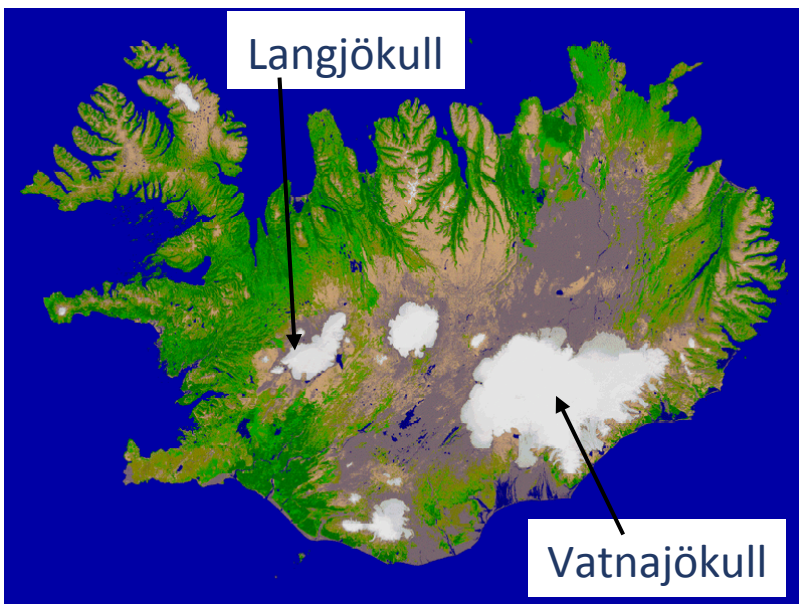


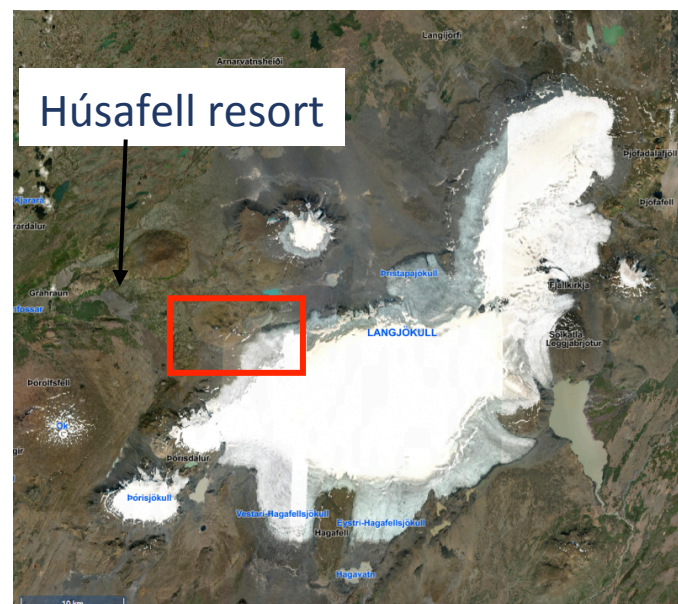
The August 2020 *jökulhlaup* from a marginal lake at Langjökull, W-Iceland: Course of events - discharge and volume estimates - future monitoring

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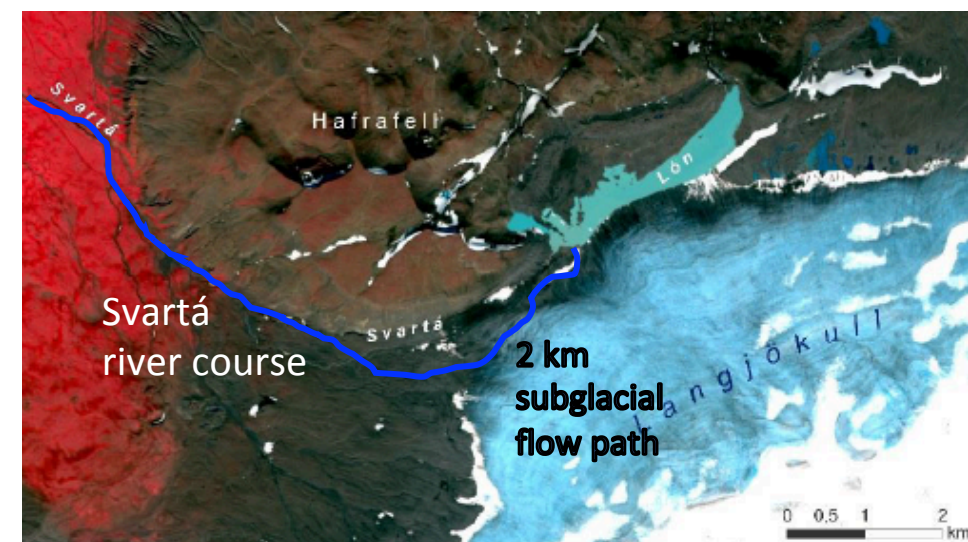
1. Veðurstofa Íslands/Icelandic Meteorological Office 2. Institute of Earth Sciences, University of Iceland
3. Landsvirkjun/National Power Company, Iceland 4. Icelandic Glaciological Society



