Icelandic Met Office

The Eyjafjallajökull eruption and its aftermath

The monitoring and guidance process

Contents

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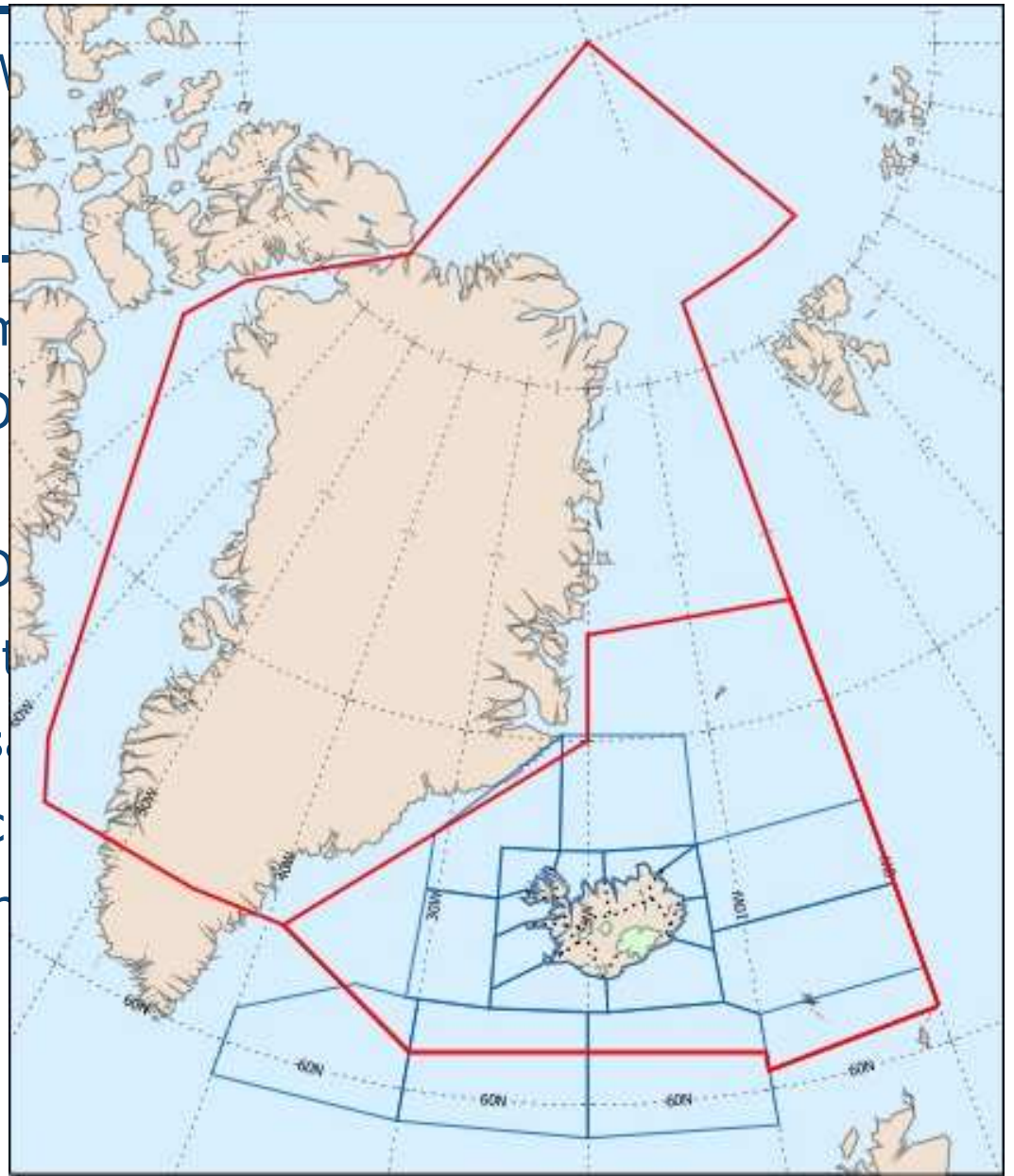
- The role of IMO
- The role of London VAAC
- Volcanic Monitoring network and other observations
- Guidance process and reporting
- Lessons learned
- Needed improvements

The role of IMO – ICAO Annex 3

- Meteorological Watch Office (MW
  - Continuous MET watch over
  - MET products (TAF,METAR...
  - SIGMET issuance and dissem
  - Supply VOLC info (from SVO
  -
- State Volcano Observatory (SVO
  - Monitoring pre - eruption act
  - Monitoring eruption (or cess
  - Monitoring airborne volcanic
  - Supply info to VAAC, ACC ar



The role of London VAAC – ICAO Annex 3

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- Monitor satellite data to detect the existence and extent of volcanic ash in the atmosphere in the area concerned;
- Activate the volcanic ash numerical trajectory/dispersion model in order to forecast the movement of any ash "cloud" which has been detected or reported;
- Issue advisory information, disseminate to MWO, ACC, FIC, other VAAC´s if affected, ……. and several others
- Issue updates at least every 6 hrs
- Shall maintain a 24 hr watch

