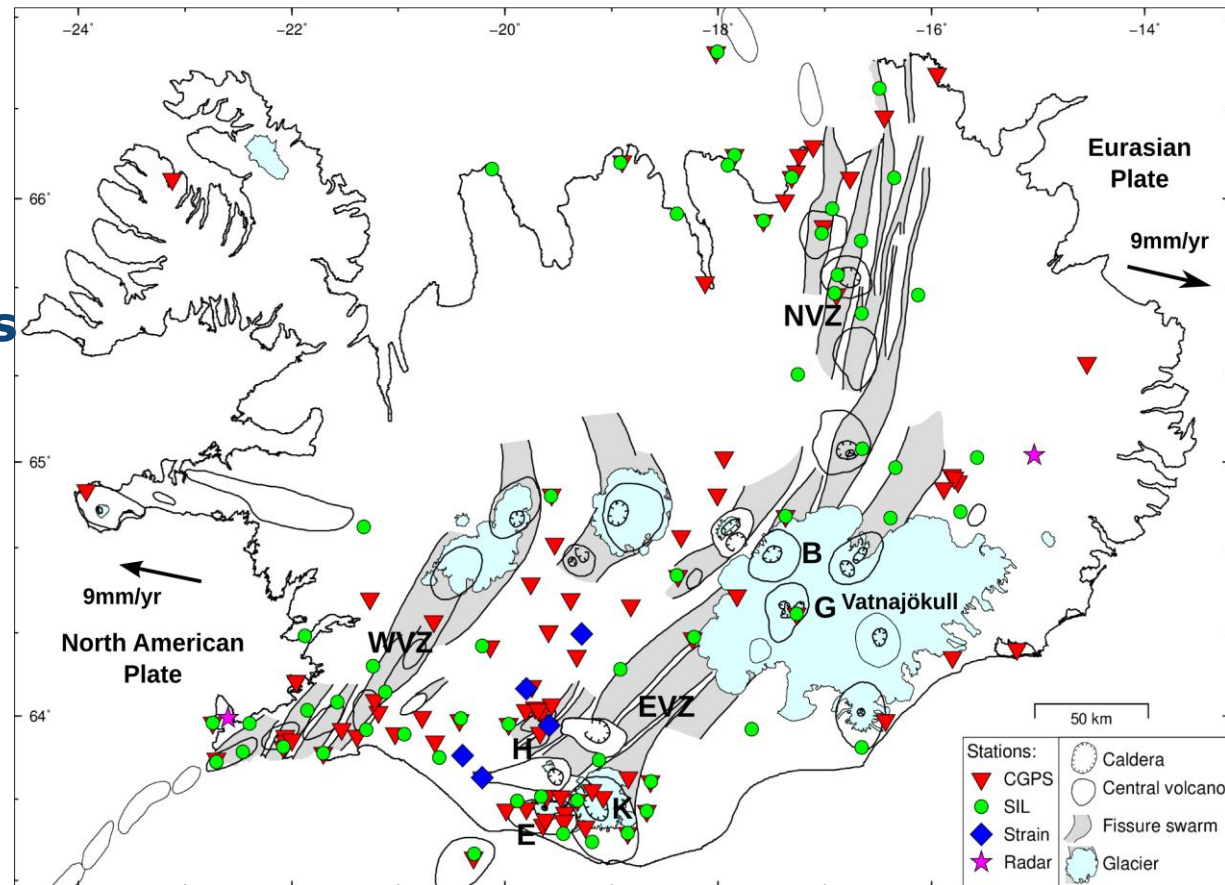

Monitoring volcanoes in Iceland: an update

Sigrún Karlsdóttir, Melissa Anne Pfeffer, Þórður Arason,
Hermann Arngrímsson, Sara Barsotti, Baldur Bergsson,
Bergur H. Bergsson, Halldór Björnsson, Evgenia Ilyinskaya,
Kristín Jónsdóttir, Ingvar Kristinsson, Sibylle von Löwis,
Guðrún Nína Petersen, Matthew J. Roberts, Gunnar S.
Sigurðsson, Kristín Vogfjörð, Richard Yeo and Hróbjartur
Þorsteinsson