Iceland: 103.000 km²
Total ice cover: ~10% of area



Langjökull ice cap: 835 km²
Avg. mass balance: -1.3 m w.eq.



Due to retreat of the ice margin (20–50 m/yr) a marginal lake has been forming since 2000. The lake was the source of the 2020 *jökulhlaup*.

Timeline of events:

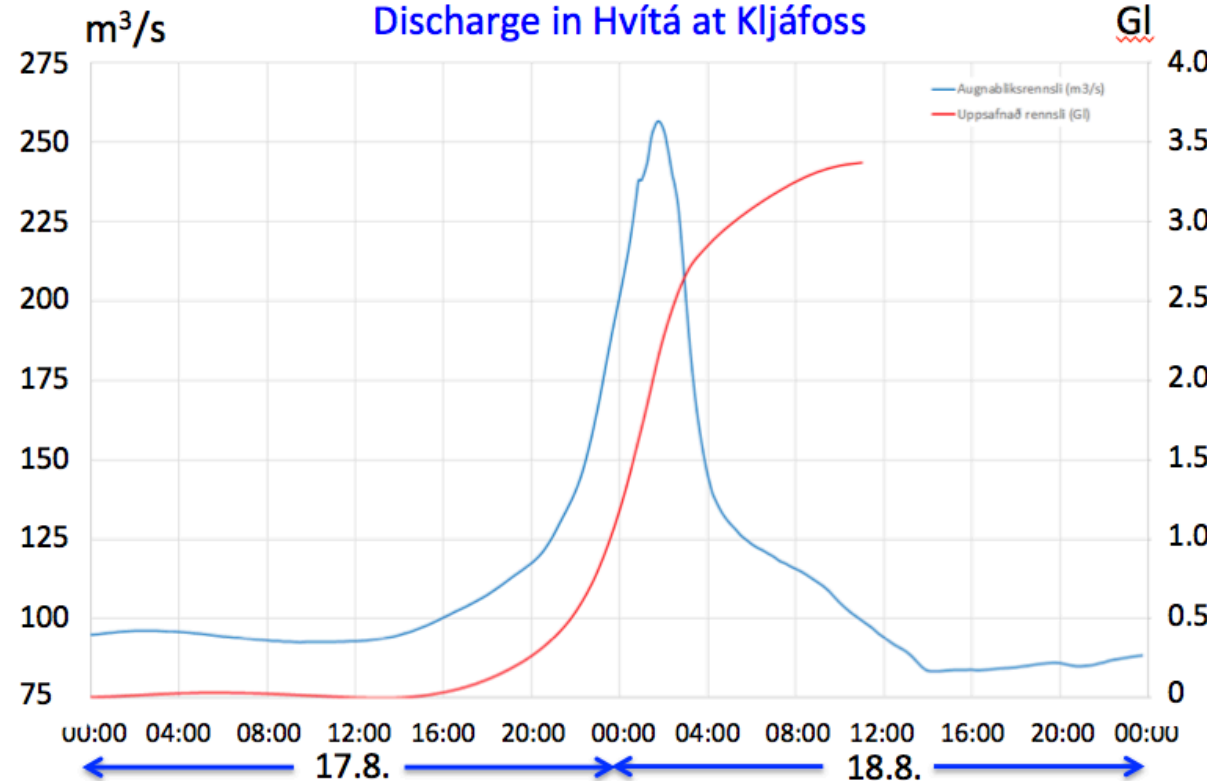
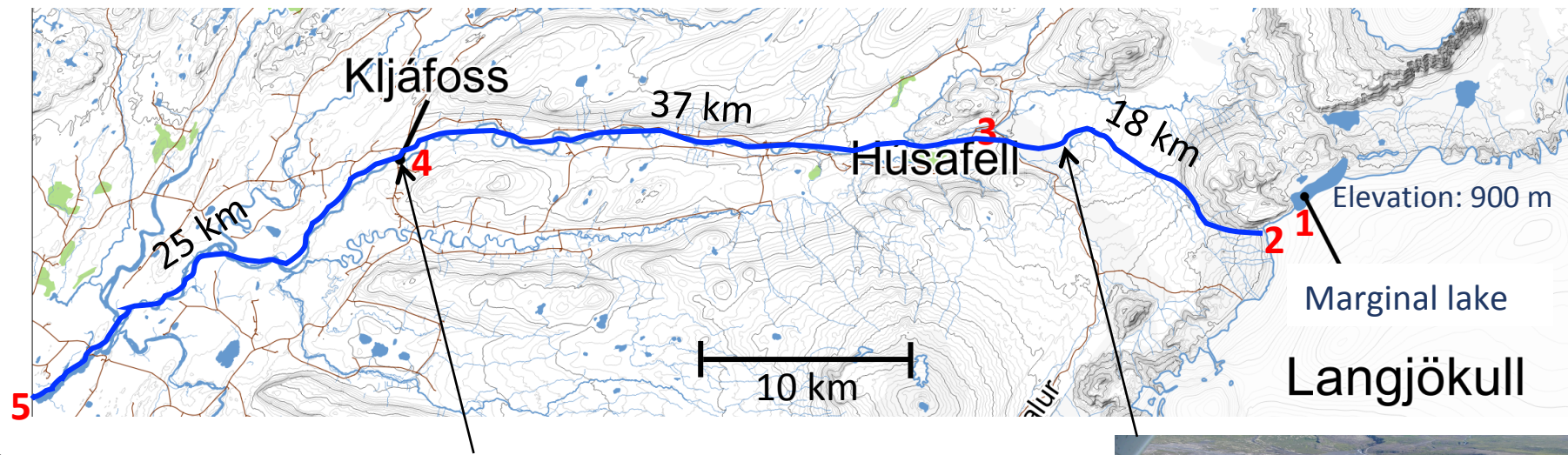
1 – August 17, early morning: Water level in the lake reaches a critical point, floats ice and water flows into subglacial tunnel.

