NATIONAL COMMISSIONER OF THE ICELANDIC POLICE

DEPARTMENT OF CIVIL PROTECTION AND EMERGENCY MANAGEMENT

THE SCIENTIFIC ADVISORY BOARD OF THE ICELANDIC CIVIL PROTECTION

Date: 30.01.2015	Time: 09:30	Location: Crisis Coordination Centre, Skogarhlid.

Regarding: Volcanic activity in the Bardarbunga system.

Attending: Scientists from Icelandic Met Office and the Institute of Earth Sciences University of Iceland along with representatives from the Icelandic Civil Protection, Directorate of Health and The Environment Agency of Iceland.

Main points

- **Volcanic eruption in Holuhraun**
- **Air quality**
- **Scenarios**

Notes

- A powerful volcanic eruption is still on going in Holuhraun with a flow of lava around 100 m3 per second.
- It is probable that the course of events will develop in a similar manner as they have for the last few months, i.e. there will be a slow decrease in the volcanic activity.
- Information on the development of the activity refers on the one hand to the subsidence of the Bardarbunga caldera and on the other hand on the intensity of the volcanic eruption in Holuhraun.
    - **Bardarbunga**: Data on the rate of the subsidence at the centre of the caldera, the volume of the subsidence, data on the tectonic movements around Bardarbunga (GPS, InSAR) and seismic activity.
    - **The volcanic eruption in Holuhraun**: Data on the size and volume of the lava field, and valuation of gas and heat stream.
- A forecast based on extrapolating the current developments of the Bardarbunga subsidence shows that if the caldera keeps subsiding along a similar trajectory then the subsidence wil go on for another 5 to 16 months.
- With the same method the volcanic eruption in Holuhraun could evolve with similar pace and the eruption might last another 4 to 15 months. Information on the volume of the lava field in Holuhraun is not as accurate as the information on the subsidence of Bardarbunga.
- These assumptions must be viewed with caution. It is entirely possible that the eruption will end sooner than predicted above. It is also possible that the eruption could become stable and go on for years, but with a greatly reduced magma flow rate.
- An eruption in Bardarbunga is still possible even though the development described above will continue. Even though the volcanic eruption in Holuhraun stops in the coming months it is not certain that the current rifting episode is at an end. It is still possible that an eruption may start on another part of the fissure swarm within the Bardarbunga volcanic system.

- The volcanic eruption in Holuhraun has now lasted for five months. Today there are 152 days since a continuous eruption started on the 31st of August 2014. The seismic activity started on the 16th of August and has therefore lasted for 167 days. The Coordination centre in Skogarhlid was fully activated on the 19th of August and the operation has therefore lasted for 164 days. For comparison the volcanic eruption in Vestmannaeyjar lasted for 130 days, from 23rd of February 1973 until 3rd of July the same year.

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- Seismic activity in Bardarbunga continues to be strong. The strongest earthquake since the last meeting of the Advisory Board on last Tuesday was measured M4,6 yesterday, Thursday, at 21:45. Rather strong and flurry wave of seismic activity was recorded in Bardarbunga cauldron yesterday evening between 20:50 and 22:30 Three earthquakes stronger than M4,0 were detected over the period and only about 4-5 earthquakes between M3,0-4,0. In total around 100 earthquakes have been detected around the caldera since last Tuesday.
- Around 30 earthquakes were detected in the dyke during the same period, the strongest was M1,5.
- A few scattered earthquakes were detected in and around Tungnafellsjokull glacier and Askja since last Tuesday. Some activity has been detected around Herdubreid but no large earthquake.

Air quality:

- Today (Friday) gas pollution might be felt south and southwest of the eruption site. Tomorrow (Saturday) gas pollution will affect areas to the south and southeast.

- Three scenarios are considered most likely:
    - The eruption in Holuhraun continues until the subsidence of the Bardarbunga caldera stops. The eruption can still go on for many months.
    - The volcanic fissure may lengthen southwards under Dyngjujokull, resulting in a jokulhlaup and an ash-producing eruption. It is also possible that eruptive fissures could develop in another location under the glacier. If such an eruption would be prolonged it could eventually produce a lava flow.
    - Volcanic eruption in the Bardarbunga caldera. Such an eruption would melt large quantities of ice, leading to a major jokulhlaup, accompanied by ash fall.

