence acquisition, depth information is required to scale the trajectories. Thus, for scaling and georeferencing of the measurements a GPS-supported photogrammetric network has been measured.

The obtained motion fields of the Colonia glacier deliver information about the glaciers behaviour before, during and after a GLOF event. If the daily subsiding of the glacier is integrated over a period of several days and projected into a satellite image, the location and shape of the drainage channel can be visualised. The high temporal resolution of the motion fields may also allow for an analysis of the tunnels changes in comparison to the changing water level of the lake.

REFERENCES

Mulsow, C., Koschitzki, R., Maas, H.-G., 2013. Photogrammetric monitoring of glacier margin lakes. Proceedings of the International Workshop "TheRole of Geomatics in Hydrogeological Risk". Padua, Italy. 27-28 February.