Icelandic active zone

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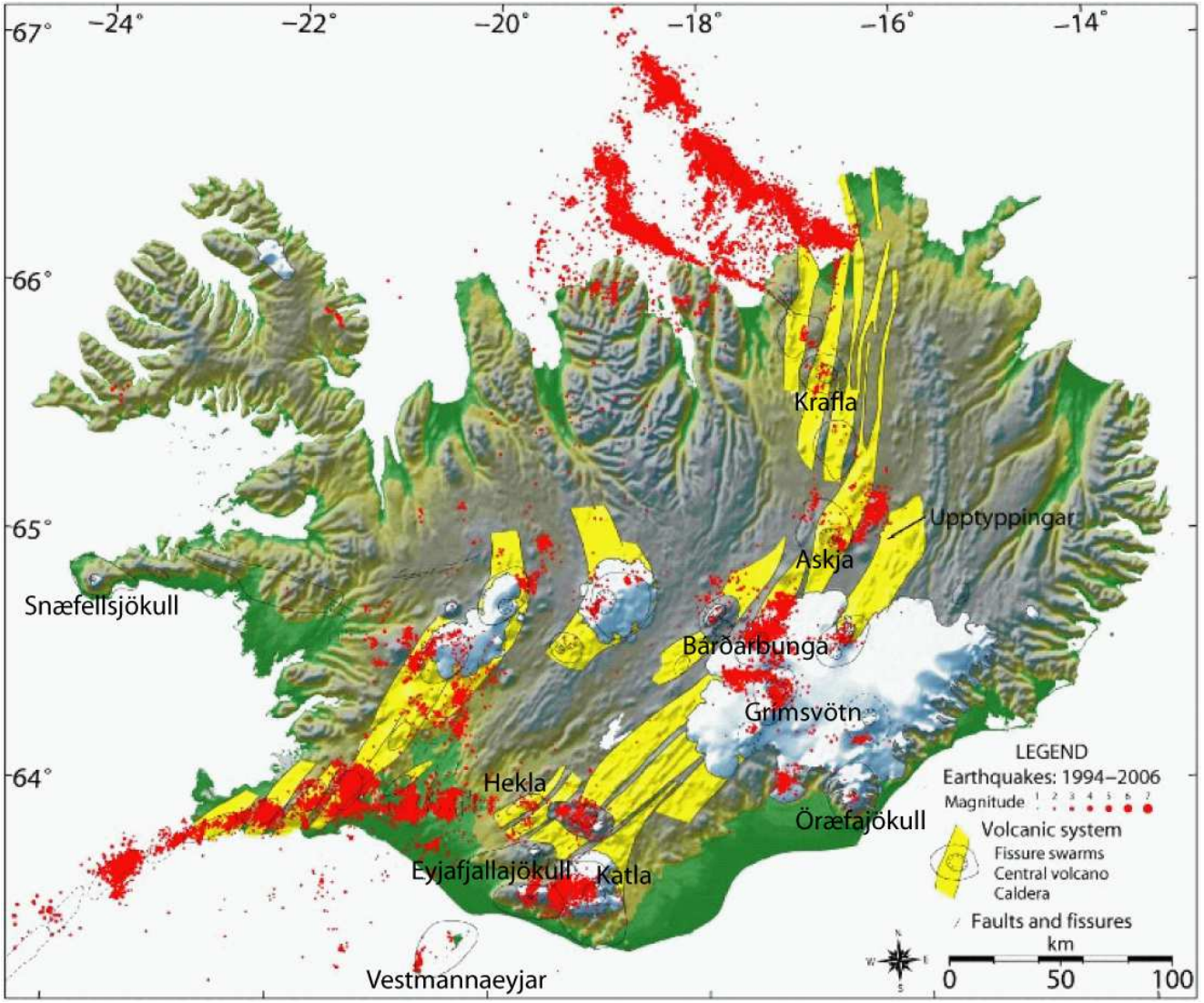
About 12 eruptions

Since 1961:

- Askja
- Surtsey
- Hekla x4
- Vestmanneyjar
- Krafla, several
- Grímsvötn x2
- Gjálp
- Eyjafjallajökull



Volcanic monitoring Overview

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- Earth science
  - Seismic monitoring
  - GPS measurements
  - Strain measurements
  - Ash size distribution and chemical composition (IES)
- Hydrology
  - Gauge meters
  - Heat and conductivity measurements
- Atmosphere
  - Weather radar
  - Direct and indirect plume measurements
  - SO_2 measurements

