

Hazard assessment of glacial lake outburst floods from Kyagar glacier, Karakoram mountains, China

Christoph HAEMMIG,¹ Matthias HUSS,^{1,2} Hansrudolf KEUSEN,¹ Josef HESS,³
Urs WEGMÜLLER,⁴ Zhigang AO,⁵ Wubuli KULUBAYI⁶

¹GEOTEST AG, Zollikofen, Switzerland

E-mail: christoph.haemmig@geotest.ch

²Department of Geosciences, University of Fribourg, Fribourg, Switzerland

³Federal Office for the Environment, Bern, Switzerland

⁴Gamma Remote Sensing AG, Gümligen, Switzerland

⁵Xinjiang Office for Flood Control, Ürümqi, China

⁶Xinjiang Kashgar Hydrographic and Water Resources Survey Bureau, Kashgar, China

ABSTRACT. Kyagar glacier is located in the Chinese Karakoram mountains. The glacier tongue entirely blocks the riverbed in the upper Shaksgam valley and impounds a glacial lake, which was the source of several violent and disastrous glacial lake outburst floods (GLOFs). A GLOF early warning system was implemented between 2011 and 2013. We present an integrative analysis of the hazard potential of Kyagar lake, taking into account the ice flow dynamics of Kyagar glacier as well as the recent surface mass-balance response to climate change. Comparison of two high-resolution digital elevation models (DEMs) for the ice dam shows surface lowering rates of $>5 \text{ m a}^{-1}$ between 2002 and 2011, leading to a significant reduction in the maximum potential lake volume. However, two DEMs covering the entire glacier for the period 2000–10 indicate mass gains in its central part, and flow speed measurements show an acceleration in this region. This pattern of local ice-thickness changes combined with varying ice flow velocities is typical for surge-type glaciers. The velocity of the glacier surface and of the ice dam between 2011 and 2012 are analyzed at high temporal and spatial resolution, based on feature tracking of synthetic aperture radar (SAR) images.

KEYWORDS: glacial lake outburst floods (GLOFs, jökulhlaups), glacier hazards, glacier mass balance, glacier surges, remote sensing