Other scenarios cannot be excluded.

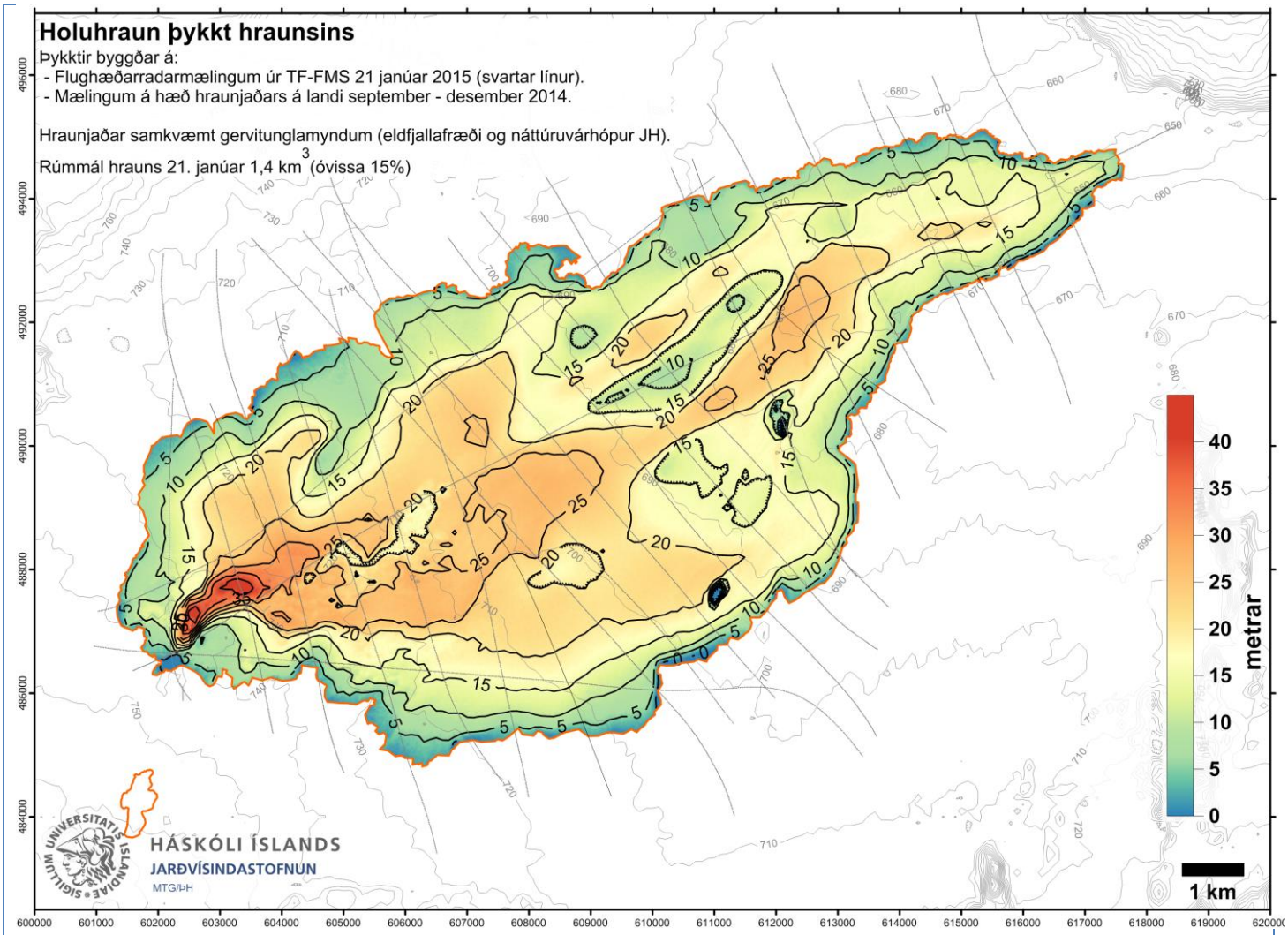


Figure 1 A map from January 21st showing the thickness of the lava at Holuhraun, numbers indicate thickness in meters.

