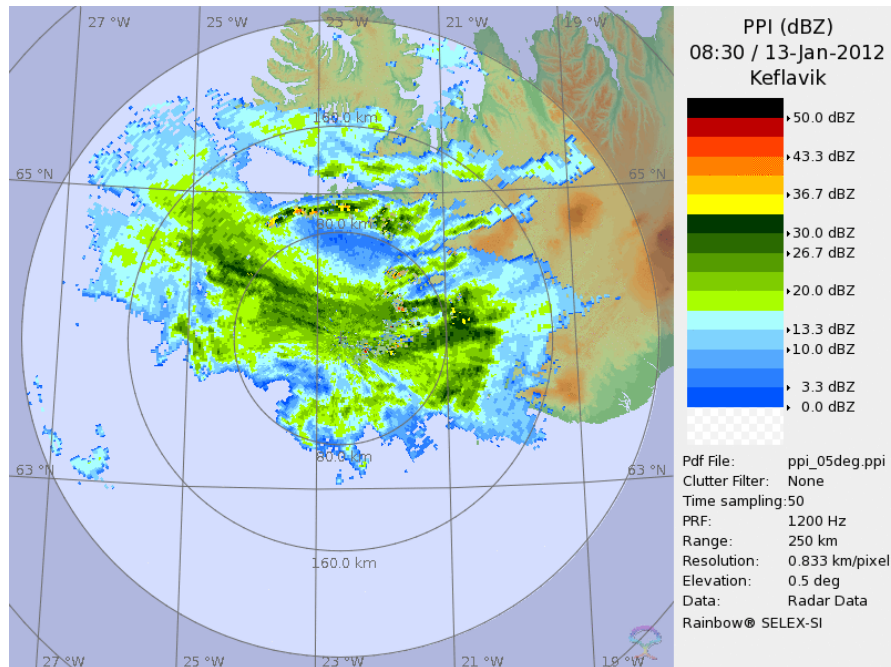

Use of radar- and Lidar measurements to monitor volcanic ash plumes

**Sigrún Karlsdóttir, Sibylle von Löwis, Geirfinnur Sigurðsson,
Halldór Pétursson, Guðrún Nína Petersen and Árni Snorrason**

- ▶ Plume height estimation → real-time input data into dispersion models
- ▶ Primary instrument for plume height estimation are weather radars
 - ▲ C-band Doppler weather radar located at Keflavik airport.
 - ▲ X-band mobile Doppler and dual polarization radar.
 - ▲ C-band Doppler weather radar at Teigsbjarg, eastern Iceland (under construction).
 - ▲ Second X-band mobile radar.
- ▶ Other observation instruments/techniques to monitor volcanic ash
 - ▲ Lidar / Ceilometer
 - ▲ Satellite data
 - ▲ Lightning
 - ▲ Aerosol particles

Ericsson C-band Doppler Radar at Keflavik Airport

- ▶ Fixed Ericsson C-band radar in operation since 1991.
- ▶ Doppler update in 2010.
- ▶ Covers big part of Iceland.
- ▶ Has detected 7 eruptions.



