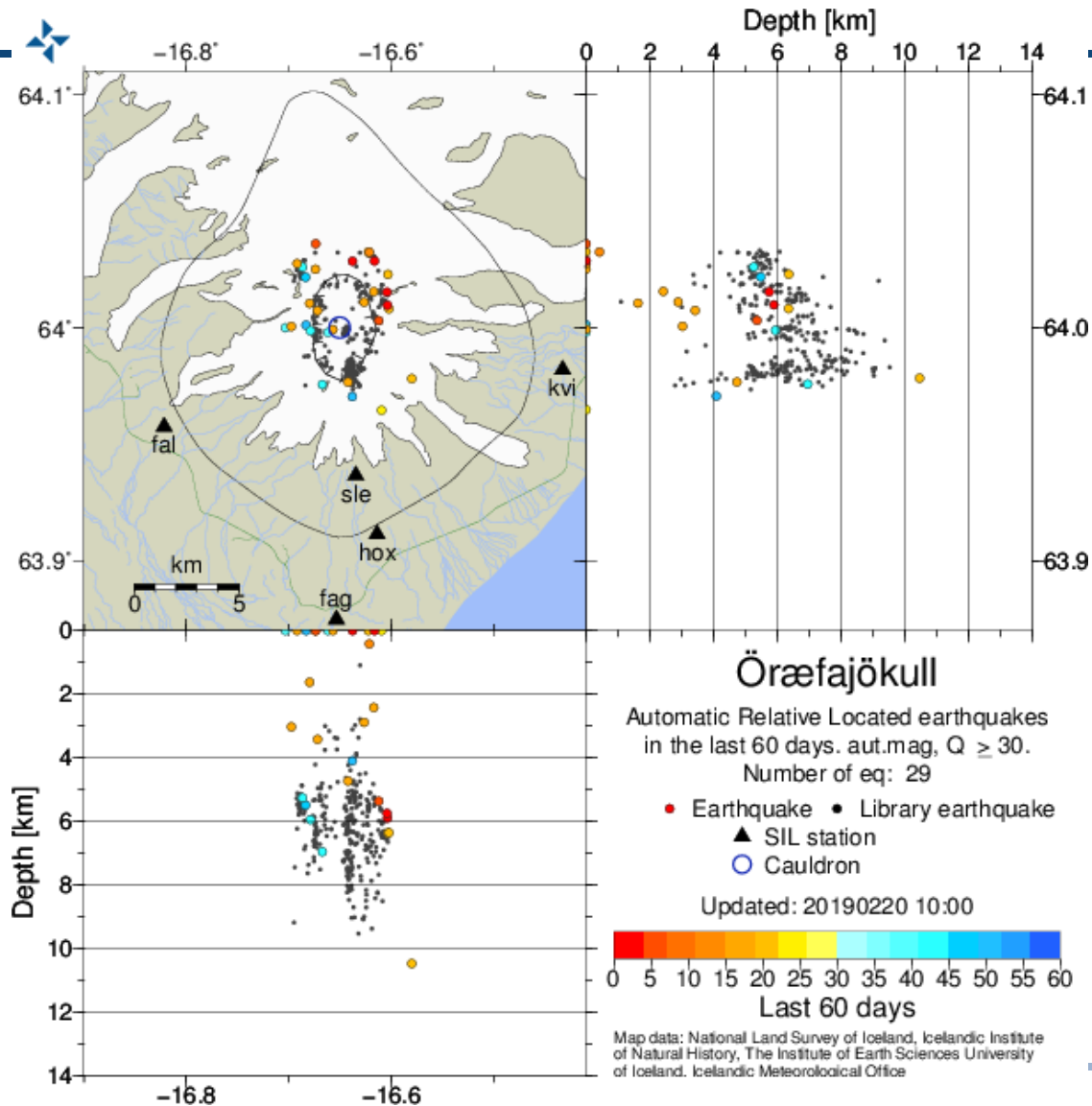

Öræfajökull, Bárðarbunga, Grímsvötn, Katla og Hekla

Kristín Jónsdóttir

20.02.2019

Öræfajökull jarðskjálftar á svipuðum slóðum

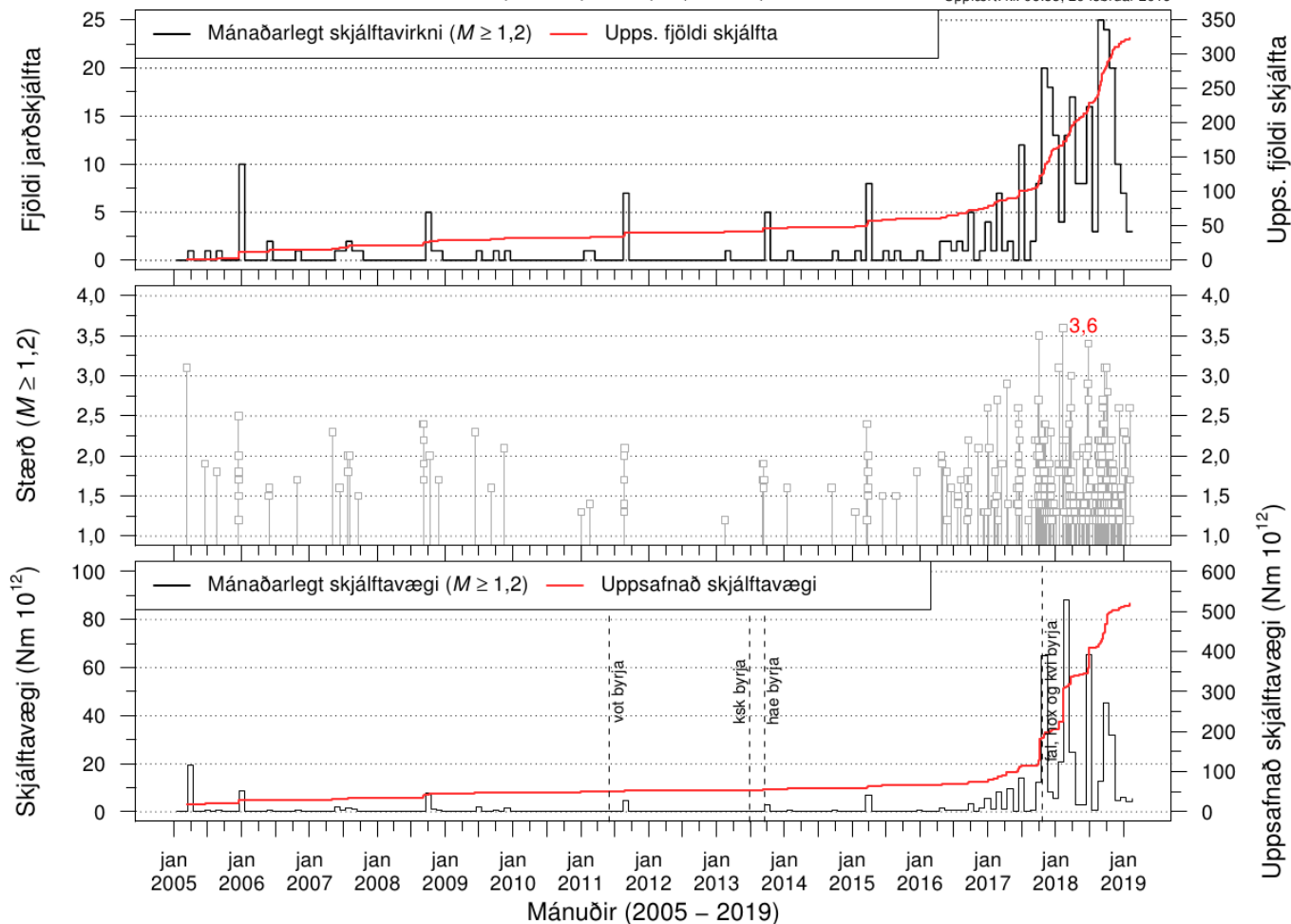


Öræfajökull dregið hefur úr jarðskjálftavirkni!

Jarðskjálftavirkni í Öræfajökli

63,920–64,023° N; 16,490–16,786° V

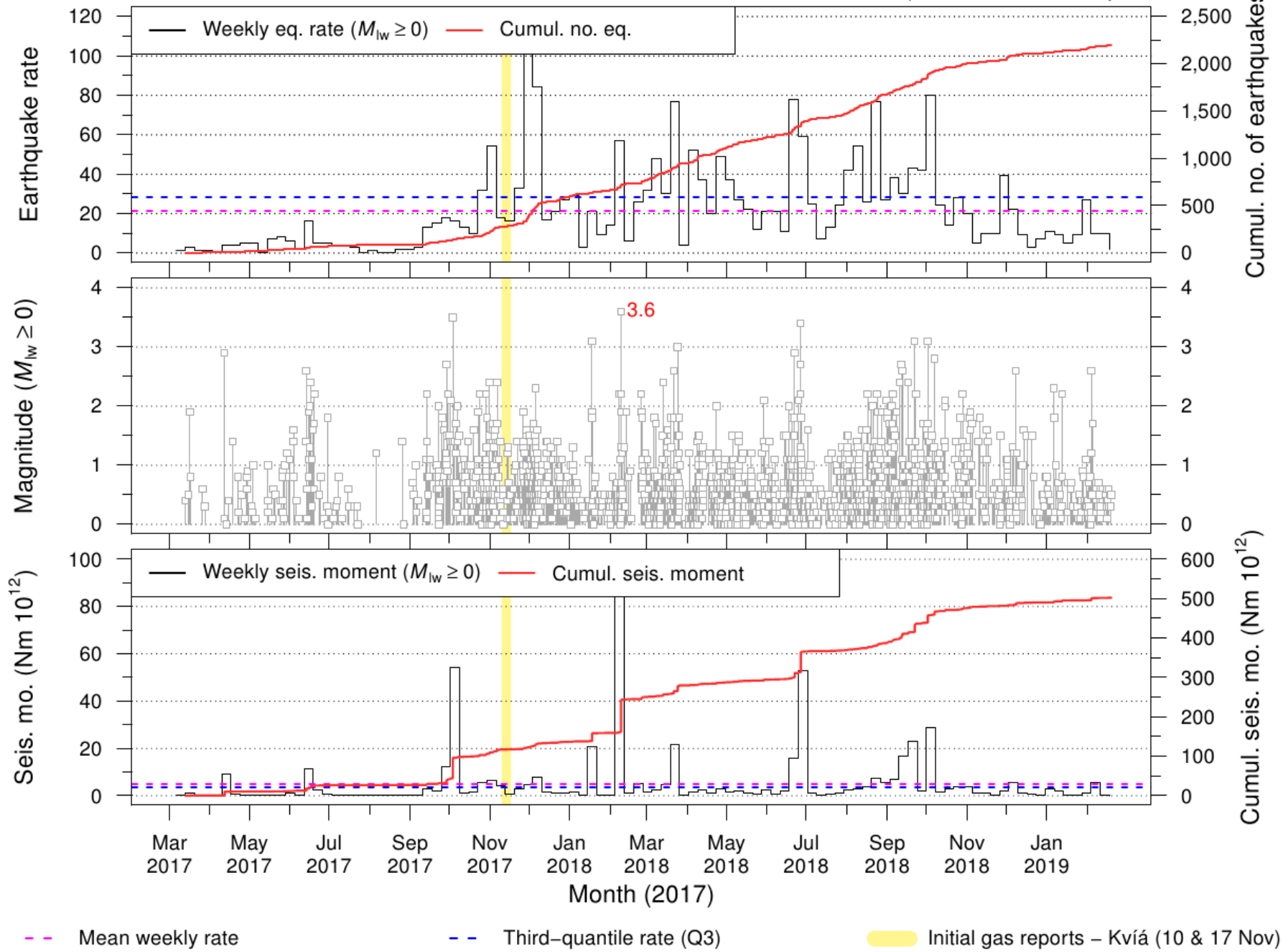
Uppfært: kl. 06:55, 20 febrúar 2019



Seismic Activity at Örfajökull

63.920–64.023° N; 16.490–16.786° W

Updated: 09:30 UTC, 20 February 2019



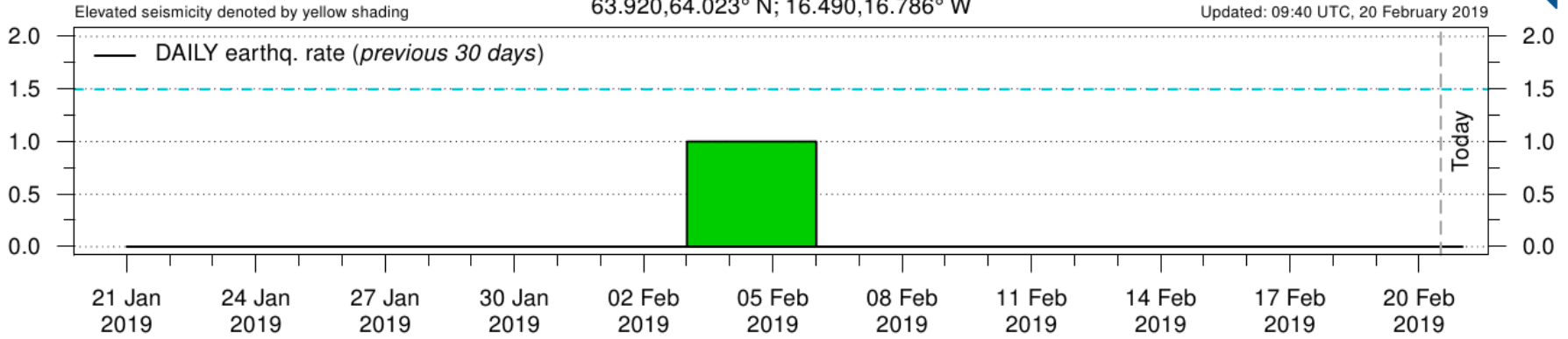
Öræfajökull volcano: $M_{lw} \geq 1.2$

63.920,64.023° N; 16.490,16.786° W

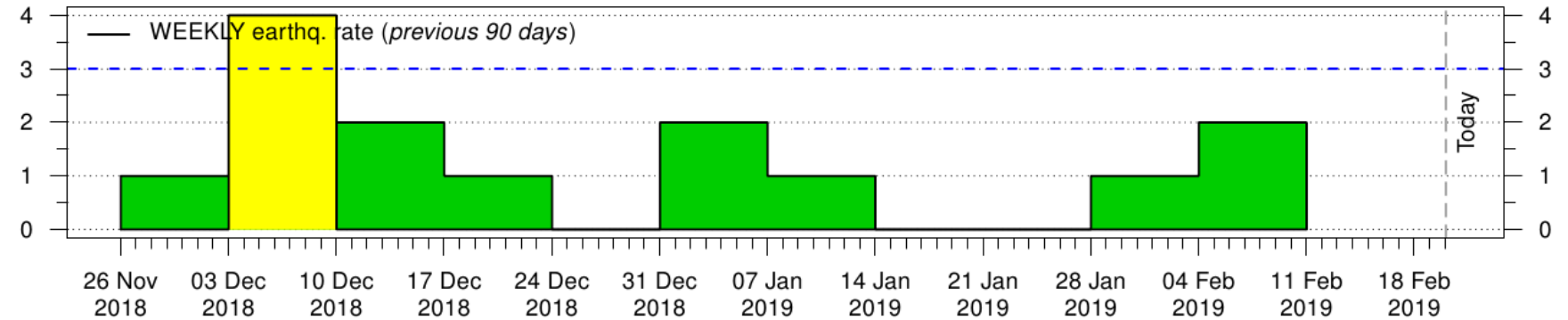
Updated: 09:40 UTC, 20 February 2019



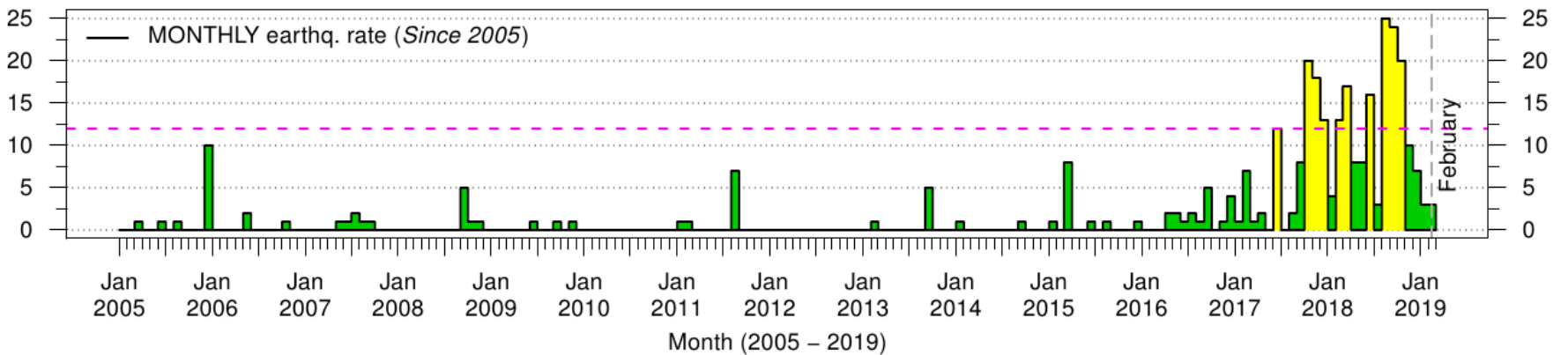
Daily earthq. rate



Weekly earthq. rate



Monthly earthq. rate



— — Third quartile $\times 1.5$ (30 days)

— — Third quartile $\times 1.5$ (90 days)

— — Third quartile $\times 1.5$ (Since 2005)

