

Grimsvotn



Dr Fred Prata
Climate & Atmosphere Department
Norwegian Institute for Air Research

8-9 July, 2011

Ash-Aviation Workshop, Melbourne

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First Notice

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Volcanic eruption expected in Grímsvötn

Sigrún Karlsdóttir [sigk@vedur.is]



To: [volcinfo \[volcinfo@vedur.is\]](mailto: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 start 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

Sigrún Karlsdóttir

Náttúruvárstjóri/Director of natural hazards

Veðurstofa Íslands/Icelandic Meteorological Office

Bústaðarvegur 9, IS-150 Reykjavík, Iceland

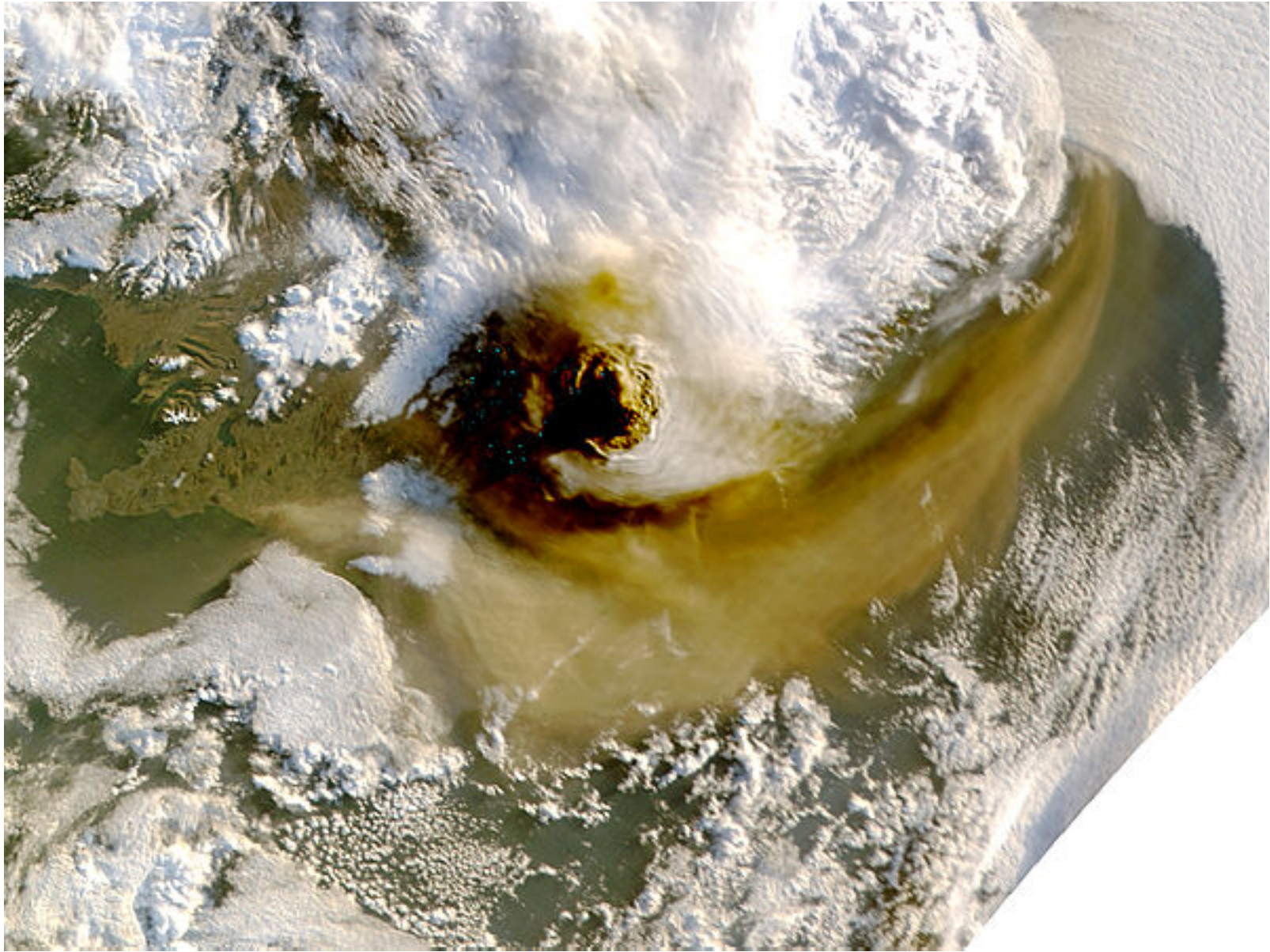
sími/tel.: + 354 522 6000, fax: + 354 522 6001

vefur/web: www.vedur.is

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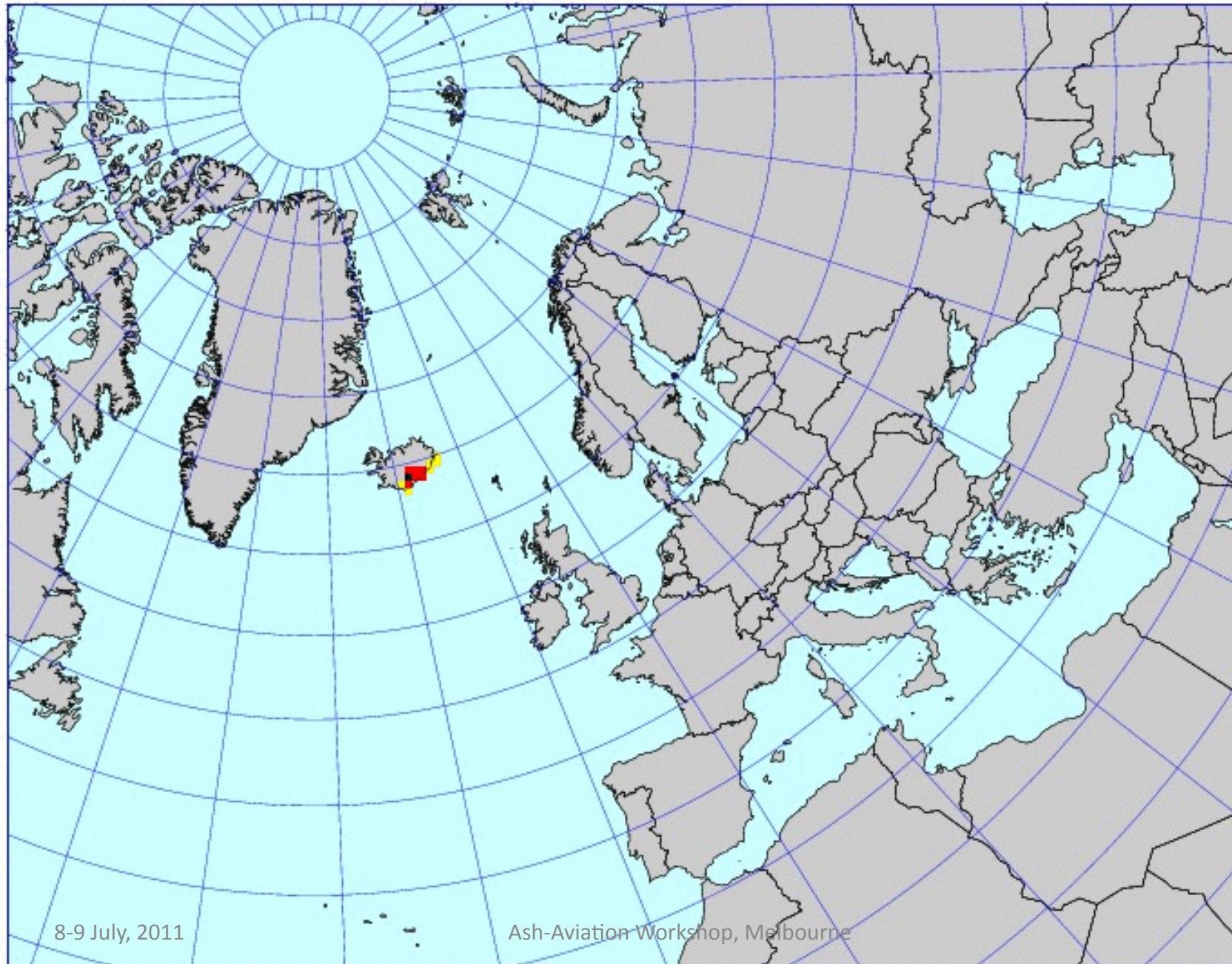
MODIS/Terra Image acquired on 22 May 2011 at 05:15 UTC



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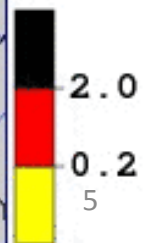
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SNAP: 20110522/0600Z 6h-MEAN CONCENTRATION (mg/m3) LEVEL: SFC/FL200