Geophysical monitoring networks around Eyjafjallajökull and Katla

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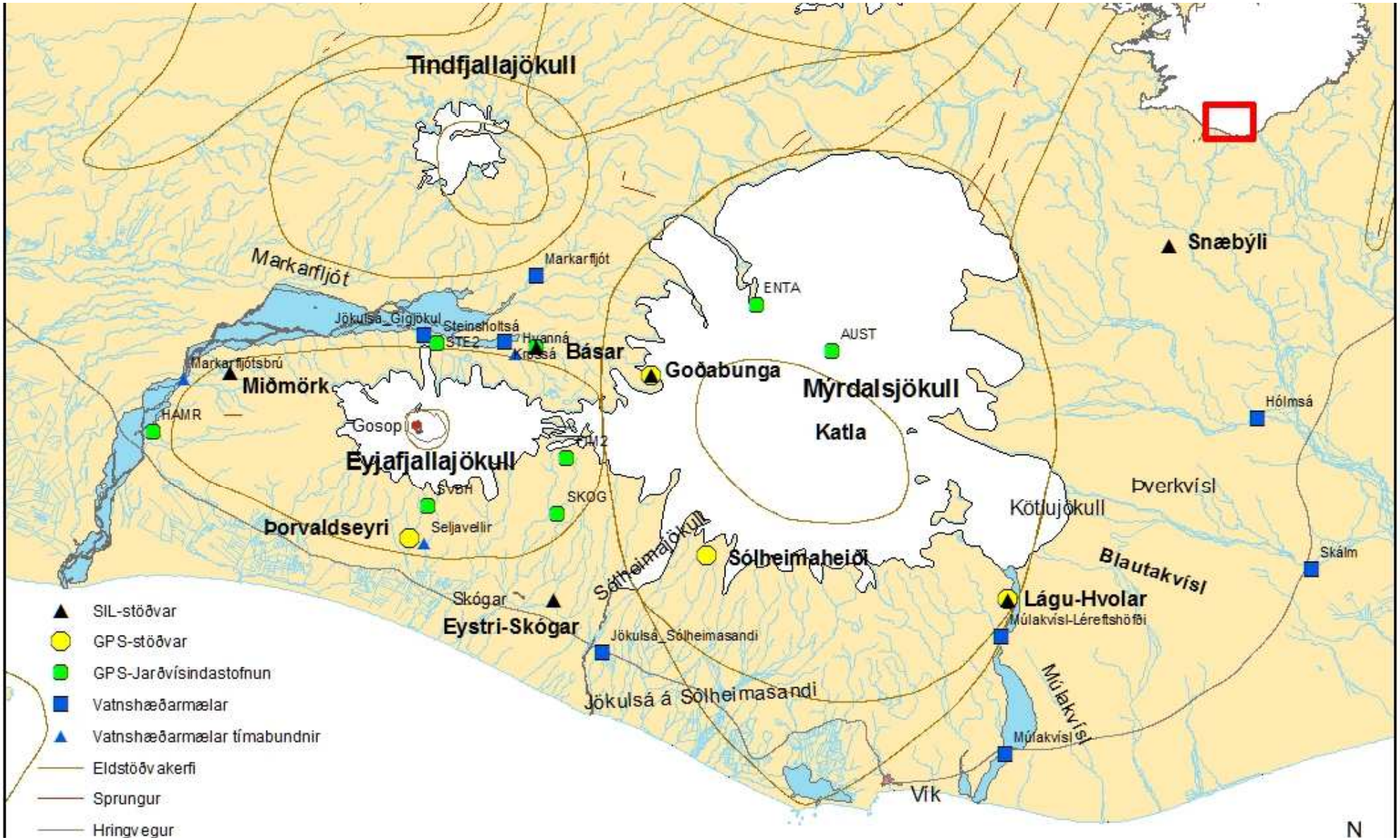
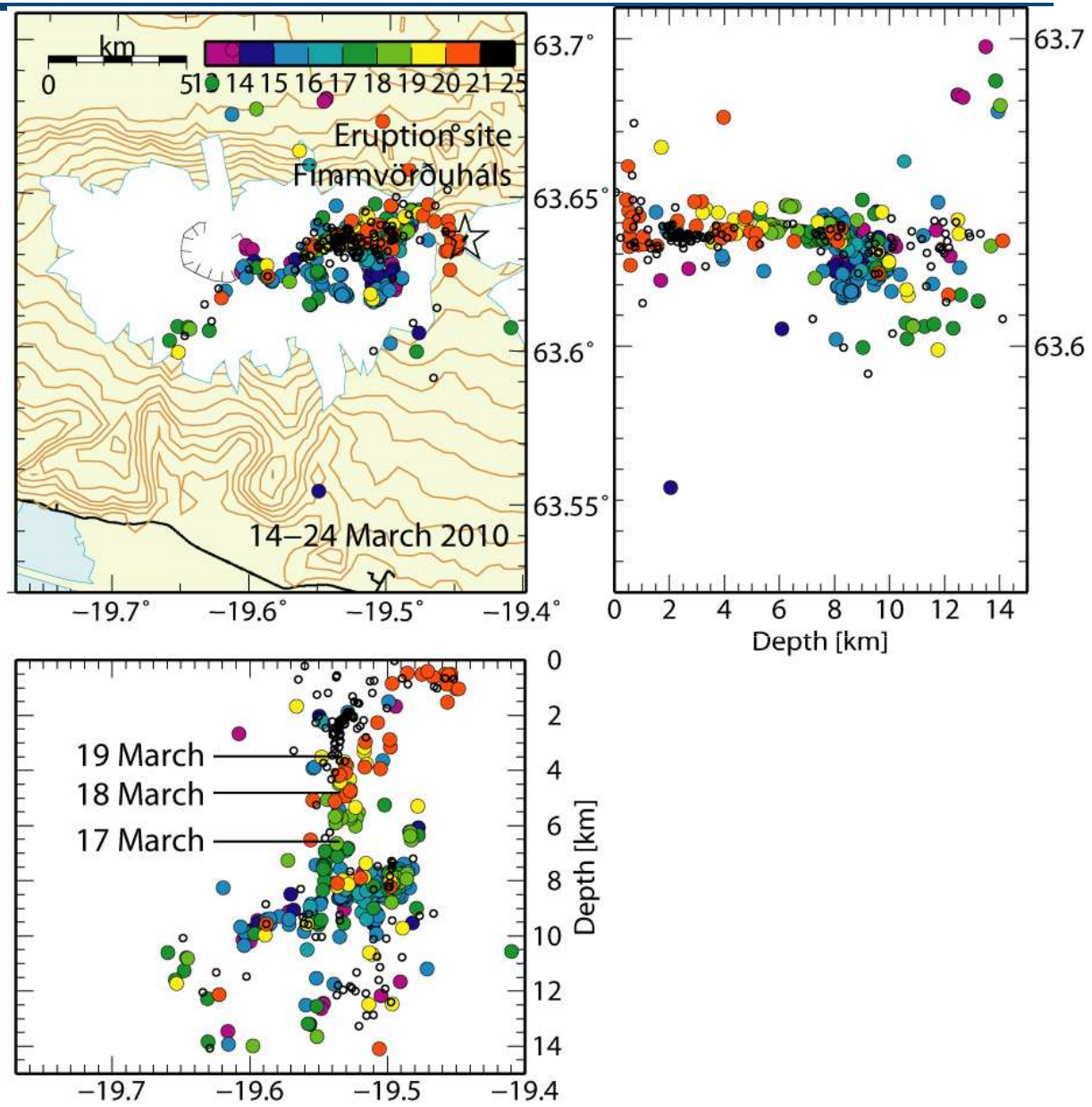