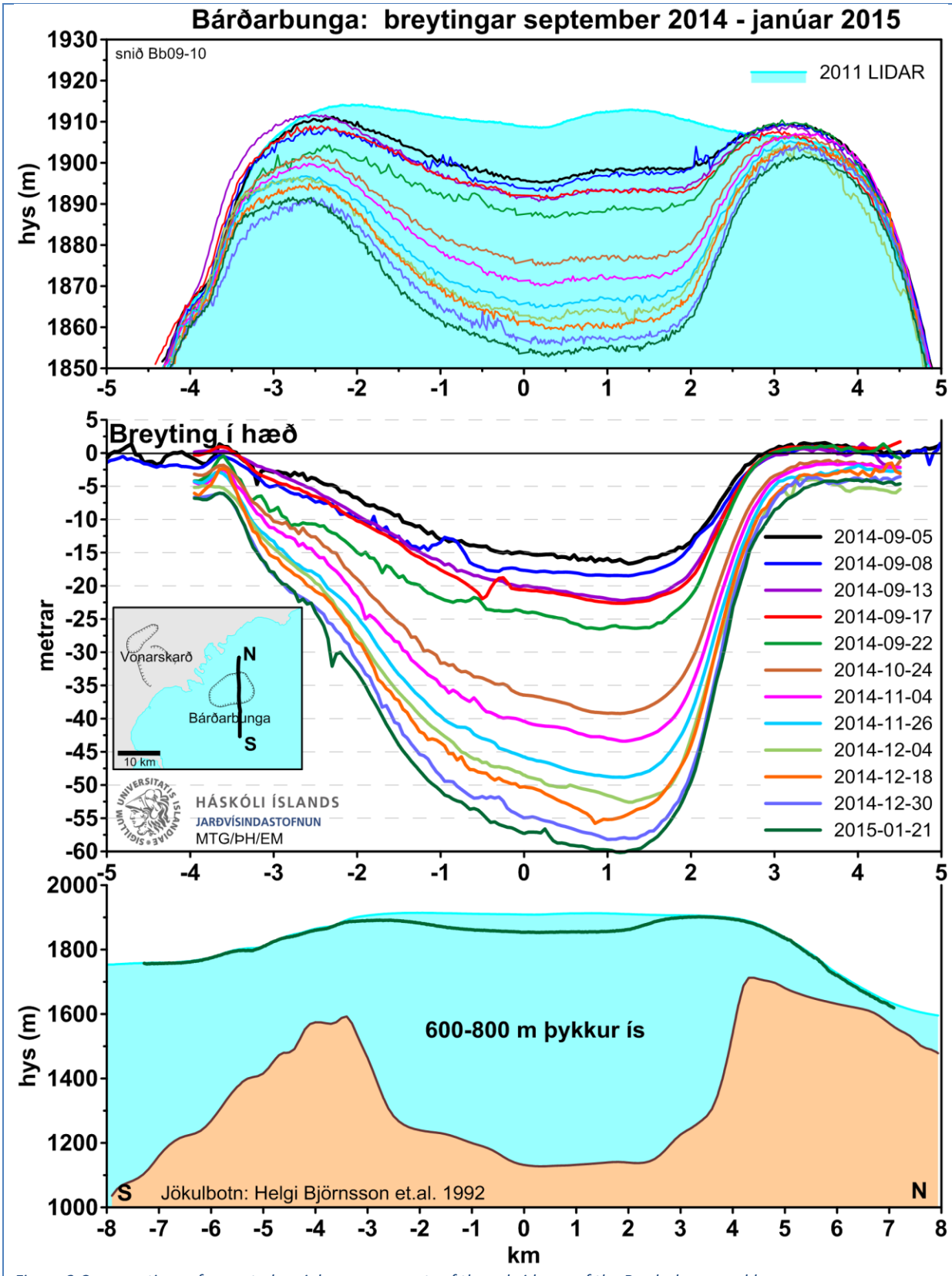


Figure 2 Cross sections of repeated aerial measurements of the subsidence of the Bardarbunga caldera.