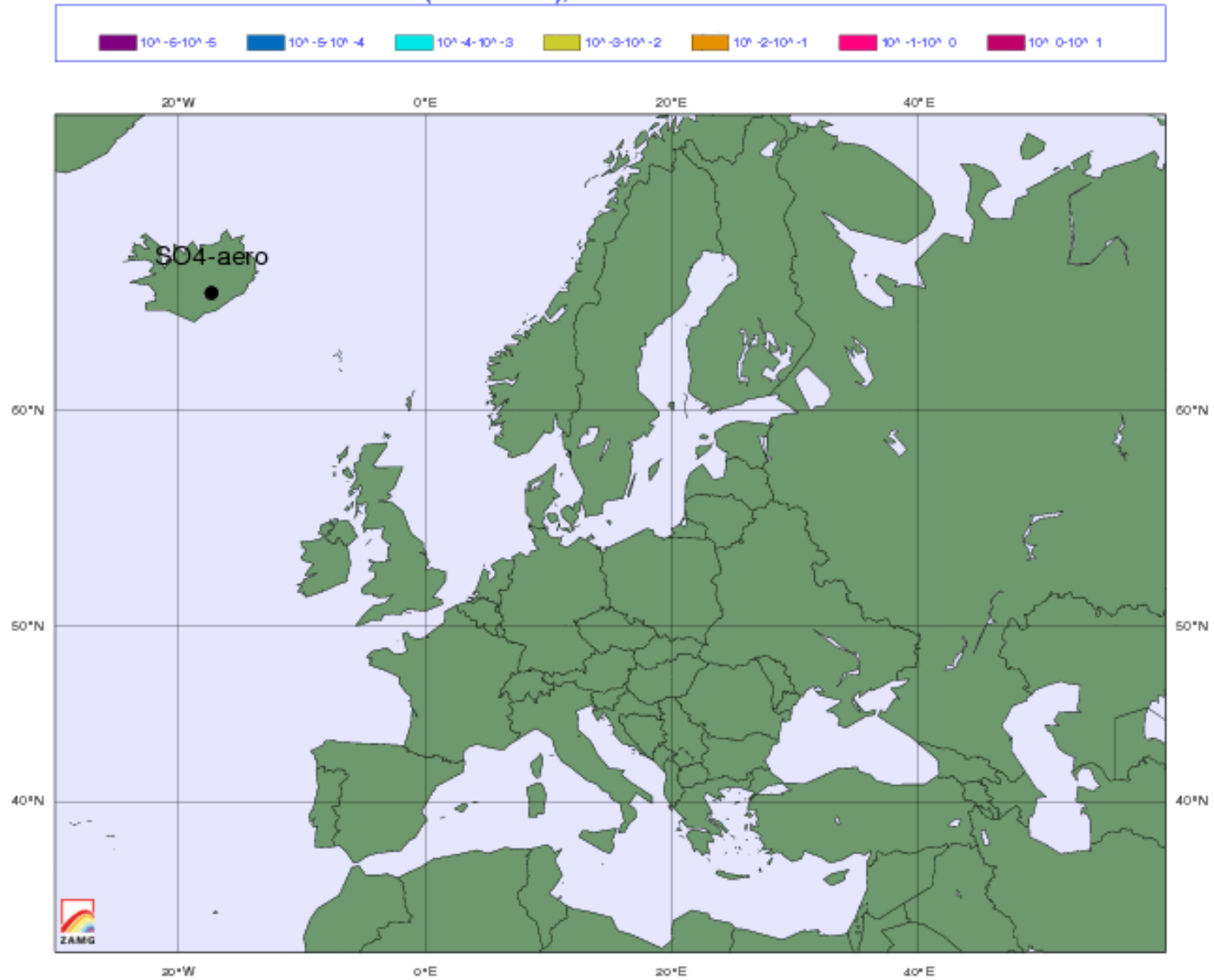


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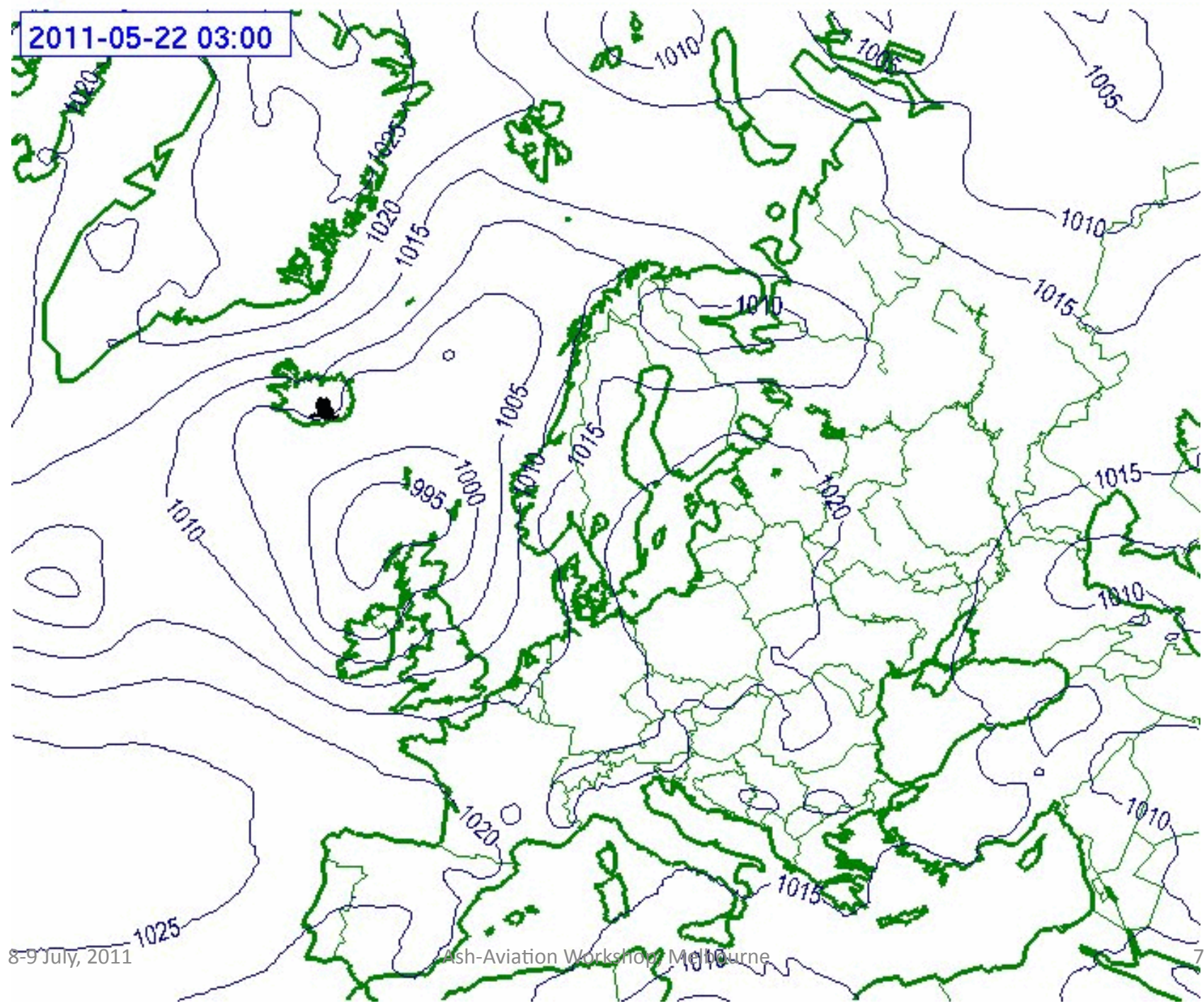
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Grimsvotn-SO4-aero
20110521-160000
Plume (units m⁻³), Release: 0.10E+16 Units