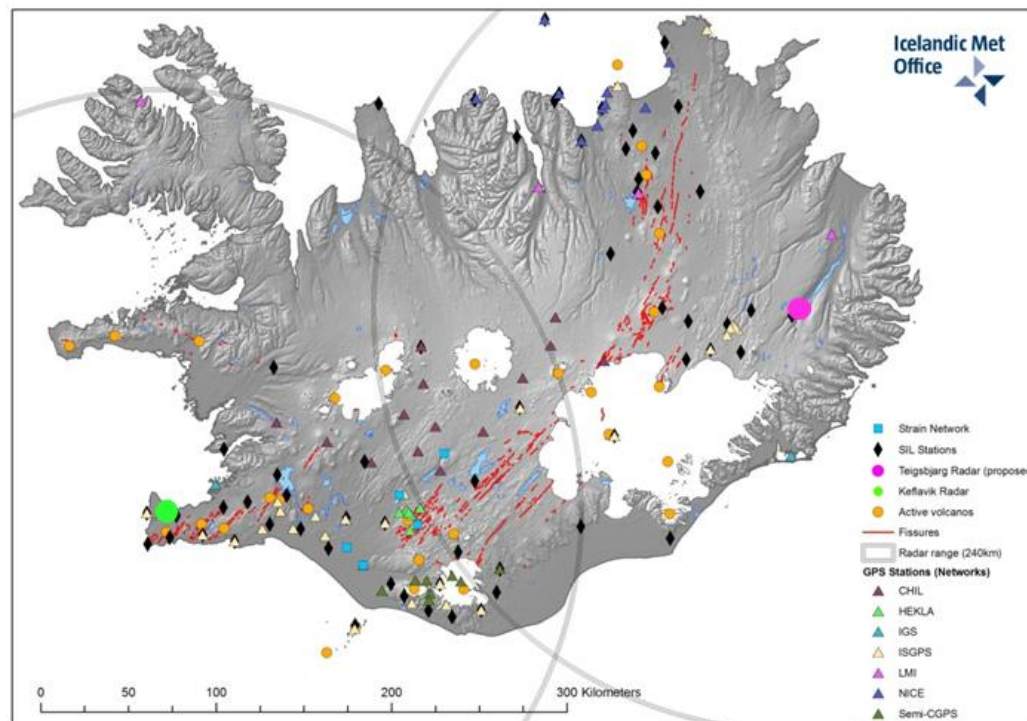
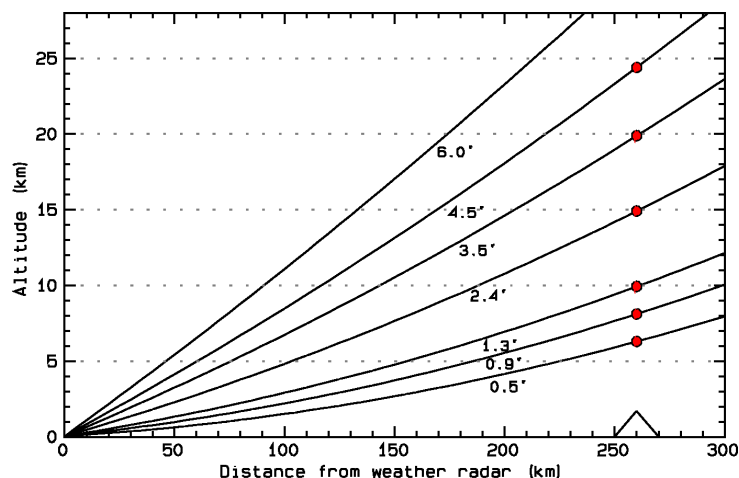
EEC C-band Doppler Radar at Teigsbjarg (under construction)

- ▶ Purchased in beginning of 2011.
- ▶ Update of SP being made at EEC.
- ▶ Constructions on site finished.
- ▶ Being prepared for transportation at the moment.
- ▶ In operation first quarter of 2012.



Radar coverage

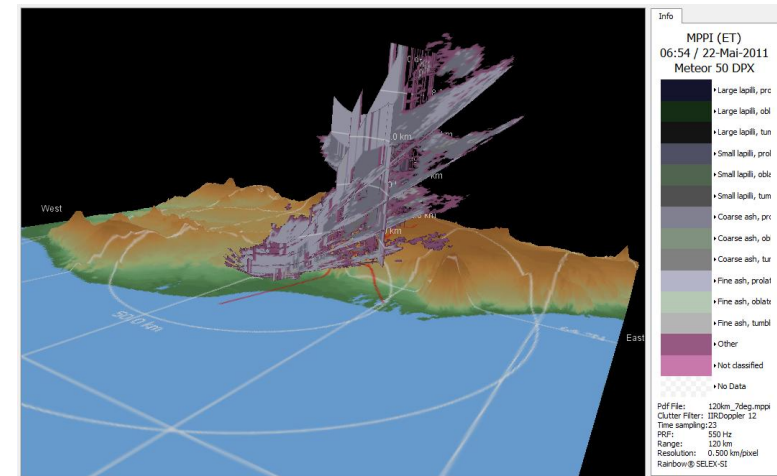
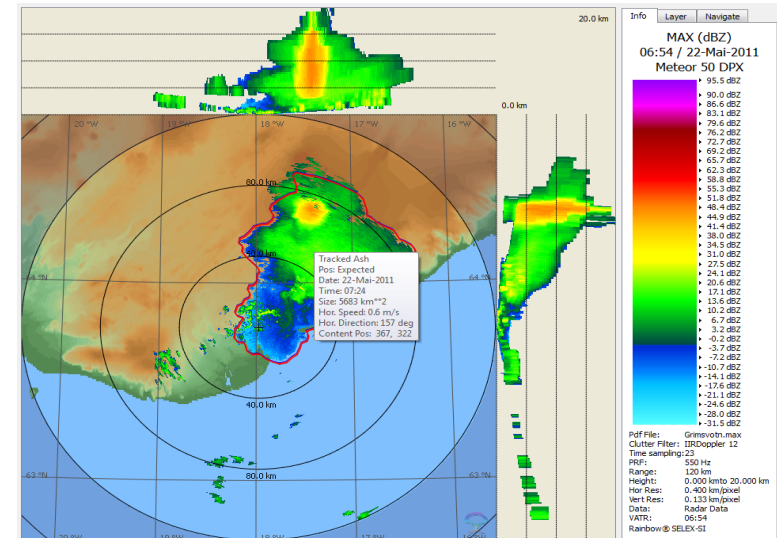
- ▶ Complete coverage of Iceland's active volcanic zone is accomplished, with these two fixed C-band radars.
- ▶ Improved information on low plume heights.