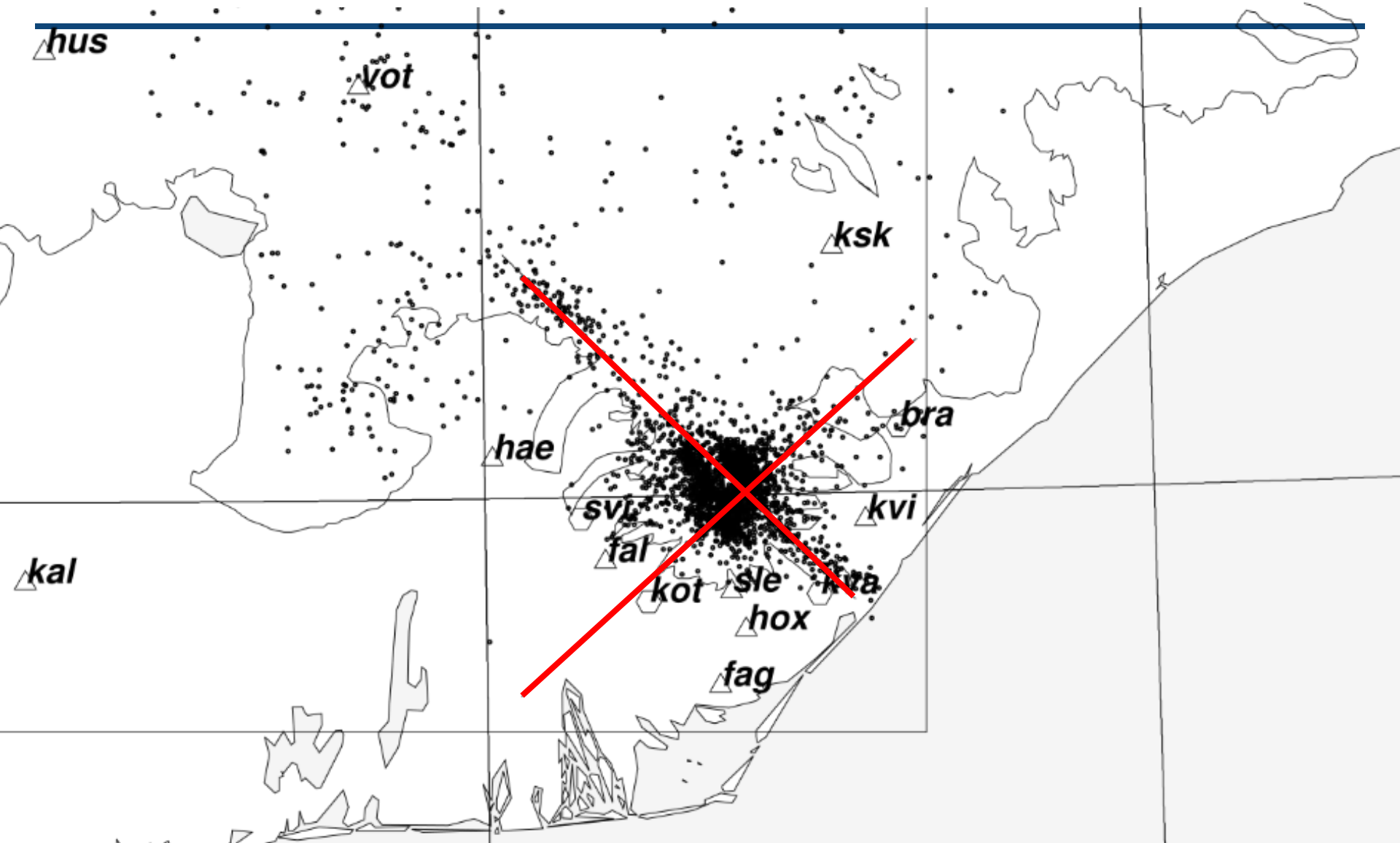
-
- Dregið mikið úr virkni sl. 3 mánuði
 - Er nú á pari við það sem hún var fyrir 2017 (áður en óróleika varð vart)

Nýjustu jarðskjálftarannsóknir á Öræfajökli

Ari Tryggvason í Uppsala
Háskóla í samvinnu við
Stínu Veðurstofu

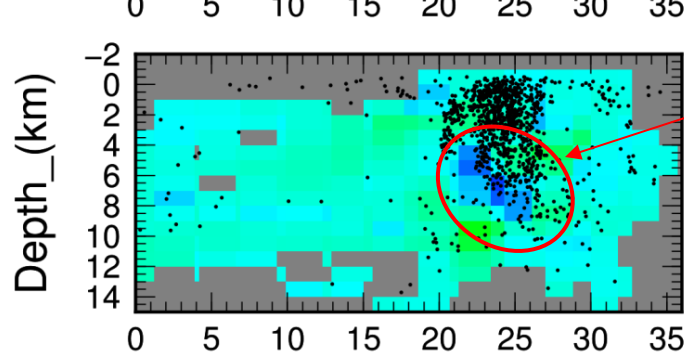
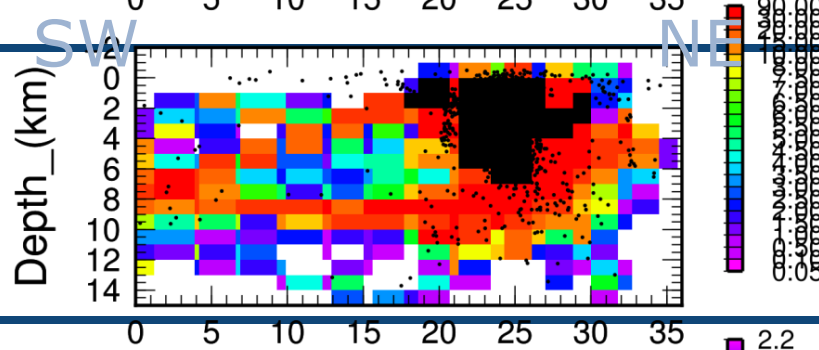
—Local earthquake tomography

Ari Tryggvason –Uppsala University



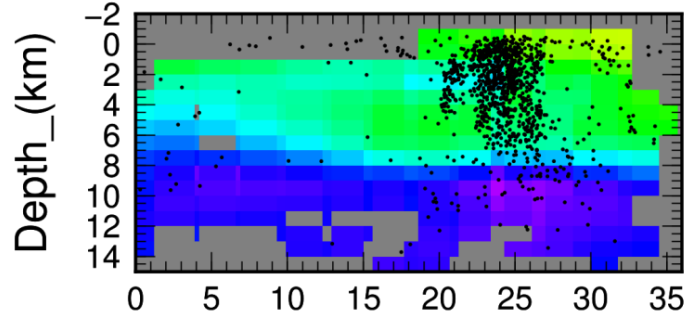


Ray coverage

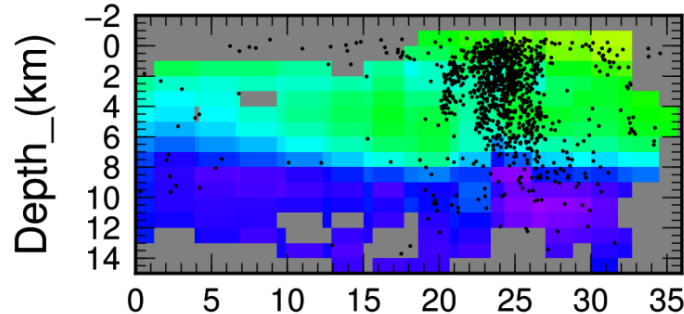


AREA OF HIGH VP/VS ratio!

Vp/Vs ratio

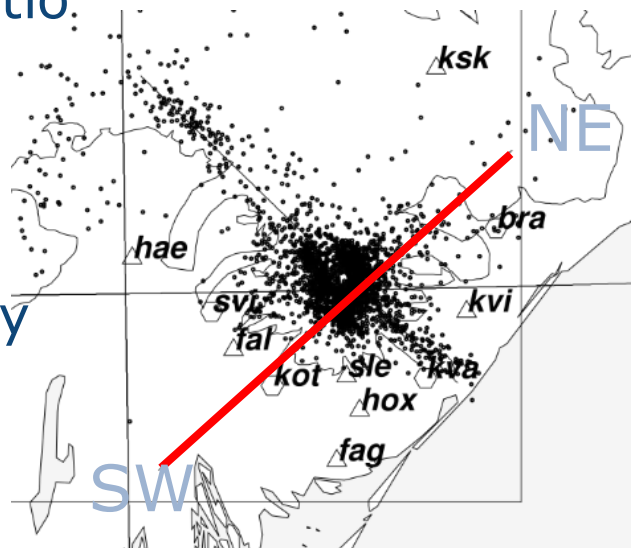


S-velocity



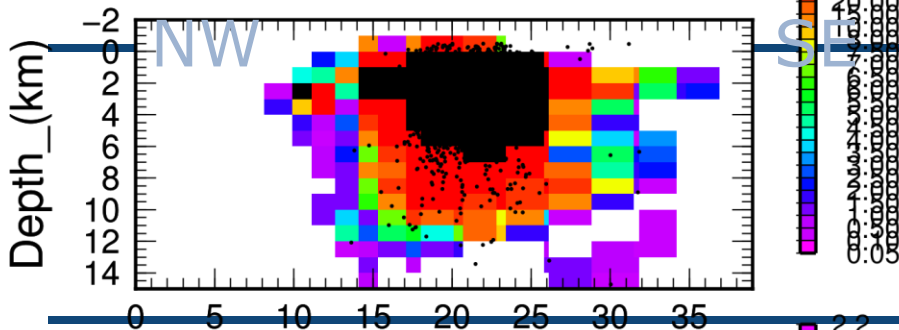
P-velocity

Distance_(km)



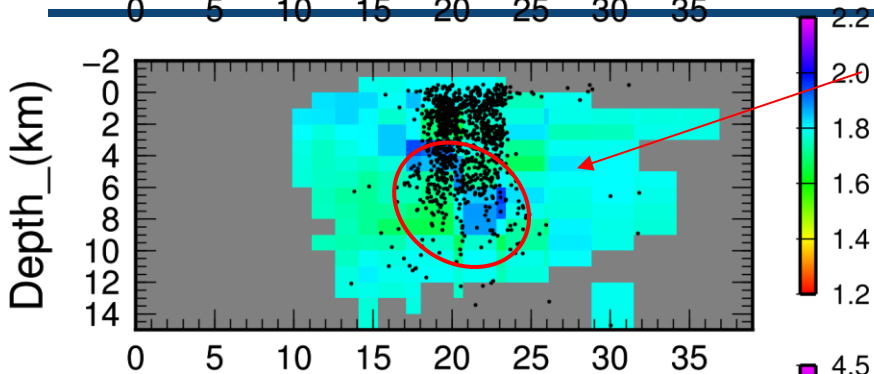


Ray coverage

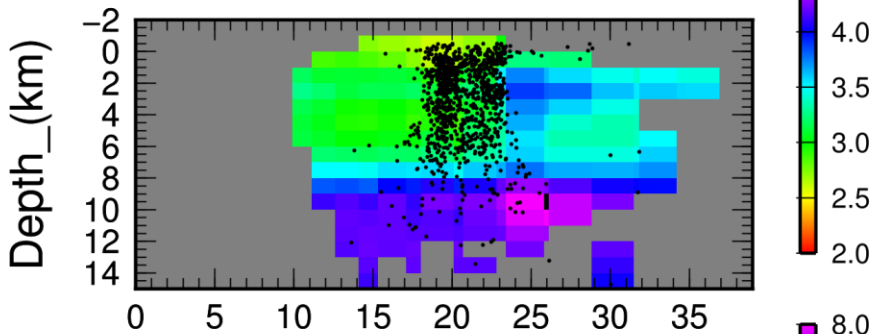


AREA OF HIGH VP/Vs ratio!

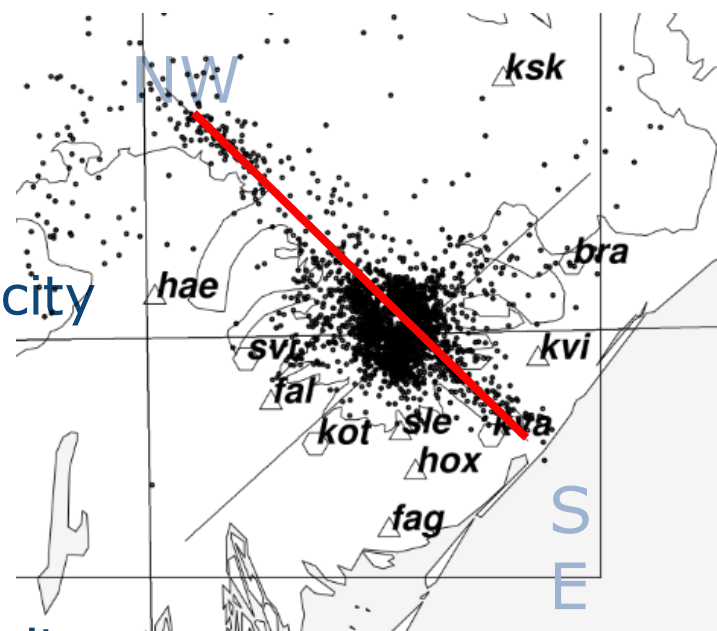
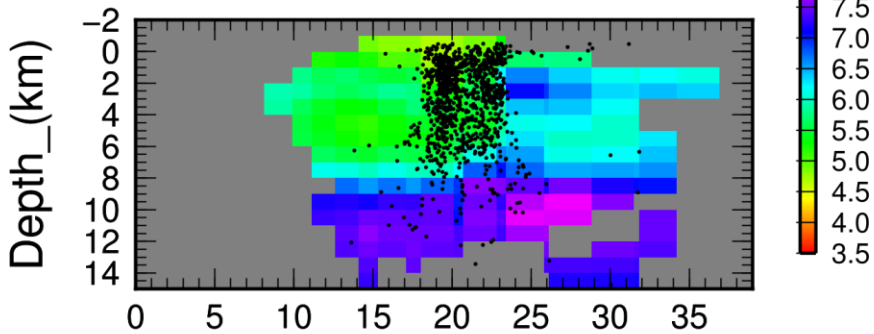
Vp/Vs ratio

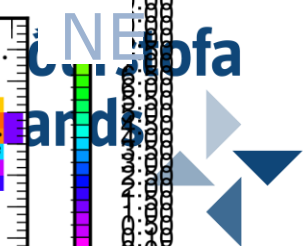
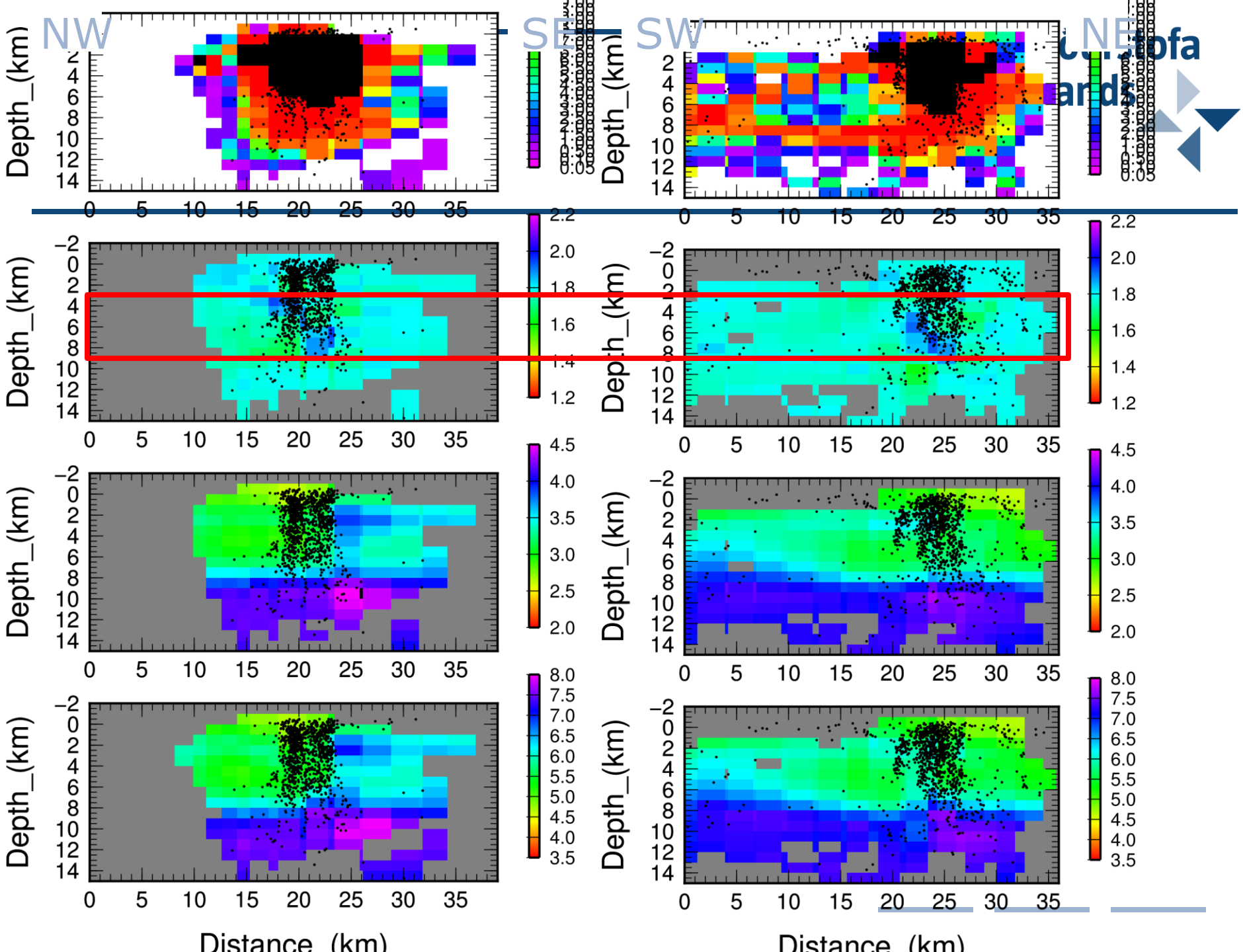


S-velocity



P-velocity





Tómógrafía (unnin með smáskjálftum):

Hátt V_p/V_s hlutfall sést í báðum sniðum á 4-8 km dýpi.

Í báðum sniðum við botn skjálftavirkni.

Há V_p/V_s hlutfall þýðir:

- ▶ Hátt hitastig
- ▶ Hugsanlega bráð (Kvika!)