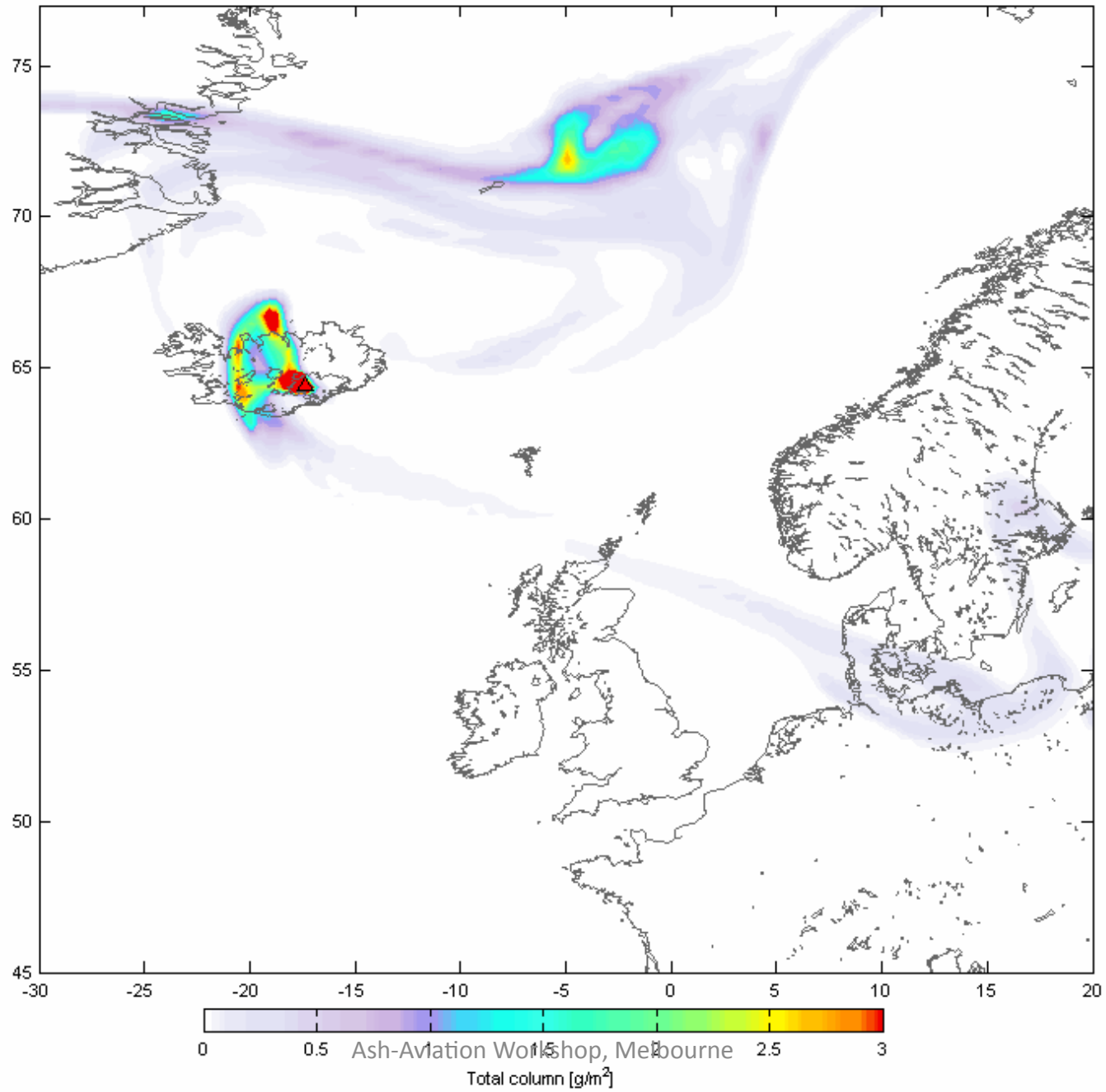
2011-05-22 03:00



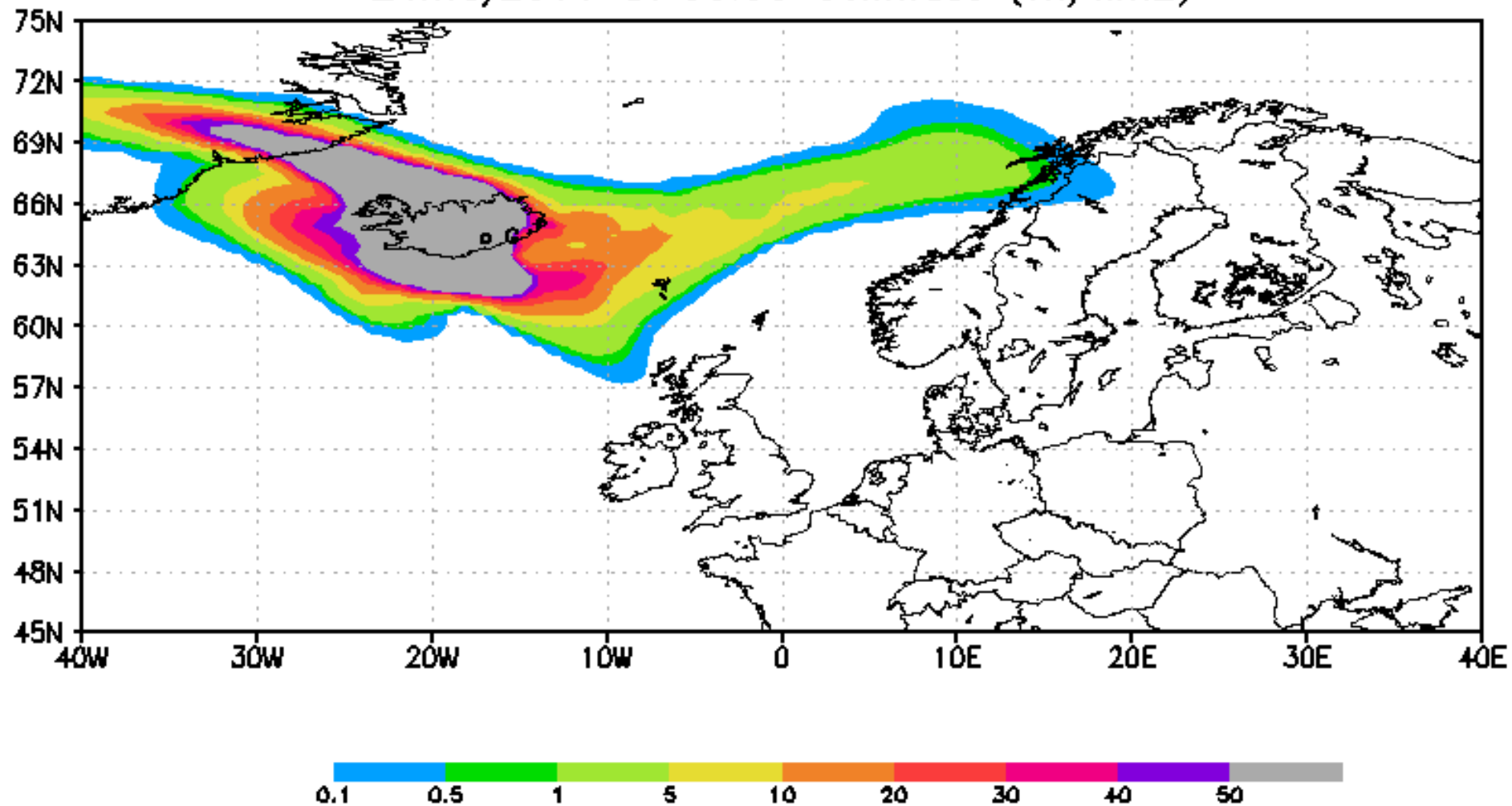
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Fish-Aviation Workshop Melbourne

FLEXPART 25 May 2011 06:00



BSC-CNS. FALL3D-6.2 ASH DISPERSION MODEL
24may2011 at 00:00 Col.mass (Tn/km²)





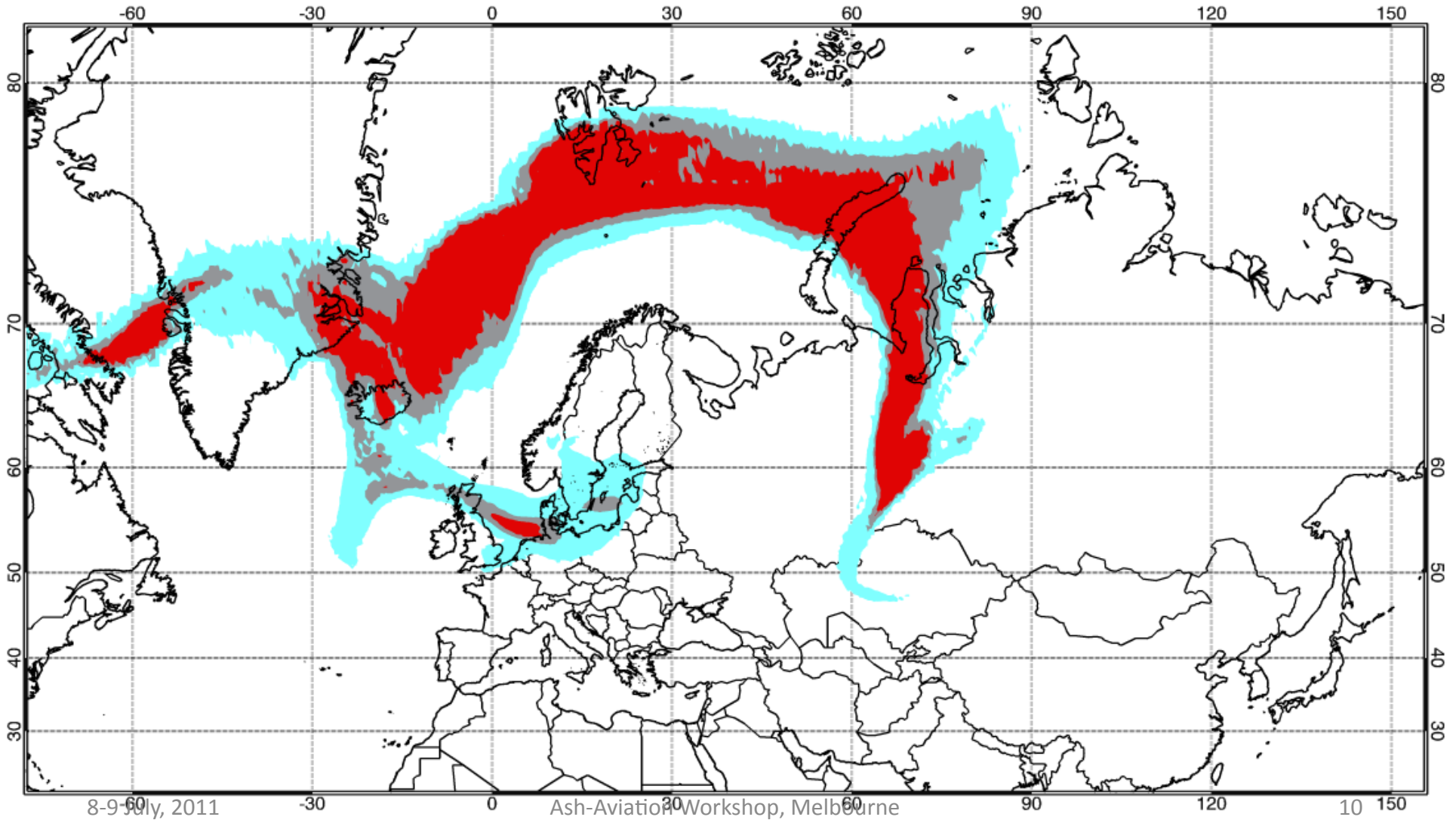
Met Office

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.

