

Proglacial lake evolution and outburst flood hazard at Fjallsjökull, southeast Iceland

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Arctic regions are warming at more than double the global average rate, causing significant glacier retreat and changing hydrologic patterns. Much of this meltwater is stored in proglacial lakes at outlet glaciers, which can drain in outburst floods if a mass movement event such as a rockfall or landslide enters the lake. Many of these lakes form in overdeepened basins, which can store large volumes of meltwater and contain steep valley walls that may be prone to paraglacial slope failures. Moreover, many lakes are upstream of infrastructure, communities, and tourism sites, resulting in a high potential societal impact in the event of a flood. This process is a well-documented trigger of floods in glacial regions across the world, but it remains understudied in Iceland. However, several large rockfalls have fallen onto Icelandic glaciers in the past decades and may enter lakes in future as ice retreat and lake expansion continue.

We investigate this emerging hazard by mapping proglacial lake evolution and evaluating outburst flood risk in southeast Iceland. This presentation focuses on the proglacial lake at Fjallsjökull, an outlet glacier of the Vatnajökull ice cap, which features many of these risk factors. First, we present results of a multibeam sonar bathymetric survey and report lake volume changes from 1945 to 2021. We then estimate future lake extent and volume based on basin topography and glacier dynamics. Finally, we identify potential source areas of slope failures and postulate scenarios of mass movement-triggered outburst floods in the lake. These results lay the foundation for future work on flood modeling and hazard planning to mitigate impacts on communities, infrastructure, and tourism at Fjallsjökull. This project also serves as an excellent pilot study for this emerging hazard in Iceland and has significant potential for application to proglacial lakes in other Arctic and alpine regions.