2 – Jökulhlaup escapes ~2 h later from beneath the ice margin, 2 km downstream, entering the Svartá river.

3 – Noon: Water level starts rising beneath bridge at Húsafell. Has risen >2 m at peak flow (~21:00).

4 – 16:00. Flood has reached Kljáfoss hydrometric station on Hvítá river. Peak flow there on August 18, at 01:45.

5 – ~19:00. Flood reaches ocean in the bottom of the fjord Borgarfjörður.



Sandur area flooded during the jökulhlaup. Sediment deposition.

Cumulative discharge:

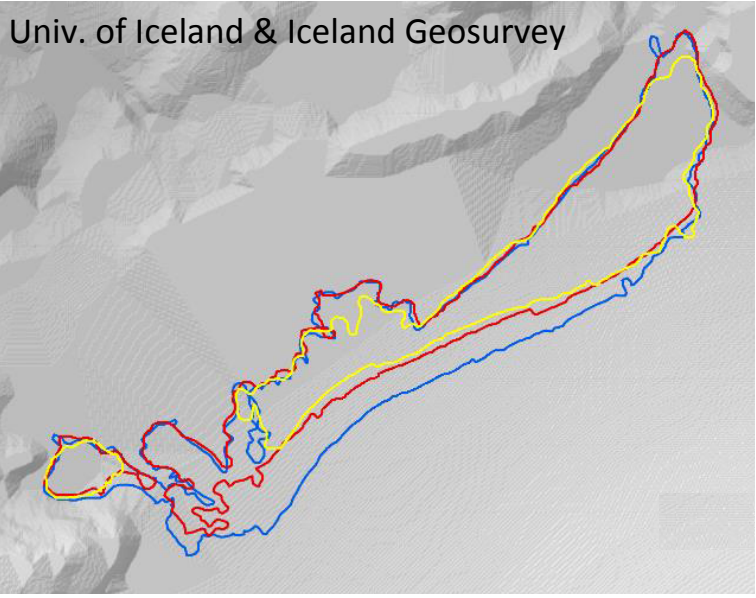
$$V = 3.4 * 10^6 \text{ m}^3$$

Classifies as a small jökulhlaup.