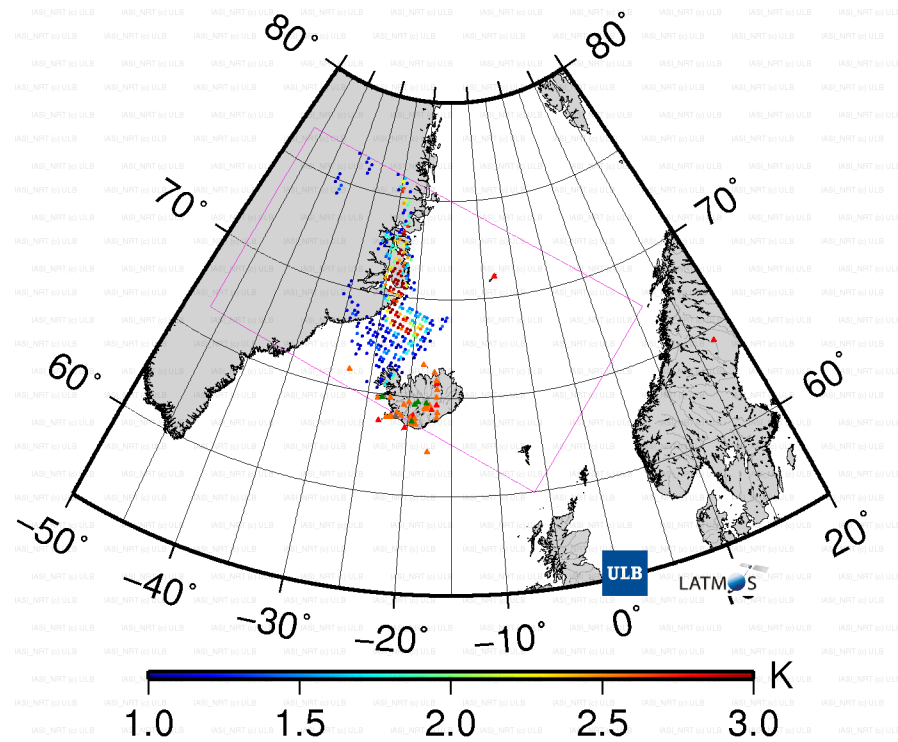
Issue time: 201105250600

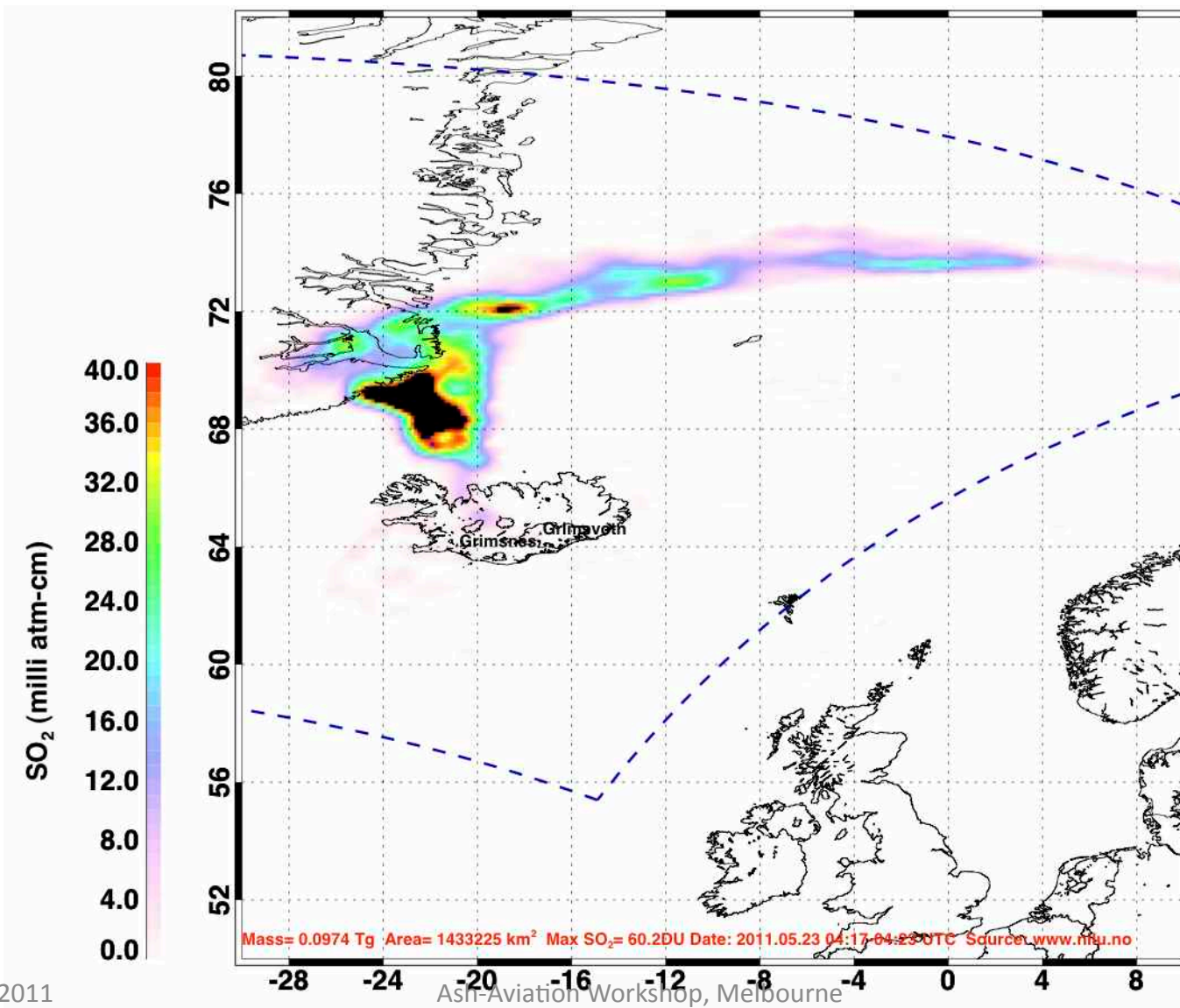
- 200-2000 micrograms per cubic metre
 - 2000-4000 micrograms per cubic metre
 - >4000 micrograms per cubic metre
- All concentrations are subject to a level of uncertainty relative to errors in the estimation of the eruption strength



SO₂ Alert 20110605.121756 (a 24007)

