FLOSI: FLow over Orographic Section of Iceland

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Introduction

In 1962 and 1963 precipitation measurements were made along a line from the capital region of Iceland eastward into the mountain ridge Bláfjöll. The results showed that the precipitation increased by about 250% from the lowest station to the highest one. In 2018 a field programme was initiated to supplement and augment this 55-year-old data set. 26 automatic precipitation gauges are stationed pairwise along a similar line during summer and into the autumn - and further over the mountain ridge to the southern coast. The programme is named FLOSI (FLow over Orographic Section of Iceland). In order to obtain reliable results, the programme is expected to last several years with measurements made along the same line. Here we describe the programme and some preliminary results from the first year.

Measurements

The measurements are conducted with HOBO Rain Gauge Data Loggers which include tipping bucket rain gauges and temperature sensors, with resolution of 0.2 mm and 0.1°C, respectively. All data where temperature is below 3°C is rejected, due to precipitation possibly being solid.

The buckets are placed pairwise at ground level, within a distance of a few meters. The total length of the cross section is 48 km with measurement interval of about 5—6 km, from sea level to 350 m a.s.l., see Figure 1.

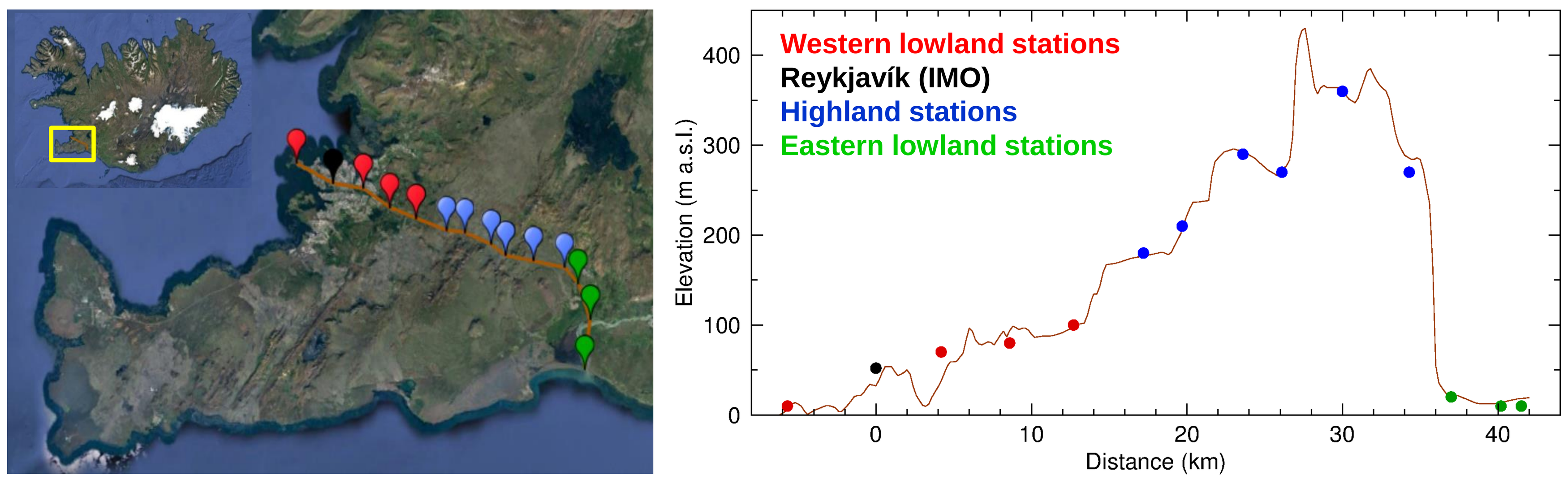

Figure 1: Left: Locations of the pairwise precipitation gauges from the capital area eastward towards the southern coast. Right: the elevation a.s.l. as a function of distance from the Icelandic Meteorological Office in Reykjavík (IMO, black point). The line shows the topography along a straight line.

Summer and autumn 2018

While most of Continental Europe was dealing with a drought during the summer of 2018, SW-Iceland experienced a wet summer and autumn. The precipitation in Reykjavík for June—Nov was 494.8 mm, 27% above a 30-year mean (1981—2010). In fact June is usually a rather dry month but in 2018 it was especially wet with more than double the 30-year mean precipitation. During a 48-hour period, 16—18 Nov, 83.2 mm fell in Reykjavík, a records value for the station.

Figure 2 shows the accumulated precipitation of FLOSI June—Nov. There are a number of events with precipitation measured at almost all. The last episode in November was by far the most extreme event. Great variability can be seen between sites during this first summer and autumn of FLOSI, from less than 300 mm on the western side to almost 1500 mm over the highland.