- ▶ Mobile radars used to get as close to volcanoes as possible → to get better resolution data.

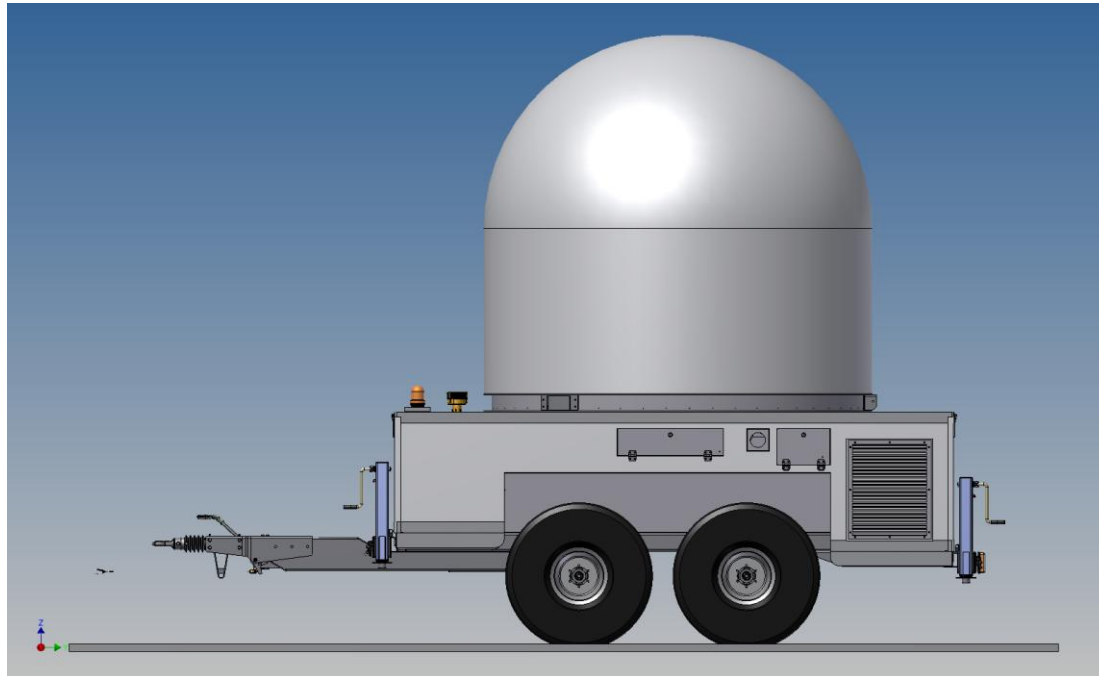
Mobile X-Band Radar

- ▶ 9 hr after the onset of Grímsvötn eruption
→ data stream to IMO.
- ▶ Mobil radar was
 - ▲ main source for plume height estimations.
 - ▲ Collected unique polarimetric data.
- ▶ Data was sent to the Civil Protection Agency in Italy and to Selex – Gematronik to help calibrate the ash detection module.