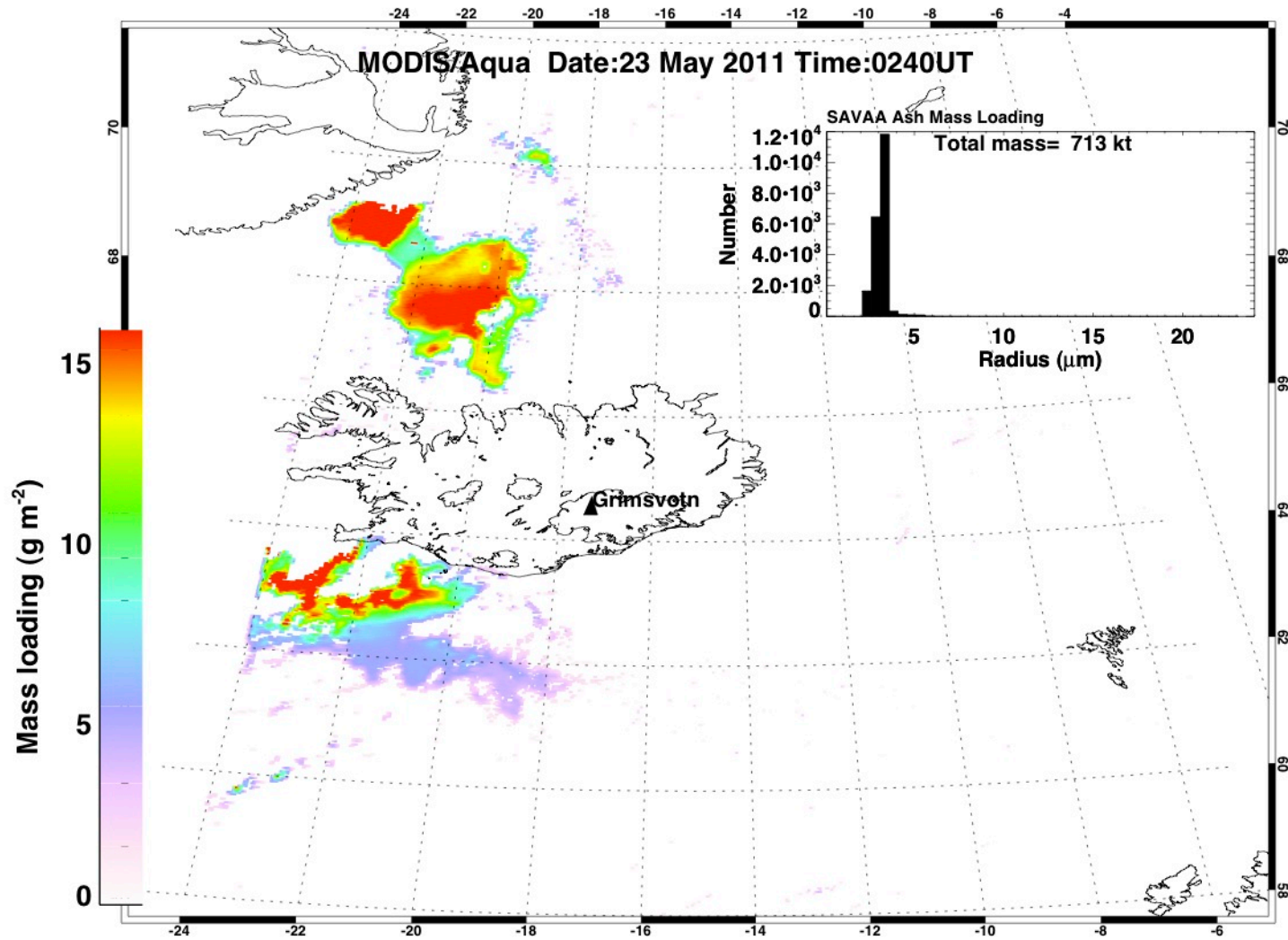
NRT_20100815



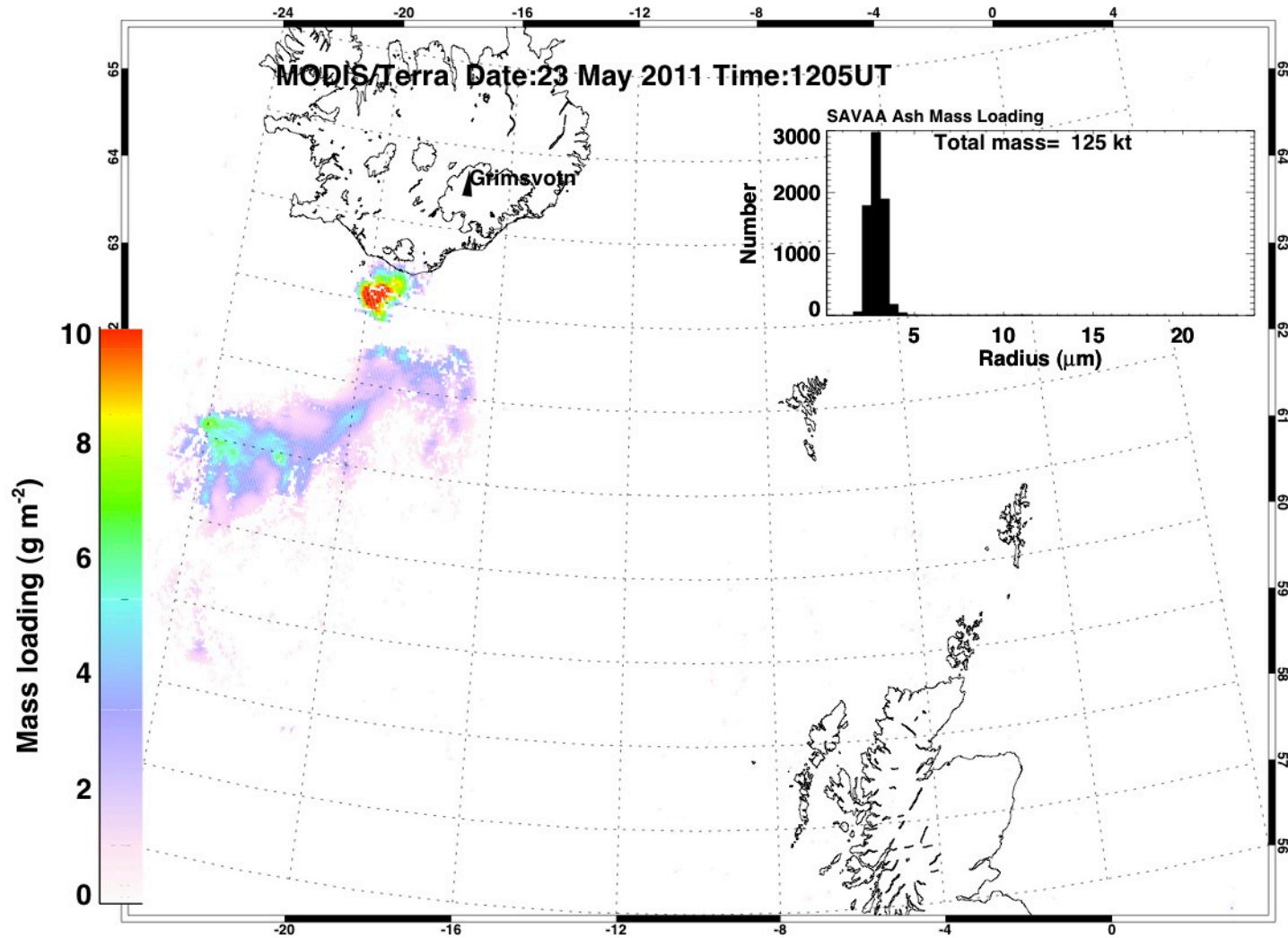


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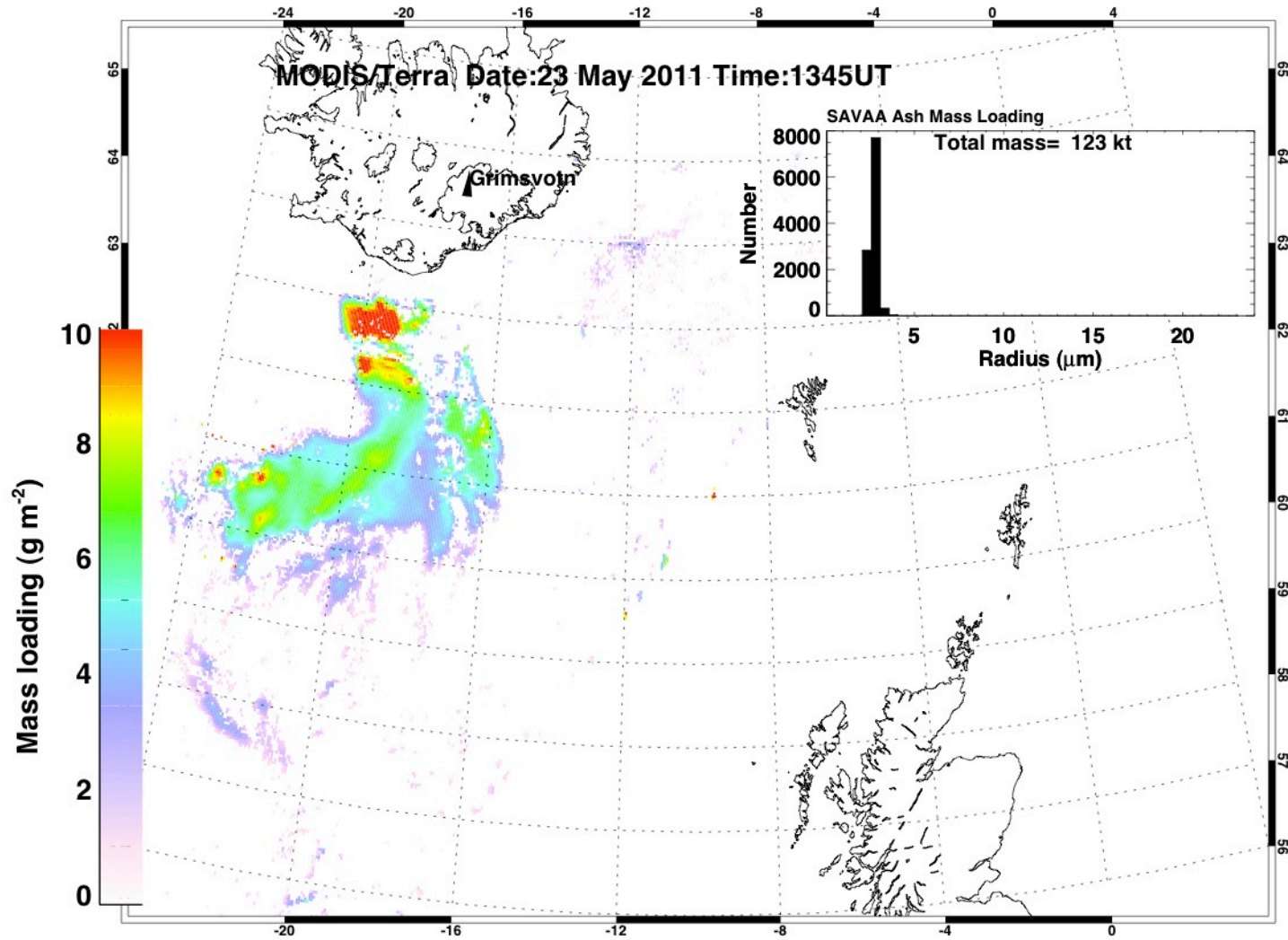
MODIS Retrievals