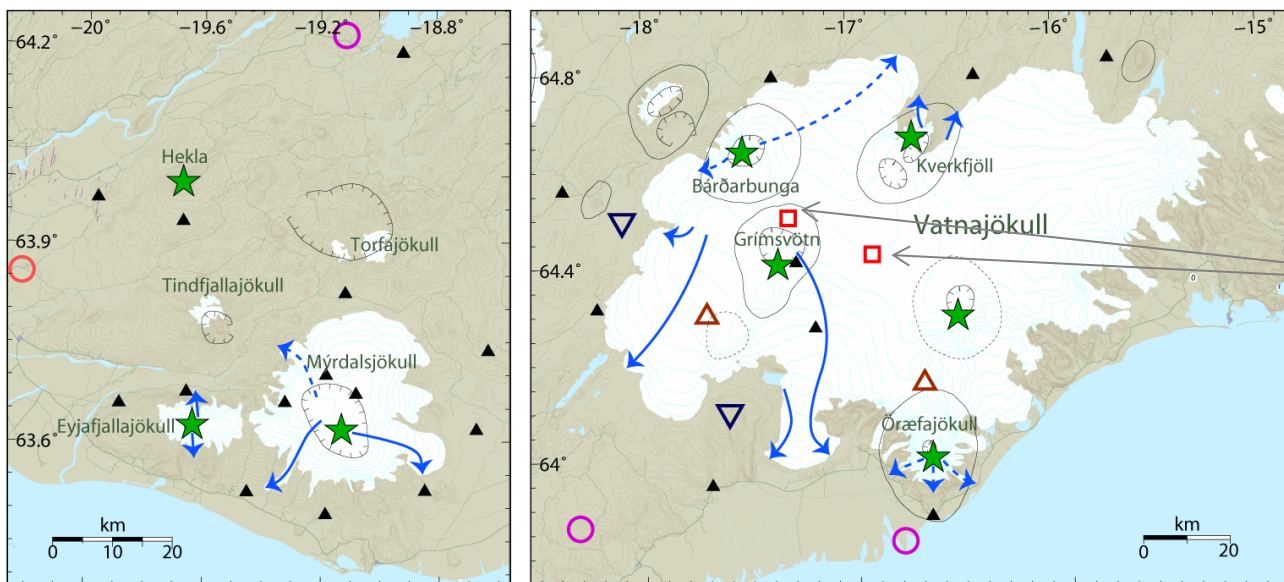
Monitoring and Research: Pre-eruptive monitoring

- ~69 seismic stations
- 2 seismic arrays
- ~70 GPS instruments
- 5 strain-meter stations
- 145 hydrological stations
- 2 infrasound arrays
- 3 quasi-continuous multigas instruments
- 3 continuous DOAS instruments



Permanent and temporary stations monitoring subglacial volcanoes

- Seismic stations and arrays installed in and around the glacier to discriminate between subglacial floods, eruptions and glacier movements
- Infrasonic arrays installed to detect and locate when eruptions become subaerial