Seismic monitoring

- Vital warning system
- Clear indications of magma movement in march



GPS measurements reflecting deformation of the volcano

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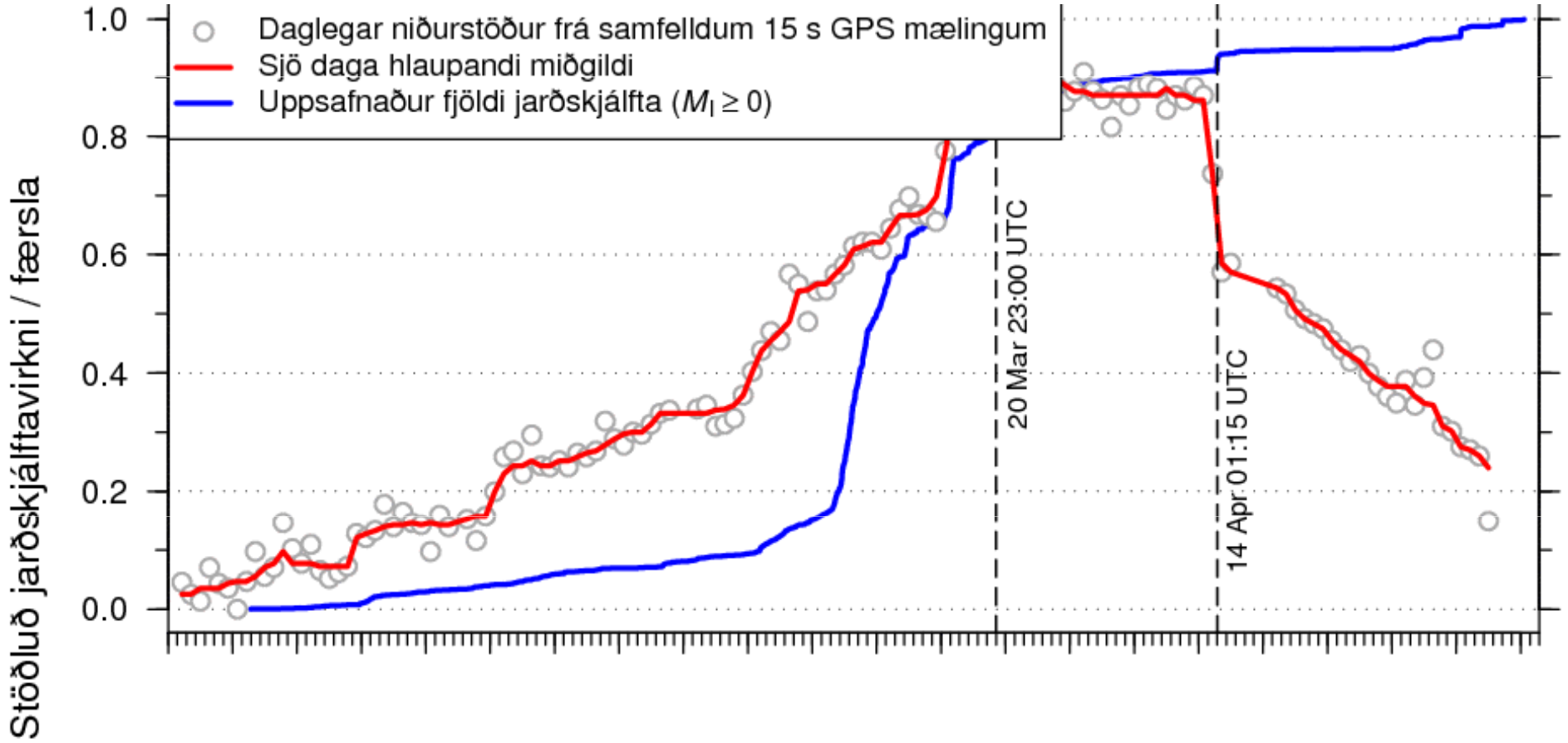