Mobile X-Band Radar

- ▶ To be able to move the radar in Icelandic terrain
 - ▲ modification of the trailer necessary
- ▶ Radar currently being constructed at Selex – Gematronik in Germany
- ▶ Four weather radars in operation by IMO before the end of this year



Lidar and ceilometers in Iceland

► Lidar – Light Detection And Ranging (Laser Radar)

- ▲ Optical remote sensing device, as light source different kind of lasers (single and multi-wavelength systems)
- ▲ In atmospheric science to measure cloud droplets and aerosol particles, for boundary layer research and wind-shear measurements
- ▲ Since March 2011: Doppler Lidar with depolarisation mode from NCAS Leeds, UK located in South Iceland

► Ceilometer

- ▲ Low-powered, single frequency Lidar
- ▲ Mostly used for cloud base height measurements
- ▲ Used to measure the aerosol layers in the atmosphere (backscatter signal)

Ceilometer in Iceland operated by IMO – Vaisala CL31, CT25K

Icelandic Met
Office

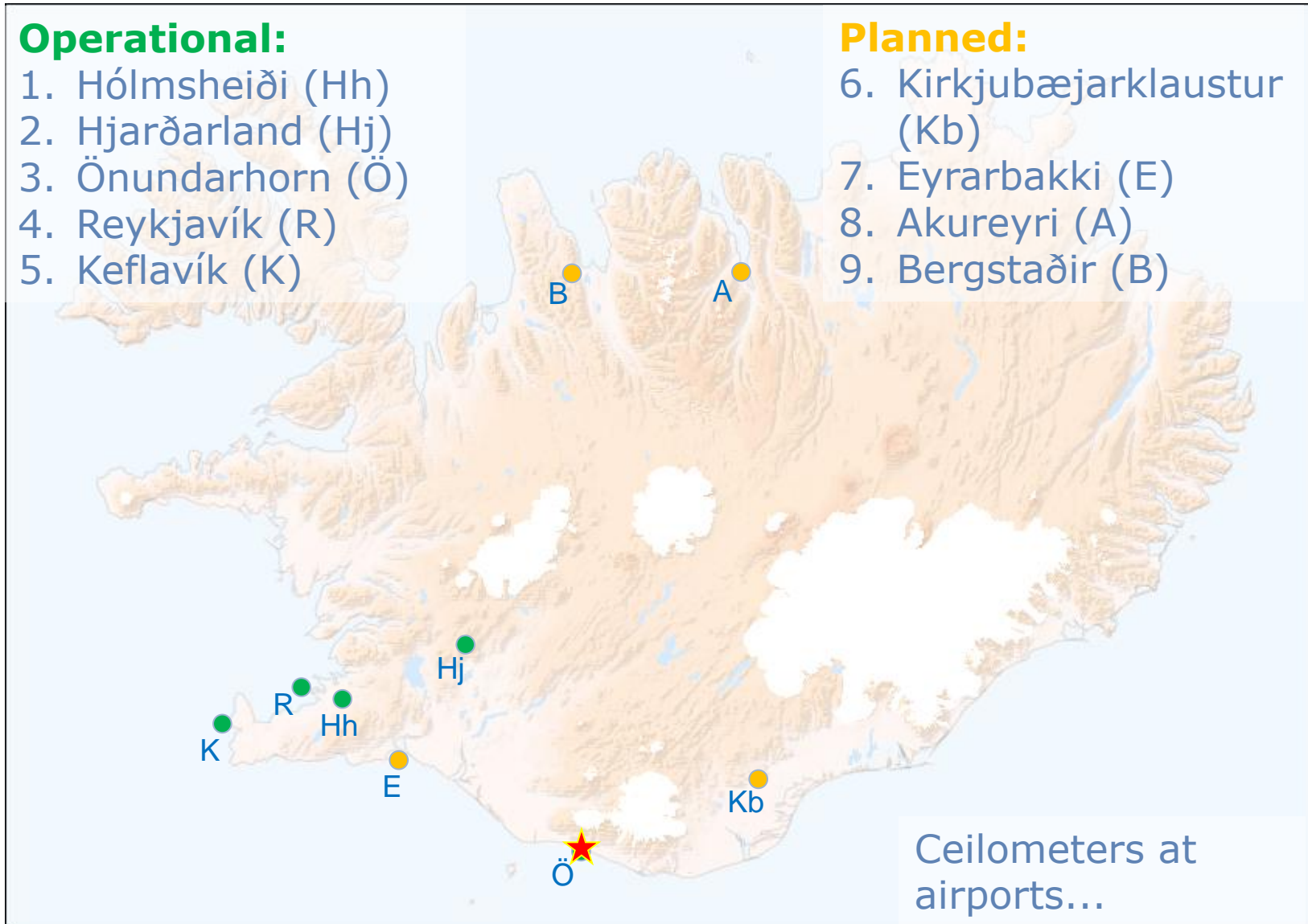


Operational:

1. Hólmseyri (Hh)
2. Hjarðarland (Hj)
3. Öndurhorn (Ö)
4. Reykjavík (R)
5. Keflavík (K)

Planned:

6. Kirkjubæjarklaustur (Kb)
7. Eyrarbakki (E)
8. Akureyri (A)
9. Bergstaðir (B)



Ceilometers at
airports...

