Future glacier lakes in the Swiss Alps: Modelling of overdeepenings in current glacier beds

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The alpine environment is strongly affected by ongoing climate change and the observed increase in temperature has already severe impacts on glaciers in the Alps. For future assessments and modelling of glacier retreat scenarios and their impacts, it is crucial to have a better knowledge on both glacier bed topography and ice volumes for all glaciers. With glacier bed topography being derived by subtracting modelled ice thickness distributions from a surface DEM, the beds can be used for modelling of future glacier evolution, glacier flow, detection of overdeepenings with potential future lake formation and hazard assessment.

For this study we used previously modelled glacier beds of all Swiss glaciers (>0.1 km^2). The geomorphometric characteristics of the glacier beds revealed a large number of overdeepenings, which can be seen as potential sites for future lake formation. Such new lakes can be attractive for tourism and hydropower production, but also constitute a serious hazard potential as they emerge in an increasingly destabilized environment (e.g. steep rock walls, warming permafrost, de-buttressing of over-steepened slopes from glacier vanishing). The total area of all 600 detected overdeepenings larger than 0.01 km^2 is 50 - 60 km^2 with 3% being larger than 0.5 km^2.

Because such proglacial lakes can strongly enhance future glacier retreat, we also estimated their possible date of appearance by superimposing simplified scenarios of glacier retreat. When current trends of glacier decline continue in the next decades, about 60% of the potential lakes will appear within the first half of this century.