



Glacier Lake Outburst Floods in Norway 2001 – 2009

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Several GLOFs or jökulhlaups occurred in Norway during the first decade of the millennium, the most significant being several from Rundvassbreen, an outlet glacier of Blåmannsisen and one from Flatbreen, an outlet glacier of Jostedalbreen. A number of minor flood events occurred also. Many of the glaciers in Norway, especially the maritime glaciers with high winter balance, demonstrated frontal advance and positive mass balance in the 1990s. However, since 2000 most glaciers have had a negative mass balance, and undergone frontal retreat and a corresponding decrease in area.

The outburst flood from Flatbreen in 2004 was from a moraine-dammed lake that usually drains under the glacier itself. The immediate cause of the flood was a sudden period of warm, wet weather and the sudden increase of additional water into the lake caused the moraine to rupture. Over 50 000 m³ of water drained from the lake, and the resulting debris flow from the lake to the valley 1000 m lower had a volume of 240 000 m³. Fortunately there were no injuries from this flood, but extensive material damage to farmland on the valley floor. Previous, but smaller events occurred from this lake in 1924 and 1947. The moraine is still partially ruptured, thus the potential for a new jökulhlaup of the same magnitude as that in 2004 is greatly reduced.

Several floods occurred from a glacier-dammed lake at the glacier Blåmannsisen in Northern Norway, the first occurring in 2001, and subsequently in 2005, 2007 and 2009. The jökulhlaups all occurred in late summer, but at different water levels of the lake. The first two events occurred when the lake was full and 35 – 40 million m³ of water drained. However, the second event occurred a year after the lake had filled again, with the excess water in the meantime draining over a spillway and away from the glacier, as it had done prior to 2001. The two subsequent events occurred before the lake was completely full, and were half the size of the first two events at about 20 million m³ of water. The thickness of ice at the barrier has decreased over the past few decades, which instigated the first event. Comparing measurements in 1961 and 1998, the part of the glacier adjacent to the lake was up to 55 m thinner. Laser scanning performed in autumn 2002 showed a further 4-10 m of thinning between 1998 and 2002. GPS measurements on the glacier surface showed that there was thinning of an average of 4.5 m from 2001 to 2004, and a further 5-10 m between 2004 and 2009. This further thinning led to the lake emptying under the glacier at a lower lake level than previously. There were no human or material damages from any of these events. In contrast, the floodwaters flowed into Sisovatn, a hydropower reservoir and were financially beneficial. No similar events have been recorded before the 2001 event. The lake is now expected to continue to empty under the glacier at fairly regular intervals.