Depolarisation Doppler Lidar, NCAS Leeds (Stream Line, Halo Photonics)



- ▶ Since May 2011 on the farm Önundarhorn in S-Iceland
- ▶ Grímsvötn eruption 2011: Moved to Keflavík airport on 22 May



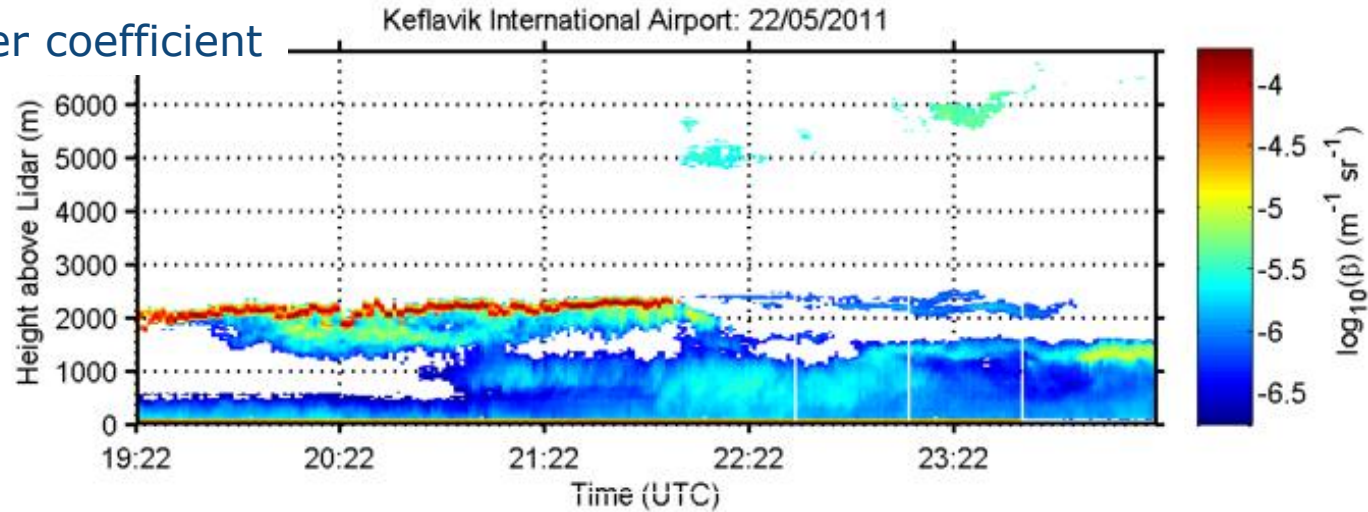
Reykjavík, 22 May 2011, 20.30 UTC

Volcanic ash cloud arrives in Reykjavík
(View to the south)

