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PILOT STUDIES WITH A PHOTOGRAMMETRIC GLACIER LAKE OUTBURST FLOOD EARLY WARNING SYSTEM

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Abstract. Glacier Lake Outburst Floods (GLOFs) depict an environmental risk with an increasing damage potential in many regions of the world. GLOFs are often caused by glacier margin lakes, which suddenly find a drainage path underneath the bottom of a glacier, which is destabilized and retreating as a consequence of local or global climate changes. In a typical GLOF event, a glacier margin lake may drain completely in 24 hours, causing a large flood wave in the area downstream the glacier.

The paper documents some recent GLOF events in the Northern Patagonian Icefield (Chile) and presents a terrestrial photogrammetric glacier margin lake monitoring system. The system is based on a camera taking images at regular time intervals. In these images, variations of the water level can be detected by tracking the water-land interface at pre-defined image spots. Due to the drainage mechanism, which is characterized by progressive erosion and melting at the bottom of the glacier, GLOFs are indicated by a progressive water level drop in the lake. Water level changes may be detected with subpixel accuracy by image sequence processing methods. If a 3D model of the lake bottom topography (or at least one height profile through the lake) exists, water level changes in monoscopic image sequences may be transformed into volume loss. The basic idea herein is the intersection of a terrain profile with a water level detected in the image and projected into object space. The camera orientation is determined through a GPS-supported photogrammetric network. Camera orientation changes, which may for instance be induced by wind, can be compensated by tracking some fiducial marks in the image.

The system has been used in a pilot study at two glacier margin lakes in the Northern Patagonian Icefield. These lakes have a depth of about 80 - 100 meters. The larger one has a length of 5 km and a maximum volume of about 200,000,000 cubic meters. During the pilot study, several GLOF events could be recorded and processed. Water level

changes can be determined at decimeter level precision. The results prove the feasibility of the concept, which has to be completed by a data telemetry and alarm system.

Conference Paper (PDF, 702 KB)

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