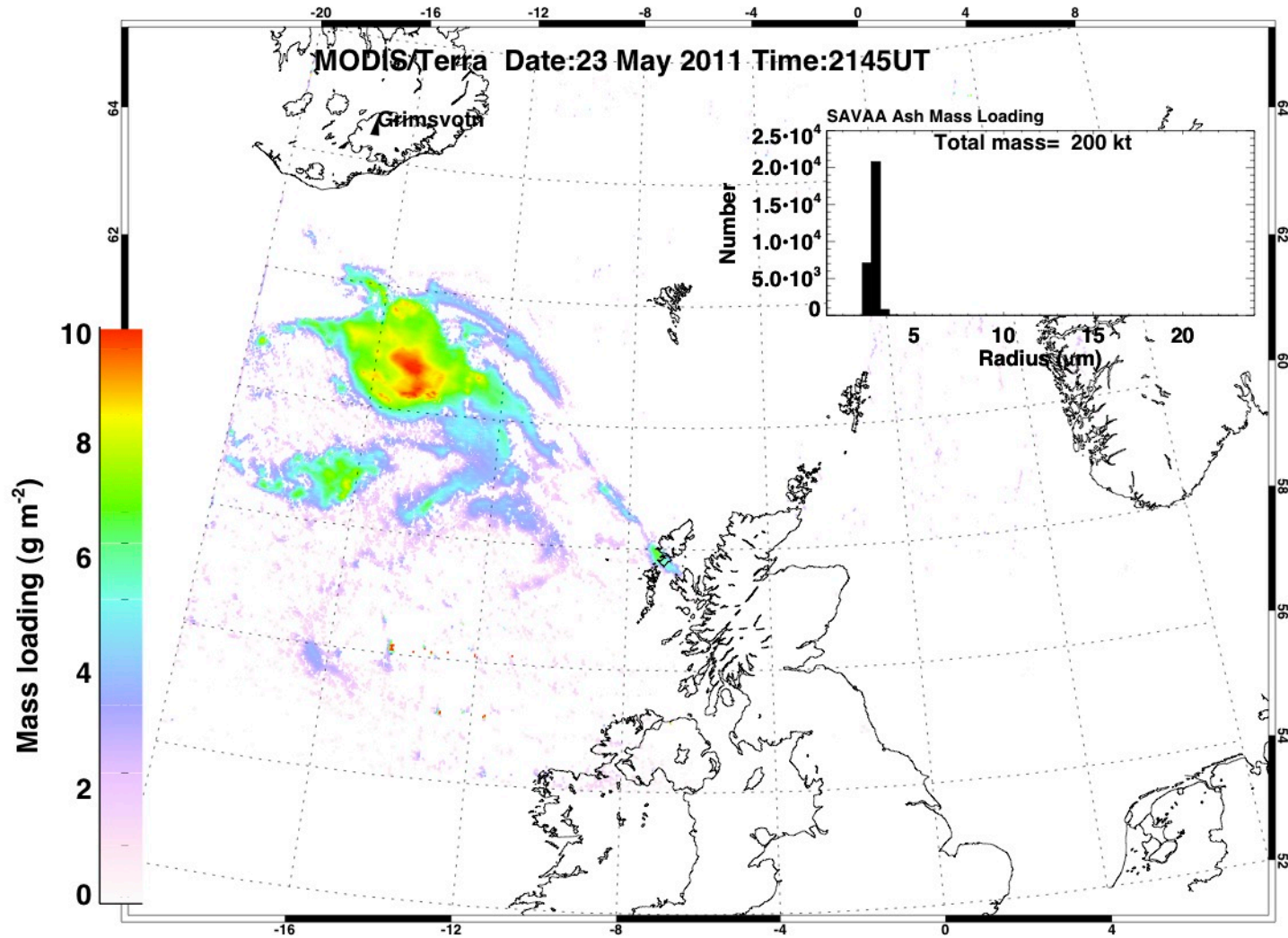
MODIS Retrievals



MODIS Retrievals

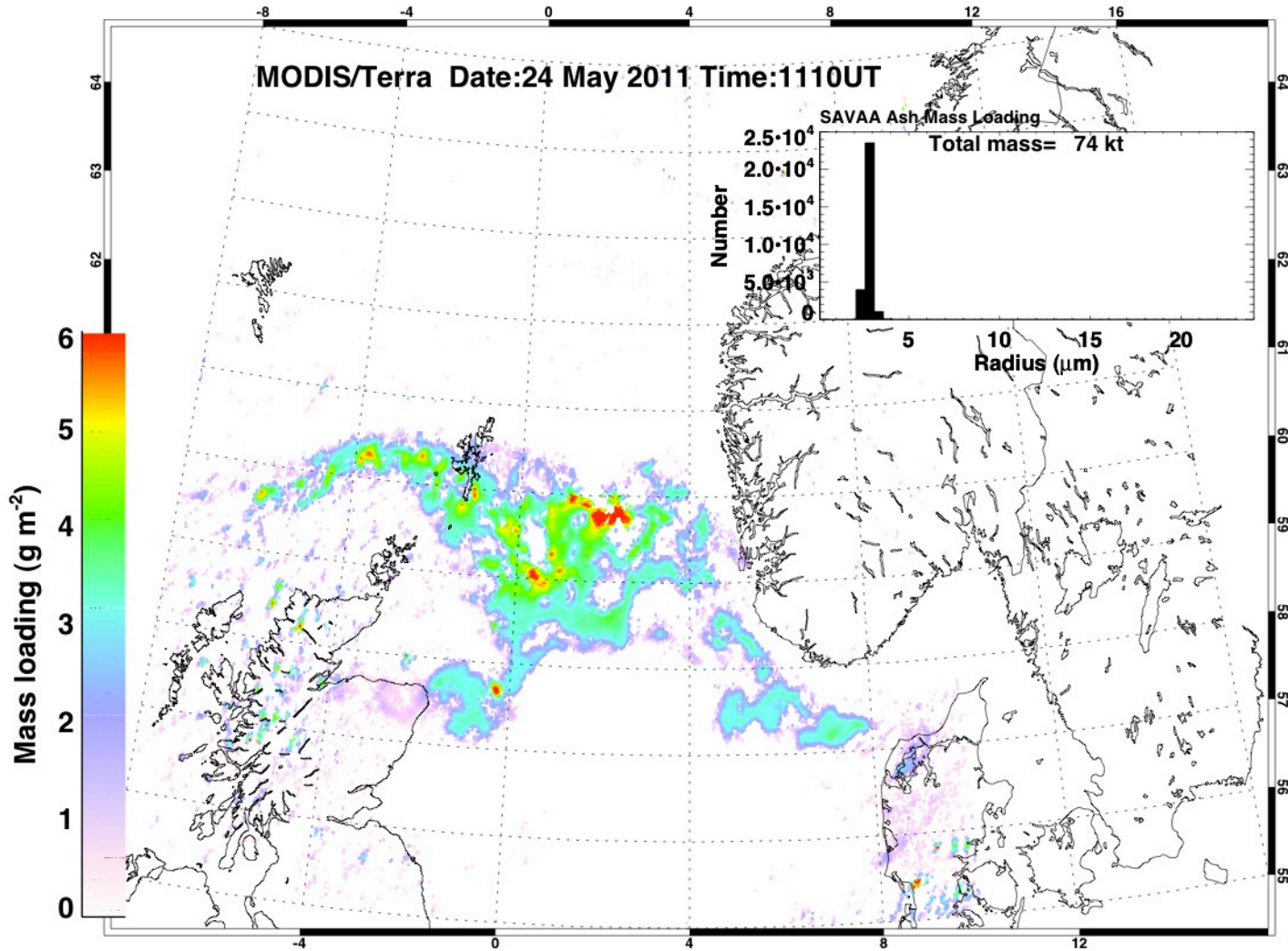


MODIS Retrievals

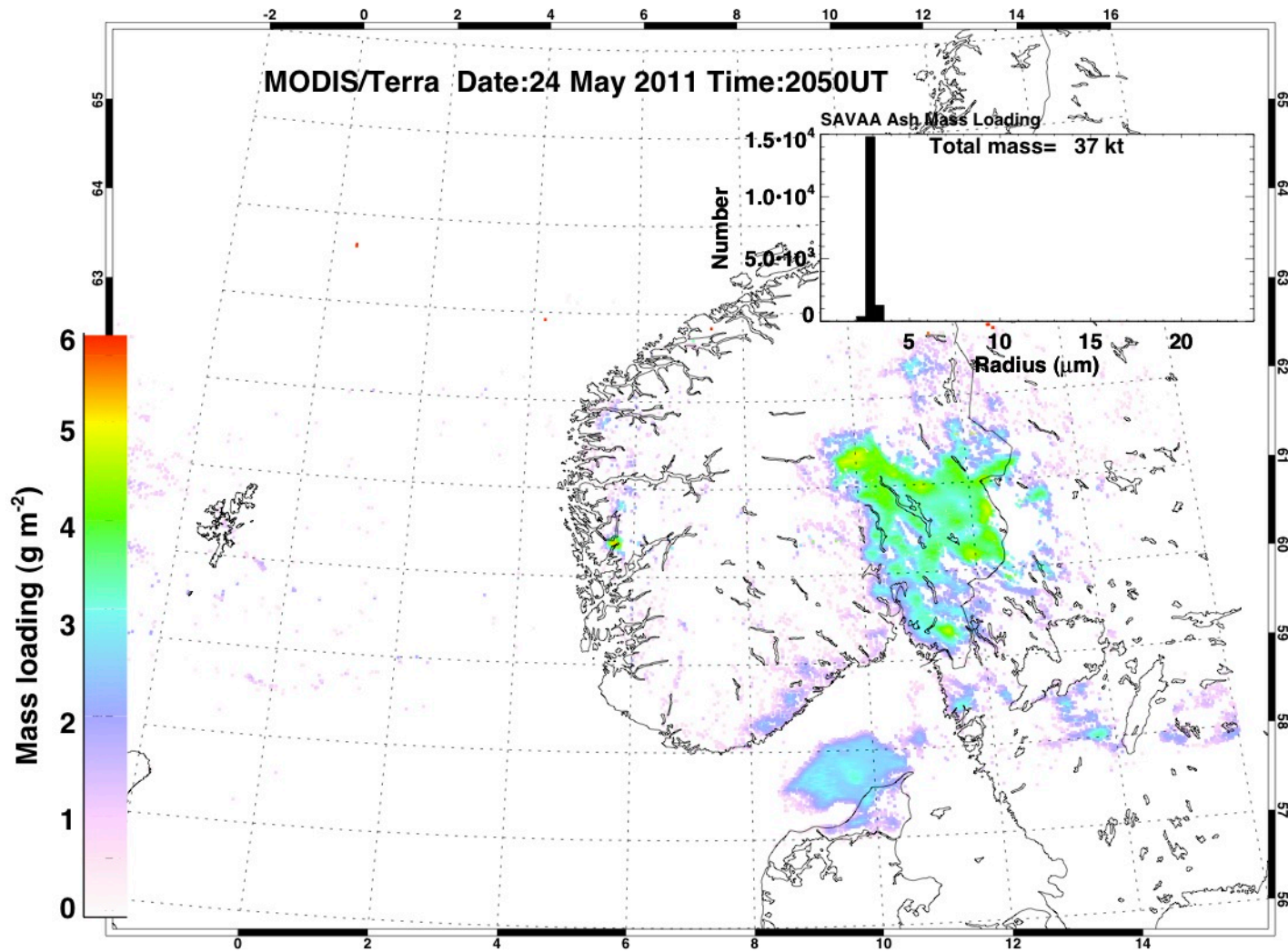


MODIS Retrievals

115V0111



MODIS Retrievals



Impacts

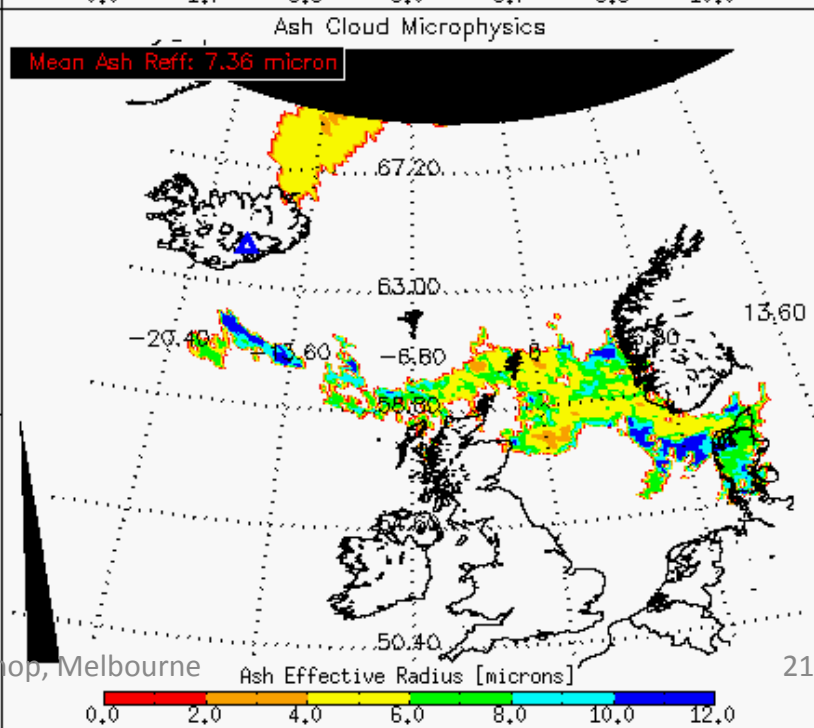
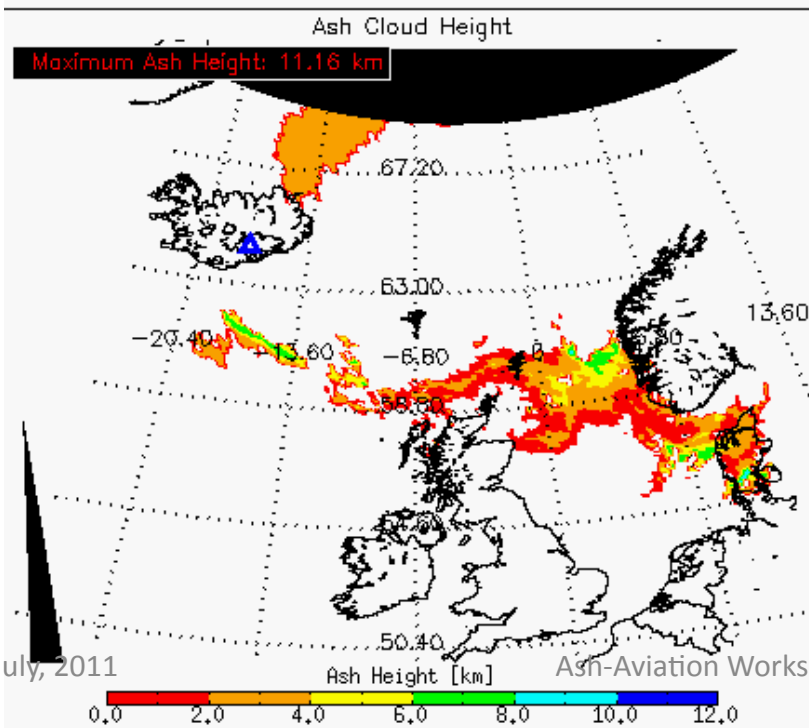
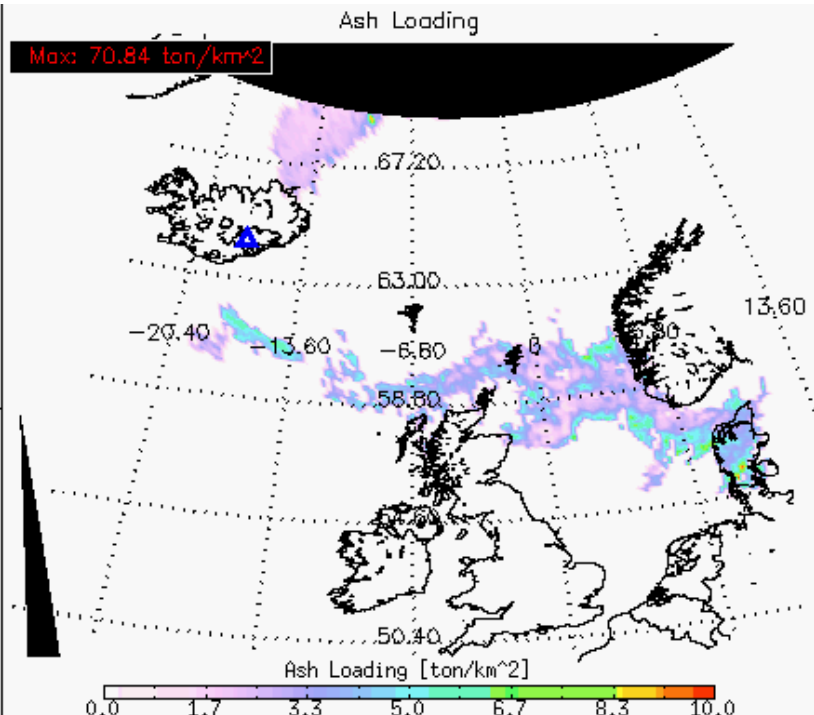
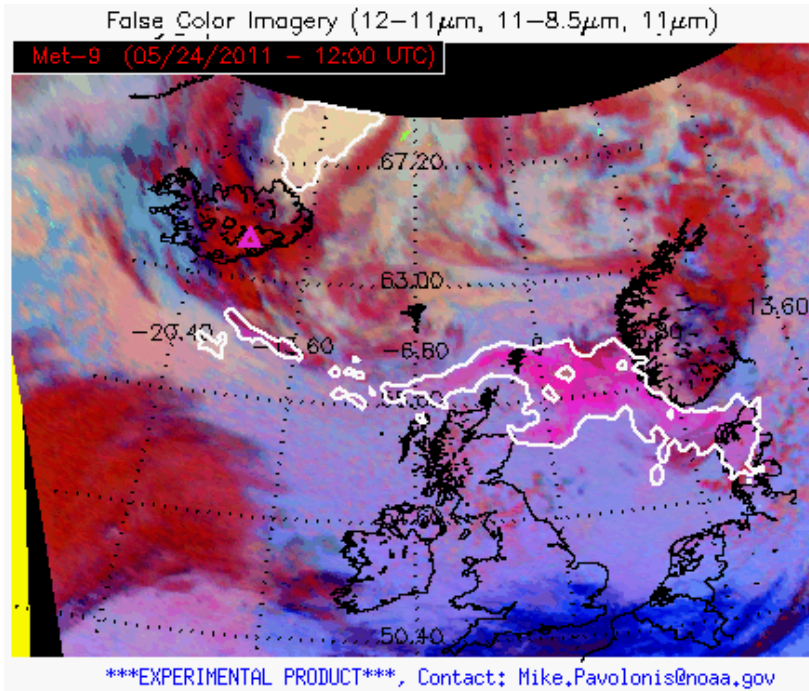