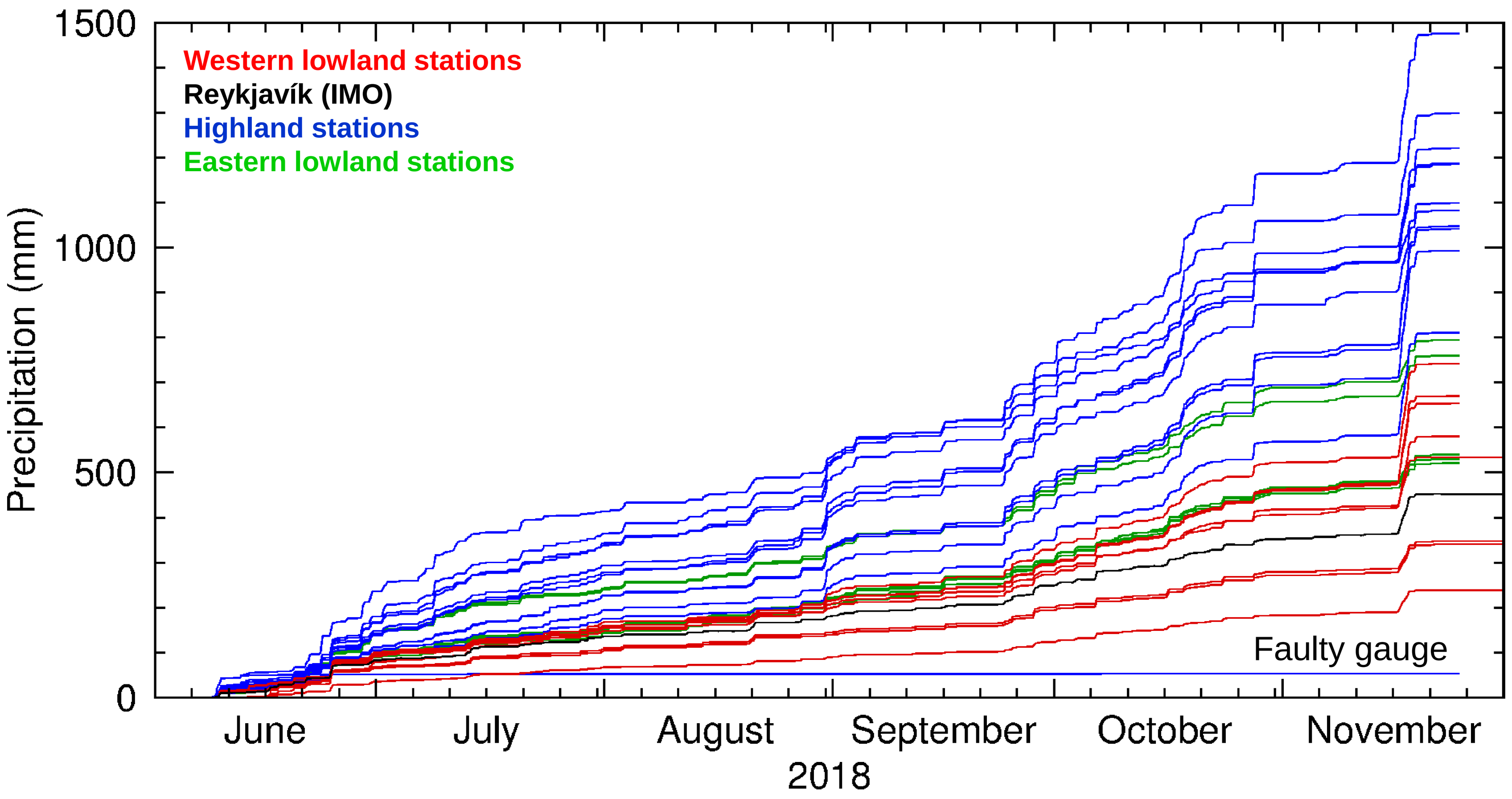

Figure 2: Accumulated precipitation during Summer—Autumn 2018. The stations are coloured according to locations. Green: eastern lowland stations, usually upstream. Blue: highland stations. Red: western lowland stations, usually downstream. Black: Reykjavík, at IMO head quarters. One of the gauges stopped working already in June.