Strain monitoring network

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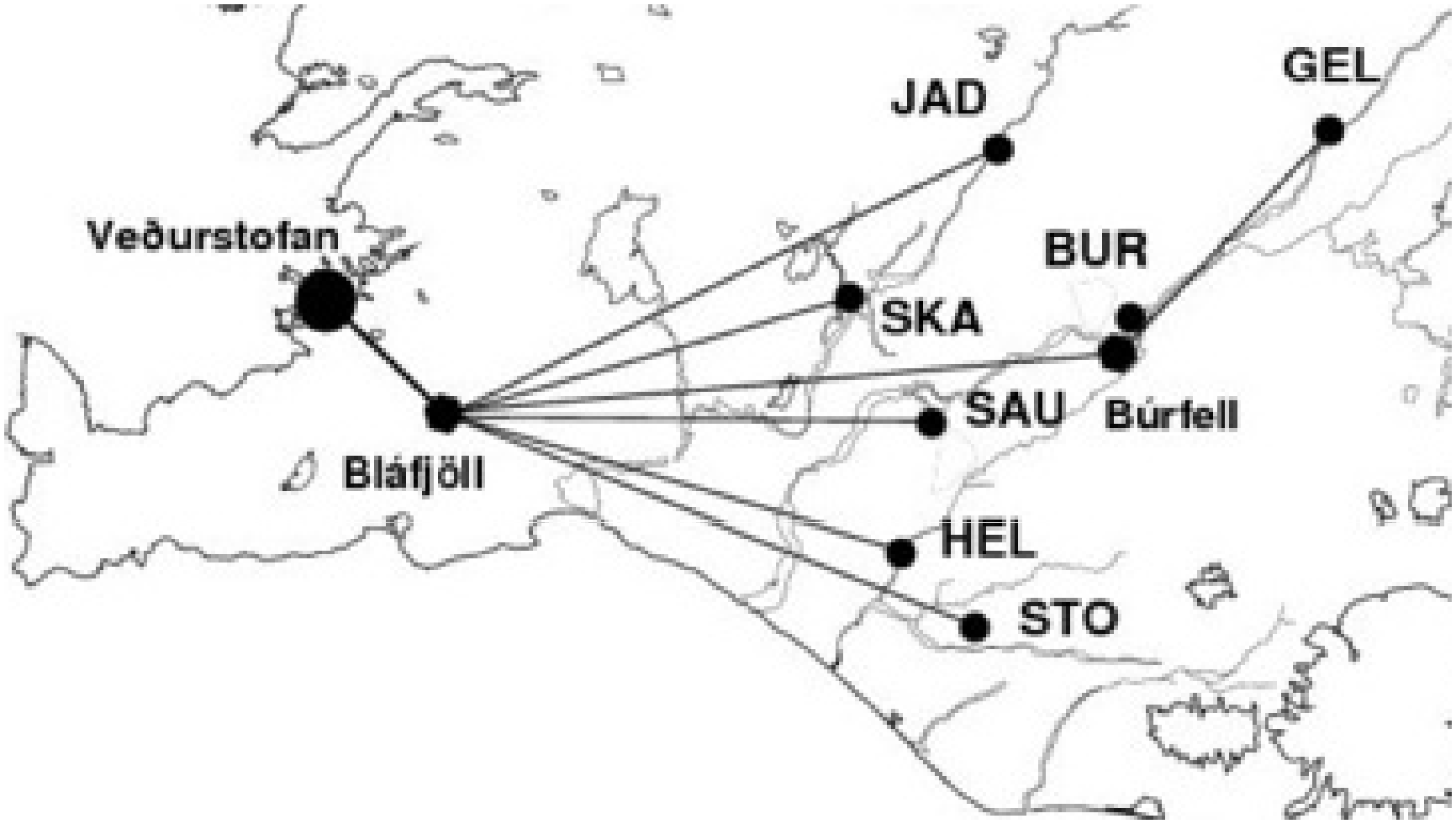
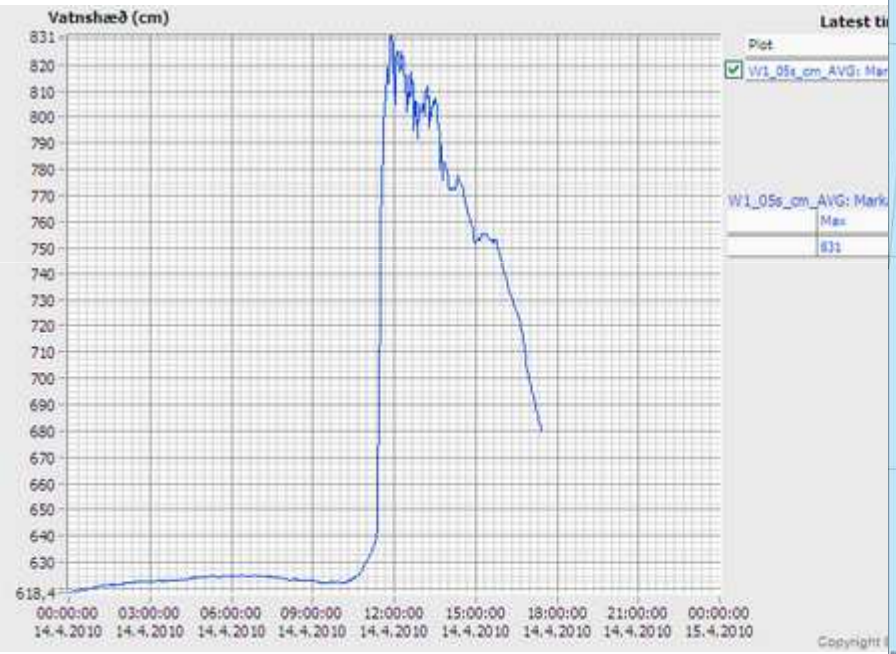
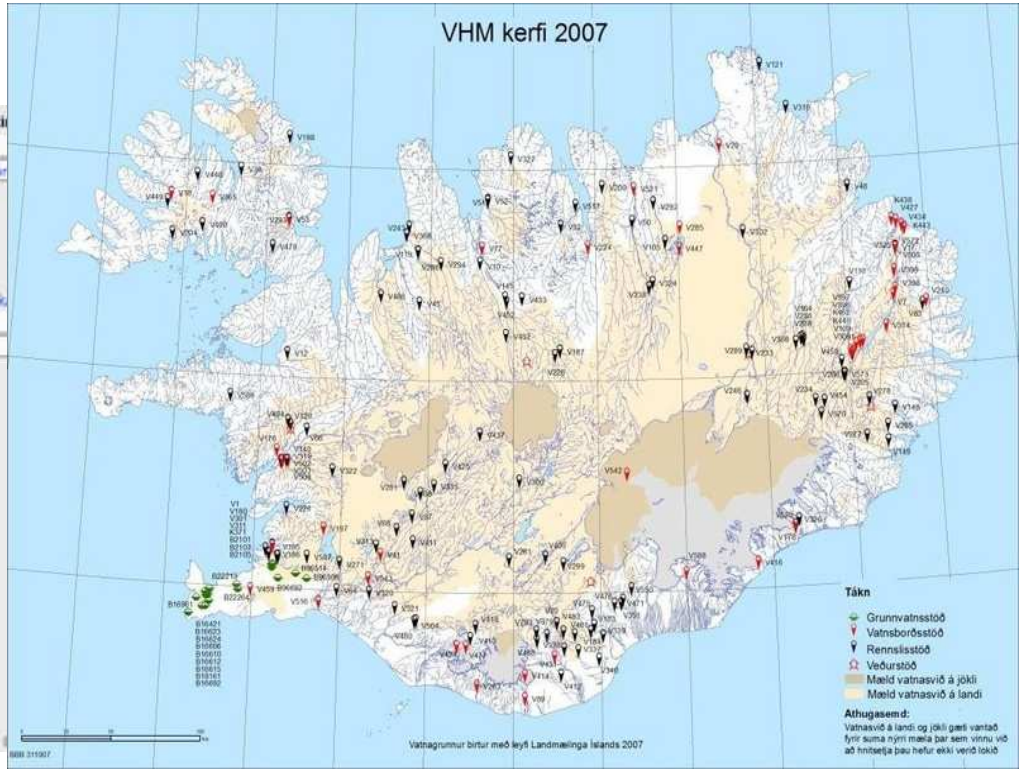