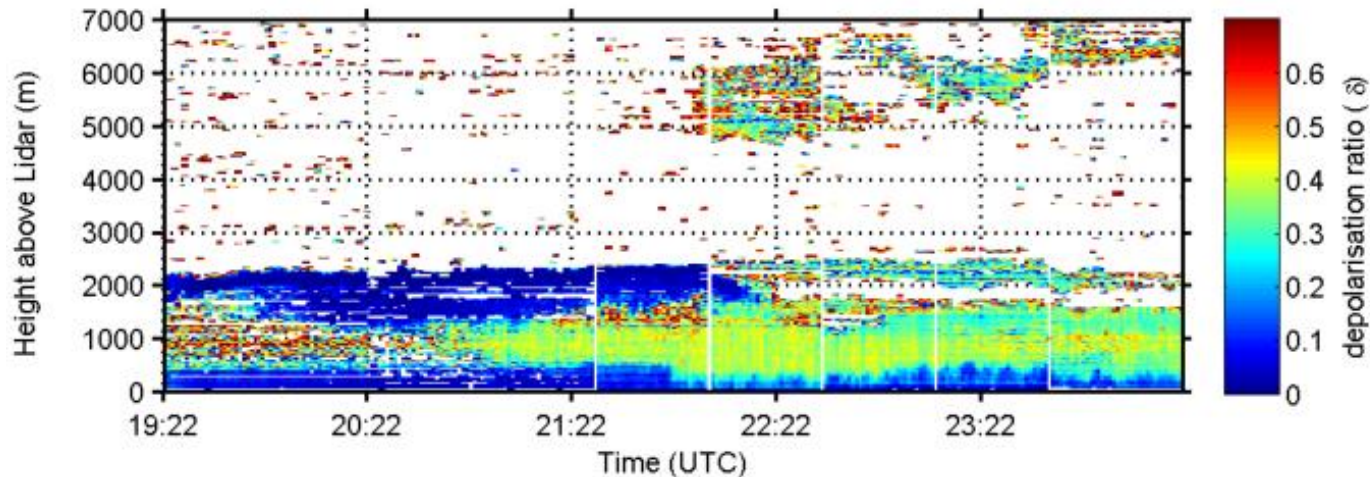
- ▶ Depolarisation used to detect aerosol layers