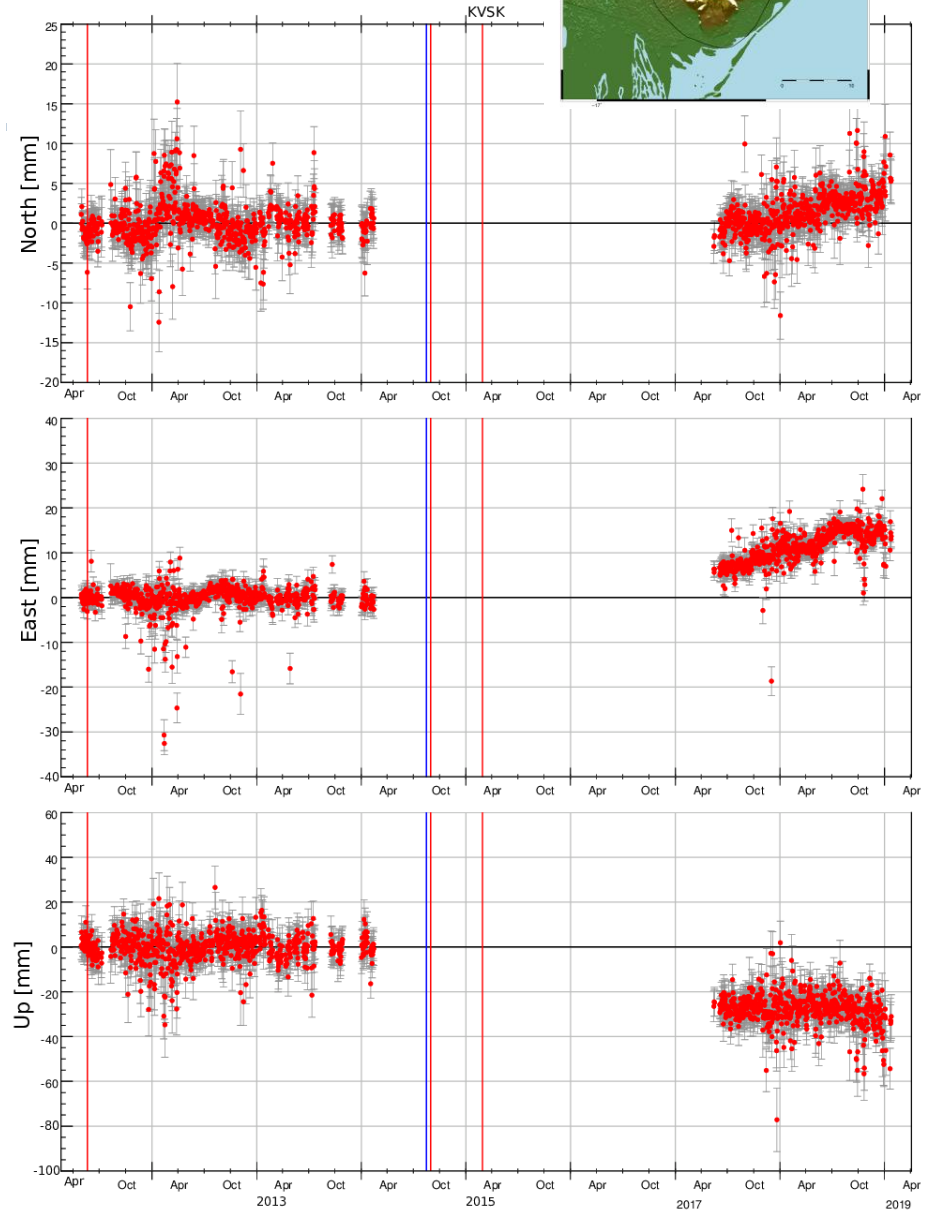
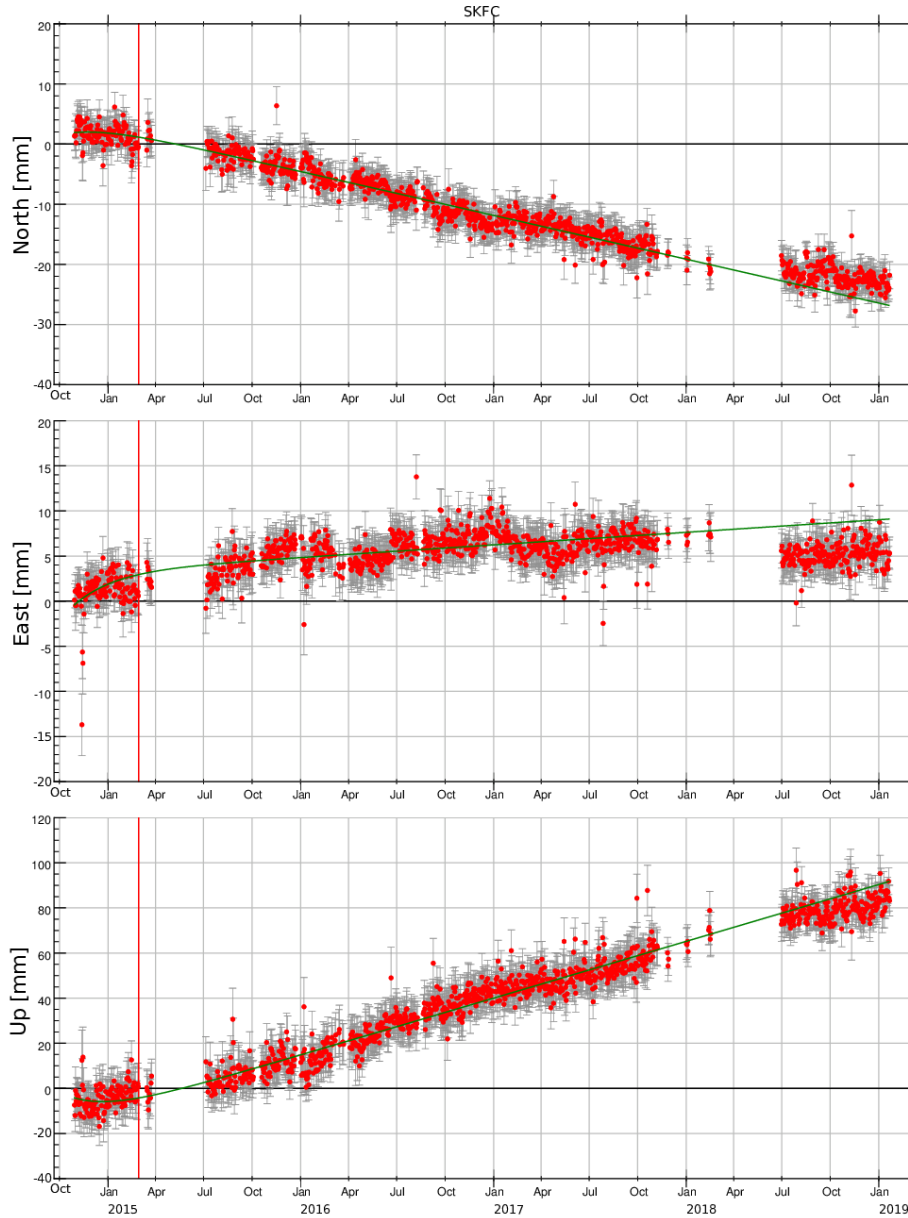
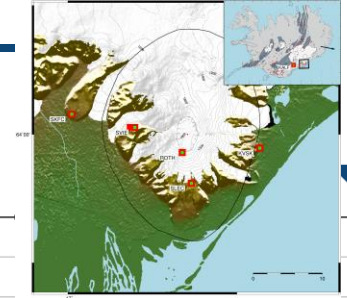
Þetta eru fyrstu niðurstöður og verða skoðaðar meir

Nýdóktor hjá Ara rannsakar Öræfajökul. Notar fleiri stöðvar sem settar voru upp 2018.

AFLÖGUN – GPS

**en ekkert nýtt InSAR (allt hvítt.. Aðferð
virkar ekki!)**

GPS



Öræfajökull
Monitoring Map

Background Imagery:

Landsat 8

Pansharpened

Imagery Acquired:

23-01-2019

12:27:30



Cauldron approx. center:
64°00,015' | -16°39,031'



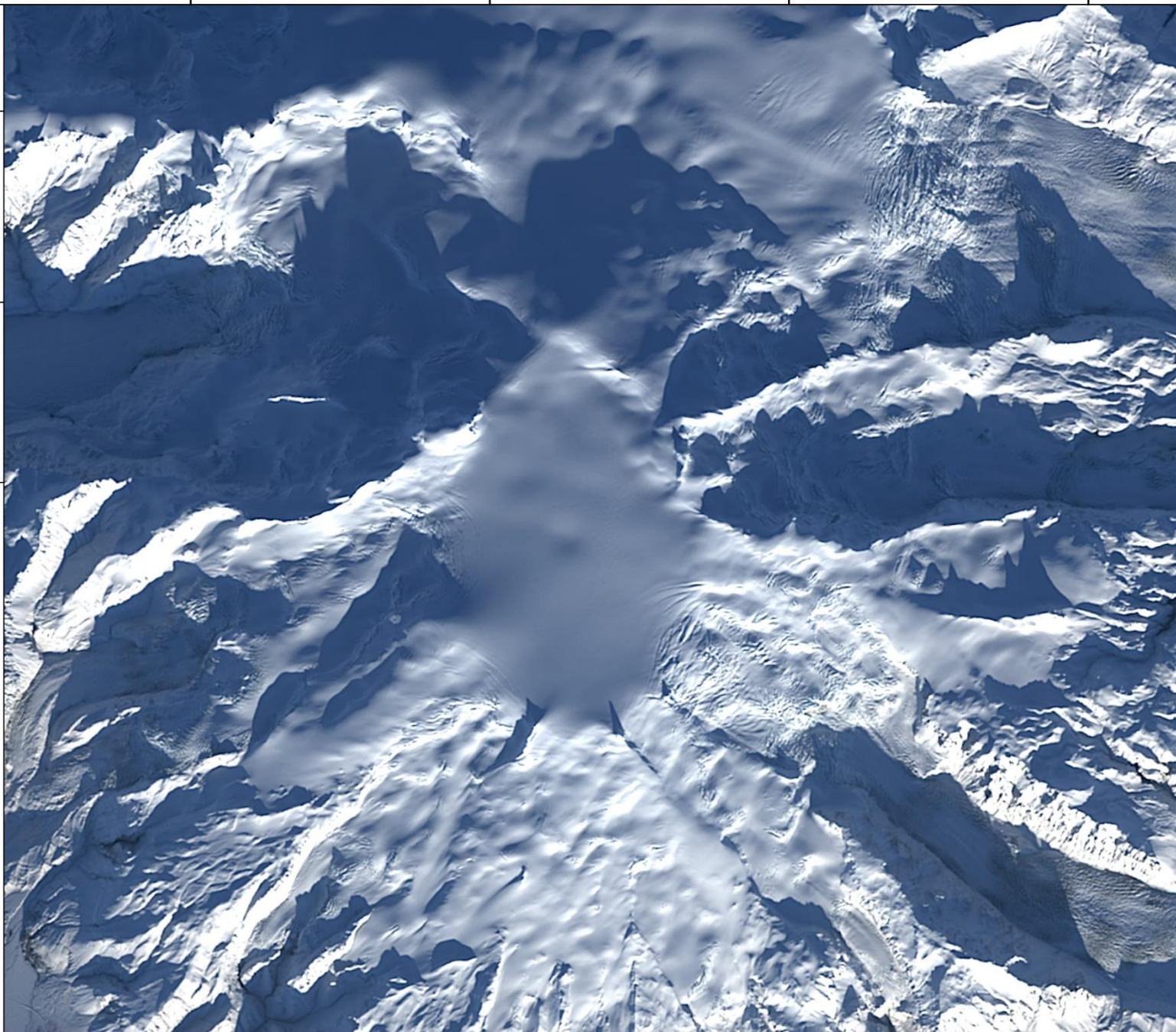
0 1 2 km



Spatial reference system: EPSG 3057

Landsat 8 image courtesy of the U.S.
Geological Survey

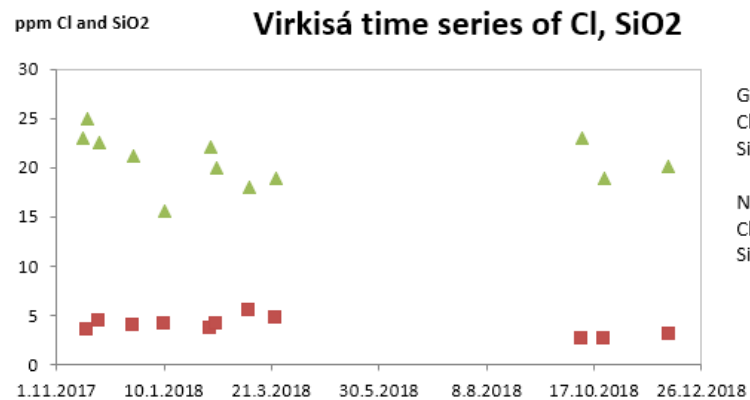
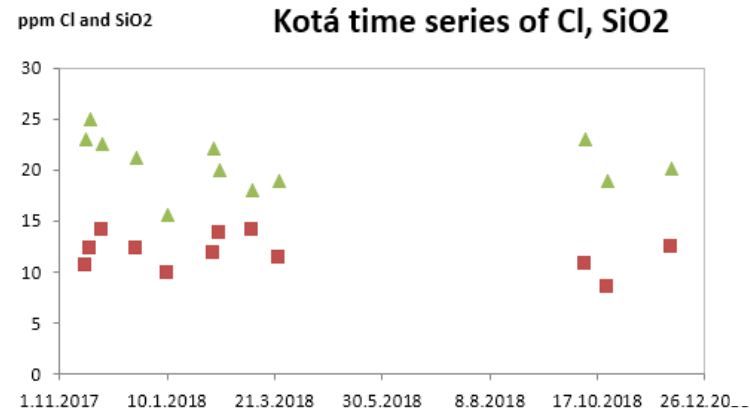
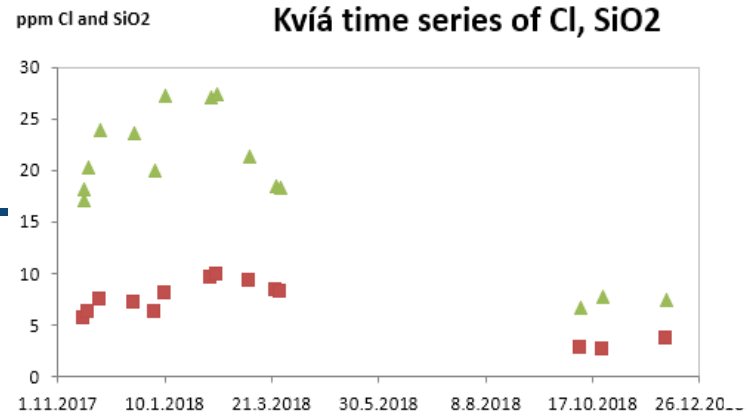
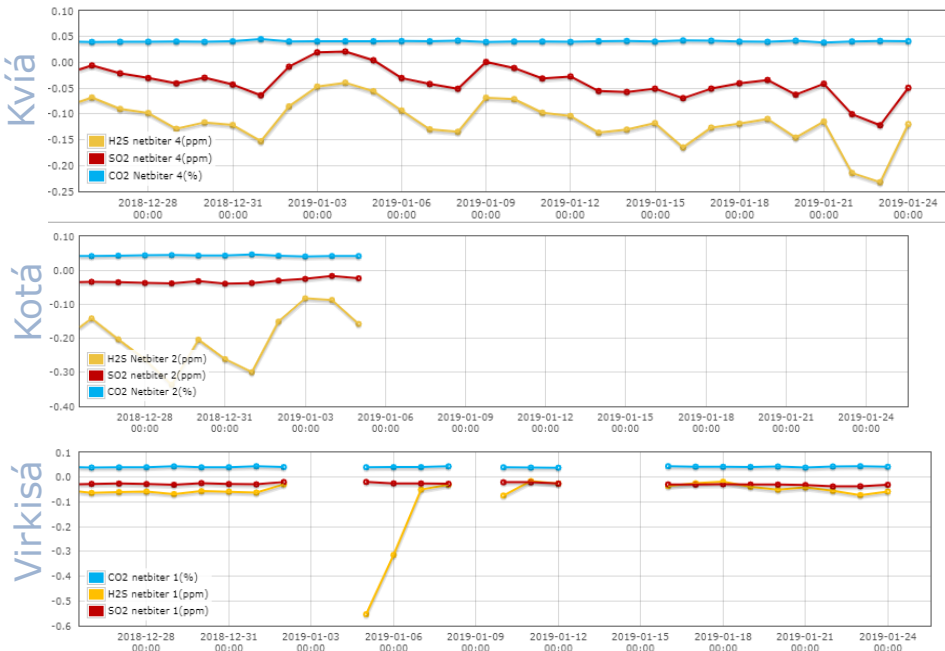
This map was published on
25-01-2019 15:37:01 UTC
by The Icelandic Met Office



Gas og efnagreiningar

Engin gös mælast frá ám Örnafajökuls sl. Mán.

Vatnssýni sýna engar breytingar frá Oct - Dec 2018



Geothermal water:
Cl 30 - 200 ppm
Si 400 - 600 ppm

Non thermal water:
Cl 3.37 ppm
Si 11.5 ppm

■ Cl
▲ SiO2

- **Jarðskjálftavirkni með minnsta móti. Á pari við virkni fyrir 2017. Dregið úr virkni sl. 3 mánuði.**
- **Engar markverðar breytingar í ám (engin merki um jarðhitavirkni)**
- **Aflögunargögn benda til stöðugs innflæðis kviku á svipuðum hraða og áður!**

Öræfajökull

- **GPS mælingar benda til að kvika safnist enn fyrir undir fjallinu (á 4-8 km dýpi). Hugsanlega hefur dregið úr þessum hraða, a.m.k. veldur þessi söfnun ekki miklum skjálftum.**
- **Ennþá mælist því óróleiki í fjallinu (þó dregið hafi úr)**
- **engar vísbendingar eru um að óróleikinn aukist (hvorki skjálftar, GPS eða efna/gas mælingar)**



Öræfajökull - Svínafellsheiði

- Það hefur mælst **lítil hreyfing frá því í haust.** Frá upphafi mælinga er etv. 1,5 mm færsla á öðrum togmælinum og 0,7 á hinum.
 - Við teljum líklegast að hlíðin hafi lítið hreyfst í vetur, en við vitum ekki hvernig hreyfingin þarna á sér stað. Mögulega gerist hún í rykkjum, og kannski er hún árstíðarbundin, mest á vorin eða haustin.
 - Það hafa verið rafmagnsvandræði og það er stefnt á feltferð núna sem fyrst til þess að koma á rafmagni fyrir togmælana og aðskilja þá GPS stöðvunum. Þá væri hægt að skoða svæðið og sjá hvort einhverjar sprungur í snjó bendi til hreyfingar.
-

- **Við viljum bæta við ca 4 togmælum í ár. Síritandi togmælar eru bestu mælarnir sem við höfum til að fylgjast með gliðnun á sprungum, en það er mikilvægt að hafa þá á nokkrum stöðum ef við viljum hafa hugmynd um það sem er að gerast á svæðinu. Þetta eru bara punktmælingar og hætta á að við missum af einhverju ef við höfum þetta ekki á nokkrum stöðum.**
- **Hlíðin verður væntanlega TLS skönnuð aftur í sumar, og feltferðir farnar til þess að mæla handvirkt á sömu stöðum og áður. Net jarðskjálftamæla væri spennandi. Einnig þarf að skoða alvarlega InSAR radar á jörðu niðri.**

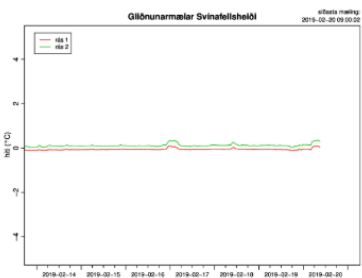
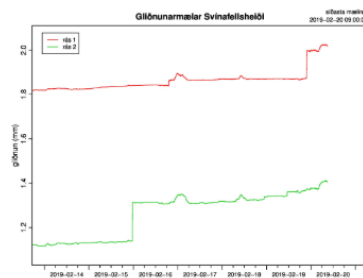
Vöktun Svínafellsheiði hjá náttúruvársérfræðingum 24/7

http://brunnur.vedur.is/gps/skridurogflod/svinafellsheidi/svinafellsheidi_voktun.html