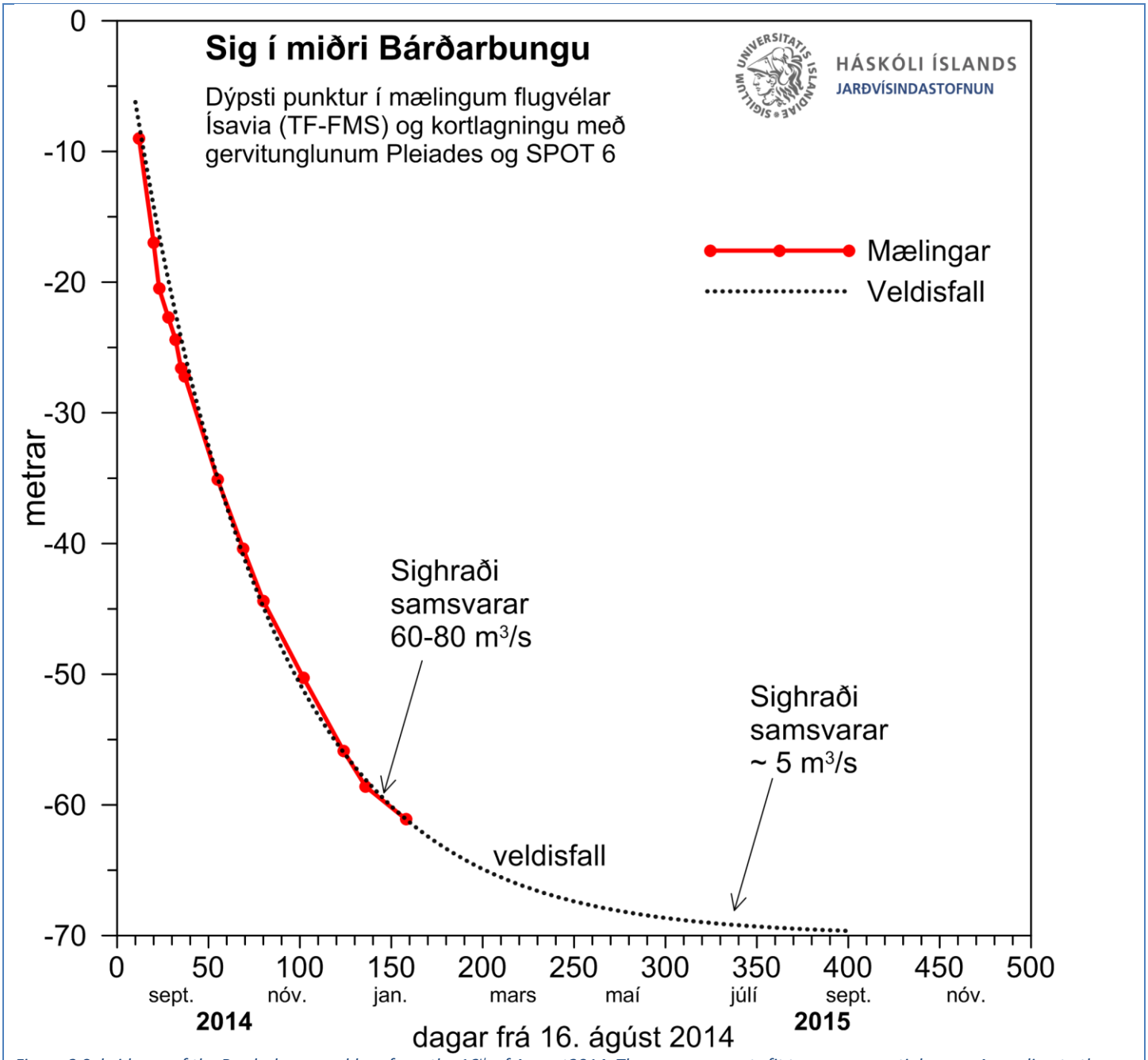


Figure 3 Subsidence of the Bardarbunga caldera from the 16th of August2014. The measurements fit to an exponential curve. According to the exponential curve the subsidence might diminish to 1 cm/day at the end of summer. The results of this curve-fitting should be viewed with causion.