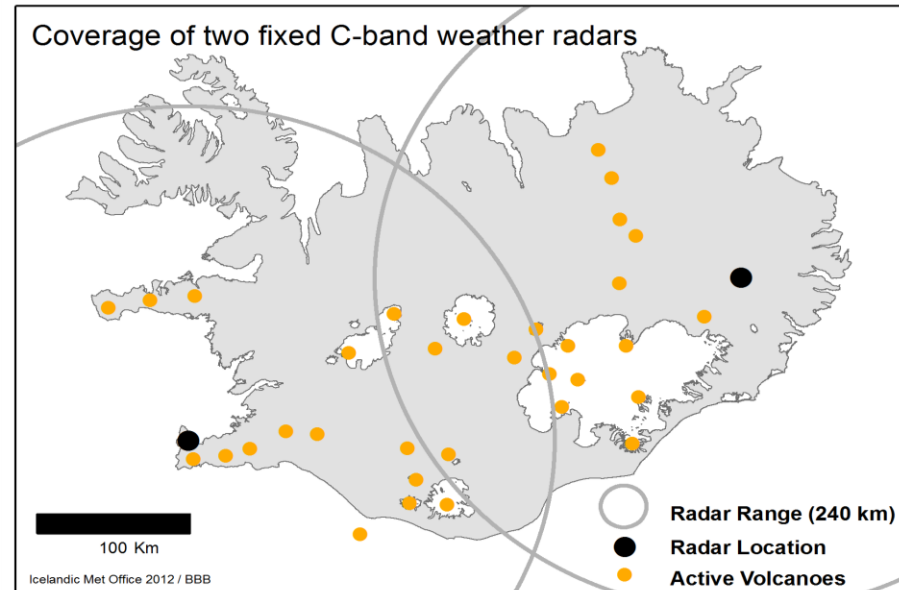


Glacier seismometer – installed 2014



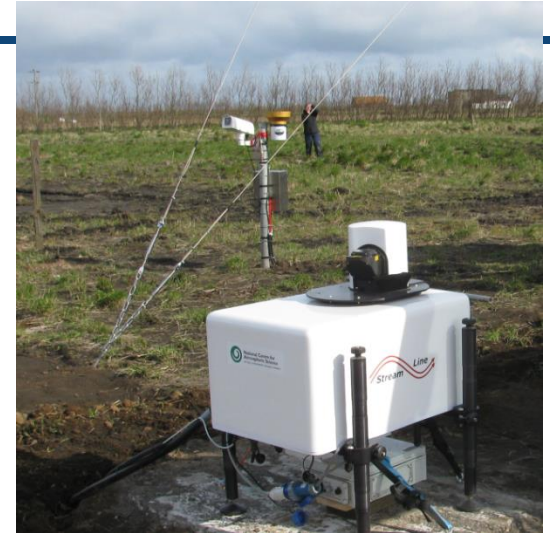
Monitoring and Research: eruption cloud detection and investigation

- **C-band weather radar close to Keflavík airport since Jan 1991**
 - has detected 7 eruptions
- **C-band weather radar in E-Iceland since April 2012**
- **2 X-band mobile radars**
- **2 Lidars (in December)**
- **7 ceilometers**
- **Mobile radiosonde soundings**
- **Lightning-detection devices**
- **FTIR, DOAS, MultiGas for gas measurements/detection**
- **2 mobile particle counters**