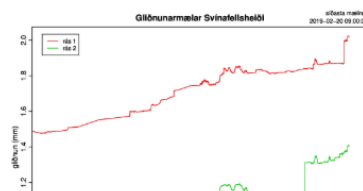
SVÍNAFELLSHEIÐI - VÖKTUN

TOGMÆLAR

VIKA - GLIÐNUN OG HITI



MÁNUÐUR - GLIÐNUN



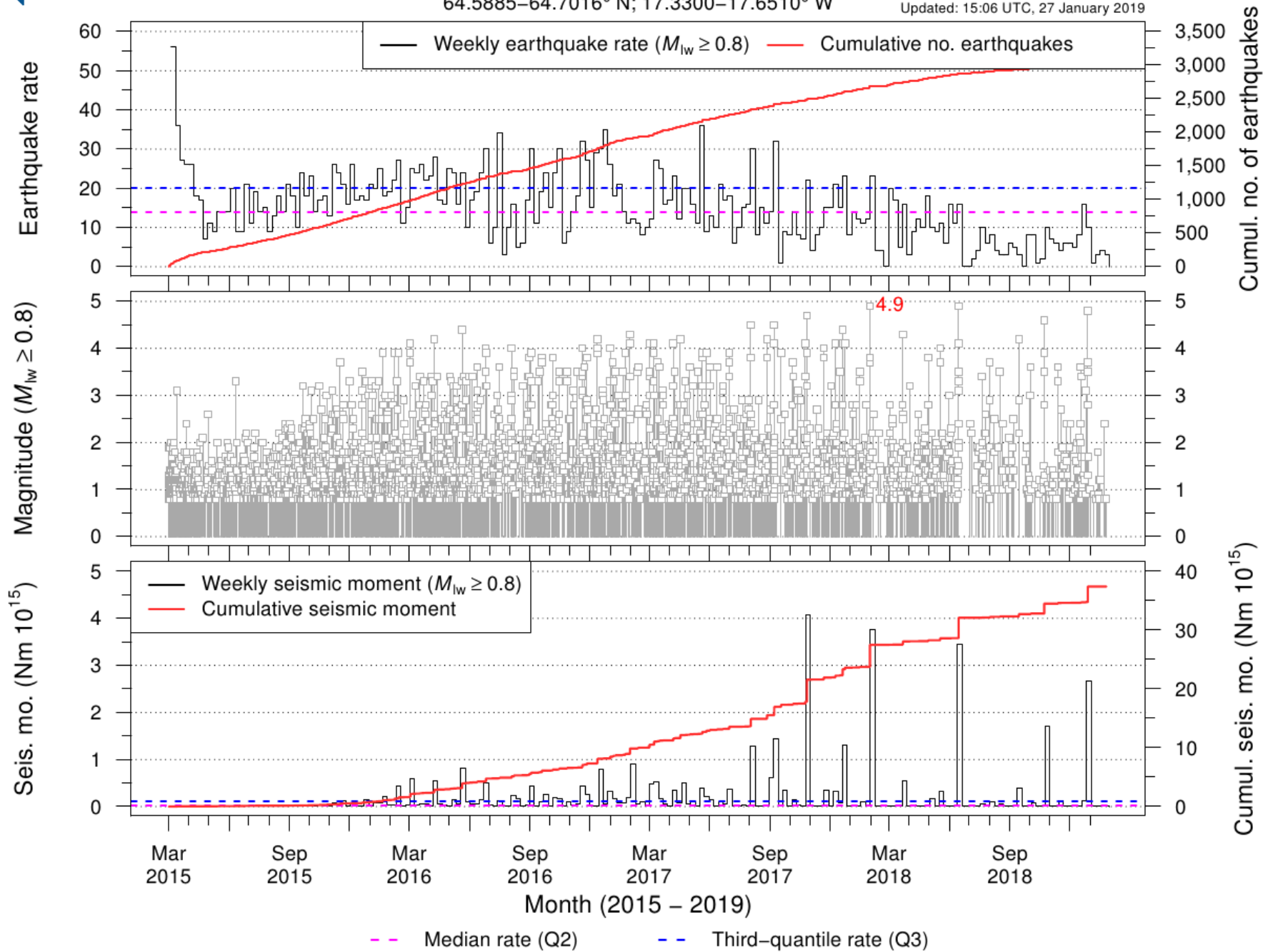
Bárðarbunga



Bárðarbunga caldera

64.5885–64.7016° N; 17.3300–17.6510° W

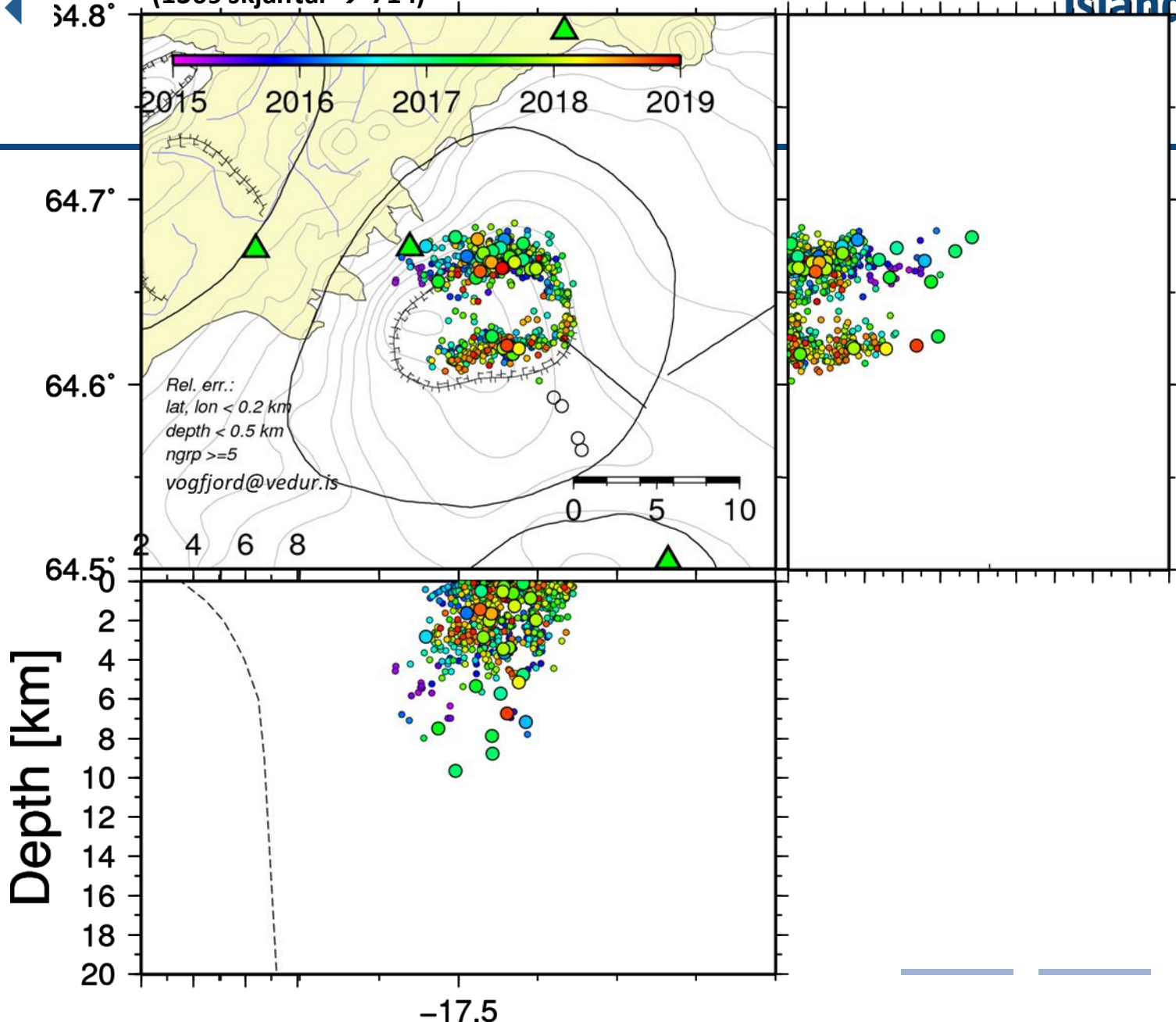
Updated: 15:06 UTC, 27 January 2019



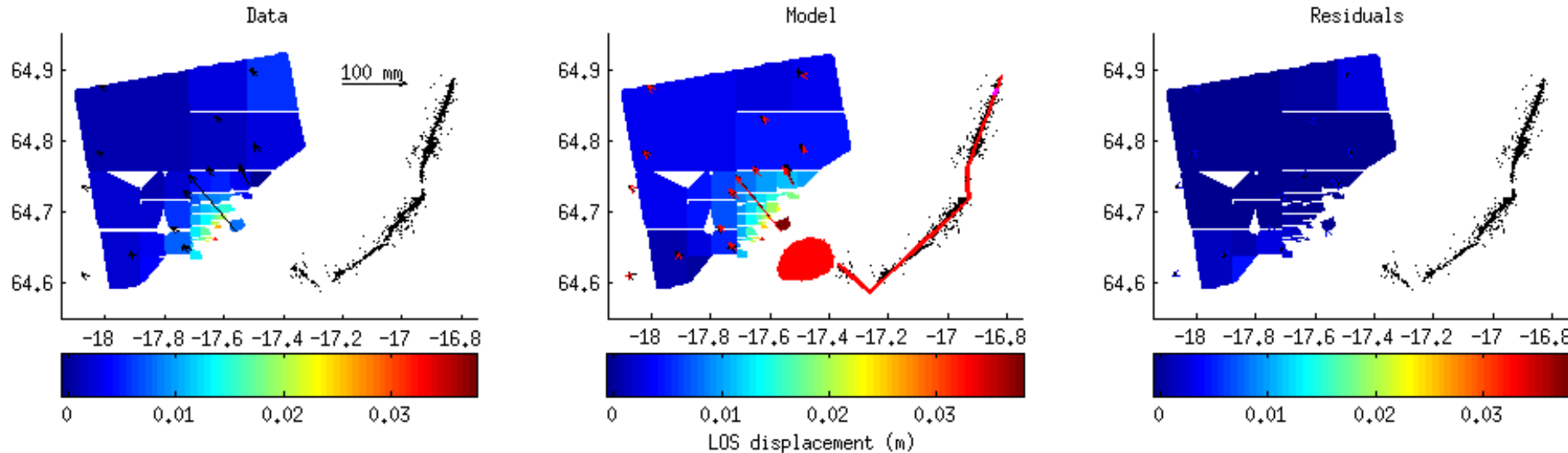
Bárðarbunga events $M \geq 1.4$

(1369 skjálftar \rightarrow 714)

Depth [km]



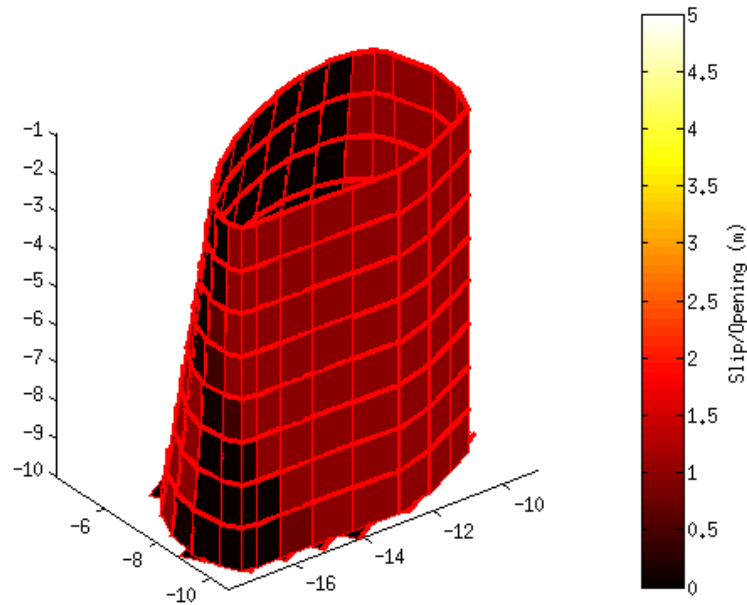
Líkön af kvikusöfnun í Bárðarbungu



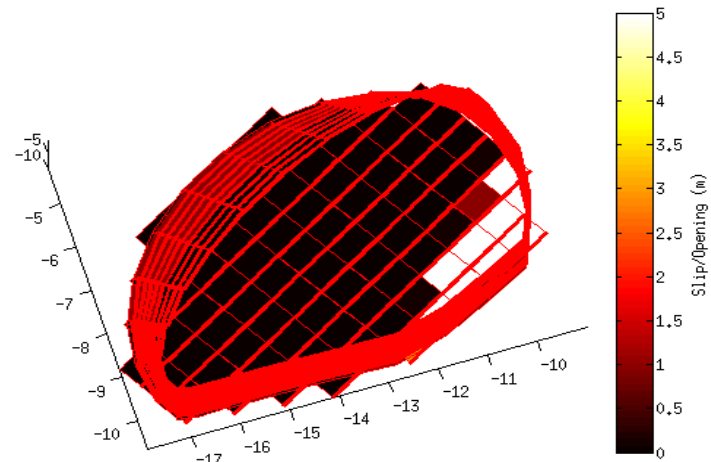
Estimated volume change per year is 0.037 km³. Since the end of the eruption the total volume change ~ 0.15 km³.

Deformation data, model and residuals

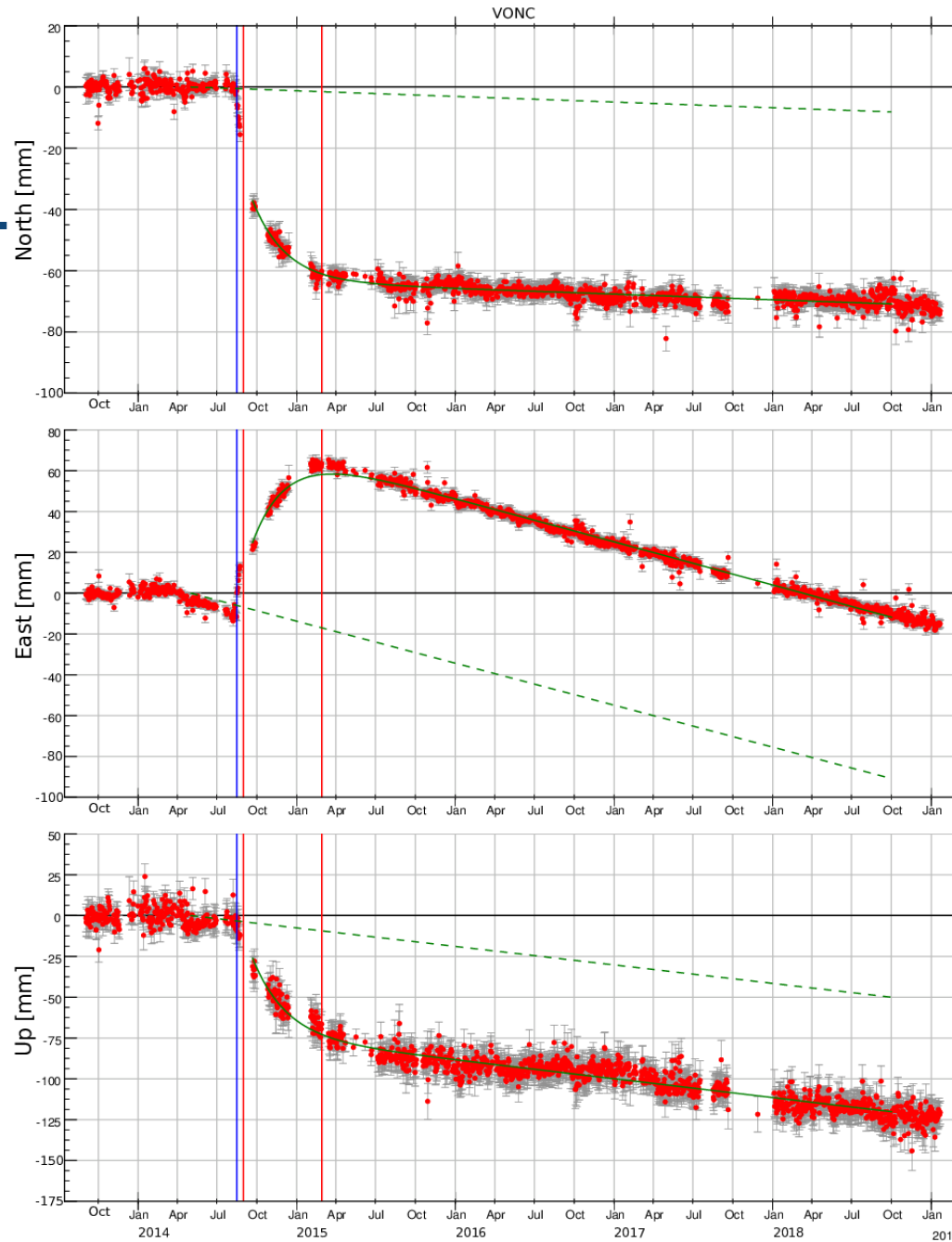
Slip on ring fault



Opening of sill at 10 km



GPS



Bárðabunga Monitoring Map

Background imagery

Landsat 8
Pansharpen

Imagery Acquired:

23-01-2019
12:27



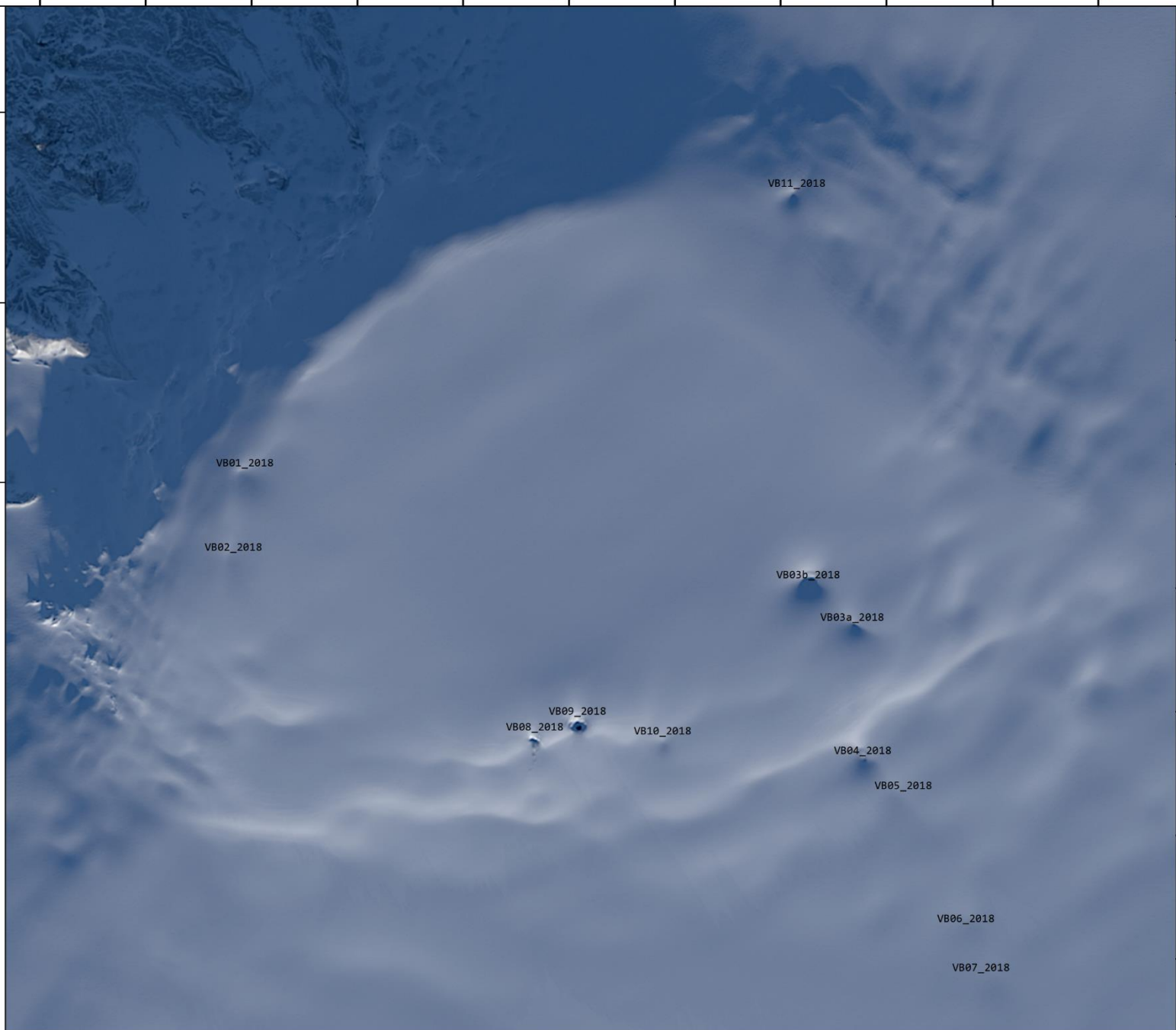
0 1 2 km



Spatial reference system: EPSG 3057

Landsat 8 image courtesy of the U.S.
Geological Survey.