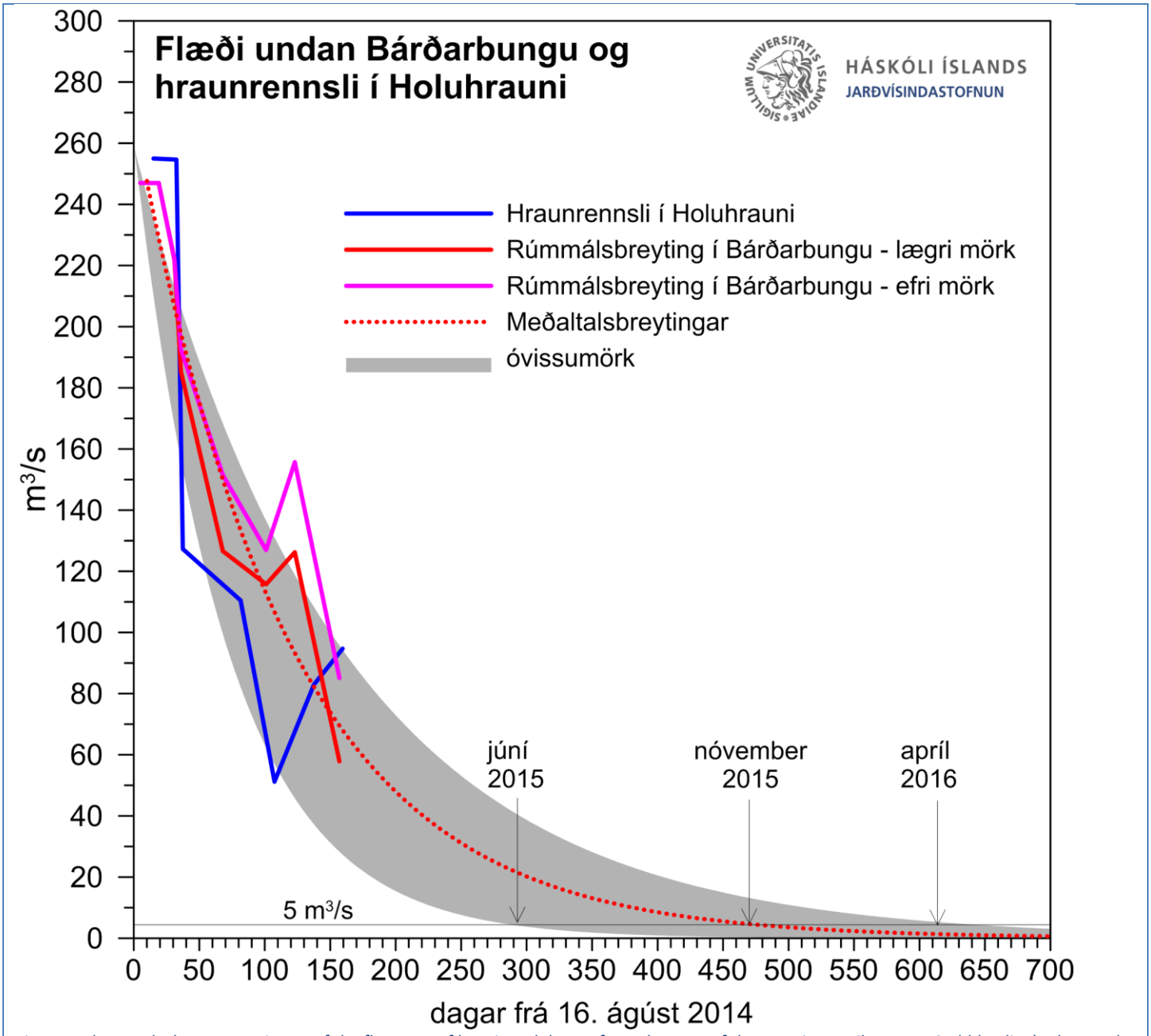


Figure 4 The graph shows an estimate of the flow rate of lava in Holuhraun from the start of the eruption until January 21st blue line). The graph is based primarily on measurements from surveillance flights by the ISAVIA plane TF-FMS. There is quite some uncertainty in individual measurements but there is a definite trend showing diminishing lava flow rates. The red and pink lines show the increase of the volume of the subsidence of the Bardarbunga caldera, these values are derived with similar methods as the volume of the lava field at Holuhraun. The red dotted line is an exponential curve used to estimate the diminishing flow of lava from the Holuhraun eruption and estimate when the lava flow will go below 5 m3/s. If the diminishing activity follows this trend then the eruption might come to an end anywhere between June 2015 and April 2016.

