Grimsvotn

Dr Fred Prata
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First Notice

Volcanic eruption expected in Grímsvötn

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To: volcinfo [volcinfo@vedur.is]

Saturday, May 21, 2011 9:03 PM

- You forwarded this message on 5/21/2011 9:20 PM.

Dear all,

volcanic tremor has been observed in Grímsvötn.

Location: N64,24 and W0172

The eruption is expected to stratified within one hour (~20:00 UTC) and then the melting of the ice will take place and the volcanic plume might reach the surface after 2 to 3 hr (~21:00 to 22:00 UTC).

The plume height might go up to 11 km height.

Please follow VAA from London VAAC and SIGMETs.

We will issue the volcanic status report later this evening and every 3 hr after that.

Good luck to everyone and best regards
Sigrún

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Ash-Aviation Workshop, Melbourne
MODIS/Terra Image acquired on 22 May 2011 at 05:15 UTC
SNAP: 20110522/0600Z 6h-MEAN CONCENTRATION (mg/m³) LEVEL: SFC/FL200

8-9 July, 2011
Ash-Aviation Workshop, Melbourne
Grimsvotn-SO4-aero
20110521-160000

Plume (units m^3), Release: 0.10E+16 Units

8-9 July, 2011
Ash-Aviation Workshop, Melbourne
Modelled Ash Concentration from FL000 to FL200 at 0600 UTC 25/05/2011

This is a guidance product, supplemental to the official VAAC London Volcanic Ash Advisory and Volcanic Ash Graphic products.

Issue time: 201105250600

- 200-2000 micrograms per cubic metre
- 2000-4000 micrograms per cubic metre
- > 4000 micrograms per cubic metre

All concentrations are subject to a level of uncertainty relative to errors in the estimation of the eruption strength.

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MODIS Retrievals

MODIS/Aqua  Date: 23 May 2011  Time: 0240UT

SAVAA Ash Mass Loading

Total mass = 713 kt

Mass loading (g m$^{-2}$)

Grimsvøtn
MODIS Retrievals

MODIS/Terra Date: 23 May 2011 Time: 1205UT

SAVAA Ash Mass Loading
Total mass = 125 kt

8-9 July, 2011
Ash-Aviation Workshop, Melbourne
MODIS Retrievals

MODIS/Terra Date: 23 May 2011 Time: 1345UT

SAVAA Ash Mass Loading

Total mass = 123 kt

Mass loading (g m⁻²)

0 2 4 6 8 10

-20 -16 -12 -8 -4 0 4

Radius (µm)

5 10 15 20
MODIS Retrievals

8-9 July, 2011
Ash-Aviation Workshop, Melbourne
MODIS Retrievals

MODIS/Terra  Date: 24 May 2011  Time: 1110UT

SAVAA Ash Mass Loading
Total mass = 74 kt

Number

Mass loading (g m$^{-2}$)

8-9 July, 2011
Ash-Aviation Workshop, Melbourne
MODIS Retrievals

MODIS/Terra Date: 24 May 2011 Time: 2050 UT

SAVAA Ash Mass Loading

Total mass = 37 kt

Number

Mass loading (g m$^{-2}$)

Radius (μm)

8-9 July, 2011
Ash-Aviation Workshop, Melbourne
Impacts

• Flights to Svalbard cancelled
• Helicopters in northern Norway grounded
• Scottish, Norwegian and (some) German airspace closed
What is “visible” ash?

Ash-Aviation Workshop, Melbourne
8-9 July, 2011
Ash Aviation Workshop, Melbourne
Modelling the Grimsvöth ash plume

The big unknown: the source term
How much ash is released into the atmosphere by the volcano?
How high does it reach?
What is the fraction of “fine ash”?

“Emergency” approach:
1) Assume an emission source (relate observed plume heights to total mass emitted, assume fine ash mass fraction)
2) Roughly scale it so it fits with satellite data
Ash plume approaching Norway
Tuesday 24 May 2011

SEVIRI satellite retrieval

MODIS true color image

8-9 July, 2011
Ash-Aviation Workshop, Melbourne
Ash plume over Norway
Tuesday 24 May 2011

SEVIRI satellite retrieval

FLEXPART modelled ash plume

Ash-Aviation Workshop, Melbourne
Ash plume over Norway
Tuesday 24 May 2011

SEVIRI satellite retrieval

FLEXPART modelled ash plume
Volcanic ash forecasts from VAAC

**Source term:**
Amount of ash released calculated from the equation:

\[ H = 2.00 \times (M/\rho)^{0.241} \]

- \( H \) = observed plume height (usually from radar)
- \( M \) = total ash mass (kg/s)
- \( \rho \) = density of the ash particles, usually 2500-3000 kg/m³

Assume “fine ash” fraction, usually 5%.

The fine ash fraction is uniformly distributed in the vertical from the volcano vent up to \( H \).

Vary the ash release when new observations on the plume heights are available.
Improvements using the new source term?

14 May 2010 12:00 UTC

Modelled ash plume with first guess emissions

Modelled ash plume with new emissions from inversion

SEVIRI

IASI

8-9 July, 2011

Ash-Aviation Workshop, Melbourne
What about last time?

The Grímsvötn Eruption in 2004: Dispersal and Total Mass of Tephra and Comparison with Plume Transport Models

Björn Oddsson

The total mass of the tephra layer was compared to predicted values obtained by integrating theoretical and empirical relations linking mass transport and plume height. The comparisons suggest, at least for this eruption, that models tend to overestimate the mass of tephra. The overestimate is 120% - 160% relative to the whole deposit and 340%-420% if restricted to the layer outside the ice cauldron. This also indicates that the available thermal energy from both the material within the and outside the ice cauldron was used to drive the eruption column.

The error margins in the models are very large and they can only provide an order of magnitude estimate the volume of the erupted material. The data on tephra mass and distribution were also compared to tephra thickness decay