THORBEX – The Þorbjörn precipitation experiment in SW-Iceland

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Abstract

During the autumn of 2014, precipitation was observed by a dense network of automatic raingauges covering a 243 m high and steep mountain Þorbjörn in the Reykjanes peninsula in SW-Iceland. The experiment is backed by continuous radar observations of winds and precipitation, radiosondes every 12 hours at the nearby Keflavik airport and a number of automatic weather stations.

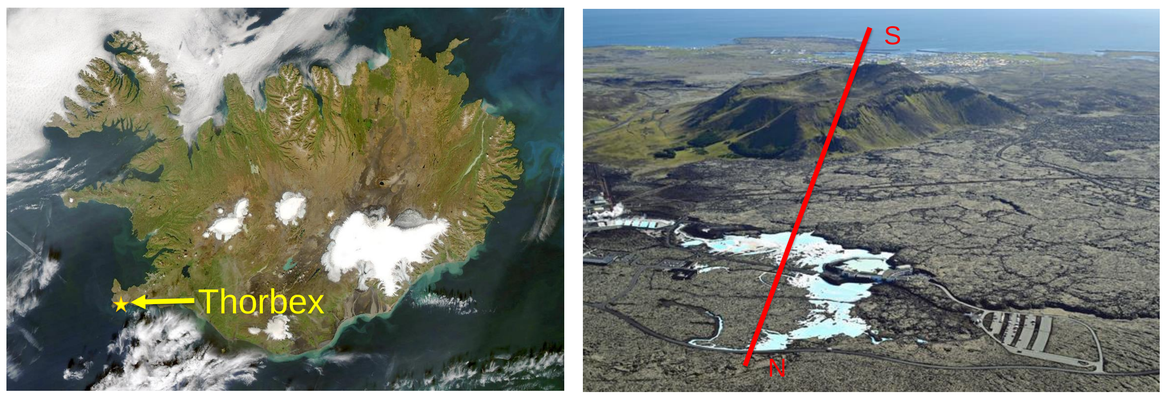

Figure 1. Left: Iceland, with the location of Þorbjörn marked with a star and right: Mt. Þorbjörn as seen from the north. The coastal Grindavík-village is in the background and the Blue Lagoon power plant wastewater site in the foreground.

Þorbjörn

Þorbjörn is a small mountain/hill on the Reykjanes Peninsula, 243 m a.s.l. It is just north of Grindavík-village at the southwestern coast (Figure 1).

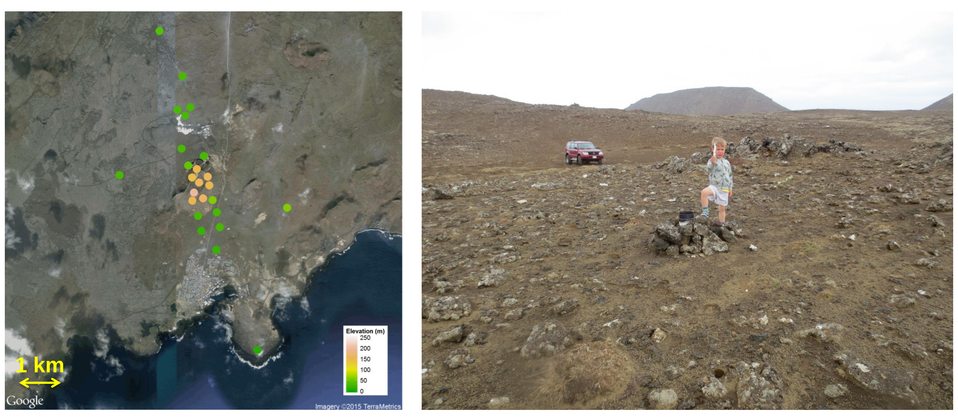

Figure 2. Left: The location and elevation of the gauges and right: one of the gauges at retrieval. (photo: Hálfdán Ágústsson)

Data

In total 25 precipitation gauges where placed on and around the mountain on 14 August 2014, with emphasis on a SSE-NNW line, in order to cover both upstream and downstream precipitation. The gauges were positioned on the ground and rocks used to both stabilize them and hide.