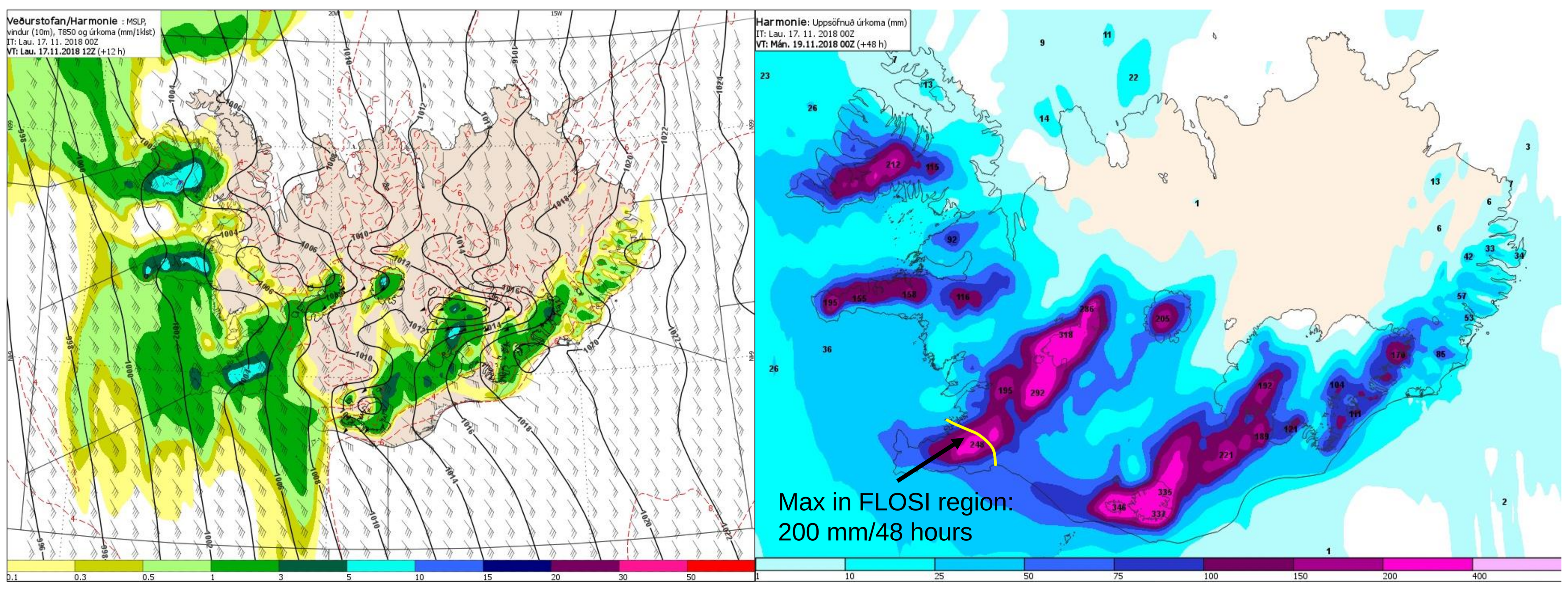

Figure 3: Left: A 12-hour forecast valid at 12 UTC on 17 Nov 2018, showing mean sea level pressure (hPa, contours), 1-hour precipitation (mm, shaded) and wind barbs. Right: Forecasted 48-hour precipitation valid at 00 UTC 19 Nov 2018. From HARMONIE-AROME run operationally at IMO.

The precipitation event 16—18 November 2018

The largest precipitation event occurred in the middle of November when a quasi-stationary warm front carried warm and moist air towards Iceland from the south (Figure 3, left). The temperature over the mountain ridge was 7°C and wind speed 15-20 m/s. The wind direction was SE-ly, almost parallel to the measurement line, thus the eastern lowland stations can be considered upstream of the mountain ridge Bláfjöll and the western ones downstream.

The operational forecasting system of IMO, HARMONIE-AROME, predicted 48-hours accumulated precipitation of up to ~200 mm along the measurement line (Figure 3, right) and ~250 mm over the Bláfjöll mountain ridge.

The measurements show a great variation in precipitation. In general the pair of rain gauges at each site measure similar amount (Figure 4), with two exceptions. Firstly, one of the gauges stopped working early in the summer (Figure 2). Secondly, at a downstream site close to the capital region one of the gauges recorded considerably less than the other gauge at the site as well as gauges at nearby sites. The data is thus not considered reliable.