Measurement at Keflavík airport – 22 May 2011

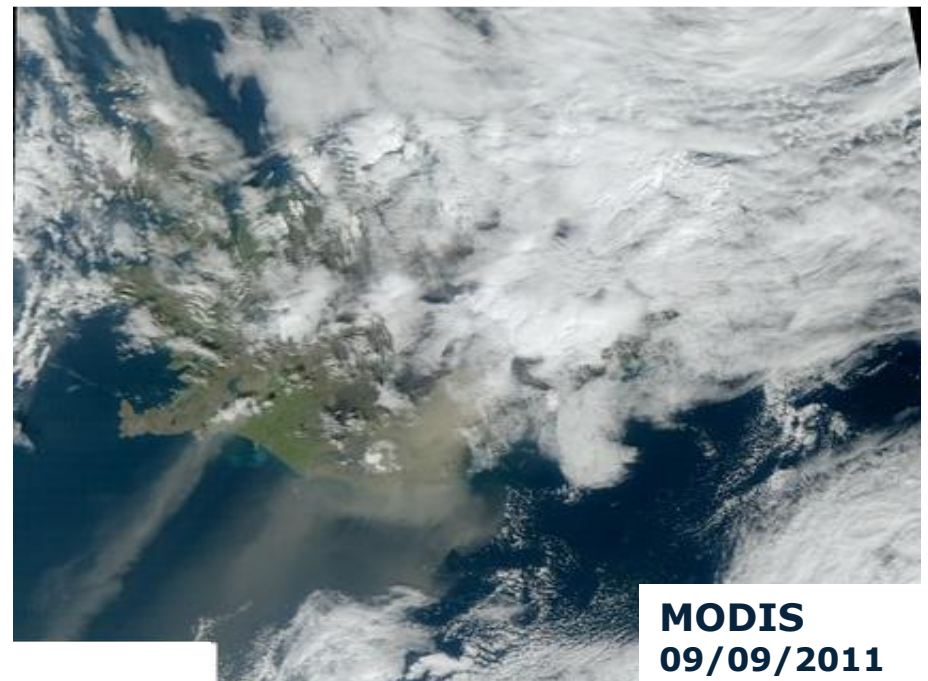
Backscatter coefficient



Depolarisation ratio

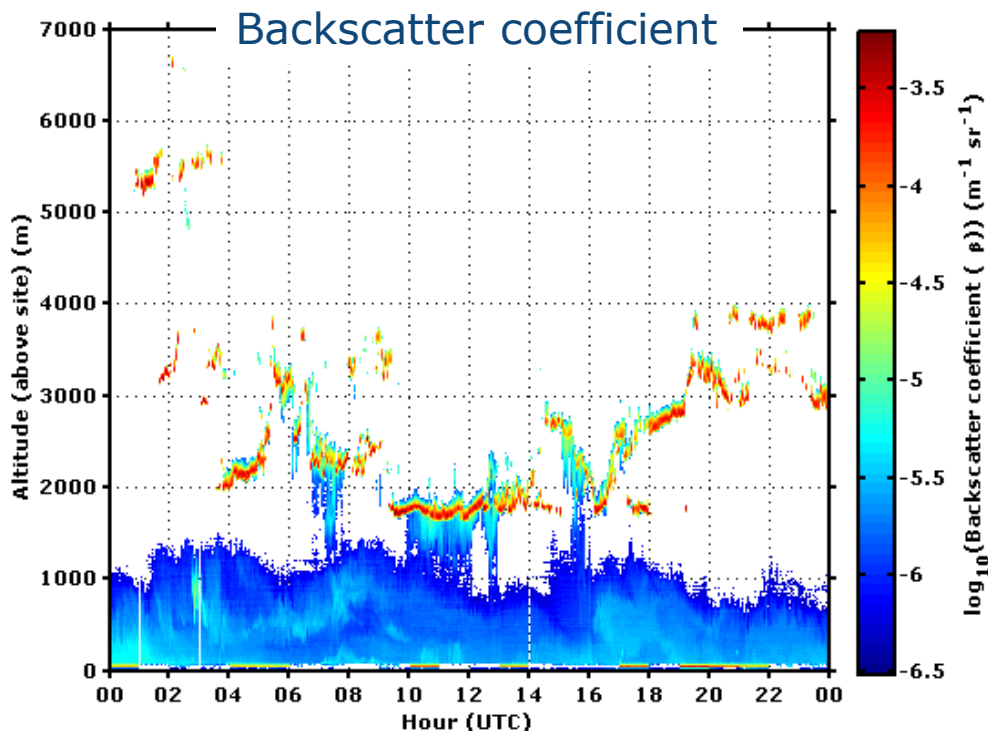


Re-suspension of volcanic ash observed near Skógar

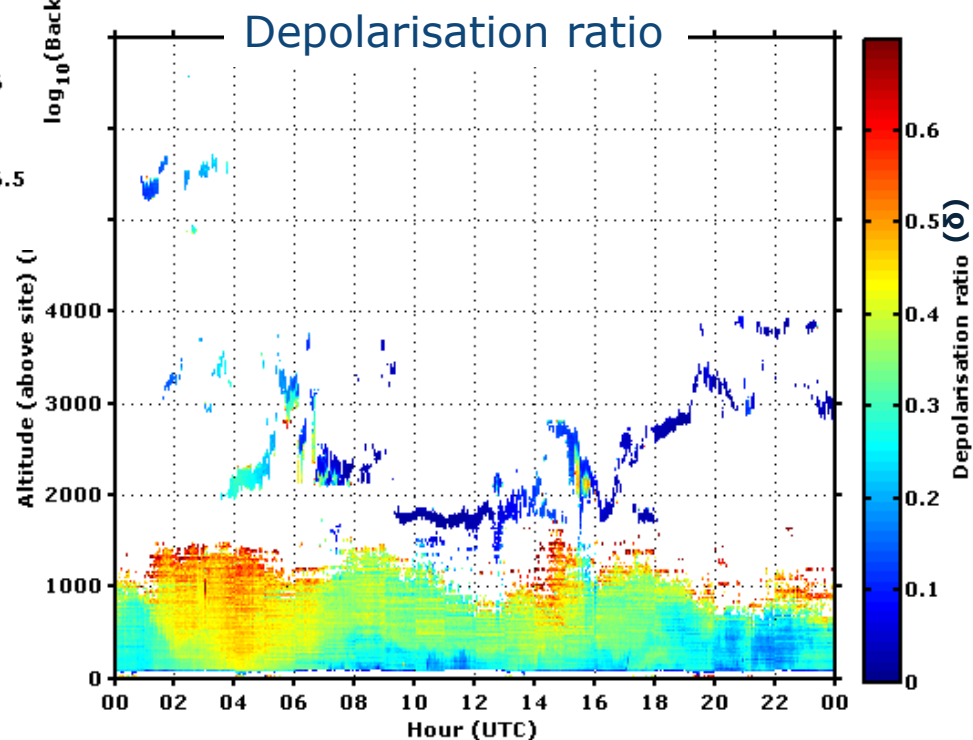


by courtesy of Magðalena Jónsdóttir

Önundarhorn – 11 September 2011



- Ceilometer and Lidar
 - ▲ Using backscatter signal (ceilometer)
 - ▲ Lidar instrument preferable at Keflavík airport for ash detection
 - ▲ Understanding of depolarisation data



THANK YOU !