Peak discharge: **257 m³/s** Base flow: 85–90 m³/s

Evidence from discharge data & satellite images indicates *jökulhlaups* also occurred from the lake in 2014 and 2017

Univ. of Iceland & Iceland Geosurvey



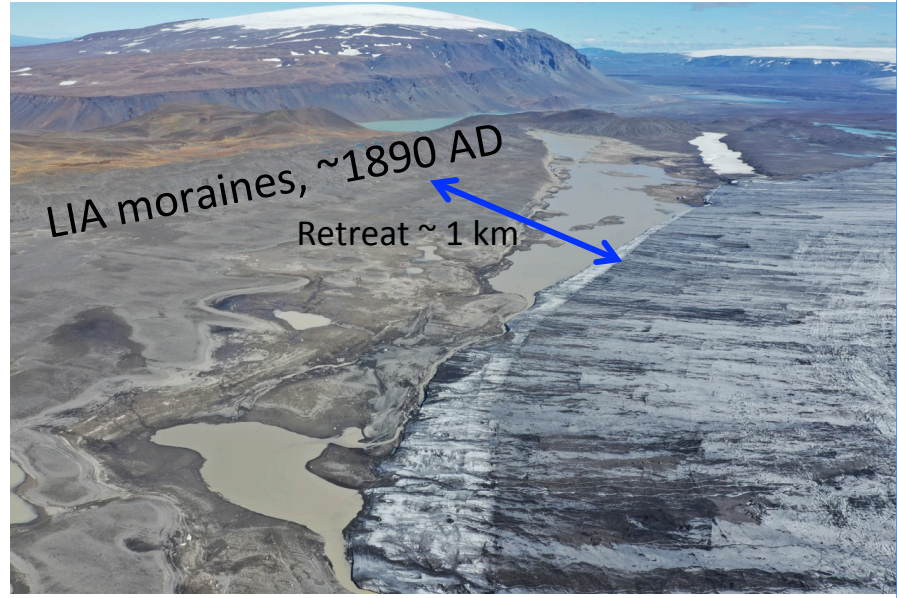
Maximum area before jökulhlaup in:

2014: 0.8 km²

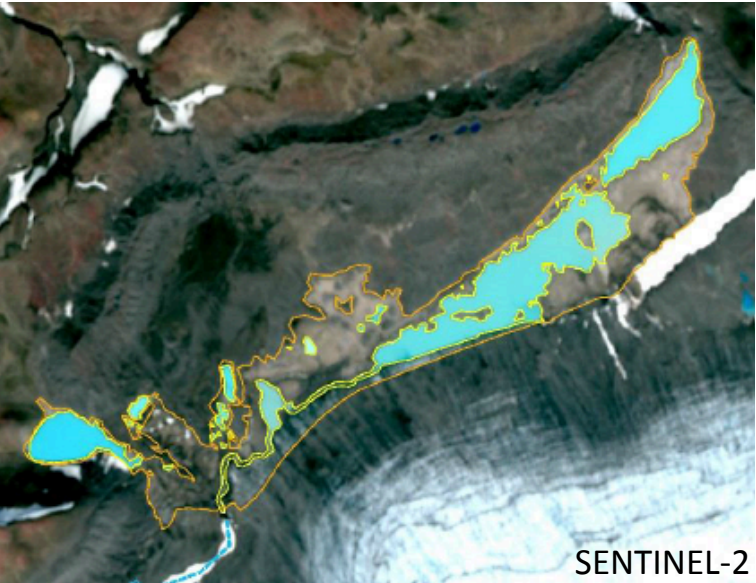
2017: 1.1 km²

2020: 1.4 km²

The floods in 2014 and 2017 were smaller and passed unnoticed downstream.