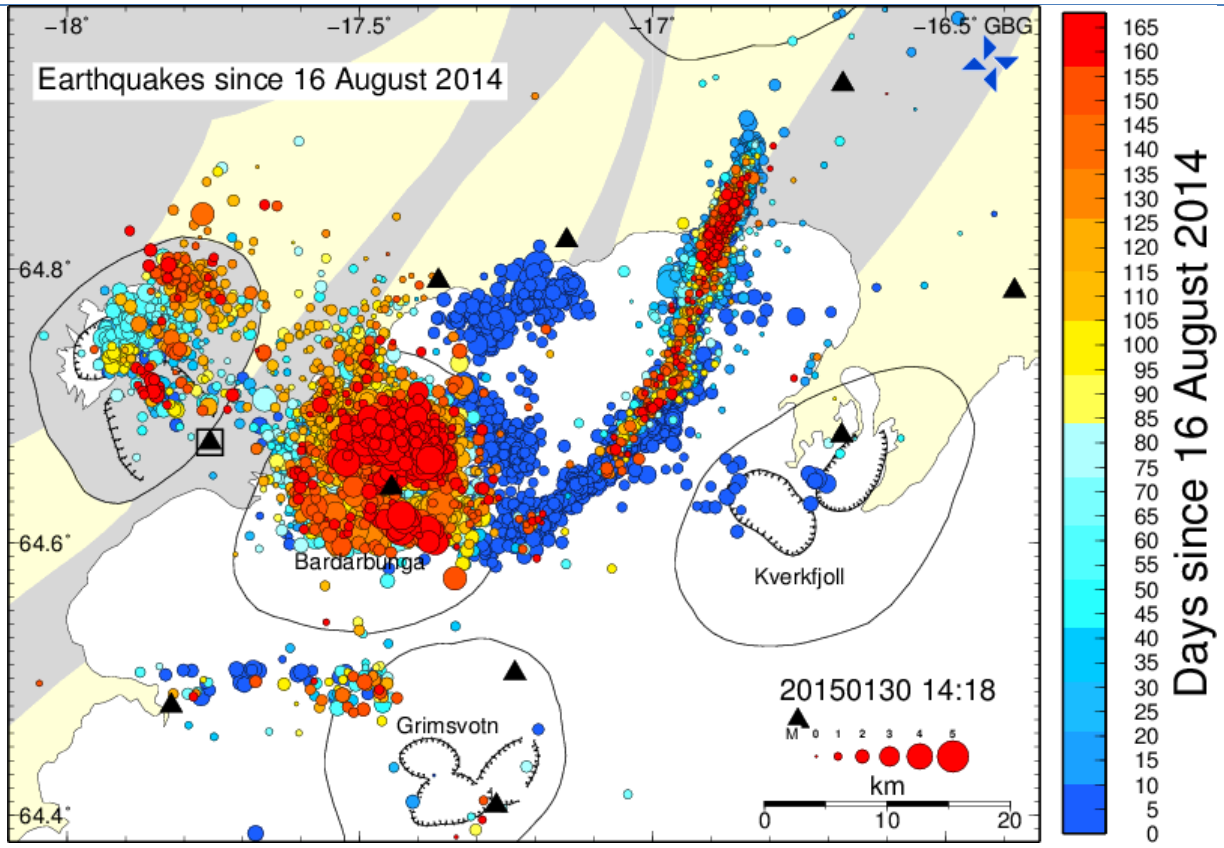


Figure 5 Earthquakes in and around Bárðarbunga since the onset of the unrest. The colorscale (colorbar shown on the right side of the image) shows the age of earthquakes; oldest earthquakes are marked with a darkblue circle while the latest events are shown with a red circle. Size of the circles are scaled dependent on earthquake magnitude (see legend in the lower right corner). Seismic stations are shown with black triangles. The GPS station von is marked with a black square.