This map was published on
25-01-2019 15:46:24 UTC
by The Icelandic Meteorology Office



Samantekt Bárðarbunga

- Jarðskjálftum fækkar, en fleiri stærri mælast. ?!
- Mikil þensla – kvikusöfnun.
- Hugsanlega er annað grynna kvikuhólf?!

Hvað þýðir þetta?

- Fjallið er órólegt –kvikusöfnun í gangi!

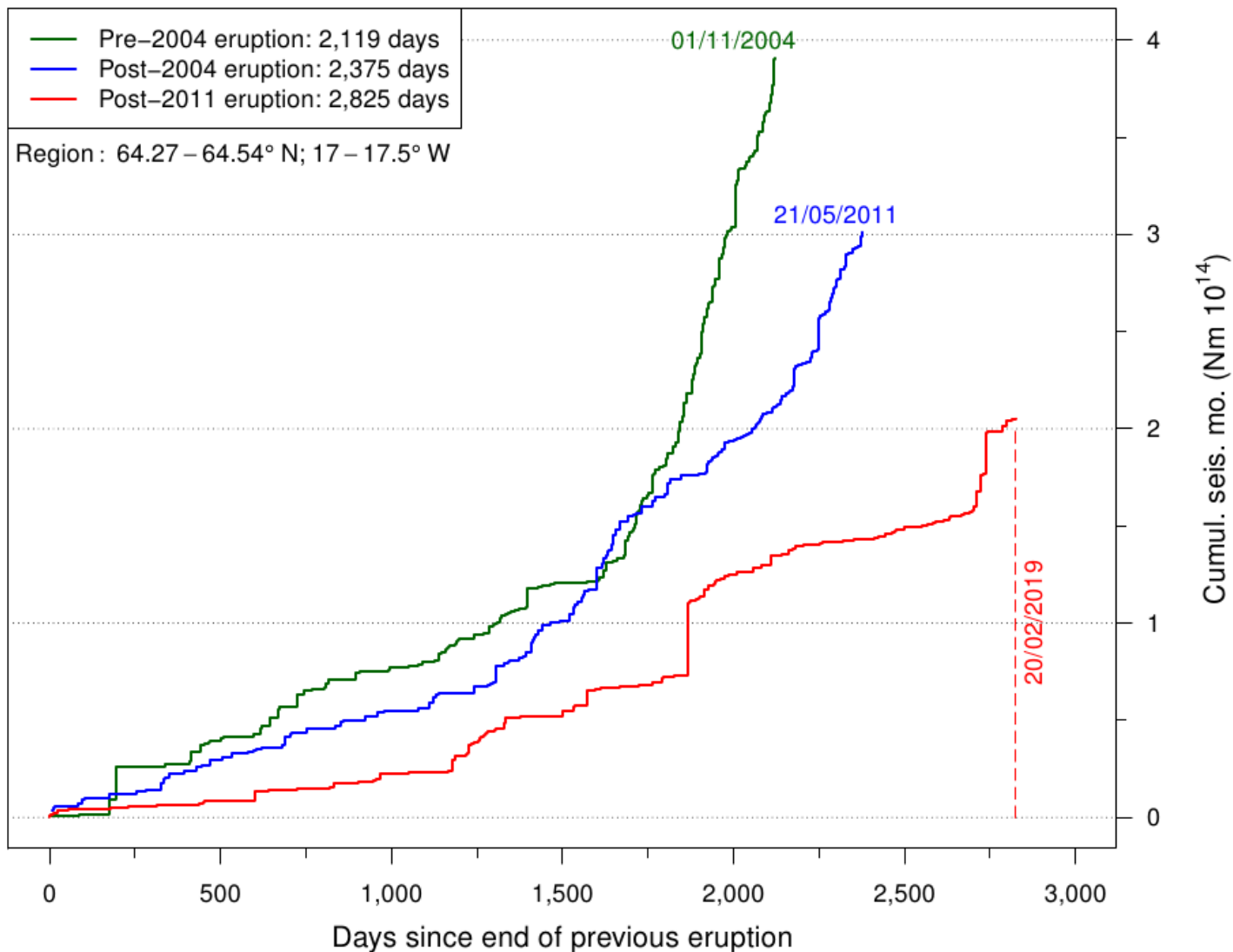
Grímsvötn

Grímsvötn



Grímsvötn: cumulative seismic moment ($M_{lw} \geq 1$)

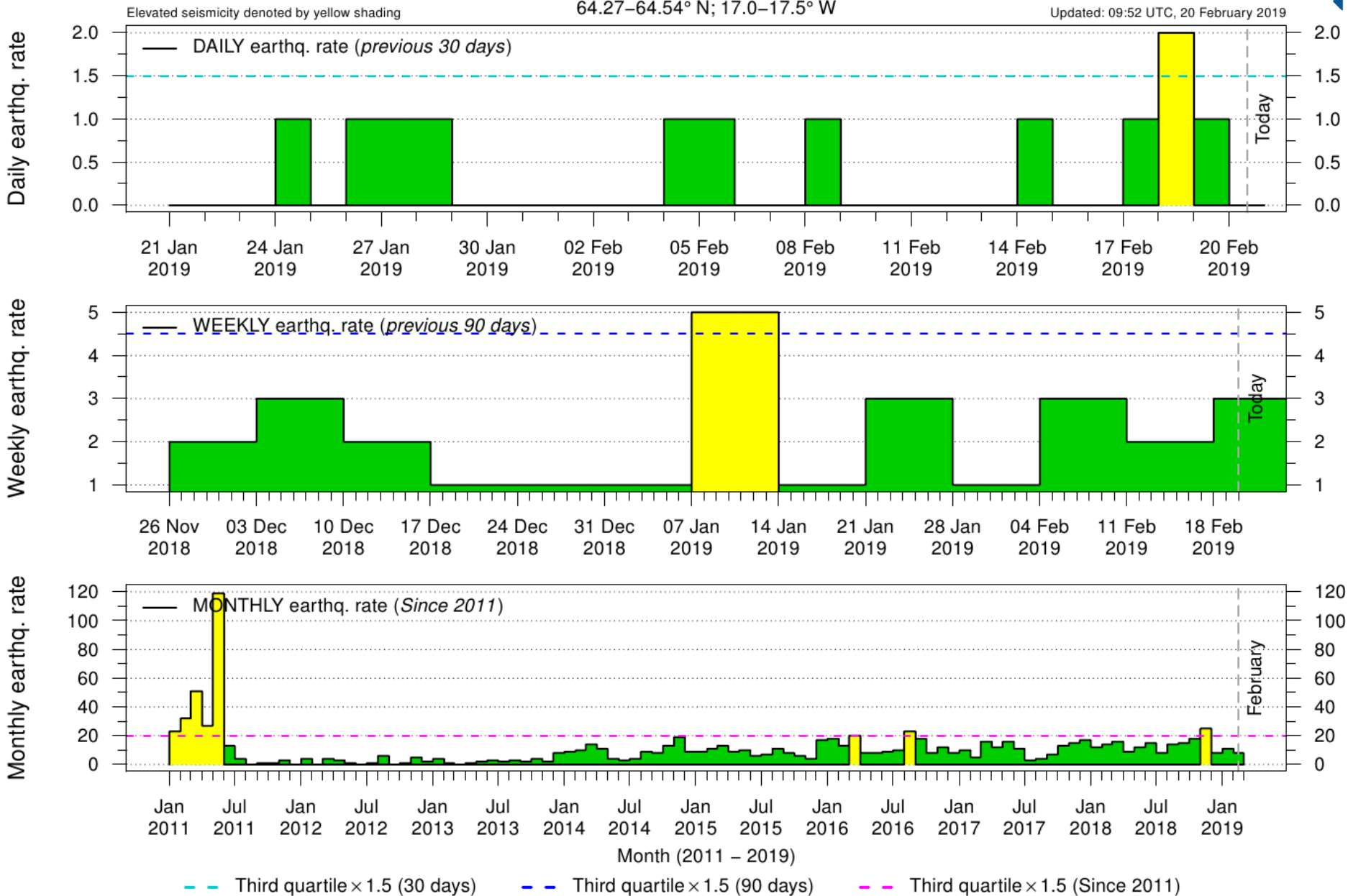
Eruption periods: 18/12/1998 – 12/01/1999, 01/11/2004 – 07/11/2004, & 21/05/2011 – 28/05/2011

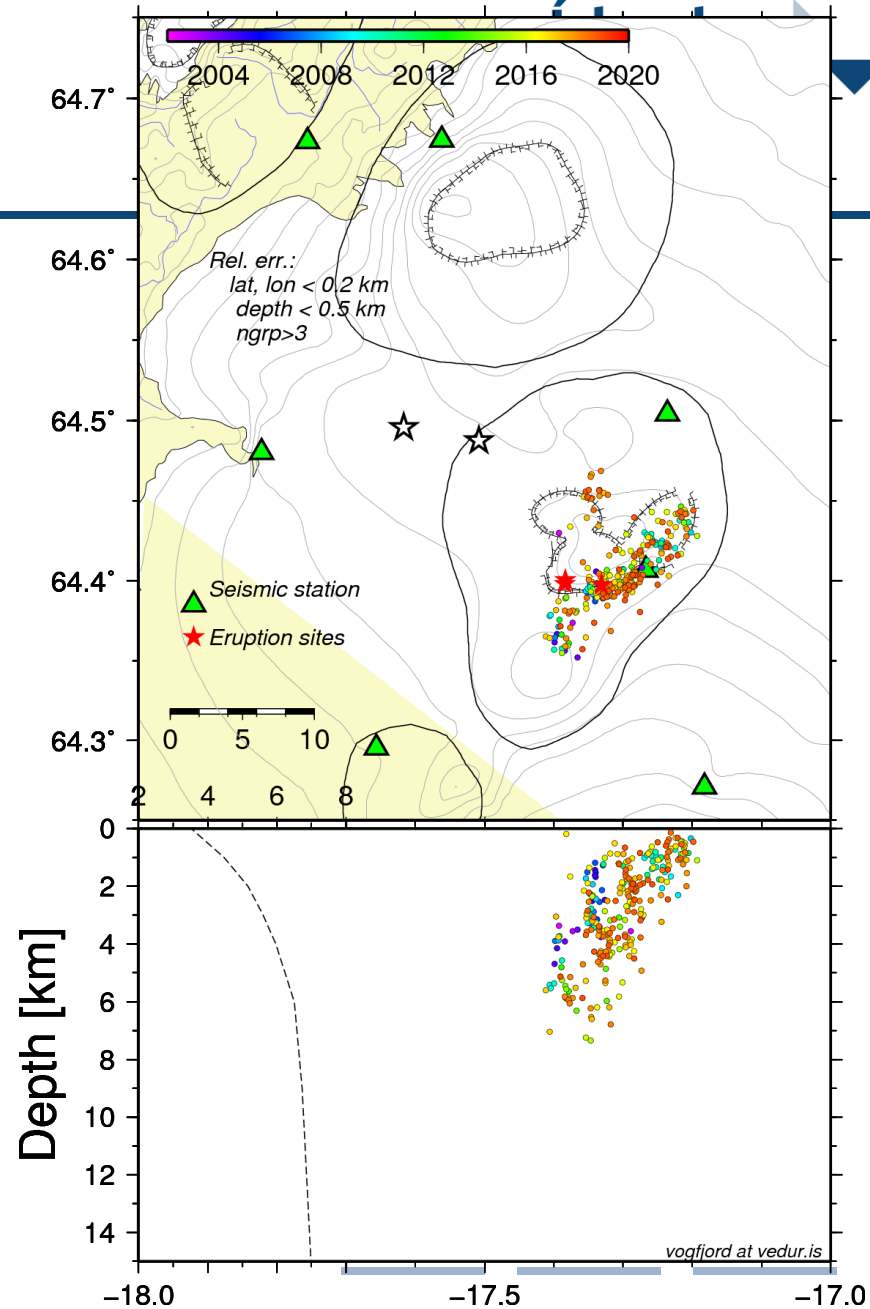
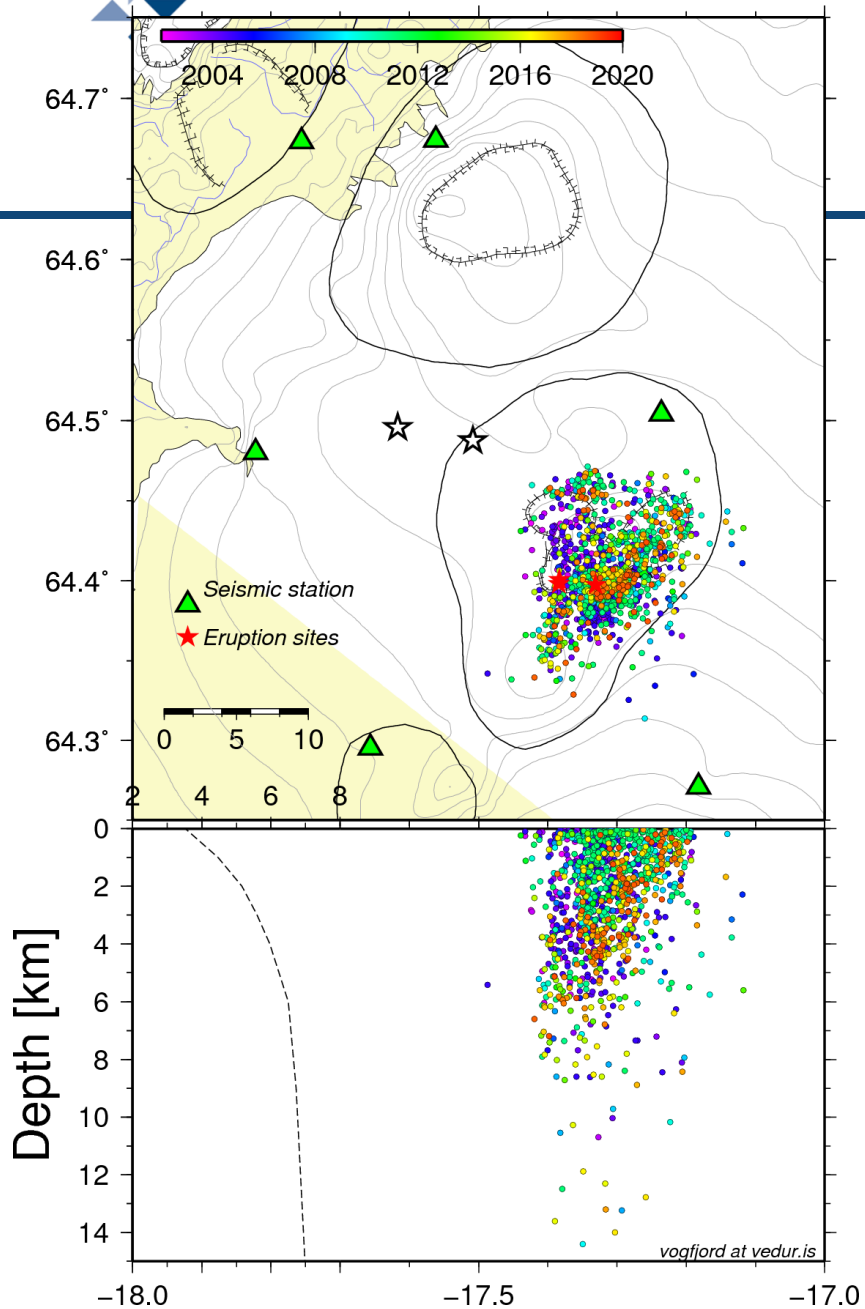


Grímsvötn volcano: $M_{lw} \geq 0.8$

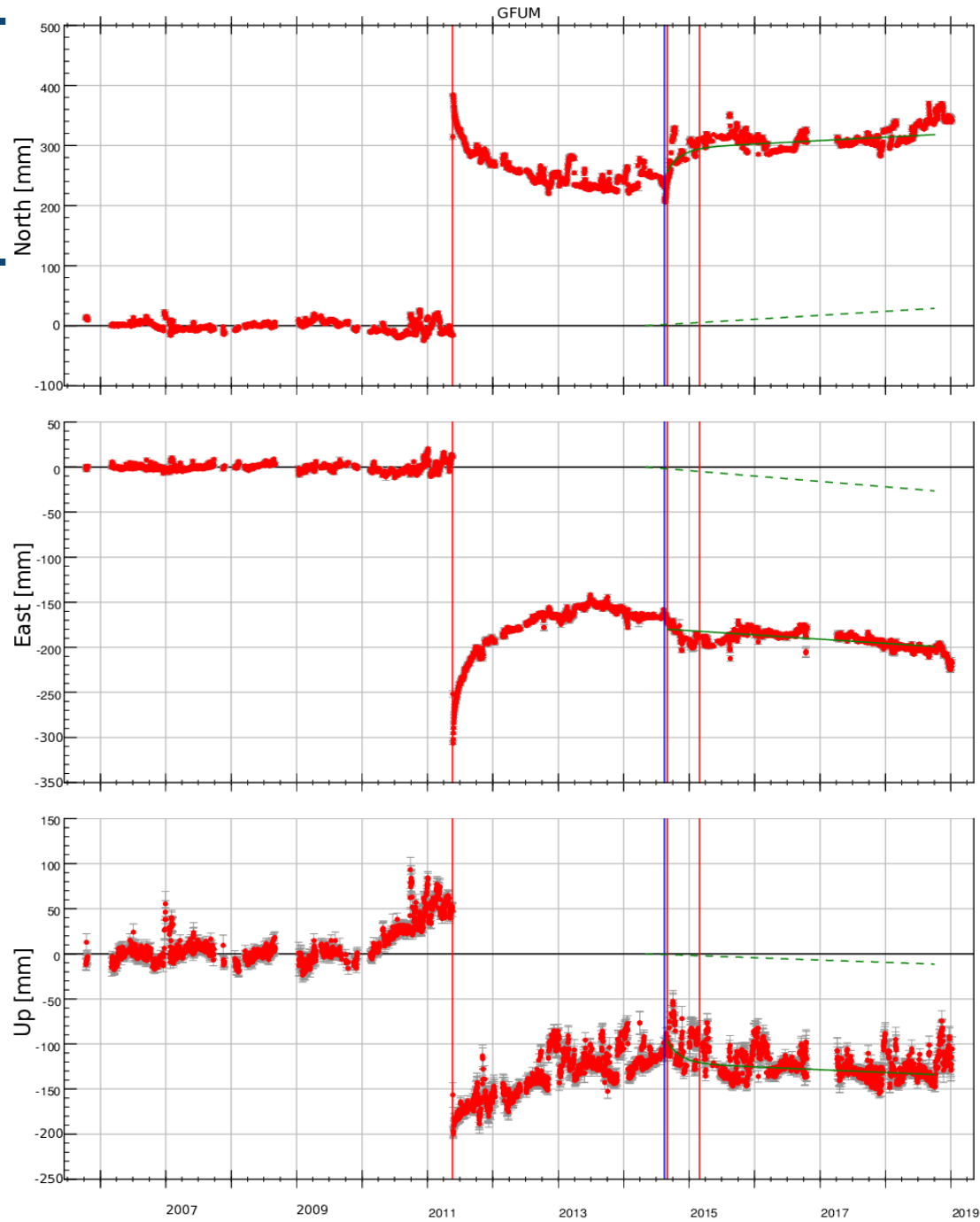
64.27–64.54° N; 17.0–17.5° W

Updated: 09:52 UTC, 20 February 2019





GPS



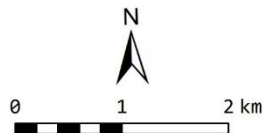
Grímsvötn Monitoring Map

Background imagery

Landsat 8
Pansharpen

Imagery Acquired:

