

Submitted Abstract

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Abstract

Glacial lake outburst floods (GLOFs) occur in various parts of the Hindu Kush Himalaya (HKH). However, a comprehensive record comprising precise location, frequency, triggering cause and scale of their effects does not exist to date. In this study, we present an open access and version controlled database of historical GLOFs from 1840s to 2021 from scientific literature, reports, news articles, social media, satellite imagery and local testimony. Information associated to triggering factors, floodpeak discharge, transboundary nature of an event, furthest documented reach of the GLOF and socioeconomic impacts are recorded. We identified 360 events in the HKH, covering 124 events from the Eastern Himalaya, 18 each from the Central and Western Himalaya, 180 from the Karakoram and 20 from the Hindu Kush. Most GLOFs occurred from moraine dammed lakes in the Eastern (85%), Central (85%) and Western (57%) Himalaya, and in Hindu Kush (50%). In the Karakoram, GLOFs occurred mostly from ice dammed lakes (79%). Repeating GLOFs from the same lake happen more often in the Karakoram. GLOFs from Khurdopin and Kyagar glacial lakes drained 30 and 28 times between 1882 and 2021 due to an increase in meltwater inflow after glacier surges blocked a valley. Most of the GLOFs in the Eastern Himalaya triggered from mass movements (ice avalanche and rockfall) and after glacier surges in the Karakoram. Intense rainfall and high melt events caused GLOFs in the remaining other regions.

As the database is paired with a detailed lake inventory as well as the Randolph Glacier Inventory, rapid queries to understand regional drivers and impacts are possible. For example, the mean area of lakes that produced GLOFs was considerably larger (0.2 km²) than those that never breached (0.06 km²). The database also reveals that GLOFs on average reached 49 km (0.28 – 293) downstream and covered 1030 m (19 – 4300) in elevation. The mean slope of GLOF paths was -8° (0.8 – 21), with big variations between regions. Such values provide the possibility to constrain future modelling efforts of GLOF runout paths.

A total of 798 fatalities were recorded in the HKH. These fatalities happened from just 15 of the recorded events, all of which occurred in the Eastern Himalaya (7 events, 759 fatalities), Karakoram (4, 19) and the Hindu Kush (4, 20). Direct financial damages were only recorded at 8 events, where they amounted to 5.2 billion USD, indicating that few destructive events can result in large damages, but records on downstream impacts so far remain patchy.