- Flights to Svalbard cancelled
- Helicopters in northern Norway grounded
- Scottish, Norwegian and (some) German airspace closed

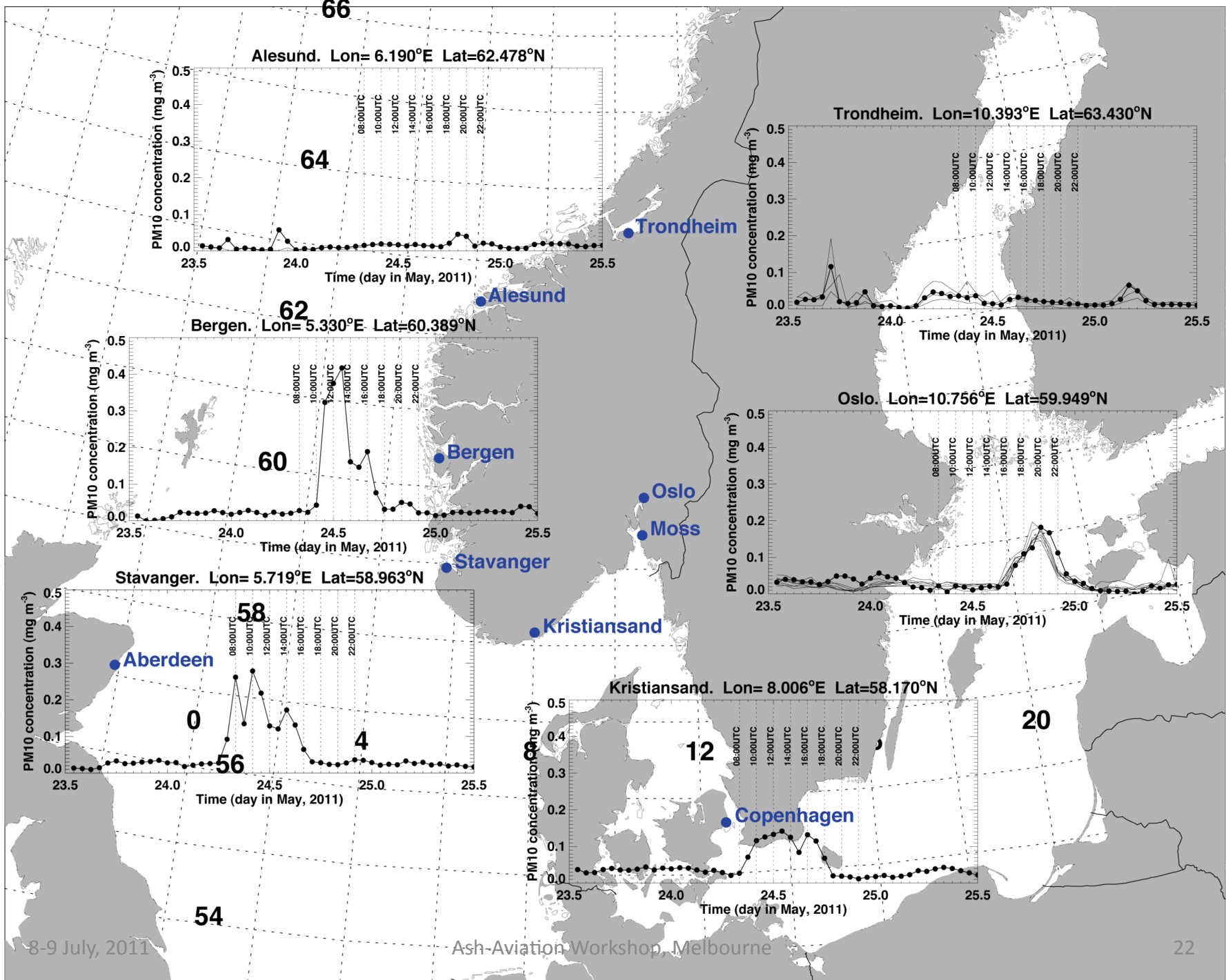
A satellite image of Earth showing a large, dark, ash plume extending from the western coast of North America across the Pacific Ocean. The plume is surrounded by white clouds. The text "What is 'visible' ash?" is overlaid in white at the bottom center.