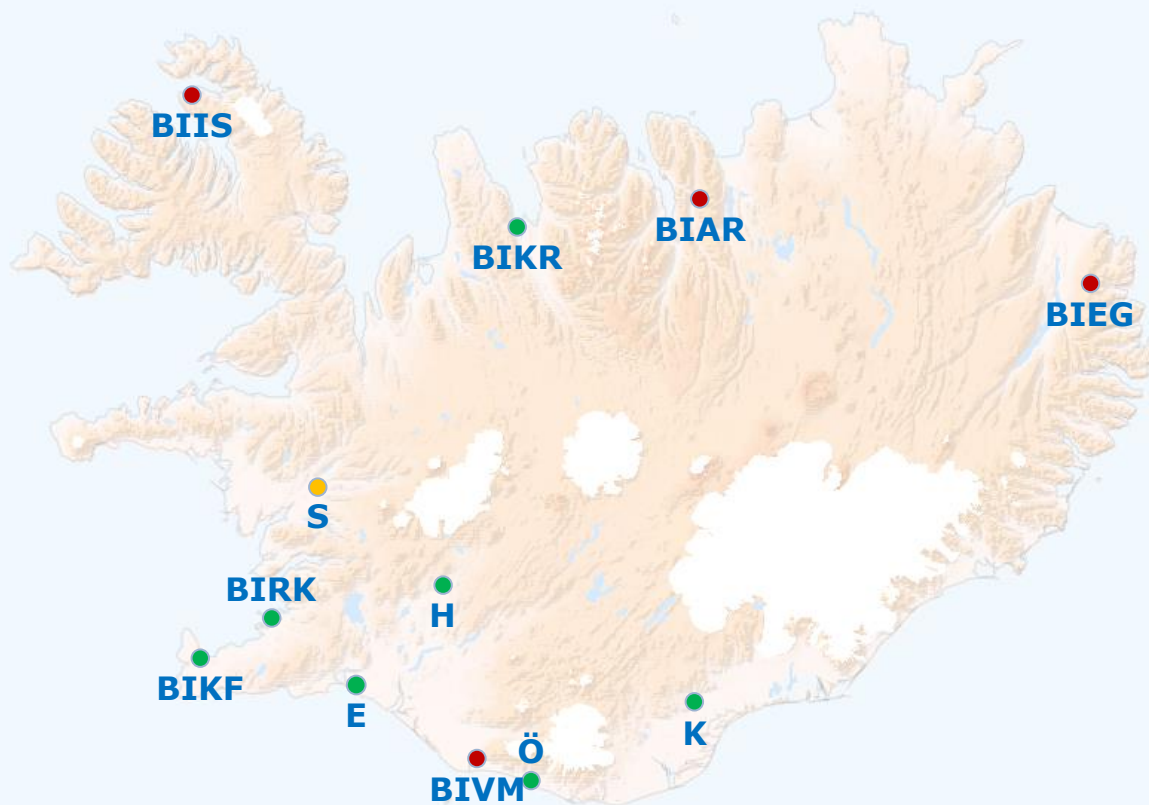


Ceilometers and Lidars

- Lidar
 - May 2011 – June 2012 on loan from NCAS, UK. Pulsed scanning Doppler LIDAR with de-polarization channel
 - December 2013 – two lidars implemented – one located in Keflavík airport and the other one mobile
- 7 Ceilometers



Ceilometers



Operational:

BIKF – Keflavík Airport
BIRK - Reykjavík
E - Eyrarbakki
H - Hjarðarland
Ö- Öndurhorn
K – Kirkjubæjarklaustur
BIKR – Sauðárkrókur

Planned:

S - Stafholtsey/Stóri-
Kroppur

ISAVIA:

BIIS – Isafjörður
BIAR – Akureyri
BIEG – Egilsstaðir
BIVM - Vestmannaeyjar

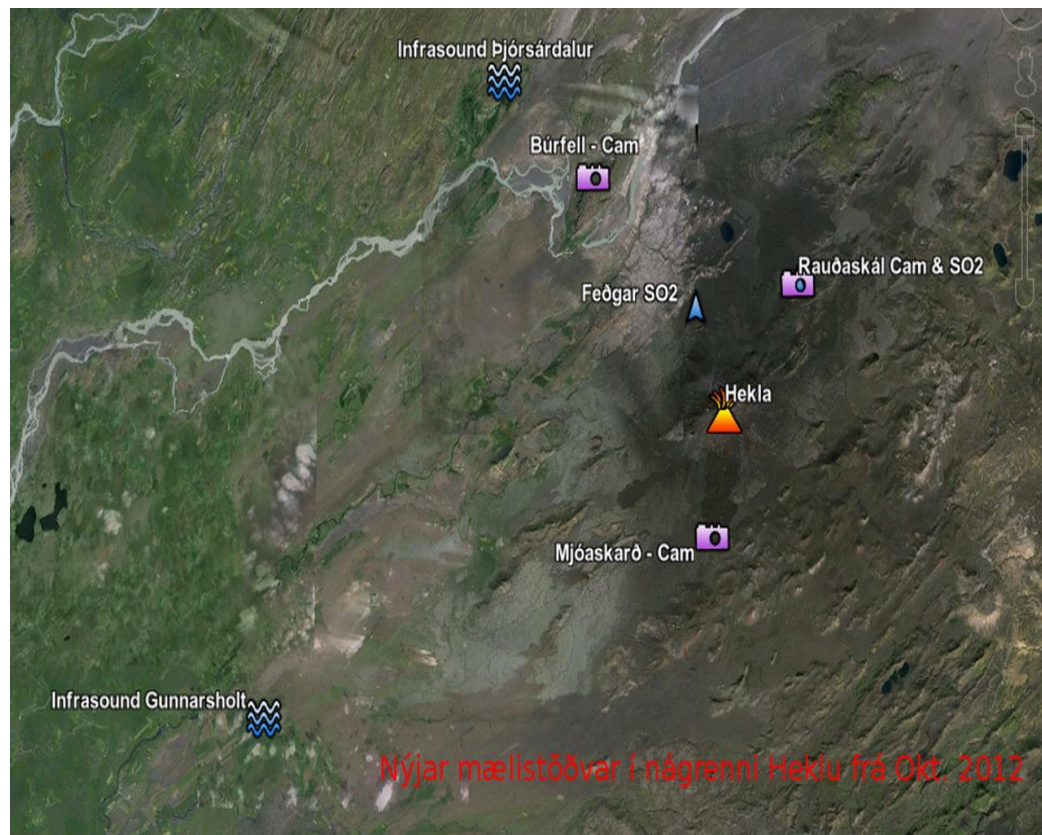
Mobile sounding station

- **Tested in 2013**
 - Experiments with additional sensors for cloud droplets and radioactivity in collaboration with the University in Reading.



- **Three spectrometers loaned from Chalmers Uni**
 - continuous SO₂ measurements at Hekla
- **Two mobile spectrometers owned by IMO+UI**
 - campaign SO₂ (+ HF and HCl) measurements during eruptions
- **Four sensor systems loaned from Uni Palermo, BGS, INGV**
 - quasi-continuous SO₂, H₂S, and CO₂ measurements at Hekla and Krýsuvík and anticipating a jökulhlaup from Vatnajökull (Loki Ridge/Hamarinn/Bárðarbunga)
 - one portable system used for campaign measurements at Eldfell, Surtsey, Grímsvötn, and Kverkfjöll summer 2013
- **Accumulation chamber loaned from ISOR**
 - campaign CO₂ measurements at Surtsey (+ Hekla) summer 2013

- **3 visible cameras have been installed around Hekla with real-time link to IMO.**
- **In conjunction with new cameras, improvements have been made to algorithms for analysing the image data.**
- **3 mobile multispectral IR cameras. Two may travel with Radars and one at Keflavík.**



Volcanic ash dispersal models - Objective

IMO needs numerical tools for forecasting volcanic ash dispersal over regional scale.

Two different numerical models are in use:

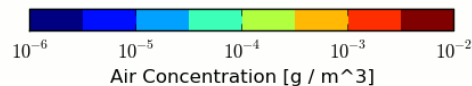
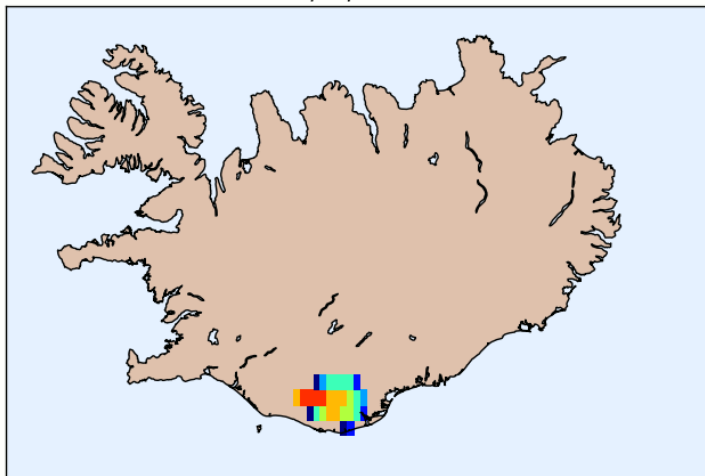
- *NAME* code (currently used by VAAC London, Jones et al. 2007) – purely Lagrangian code for simulating volcanic particles transport and deposition
- *VOL-CALPUFF* code (Barsotti et al. 2008) – hybrid code for simulating volcanic plume rise and volcanic particles transport and deposition

These codes will be operational and will produce daily forecasting ash concentration and ground deposition maps for Hekla, Katla and Grímsvötn volcanoes. In case of eruption ad-hoc runs will be set up.