23-01-2019
12:27

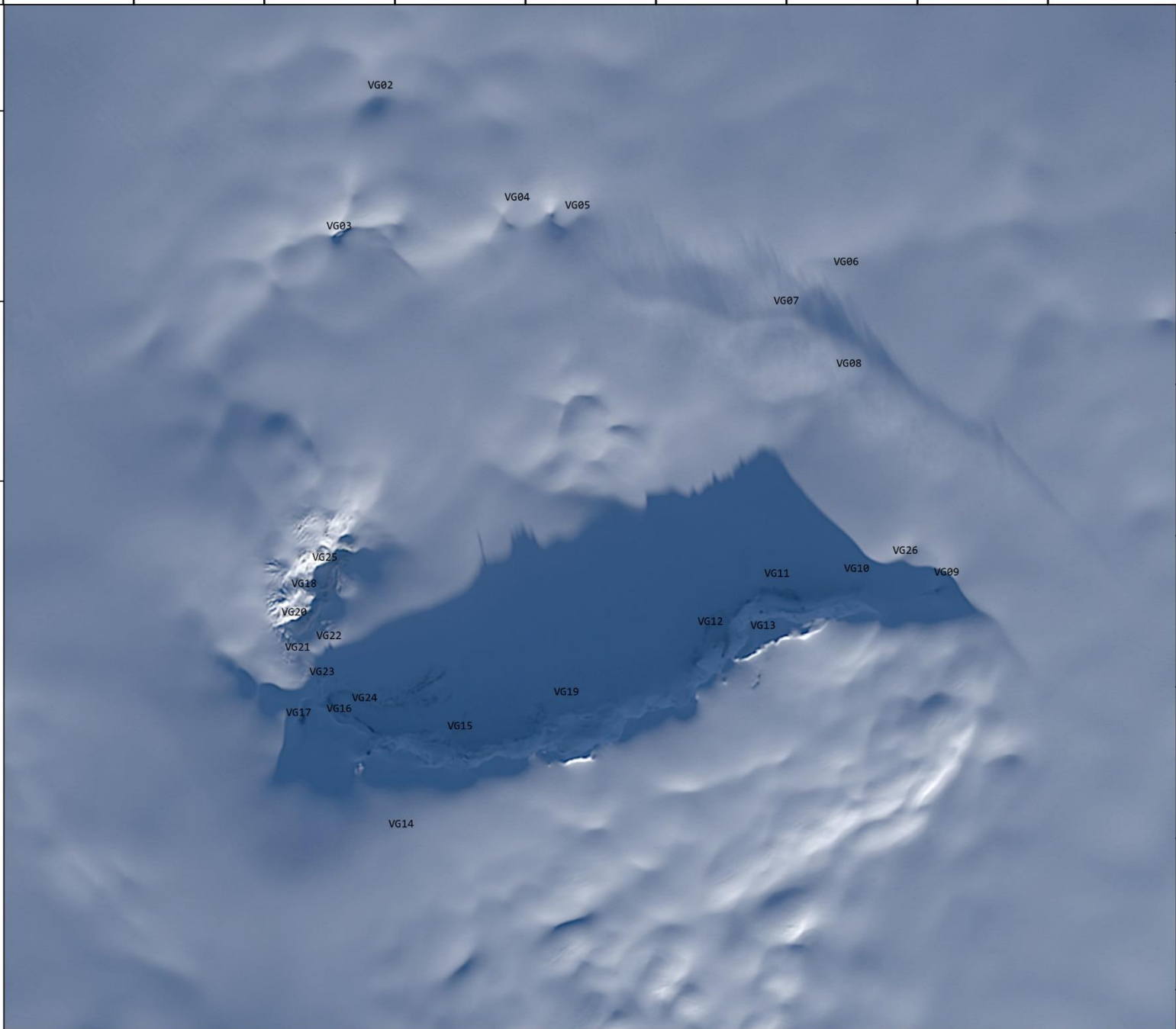


Spatial reference system: EPSG 3057

Ice cauldrons supplied by The Institute of Earth Sciences, University of Iceland.

Landsat 8 image courtesy of the U.S. Geological Survey.

This map was published on
27-01-2019 20:10:11 UTC
by The Icelandic Met Office



**MultiGAS- mælingar gerðar 16 and 17 Nov, 21 and 22 Dec
2018.**

EKKERT SO₂ = EKKERT KVIKUGAS

**CO₂/H₂S hlutfall fékkst ekki vegna raka, en gögn virðast
eðlileg**

Samantekt Grímsvötn

- Jarðskjálftavirkni eðlileg bakgrunnsvirkni
- Aflögun bendir til þenslu og kvikusöfnunar

Hvað þýðir þetta?

- Með því að bera saman orkuútlausn skjálfta og aflögun nú og fyrir síðustu gos þá er ennþá eitthvað í næsta gos (months, years?)

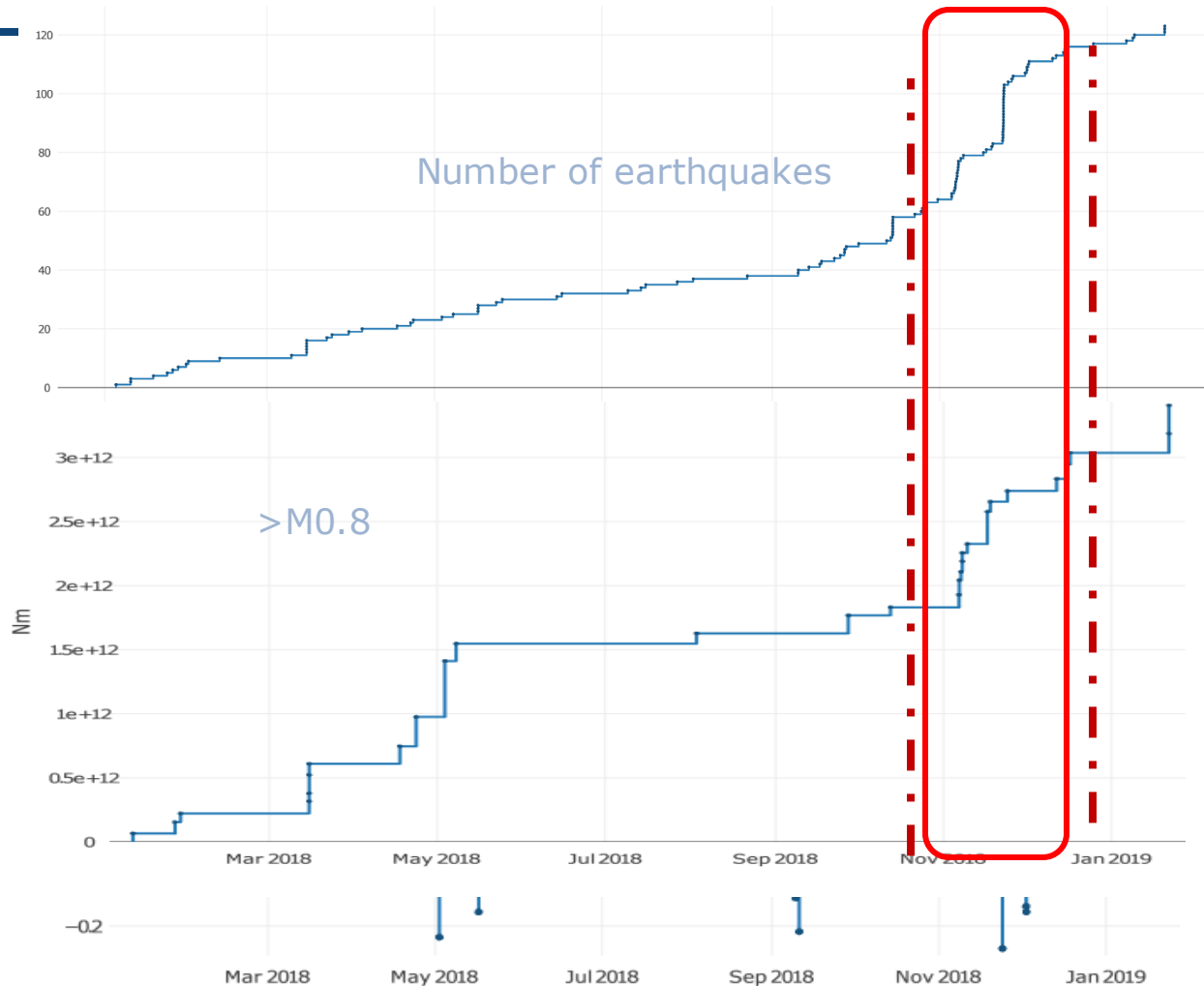
Hekla

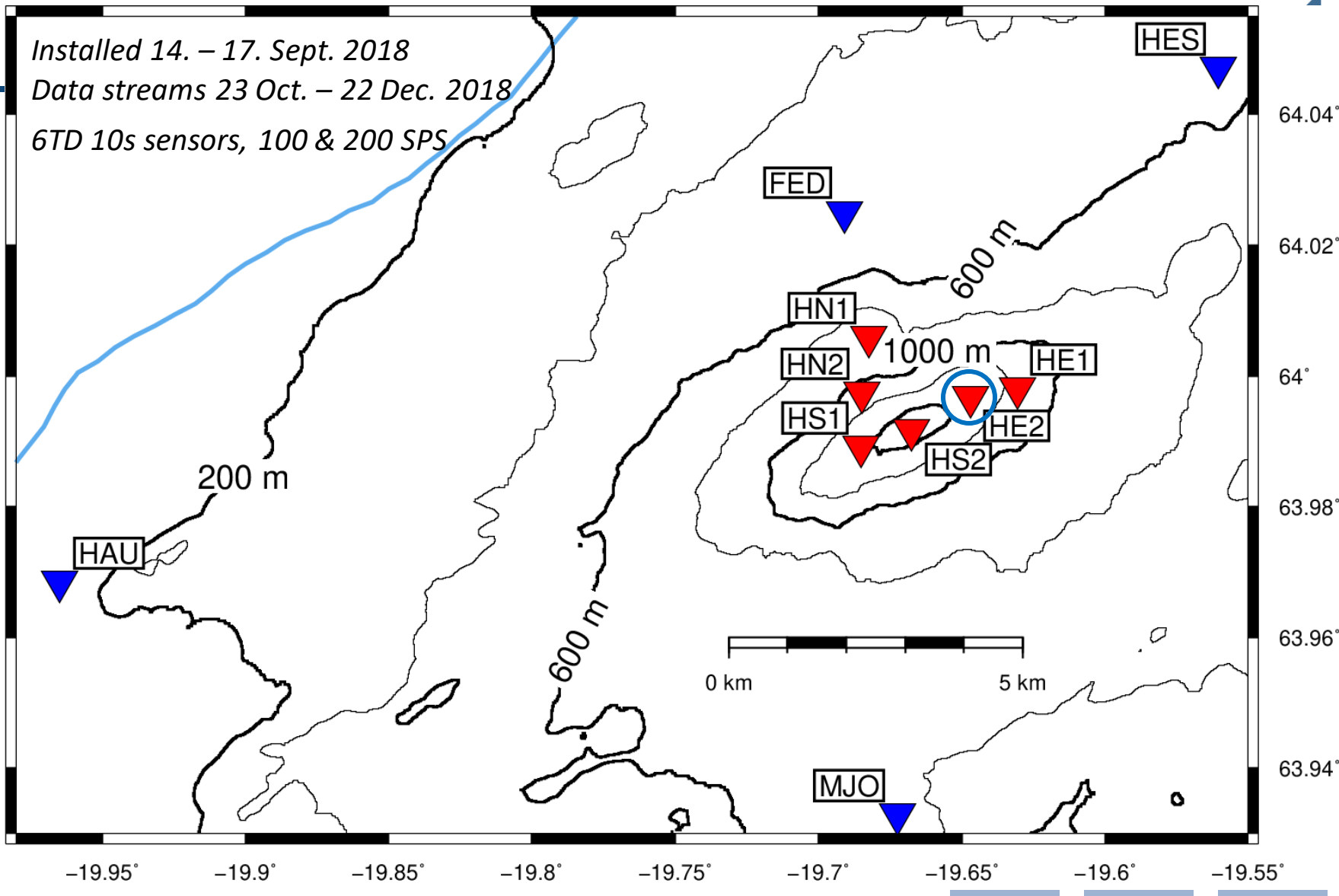
Jarðskjálftavirkni lítil



Auking haustið 2018

Ný stöð 23 okt – 22 des

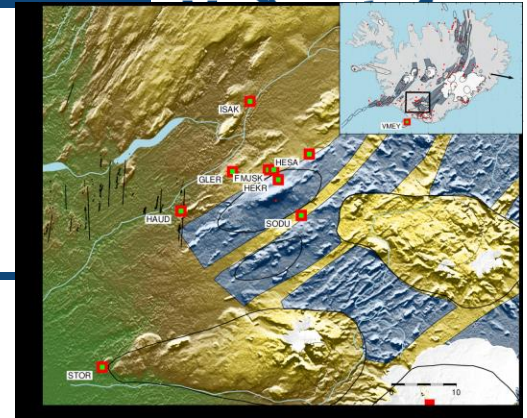
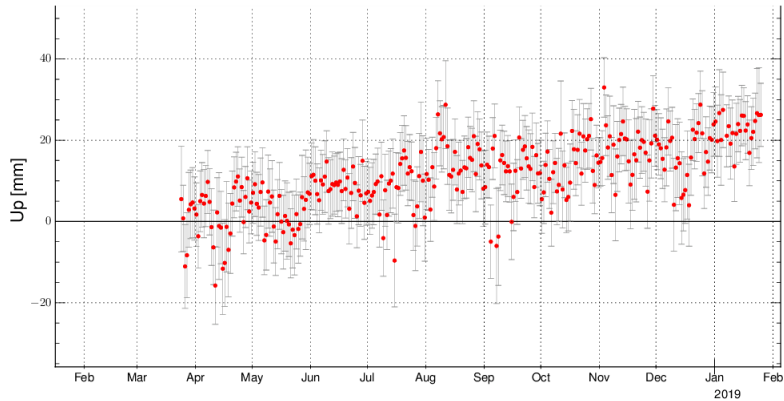
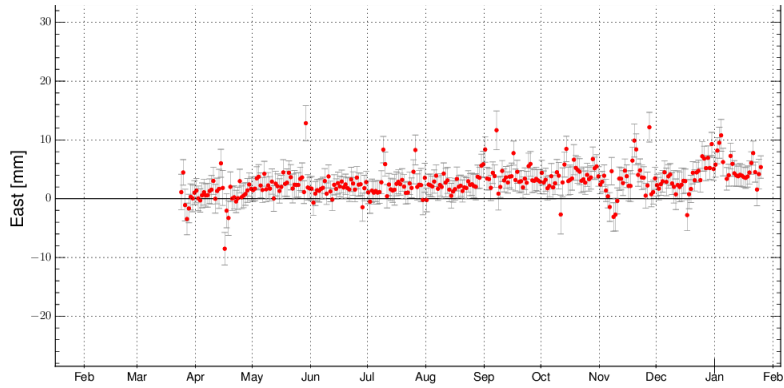
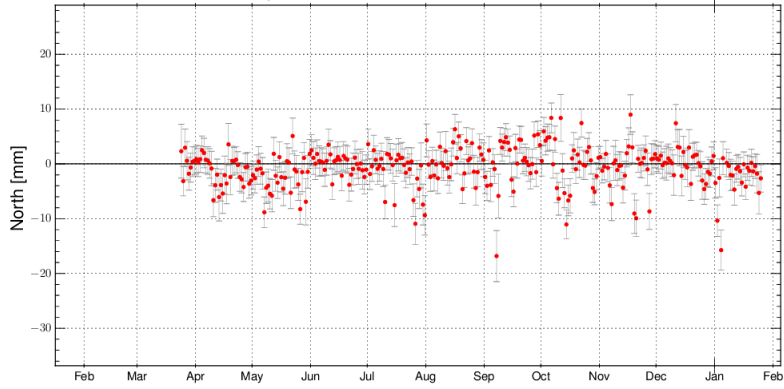




GPS

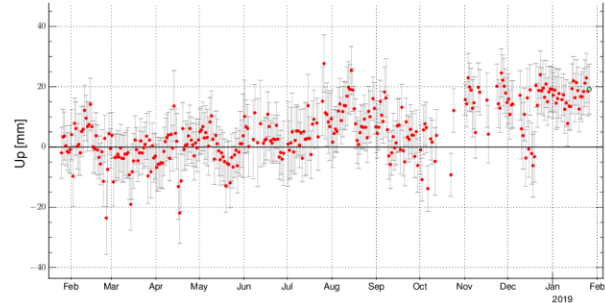
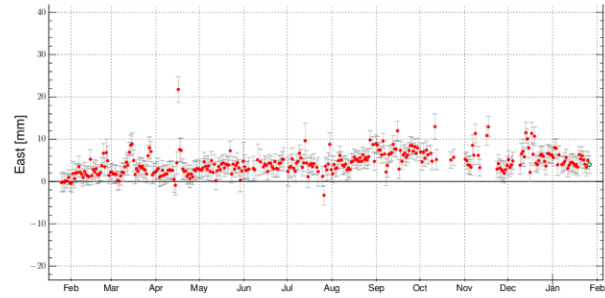
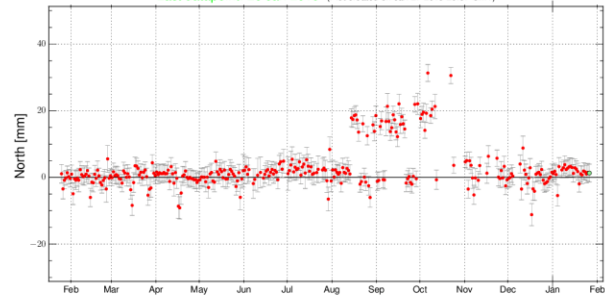
Fedgar (FEDG) Reference frame: North American plate

Last datapoint: 25 Jan 2019 (Plot created on Jan 27 2019 20:57 GMT)



Glerhaus (GLER) Reference frame: North American plate

Last datapoint: 26 Jan 2019 (Plot created on Jan 27 2019 20:57 GMT)