Hydrological monitoring

- IMO operates a network of water-level gauges, heat and electrical conductivity meters
- Show early signs of volcanic activity under the glacial caps.





Veðurstofa Íslands

Glacial bursts triggered by the eruption of Eyjafjallajökull volcano on April 14 2010

Flood area

Boundaries are provisional; mapping of the flooded areas is based on field work measurements and on photo-interpretation (ground pictures, aerial pictures, satellite imagery). Areas flooded because of hypo-reic flow are not mapped.
The location of the craters is given from radar (Plane survey).

Asphalt road
Gravel road

Building

River body (linear), ditch
River body (surfacic), lake

Projection: Lambert Conformal Conic
Datum: WGS 1984
Roads, buildings, and water bodies are from LMÍ/IS50V
DTM is from ÍSOR
Flood mapping: EPP/BBB

Atmospheric monitoring

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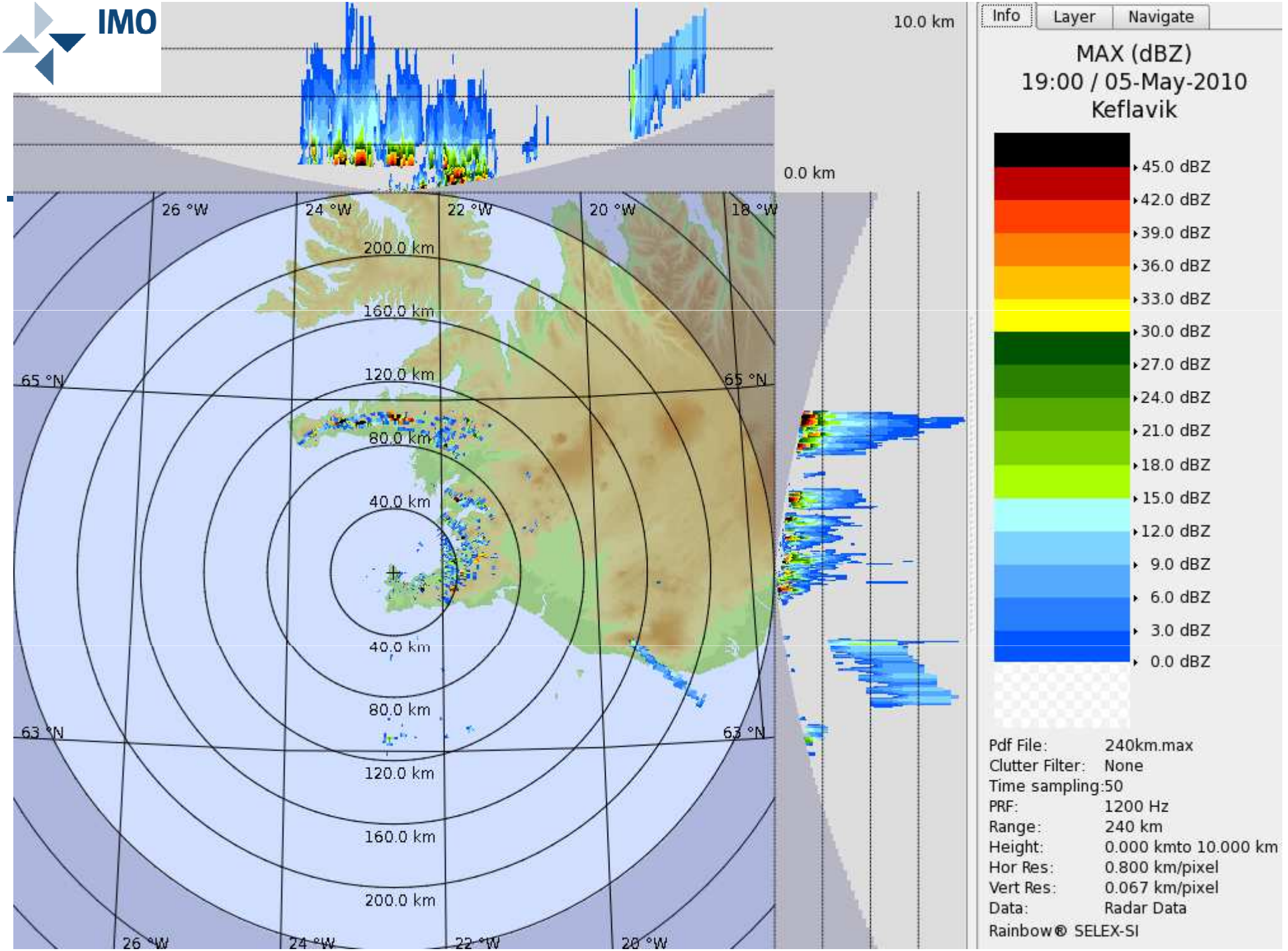
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Plume hight during eruption