Volcanic ash dispersal models - NAME and VOL-CALPUFF

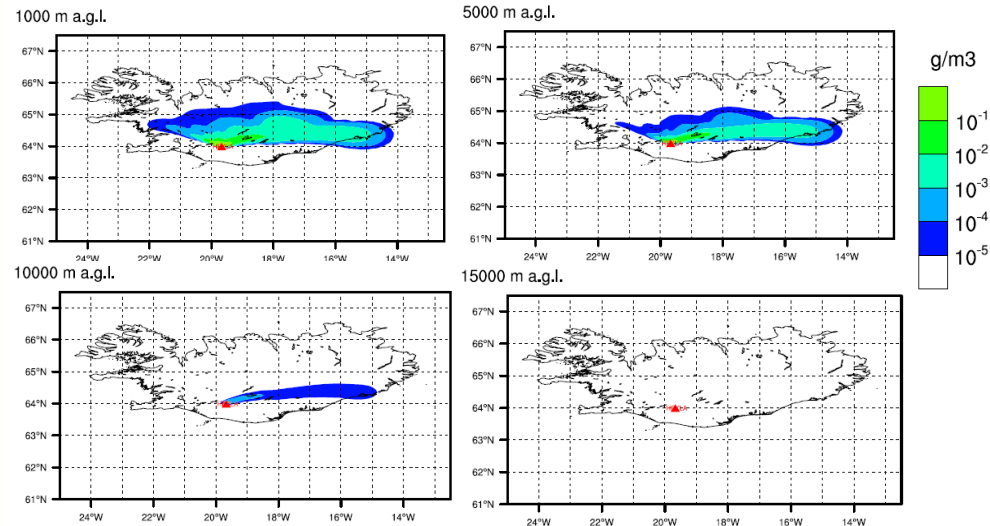
NAME and VOL-CALPUFF are now running at IMO. We are now testing model outcomes with different meteorological data sets.

Run name: ECMWF OPER 0125 demonstration: Eyja 2010
Valid at: 04/05/2010 01:00 UTC



Eyjafjallajökull eruption (4-5 May 2010) simulated with NAME.

The ERA OPERATIONAL archive data with a resolution of 0.125° has been used for this test run.



Hypothetical eruption at Hekla (26 October 2013) simulated with VOL-CALPUFF. Ash concentration at four altitudes (agl) is shown. 0.5° NOAA-NCEP data have been used.

Volcanic ash dispersal models

-
- **NAME and VOL-CALPUFF will be set up to run with high-resolution meteorological data provided by HARMONIE code over regional scale**
 - **Multiple runs will allow to produce hazard maps for airborne ash concentration, tephra ground deposition, volcanic PM10 concentration at ground level and visibility**
 - **Multi-model runs will be performed and the model-dependent uncertainty will be investigated**
 - **Simulations of SO₂ dispersion will be addressed**

-
- **Lack of qualified man-power to deal with build-up of infrastructure especially in remote sensing**
 - IMO is in the process of finding an expert
 - **Integration of many monitoring data to produce a unique strong and reliable warning system**
 - Continuous effort ongoing to guarantee a collaboration between different monitoring groups within IMO
 - **Renewal of outdated GPS stations**
 - The renewal strategy has been set and three stations will be purchased before the end of 2013

Challenges continue

- **To guarantee continuous funding for the the risk assessment project of volcanoes in Iceland**
 - To be done early next year
- **Improve information flow to stakeholders about ash dispersion and deposition at local and regional scale**
 - The NAME and VOL-CALPUFF models with meteorological input data from the HARMONIE model will be used to answer this need.