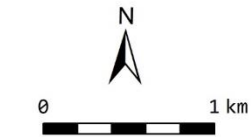
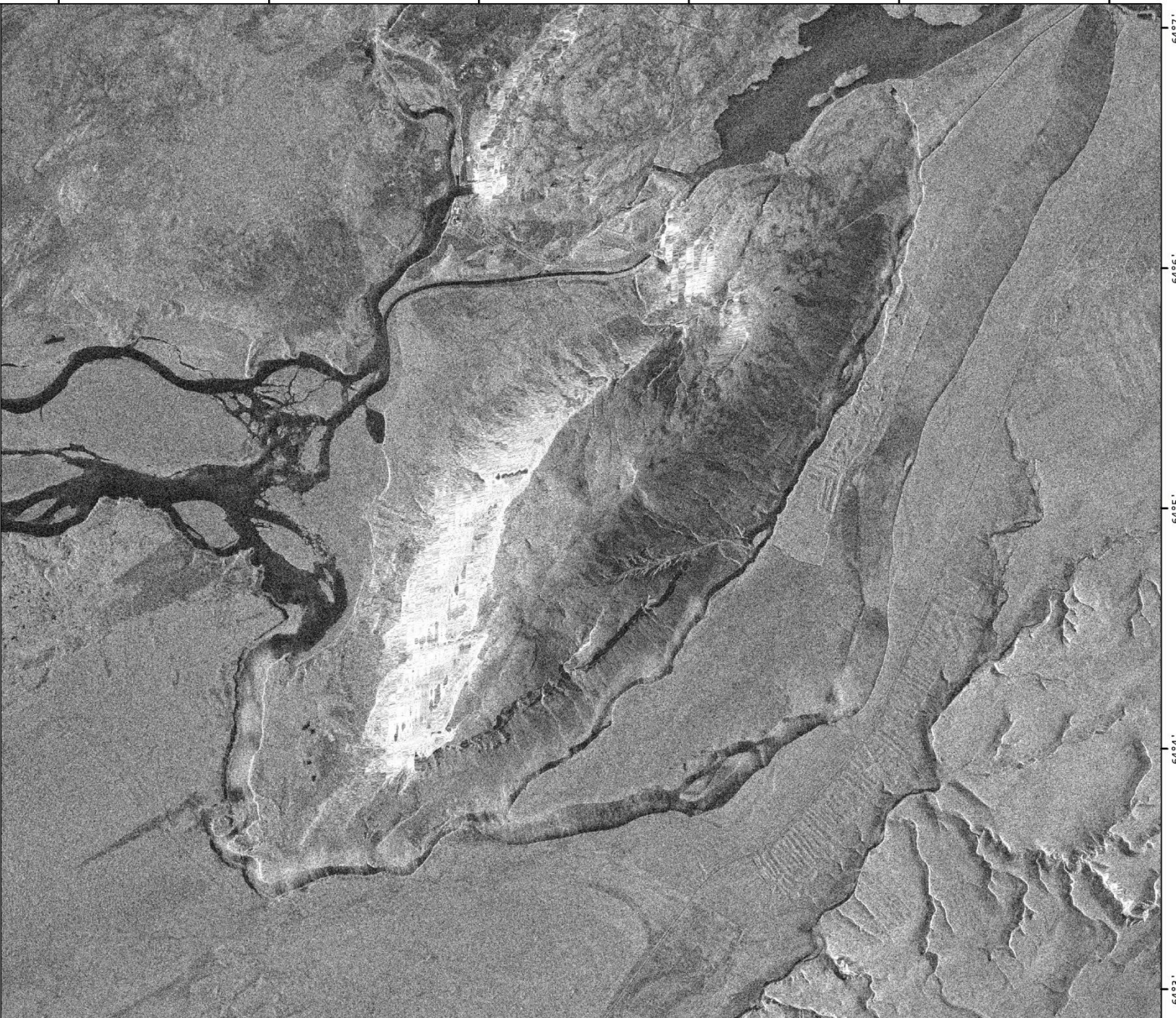


-19°56' -19°54' -19°52' -19°50' -19°48' -19°46' -19°44'

Hekla

Monitoring Map

Background imagery
COSMO-SkyMed
SAR Intensity
Imagery Acquired:
11-01-2019



Spatial reference system: EPSG 3057

This map was published on
27-01-2019 21:33:31 UTC
by The Icelandic Meteorology Office

-19°56' -19°54' -19°52' -19°50' -19°48' -19°46' -19°44'

64°7'
64°6'
64°5'
64°4'
64°3'

64°7'
64°6'
64°5'
64°4'
64°3'

Samantekt um Heklu

- Óveruleg jarðskjálftavirkni. Vegna uppsetningar nýrra jarðskjálftamæla á svæðinu var mælakerfið næmara fyrir litlum skjálftum og þess vegna mældust fleiri smáskjálftar í nóvember og desember 2018.
- Aflögunargögn (bæði cGPS og hallarmælar) gefa til kynna áframhaldandi stöðuga þenslu sem hefur verið í gangi frá síðasta eldgosi árið 2000.
- Hekla sýnir ekki merki um aukna virkni. Fyrirboðar gosa í Heklu virðast hinsvegar stuttir og því er fylgst náið með öllum merkjum sem gætu gefið til kynna að gos sé í aðsigi.

Katla

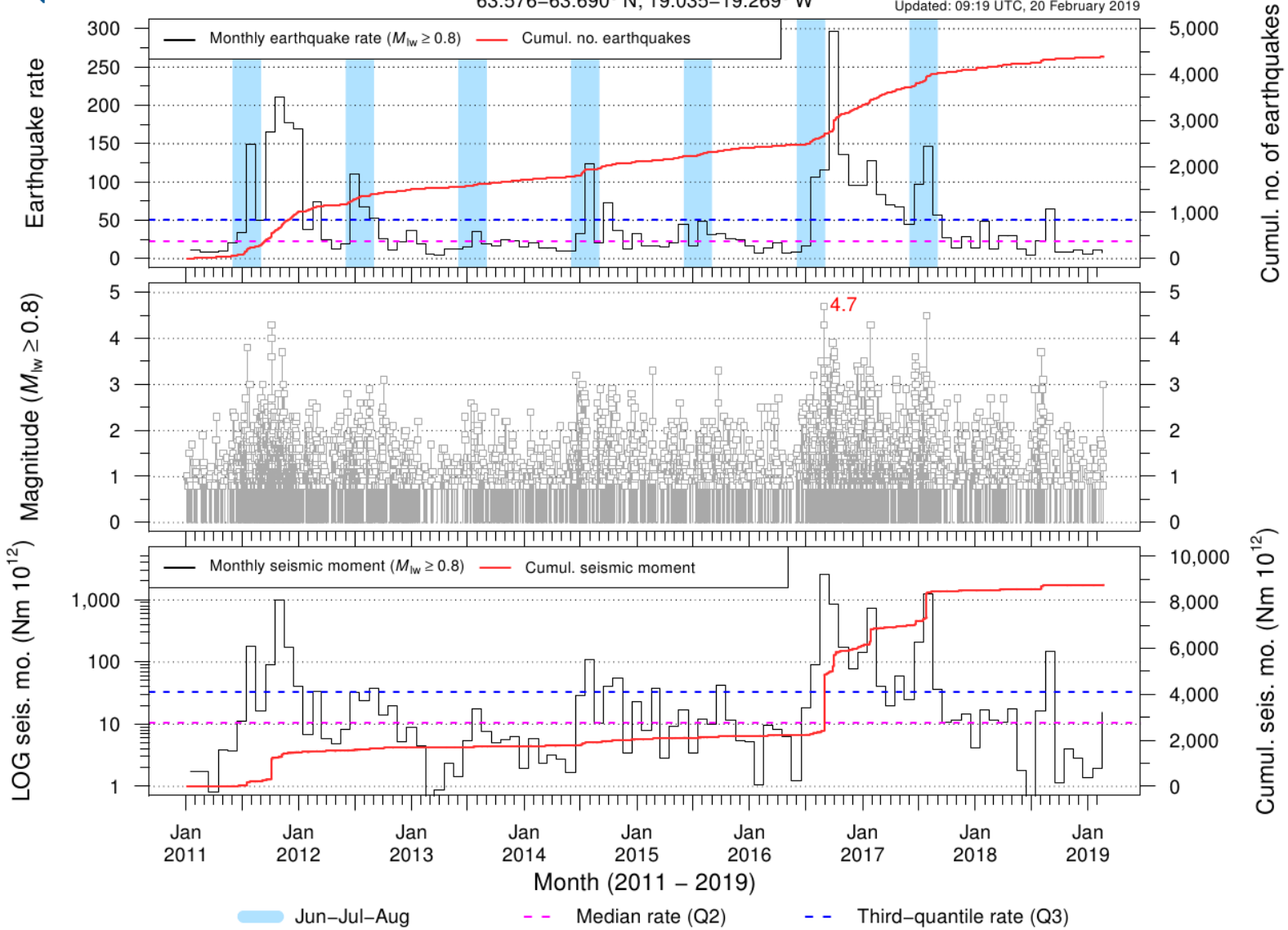
Katla



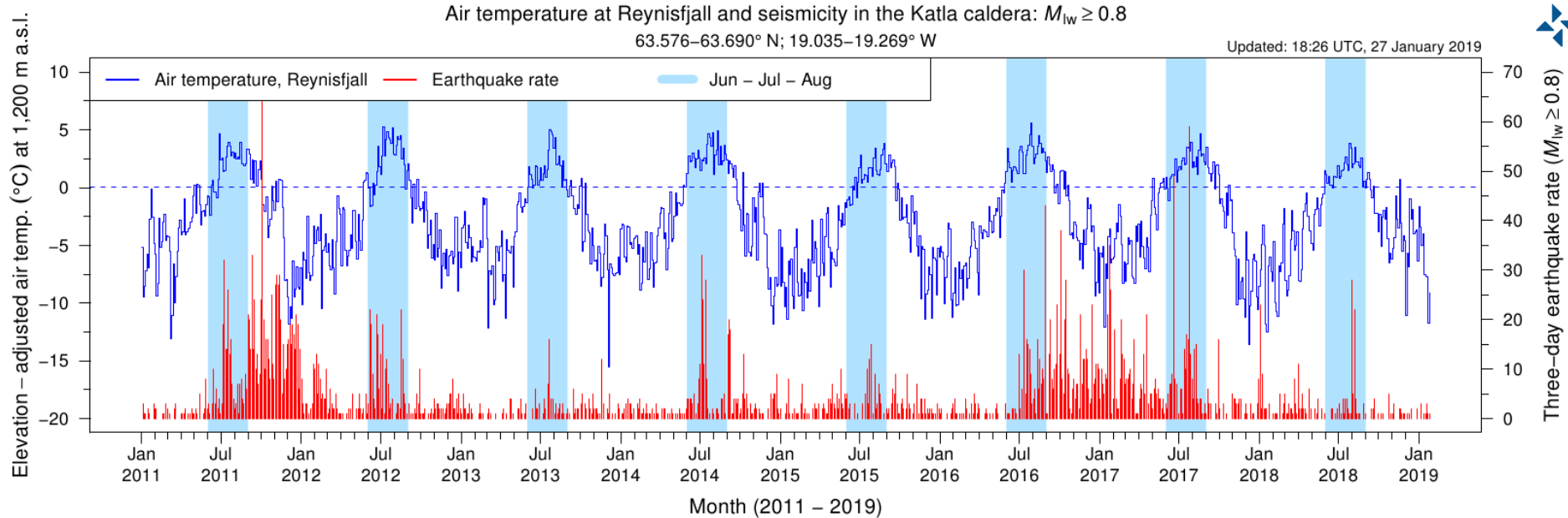
Katla caldera

63.576–63.690° N; 19.035–19.269° W

Updated: 09:19 UTC, 20 February 2019



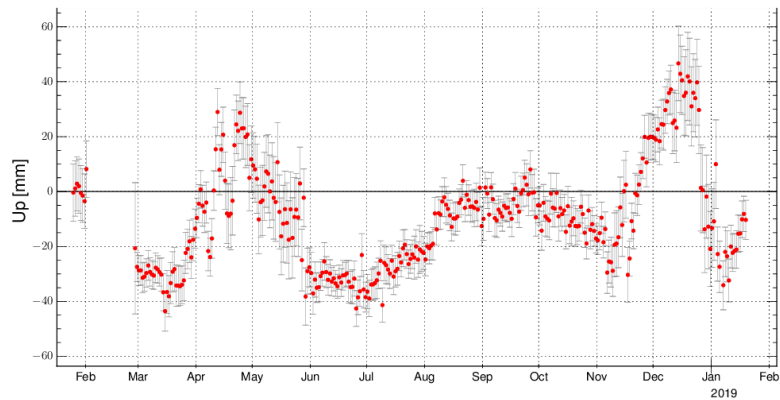
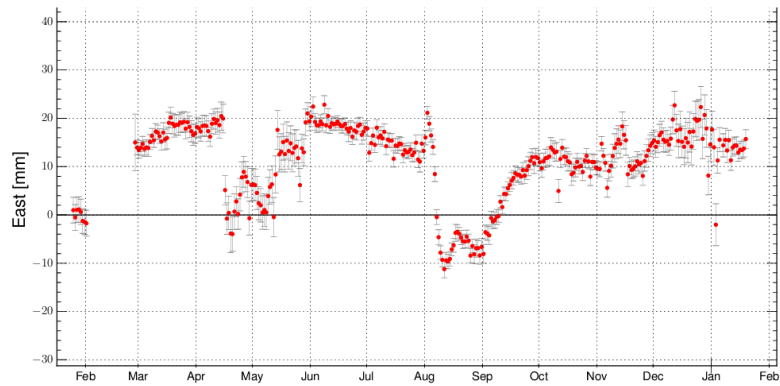
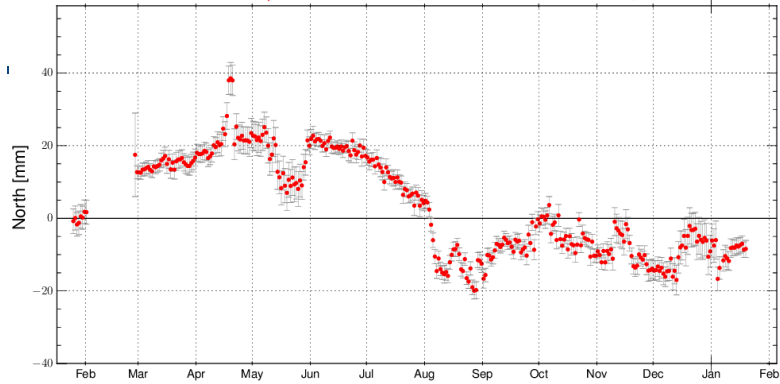
Árstíðabundin skjálftavirkni – Katla caldera



GPS

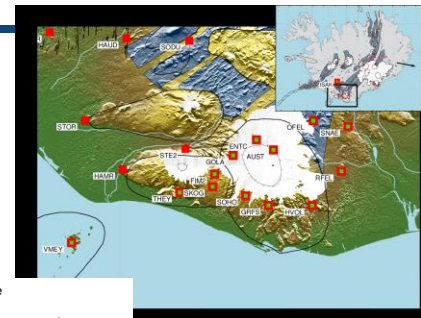
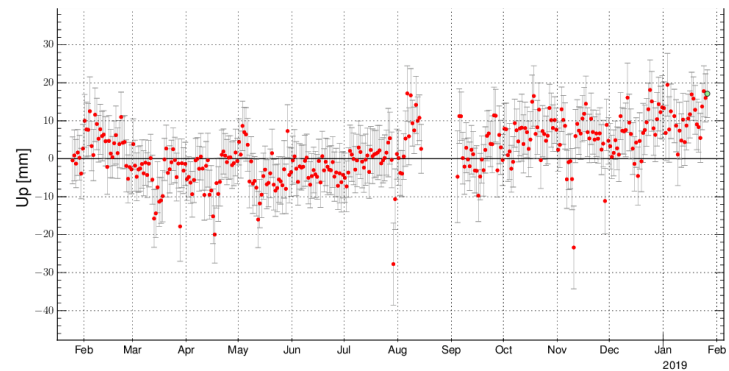
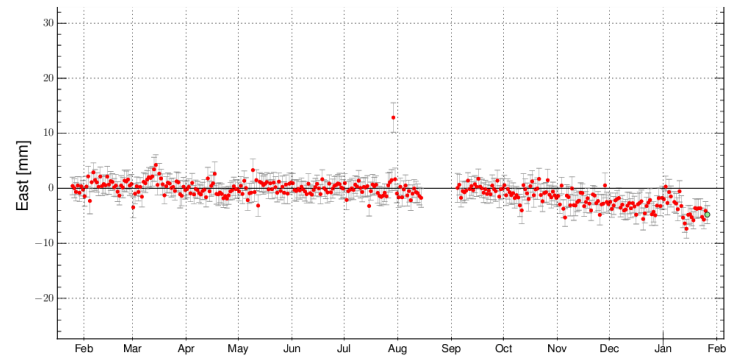
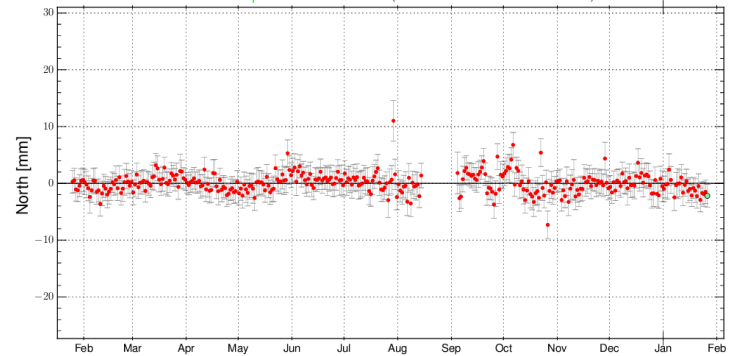
Austmannsbunga (AUST) Reference frame: North American plate

Last datapoint: 19 Jan 2019 (Plot created on Jan 27 2019 20:56 GMT)



Sólheimasheidi (SOHO) Reference frame: Eurasian Plate

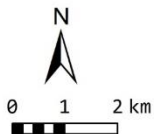
Last datapoint: 26 Jan 2019 (Plot created on Jan 27 2019 20:57 GMT)