Preliminary results

There were two periods in the autumn where temperature was above 3°C and thus the precipitation liquid:

- P1: 15 August – 02 October (49 days)
- P2: 12-25 November (14 days)

The accumulated precipitation for each gauge is shown in Figure 3. There are distinct precipitation events, most due to frontal precipitation, during both periods. One of the gauges measured significantly less than the rest and in total measurements from three gauges were not as expected. However, an intercomparison between the gauges and standard measurements at the IMO's observational station in Reykjavík showed only one gauge to measure significantly less; and the three mentioned earlier to be within reasonable range.

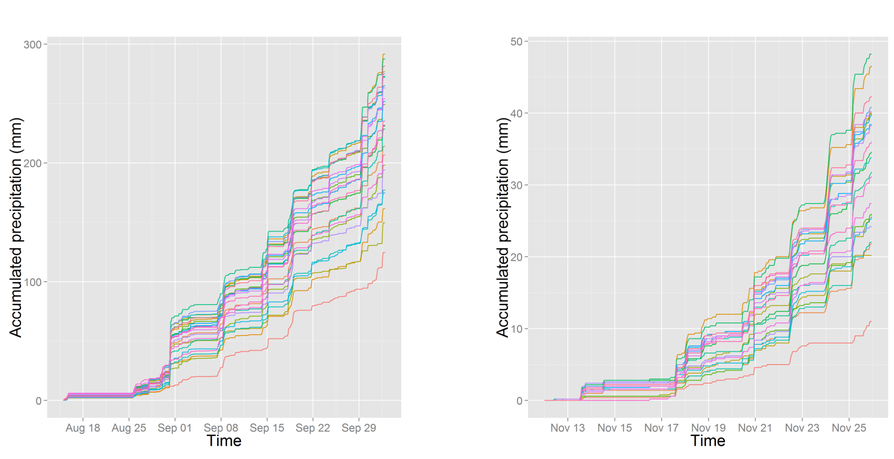

Figure 3. Accumulated precipitation (mm) for each gauge for the two time periods: P1 and P2. Note the different scales.

The most significant event was on 31 August 2014 when the remains of the hurricane Christobal arrived in Iceland with wet and windy conditions. The majority of the precipitation fell in strong ESE-winds in the morning, with 12 gauges measuring 24-hour precipitation exceeding 30 mm (Figure 4). Two gauges measured significantly less; the reason probably linked to extreme wind loss. The most noticeable pattern is that there is little precipitation measured over the northern part of the mountain. There also is a reduction in measured precipitation on the upstream part of the mountain.

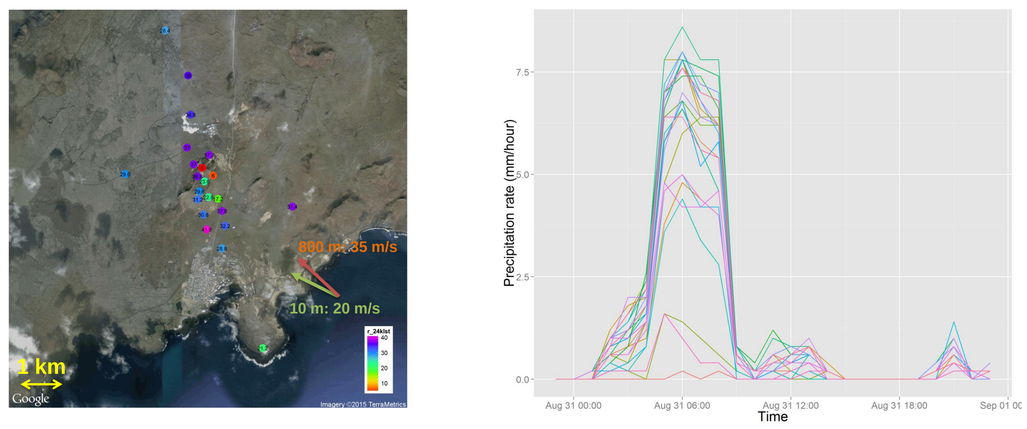

Figure 4. Left: 24 hours accumulated precipitation (mm) and right: 1 hour precipitation rate as a function of time for the rain gauges on 31 August 2014.