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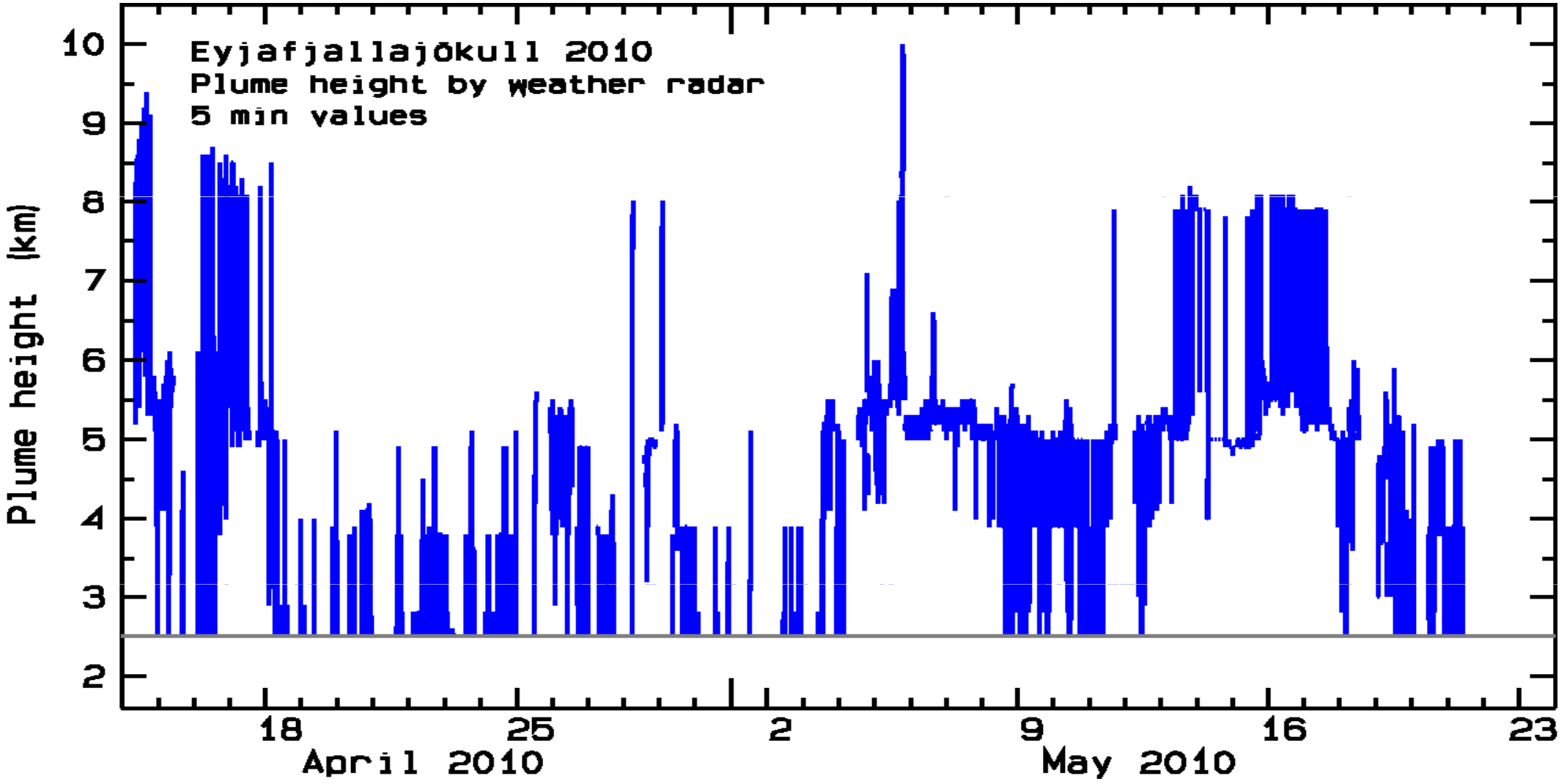

Dry ash shows poor radar reflectivity

Visual observations of plume activity

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- Surface based
  - Several webcams
  - Theodolit measurements
- Pilot reports
  - Uncertainty in plume height estimates
  - Air traffic can be limited during eruption
- Any other means available

Guidance process and report

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- Key players: London VAAC, IMO, ACC
  - IMO reports to London VAAC and ACC
  - London VAAC issues VAA, based on numerical dispersion model. Dissemination to relevant MWO, ACC, FIC and other “stakeholders”
  - IMO and other MWO´s issue SIGMET´s (T0-T+6)
  - ACC/FIC issue NOTAM´s and ASHTAM´s
  - ACC give clearences/non-clearences for operations in their AoR or part of their AoR.