Aerial views over the lake on August 21 2020



Area before and after 2020 event:

Before: 1.4 km²

After: 0.4 km²

Estimate of volume of water emptied out :

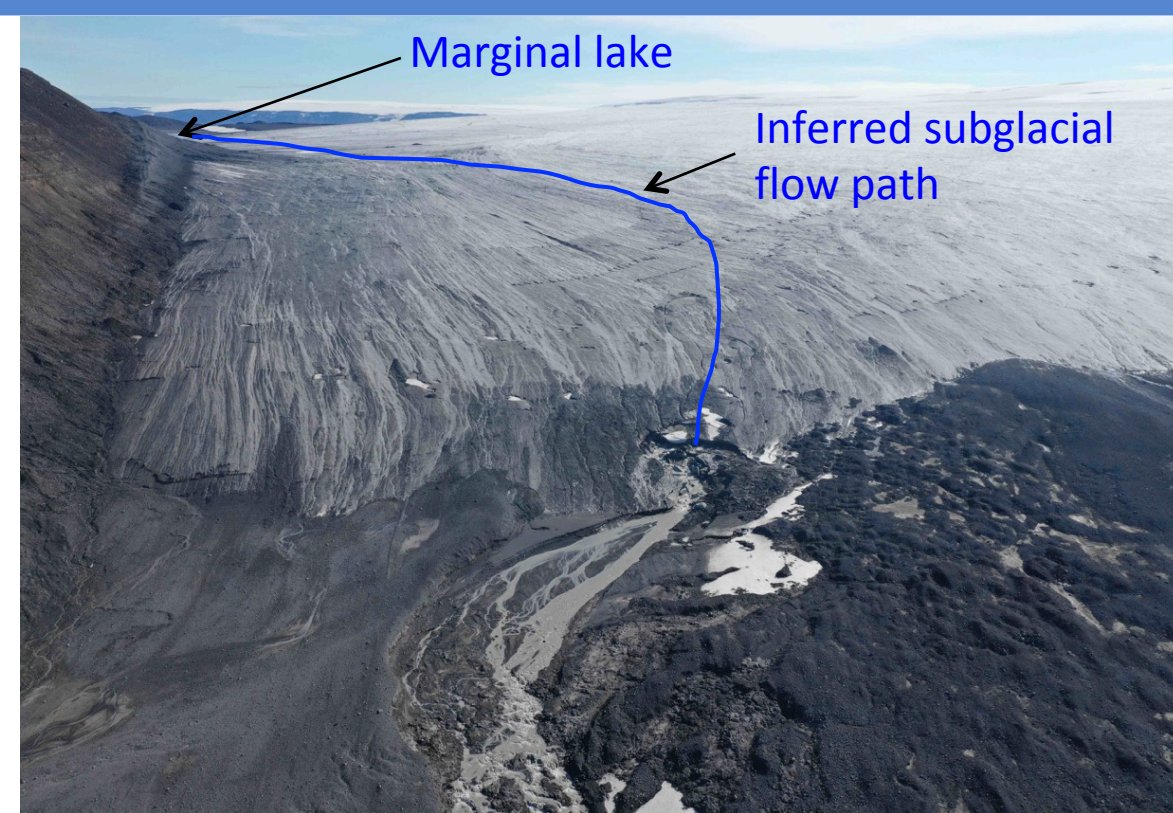
$V = 3.5 \cdot 10^6 \text{ m}^3$

Compares well with data from hydrometric station downstream.



Outlook:

- The event confirms predictions that glacier retreat will lead to formation of new marginal lakes → jökulhlaup hazards
- The lake is a cause of concern, but not a major threat to inhabited areas/resorts
- Windblown dust from the jökulhlaup deposits may become a nuisance in the region
- Monitoring efforts must be stepped up in coming years
- Remote sensing (SENTINEL images) will allow steady monitoring during summer, when the lake fills up
- Low-cost webcams can be deployed at short notice
- Water-level sensors that can transmit real-time data and early warnings could be installed at a later stage
- Hydrological models are currently being employed to simulate the 2020 event and evaluate potential hazards downstream
- Average flow speed of the jökulhlaup front ~ 3 m/s → warning time hours ahead of flood reaching Húsafell resort



Aerial view from the west, towards the outflow location

- The glacier thickness is 50–100 m along much of the flow path and the ice is thinning at a rate of 3 m/yr
- The depression containing the lake is expected to become larger when glacier retreats further, collecting more water
- Thinning of the glacier may lead to smaller, more frequent floods