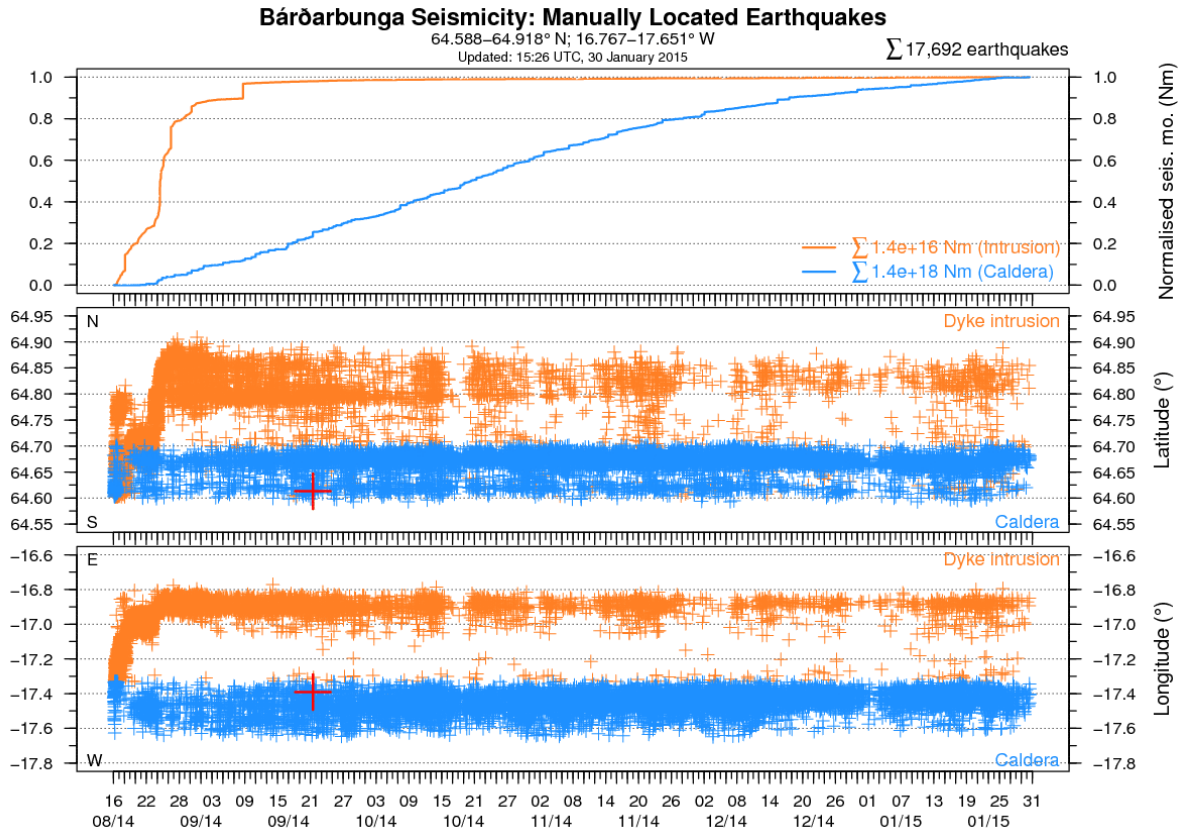
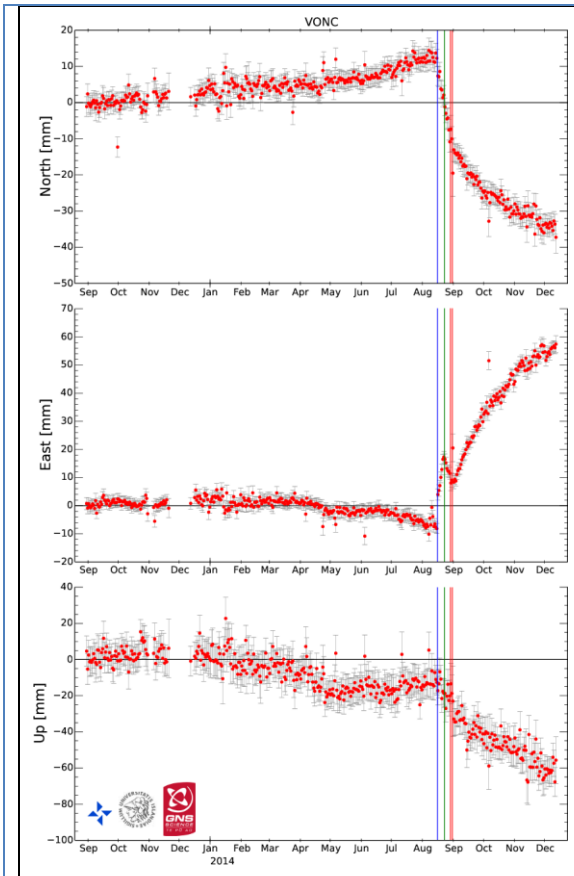


Figure 6 The graphs show the temporal evolution of seismicity in the dyke, represented with orange color, and in the Bárðarbunga caldera, shown with blue colour.

