

Glacial lakes in South Tyrol: distribution, evolution and potential for GLOFs

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All over the world glaciers are currently retreating, leading to the formation or growth of glacial lakes. Some of these lakes are susceptible to sudden drainage. In order to assess the danger of glacial lake outburst floods (GLOFs) in South Tyrol in the Italian Alps, we present (i) an inventory of lakes, (ii) an analysis of the development of selected glacial lakes since 1945, and (iii) the susceptibility to and the possible impact areas of GLOFs.

The inventory includes 1010 lakes that are larger than 250 m² at an elevation above 2000 m asl, most of them of glacial origin. These lakes are mapped manually from orthophotos. Apart from collecting information on the spatial distribution of these lakes, the inventory lists dam material, glacier contact, and further parameters. 89% of the lakes in the investigation area are impounded by bedrock, whereas 93% of the lakes are detached from the associated glacier. The majority of lakes is small to medium sized (<5000 m²). Between 1999 and 2011 60% of all lakes remained stable in size. Only 16% of the lakes grew in this period of time. This is particularly true for lakes in proximity to a glacier.

Ten selected lakes are analyzed in detail in the field and from multi-temporal orthophotos, including the development of lake size and surroundings in the period since 1945. The majority of the selected lakes, however, was first recorded on orthophotos from the early 1980s. Eight of ten lakes grew significantly in that period. But when the lakes detached from the glacier until the early 2000s, the growth slowed down or ceased. Based on the current development of the selected lakes we conclude that the close surroundings of these lakes have stabilised and the lakes' susceptibility to an outburst has thus decreased.

We further conduct broad-scale analyses of the susceptibility of the mapped lakes to GLOFs, and of the potential reach of possible GLOFs. The tool *r.glachaz* is used to determine the potentially dangerous lakes. Even though some few lakes require closer attention, the overall susceptibility to GLOFs in South Tyrol is relatively low, as most lakes are impounded by bedrock. In some cases, GLOFs caused by impact waves from mass movements cannot be completely ruled out. The possible reach of potential GLOFs is estimated with the assistance of the tool *r.randomwalk*. GLOFs could turn into debris flows or significant flood waves which could locally interfere with people or structures. Flood waves could possibly travel for long distances to the major valleys – albeit they would likely only incur rising water levels in already existing streambeds down there.