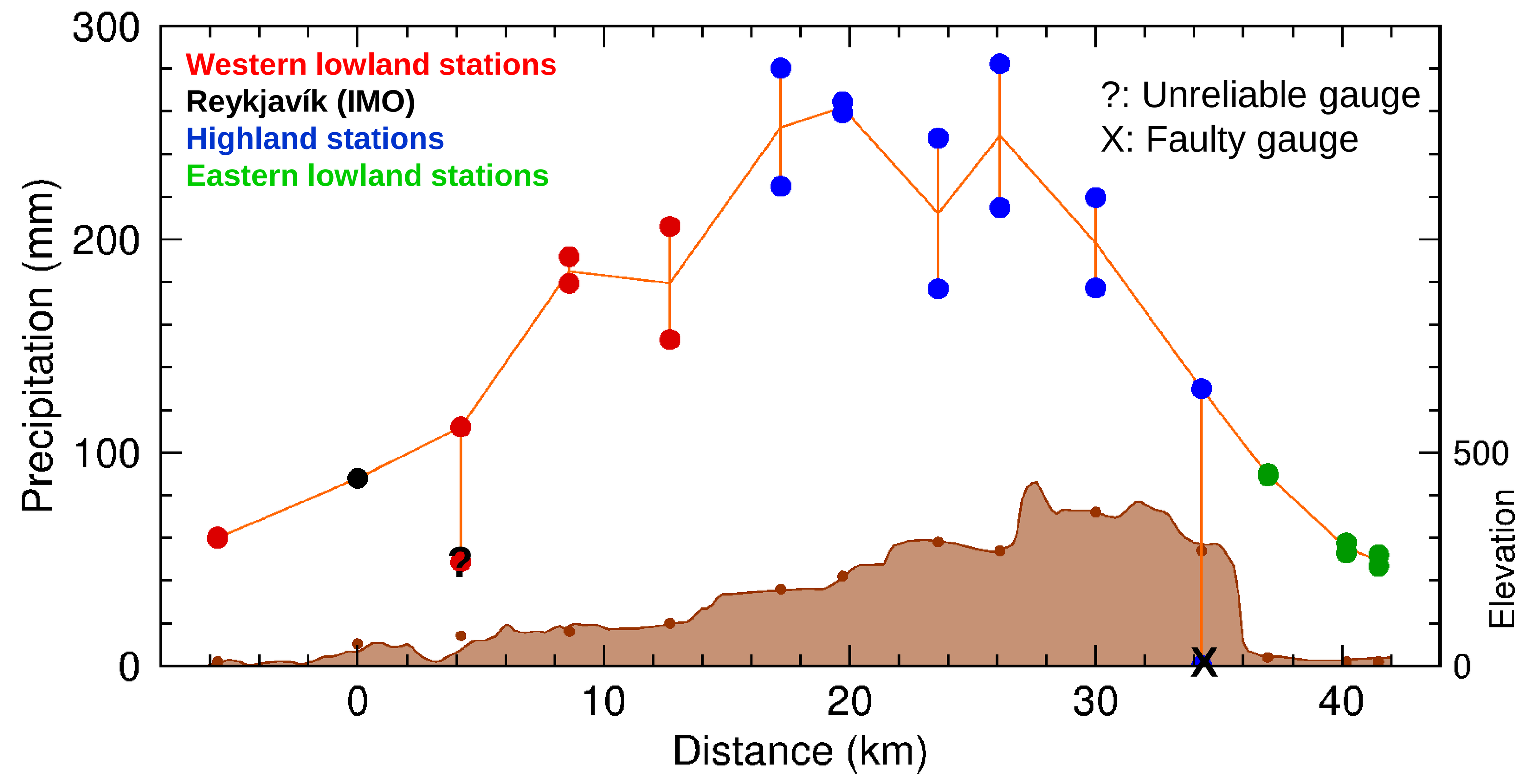

Figure 4: 72-hour accumulated precipitation, 12 UTC 16 Nov—12 UTC 19 Nov 2018. The orange line present a simple interpolation. The shaded region shows the topography.

Over the upstream lowlands accumulated precipitation is ~50 mm in 72 hours, reaching similar values at the western edge of the line. The maximum precipitation is not at the highest point of the orography but about 10 km downstream. There is also a considerable spill over to the western lowland stations. In fact more precipitation is measured at these stations than at the upstream lowland stations. This is due to orographic enhancement as well as windy conditions. Undercatch due to wind speed is likely to have some effect. The maximum 48-hour precipitation is 190 mm, similar to the forecasted value.

Summary

FLOSI started off well, with the summer and autumn of 2018 being one of the wettest on records in SW-Iceland. A few events were collected, one of them the largest 48-hour event on records in Reykjavík. The same line was instrumented in May 2019. In contrast to 2018, this year the summer started with a dry June and a normal July. It will be interesting to see if the next few months bring some significant events. Due to year-to-year variability it is important to measure along the line for a few years in order to collect a significant number of good events. Most precipitation in Iceland falls in windy conditions and the November event shows spill over, i.e. the largest precipitation falling about 10 km downstream of the highest point. Also, undercatch is expected in these conditions. This spill over may be of importance for the ground water supplying water to the capital region.

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