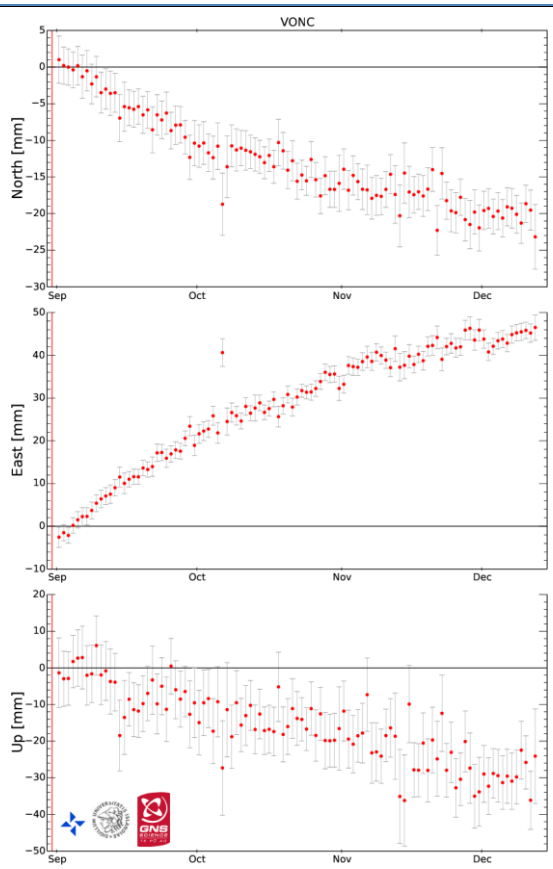
The top graph shows cumulative seismic moment (normalized) from the onset of the Bárðarbunga crisis until 30th of January 2015. The total cumulative seismic moment for the dyke is 1.4 $*10^{16}$Nm and for the Bárðarbunga caldera 1.4$*10^{18}$Nm.

The middle graph shows the temporal evolution of seismicity with respect to latitudes.

The bottom graph shows the temporal evolution of seismicity with respect to longitudes.



Graph a



Graph b

Figure 7 Graph a) shows a time series for the GPS station in Vonarskad (VONC), the station is labelled with a black box on the earthquake map above. The time series shows a change in the location of the station to the north (top), to the east (middle) and vertical (bottom) in mm. Background signals have been removed from the time series. From May 2014 a displacement to North-West is detectable, which may be connected to the tension in Bardarbunga. Displacement towards the Bardarbunga caldera can be detected on the 16th of August (blue line), when the seismic activity started. A disturbance in the signal is detected on the 23rd of August (green line) when displacement in the dyke started. This displacement continued until the start of the second eruption, this displacement is evident in the east component (right red line the left red line shows the start of the first eruption on August 29th). After that there is a strong signal showing subsidence towards the Bardarbunga caldera. From the start of the eruption on August 31st there has been an exponential decay in the subsidence signal. The decay rate has had a half-life of about 20-40 days. Graph b shows the same time series after August 31st. Similar movements towards the Bardarbunga caldera are evidend on other nearby GPS stations.

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If the data are used in publications, they should be clearly referenced as: "Preliminary analysed data by the SIL seismic monitoring group of the Icelandic Meteorological Office." Date of delivery from the data bank must follow.Further information on usage of data from IMO's web-site is given under pages about IMO.

http://en.vedur.is/about-imo/the-web/conditions

- **From the Icelandic Met Office:** The Aviation Colour Code for Bardarbunga remains at 'orange'.
- The next meeting will be held on Tuesday 3rd of February 2015.

The National Commissioner of the Icelandic Police, Department of Civil Protection and Emergency Management
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