8 September 2014 – wind from the south

There was just one event, on 8 September, with rain in winds from the south, approximately parallel to the stations profile. In this case the observations indicate a maximum of 1.8 times the upstream precipitation immediately downstream of the mountain (Figure 5). Very low values were recorded on top of the mountain, indicating substantial wind loss.

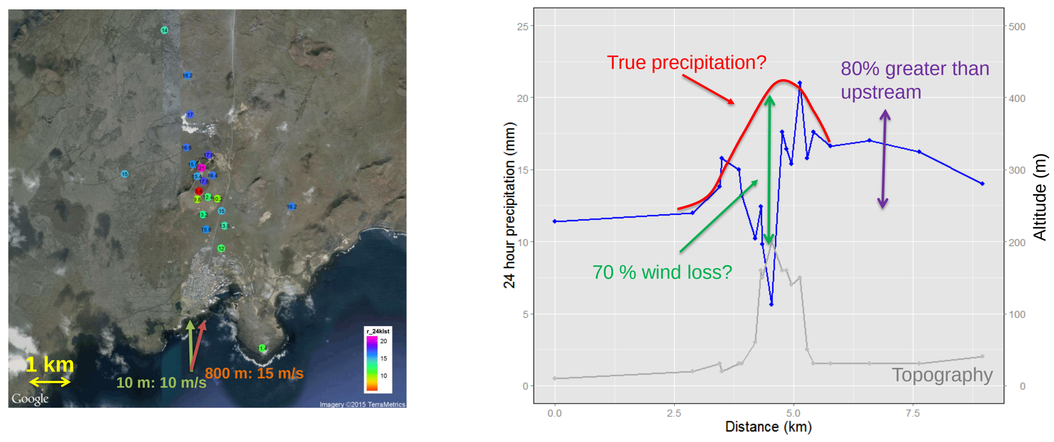

Figure 5. 24-hour precipitation (mm) on 08 September 2014. Left: as a function of location and right: with altitude of rain gauges as a function of distance along the S-N profile.

Total precipitation

The total precipitation during P1+P2 indicates that the maximum precipitation may be close to 1.7 times the upstream precipitation (at the coast) and suggests ~50% average wind loss at the top of the mountain.

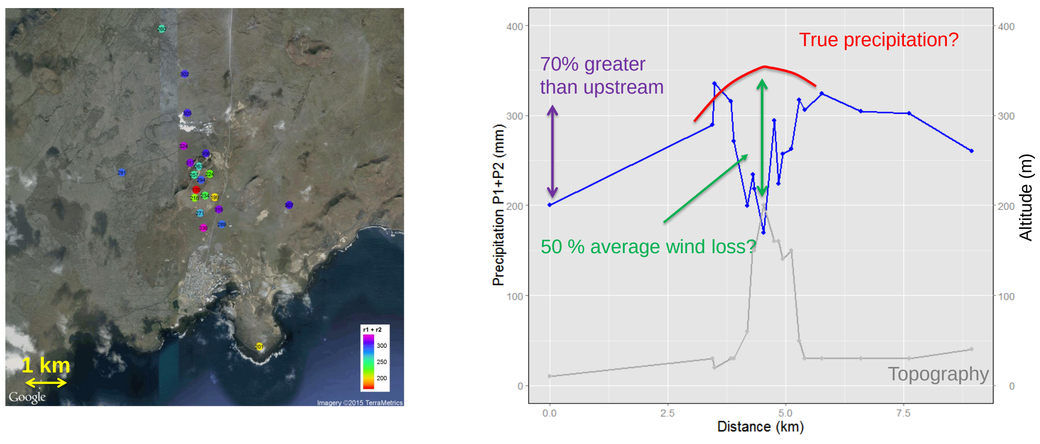

Figure 6. Total accumulated precipitation (mm) during P1+P2. Left: as a function of location and right: with altitude of rain gauges and as a function of distance along the S-N profile.

Main points

- The observations indicate that the average maximum rain over or close to the mountain may be ~1.7 times the background rain.
- Although the precipitation is only liquid, there seems to be great observation errors, likely due to strong winds. This calls for revision the climatology of precipitation in Iceland and in other windy places.
- The maximum wind loss and the spatial variability are of a similar magnitude. This complicates mapping of true precipitation.

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