Katla

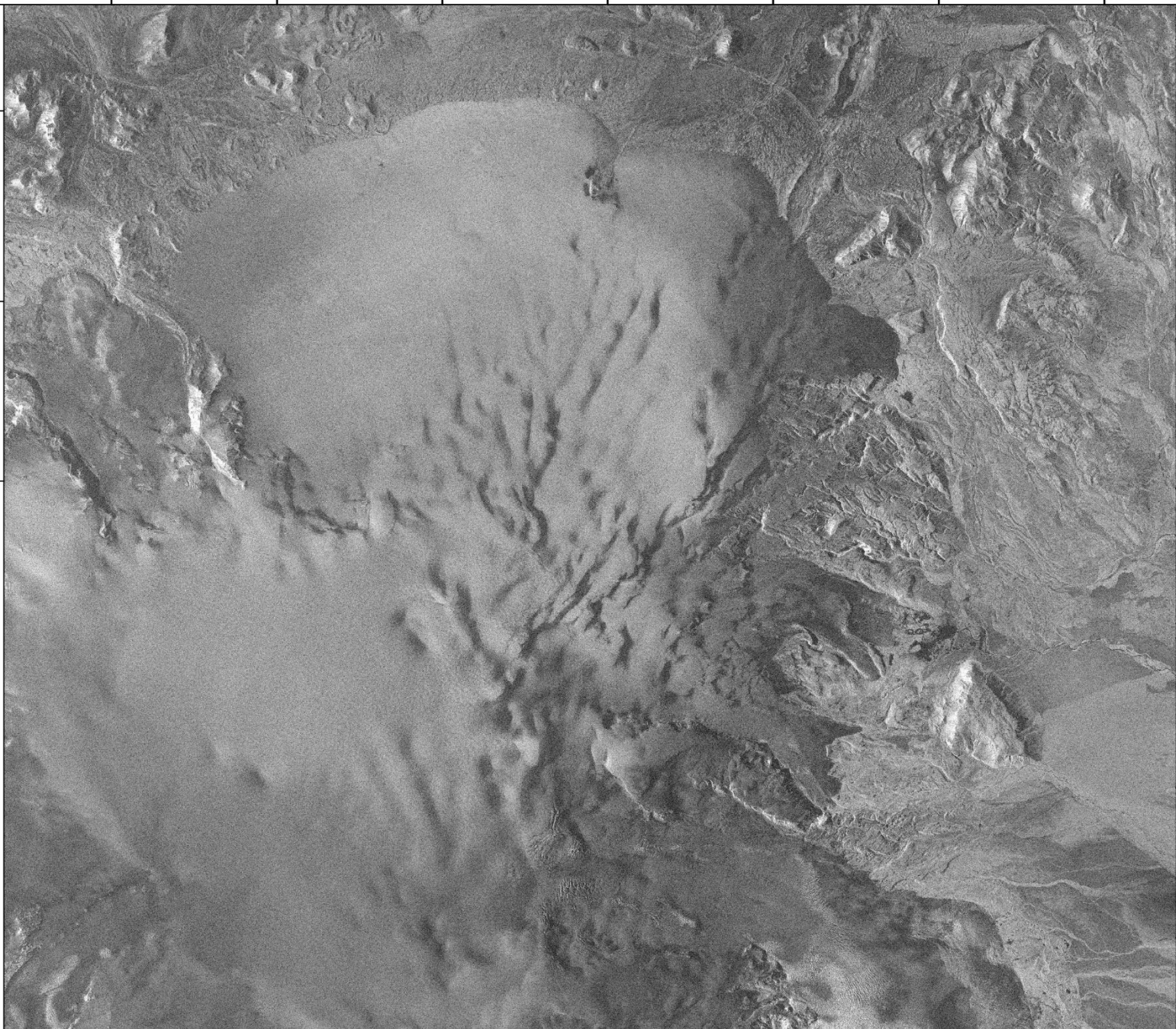
Monitoring Map

Background imagery
COSMO-SkyMed
SAR Intensity
Imagery Acquired:
11-01-2019



Spatial reference system: EPSG 3057

This map was published on
27-01-2019 21:32:12 UTC
by The Icelandic Meteorology Office



River sensor at Láguhvolar

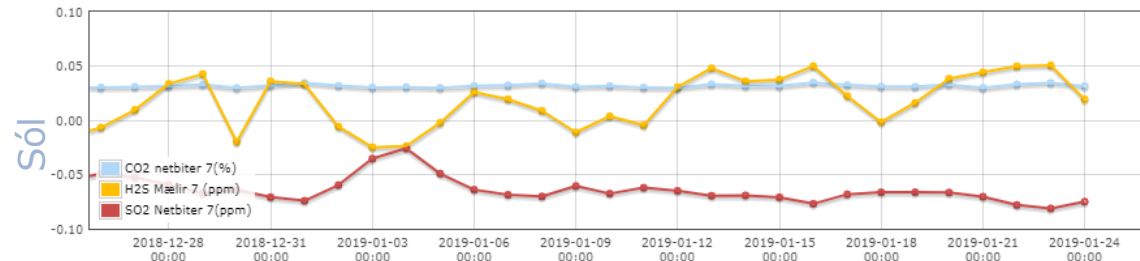
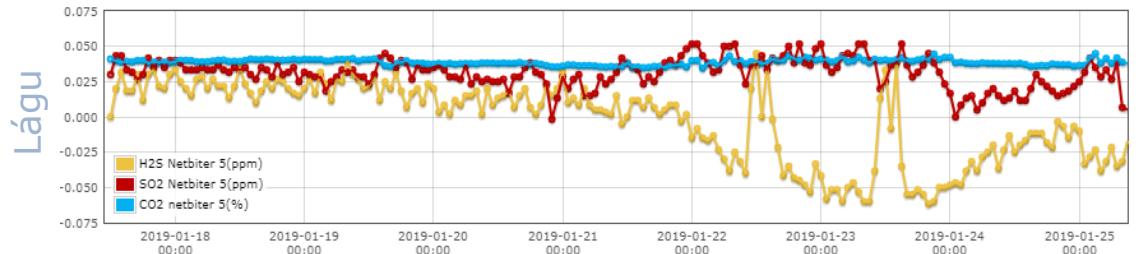
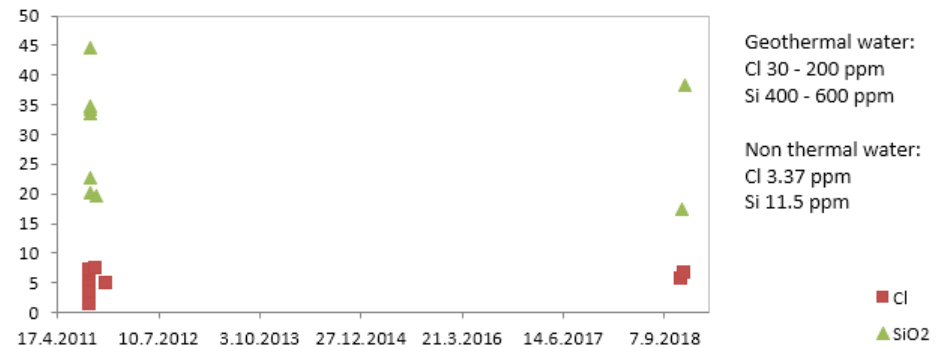
mælir einstaka sinnum CO_2 and H_2S sem mælist ekki á Jökulsá á Sólheimasandi

Non-reactive species Cl and SiO_2 : Múlakvísl water similar to samples measured during 2011 jökulhlaup. Concentrations quite similar to Örfæfajökull rivers

Reactive species CO_2 and SO_4 : Múlakvísl and Jökulsá á Sólheimasandi much higher than Örfæfajökull rivers currently; similar to Kvía in early 2018. CO_2 within the range measured over the course of the 2011 Múlakvísl jökulhlaup; SO_4 higher.

ppm Cl and SiO_2

Múlakvísl time series of Cl, SiO_2



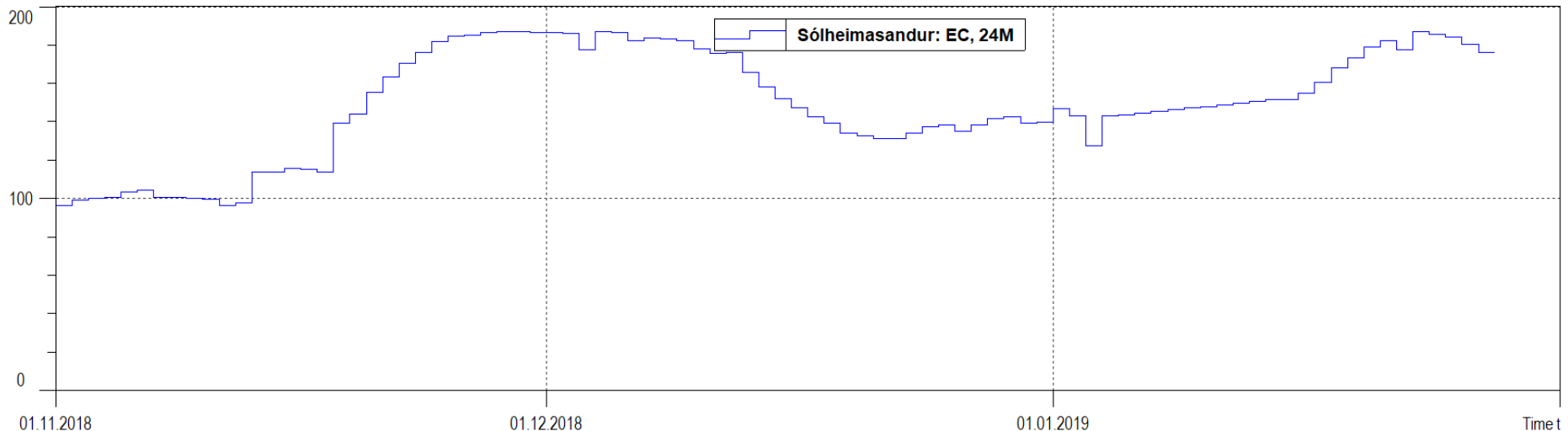
Mýrdalsjökull

sólheimasandi: Aukin rafleiðni; lykt af H_2S í Nov `18

Óvenjuhá leiðni 20 Nov 2018. tilkynningar um H_2S lykt við jökulrönd þann 21 Nov. Ekki aukið rennsli í ánni.

Note that the glacial lagoon is a large buffer, so downstream EC changes are probably lagged by hours to days.

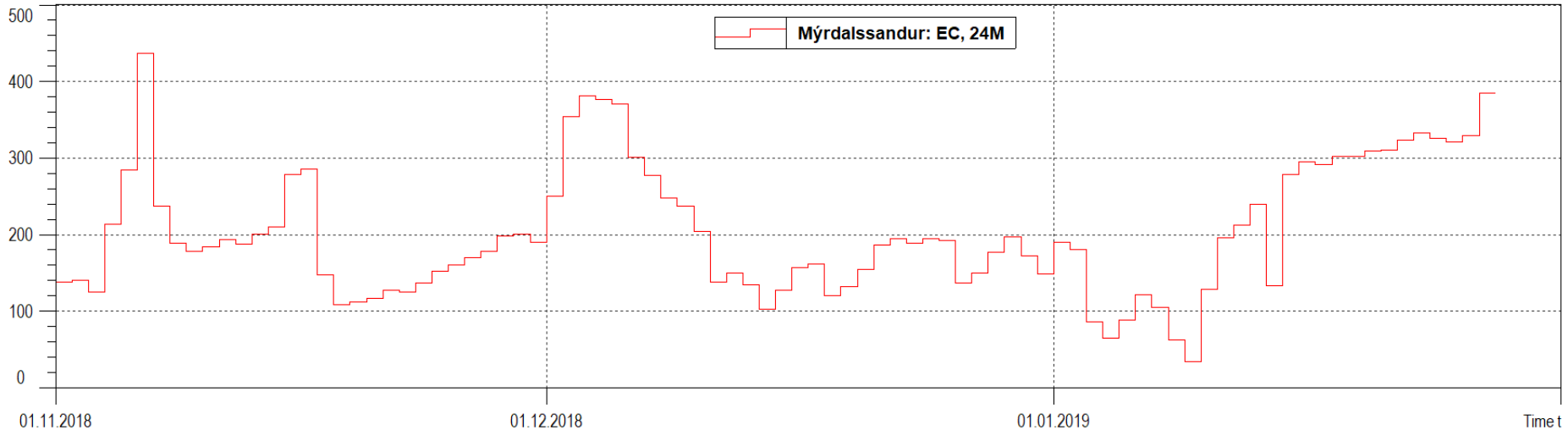
EC measurements need to be made in the lagoon.



Mýrdalsjökull

Múlakvísl: Three periods of heightened EC

Noticeable increase in EC on 15 Jan '19, together with increased discharge and appearance of dark-coloured floodwater. EC levels have increased further since mid Jan, but the discharge of the river is lower, signifying higher concentration of geothermal traces.



Mýrdalsjökull

Múlkvísl: Óvenjuhá rafleiðni í January 2019

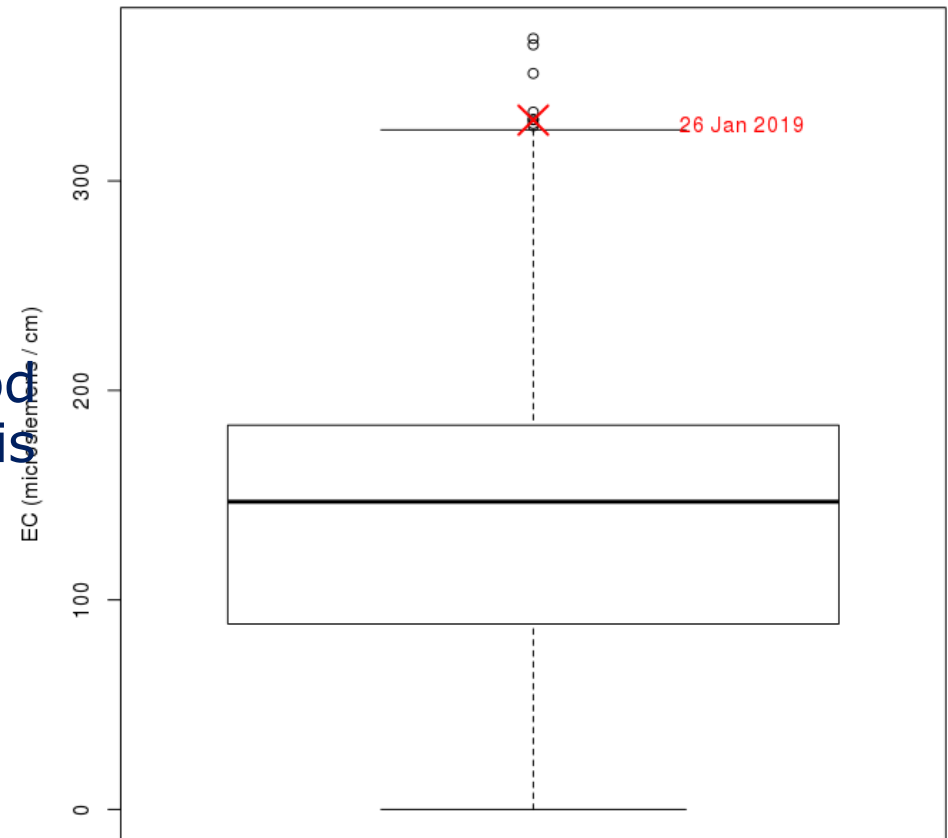
EC values for January are typically $\sim 155 \mu\text{S} / \text{cm}$.

Svona tímabil hafa áður mælst.

The ongoing period of cold weather complicates the EC measurements. The latest period of EC increase ($> 300 \mu\text{S} / \text{cm}$) is probably due to sensor issues, as can be seen in recent web-cam images.

Open leak or slow drainage of a cauldron?

Múlkvísl: V089 EC measurements

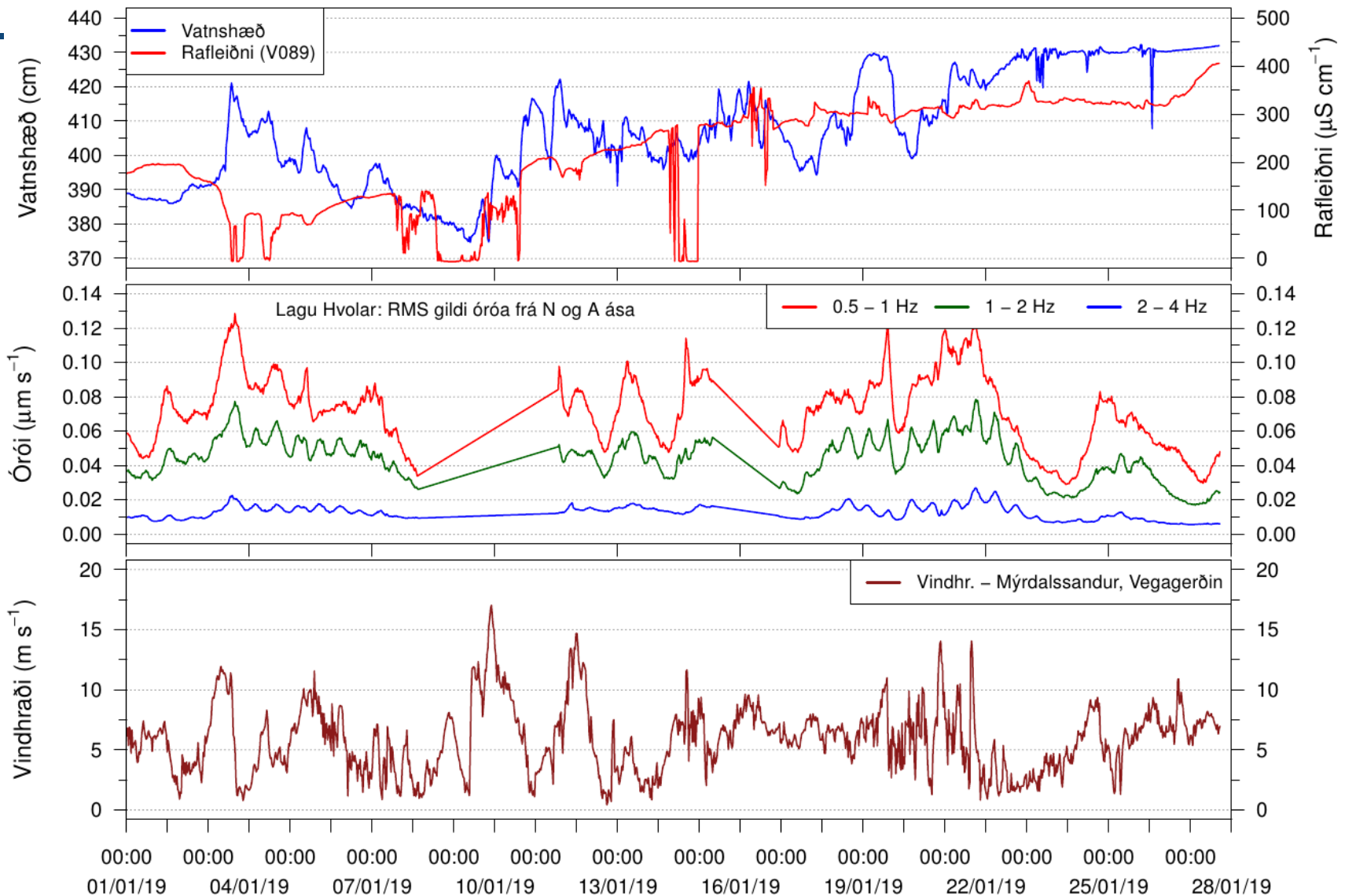


January
2006 - 2019

Múlakvísí: January 2019



Aukin rafleiðni í Múlakvísí (V089): janúar 2019



Samantekt um Kötlu

- Jarðskjálftavirkni óveruleg
- Gas og vatnamælingar sýna jarðhitaleka
- Engin breyting í aflögun
- Minniháttar “flóð” í Múlakvísl

Hvað þýðir þetta

- Engin augljós merki um að Katla sé að koma á næsta leiti
 - Töluverð jarðhitavirkni
 - Leki dregur úr líkum á stærra flóði
 - Hætta af gasmengun
-

Eitt og annað

- OR + Veitur Ætla að örva holu í Geldinganesi á höfuðborgarsvæðinu í haust. Allt verður gert til að lágmarka jarðskjálftahættu
- Húsavík fundur 22-24 Maí
- Húsavík Jarðskjálftaæfing 8 og 10 maí (afleiddar hættur)
- Hekla – er þörf á nýju áhættumati hjá ISAVIA?