A RECORD JÖKULHLAUP FROM THE SUBGLACIAL LAKE BENEATH THE EASTERN SKAFTÁ CAULDRON, VATNAJÖKULL ICE CAP, ICELAND

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Introduction. Steady ice melting due to geothermal areas beneath the Vatnajökull ice cap sustains two subglacial lakes beneath Skaftárkatlar (Skaftár cauldrons), located 10-15 km NW of the Grímsvötn subglacial caldera. Each lake releases 0.05-0.4 km^3 of meltwater in *jökulhlaups* every 2 years on average.

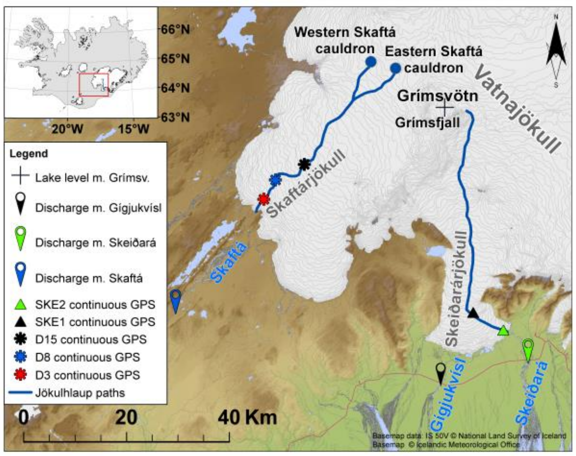

Fig. 1. The setting on Western Vatnajökull. The subglacial routes of jökulhlaups from Grímsvötn and the two Skaftár cauldrons is shown in blue. The location of GPS stations placed on the ice surface, directly above the jökulhlaup routes are indicated.

The 2015 jökulhlaup. A *jökulhlaup* (glacier outburst flood) from the subglacial lake beneath the Eastern Skaftá cauldron in W-Vatnajökull ice cap, Iceland, was released into the river Skaftá near the end of September 2015. The flood reached a record discharge of >3000 m^3/s on 2 October. The flood occurred after more than five years had elapsed since the lake last released a jökulhlaup in June 2010. This was an unusually long time interval between jökulhlaups from this cauldron, which typically occur every 2 to 3 years. The maximum discharge was approximately twice the previous maximum for jökulhlaups in Skaftá and the flood caused substantial damage to roads and infrastructure on its way to the ocean in the Skaftárhreppur district in southern Iceland. The initial jökulhlaup flood front burst through the glacier at several locations 1–2 km from the terminus. Dark bands of debris that had sedimented from the flood waters extended down the terminus where the jökulhlaup had flowed. Ice fragments were scattered over the surface of the glacier, a few tens of cm in size near the terminus but blocks up to 3–5 m high and 10 m long were observed close to the outflow points where the water had burst through the ice. The flood waters appeared to have flowed through the glacier for some time and concentrated in one or more circular channels that the flow melted through the glacier. The flow up through the glacier did not last long, though, and a few hours after the initial outburst, the jökulhlaup flowed out through six or seven main outlets at the terminus. The outburst of this jökulhlaup in Skaftá through the terminus area of Skaftárjökull glacier appears in many ways similar to the start of the much larger jökulhlaup from Grímsvötn through Skeiðarárjökull in S-Vatnajökull in 1996 except that the breakup of the ice in 1996 was much more dramatic and the ice blocks correspondingly larger. The subsidence of the ice shelf in the cauldron was monitored in real-time with a networked GPS-instrument allowing a several day warning of the impending flood. Other instruments and measurement systems, including two GPS-instruments on the glacier over the flood path 15 and 3 km from the terminus, seismic stations on the glacier and near the glacier margin, seismic arrays close by the glacier, and hydrometric stations in Skaftá river, provide an unprecedented data set documenting the developments of this flood, both as it propagated subglacially along the glacier bed and also after it entered the river path and continued into the lowland as a subaerial flood. The propagation mechanism of this jökulhlaup, its effects in lowland areas and the potential hazards of similar sized floods in the future are currently being assessed by the Icelandic Meteorological Office and other bodies.

Fig. 2. View of the surface cauldron after the jökulhlaup in October 2015.

Fig. 3. Ice blocks on the surface close to the place where the floodwater burst through the ice.

Fig. 4. Debris flows on the ice surface due to floodwaters emerging from below. Photo from a 2006 jökulhlaup at the same site.

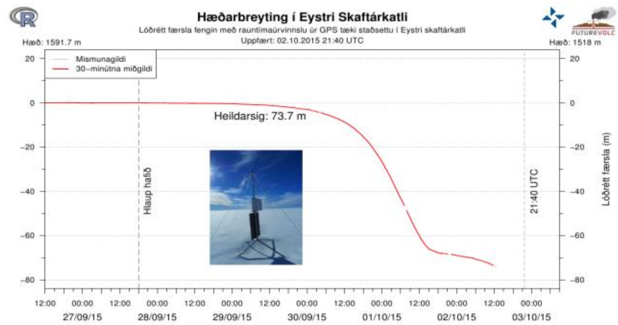

Fig. 5. Lowering of the central part of the surface cauldron (left) during outflow of water from the 100 m deep subglacial lake under 300 m thick ice cover. A 70 m lowering occurred in 36 hours during this event.