Eyjafjallajökull 2010 eruption
IMO – London VAAC interaction

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- VA status reports issued by IMO every 3 hr, and more frequently if necessary:
  - Plume height (key parameter)
  - Plume activity (height and variation in height)
  - Color/shade of the plume
  - Lightning activity
  - seismic and hydrological activity
  - surface and upper air observations
- Contact by phone between forecasters at IMO and London VAAC, all significant changes reported promptly

- IMO gives further guidance to local stakeholders

Lessons learned

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- Atmospheric monitoring of key parameters insufficient
  - Distant C-band radar could not distinguish ash from droplets/aerosols during cloudy/rainy spells, dry ash low reflectivity
  - Use of satellite data has limitations
  - Cloudy/rainy spells limit surface monitoring in long stretches
  - During eruption, air traffic can be limited or totally absent
- Crustal monitoring should be improved for future events
  - Denser network of SIL stations in strategic locations
  - GPS/Strain network could also be improved
- Further VOLC exercises neccessary
- Need for higher resolution dispersion output in Iceland

Ongoing improvements

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- Investment in mobile X-band radar, ongoing process
  - Will be deployed within 25-30 km from source (volcano)
  - Should distinguish better between ash and cloud/water droplets
  - Should give better real-time measurements of plume height
  - Could give better estimates of source mass rate
- Italian Civil Protection loaning out similar radar in the meantime
  - Will arrive in Iceland in a month
- Several research initiatives ongoing with regard to monitoring
  - SO2, LIDAR
  - FP7 research projects lurching
- Investment in second C-band radar in the eastern part of Iceland

Current status – ash resuspension

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On June 4-5th, ash resuspension was serious and a SIGMET was issued. Measurements and modelling are needed as this will prevail.

Questions ?

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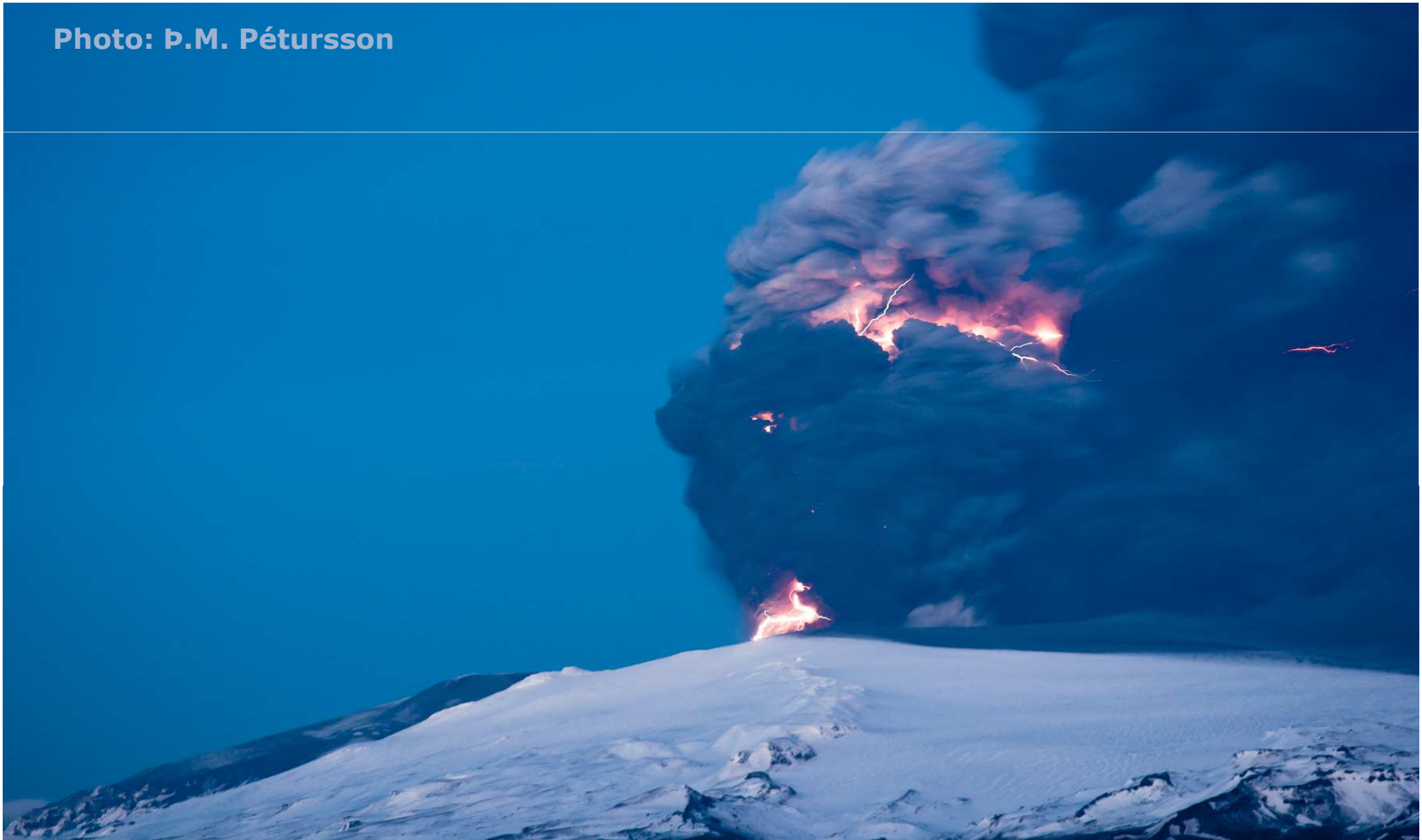

Photo: Þ.M. Pétursson