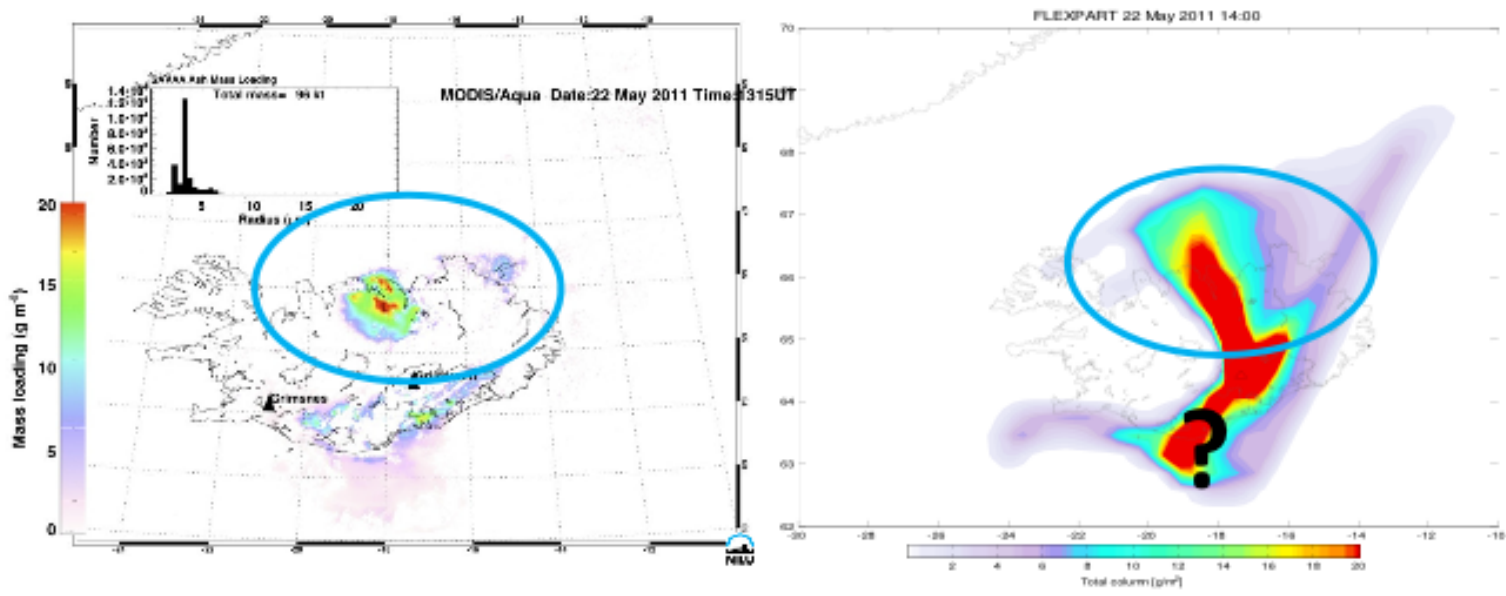
What is "visible" ash?

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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?

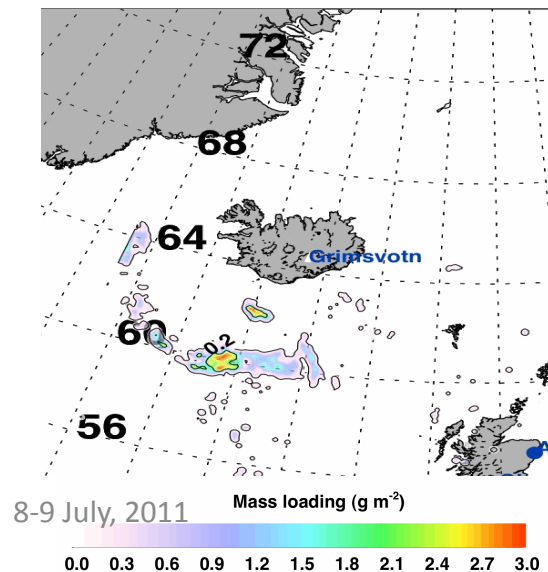
What is the fraction of “fine ash”?

“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

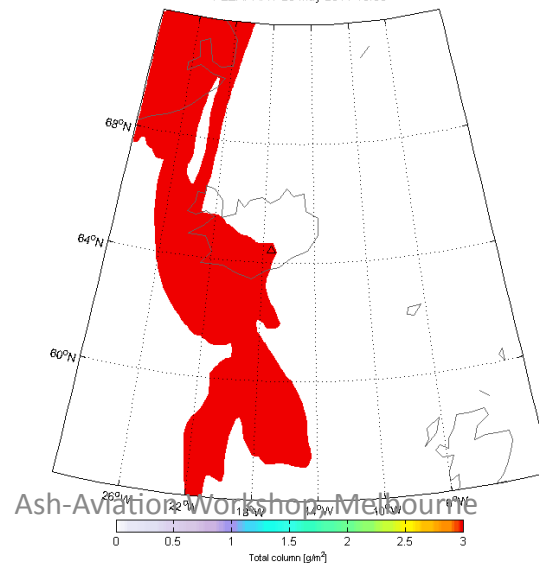
Satellite observation

Date: 2011.05.23
Time: 16:15 UTC



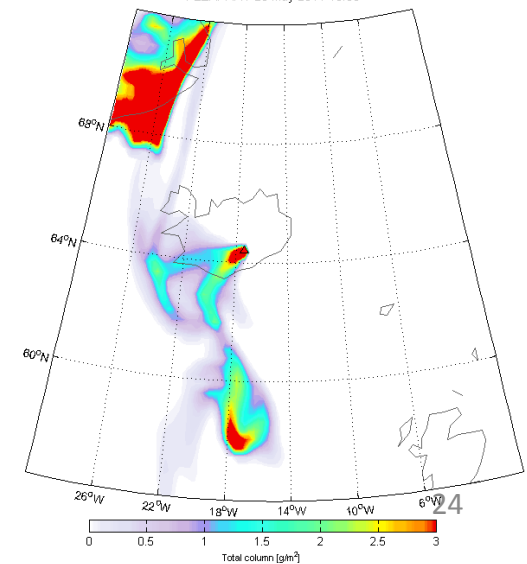
Modelled first guess emissions

FLEXPART 23 May 2011 16:00



Modelled scaled emissions

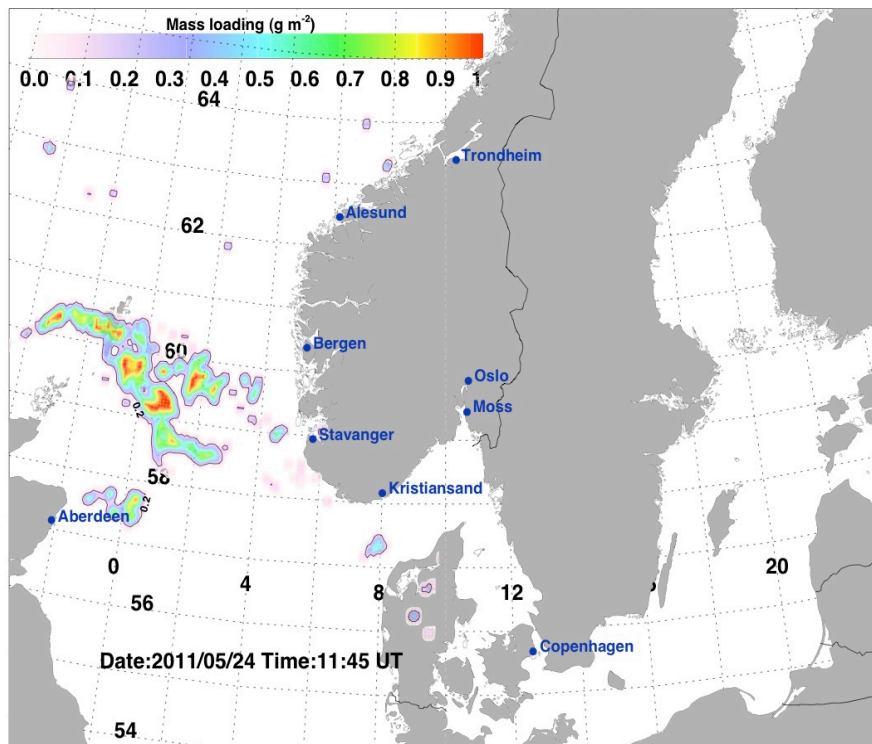
FLEXPART 23 May 2011 16:00



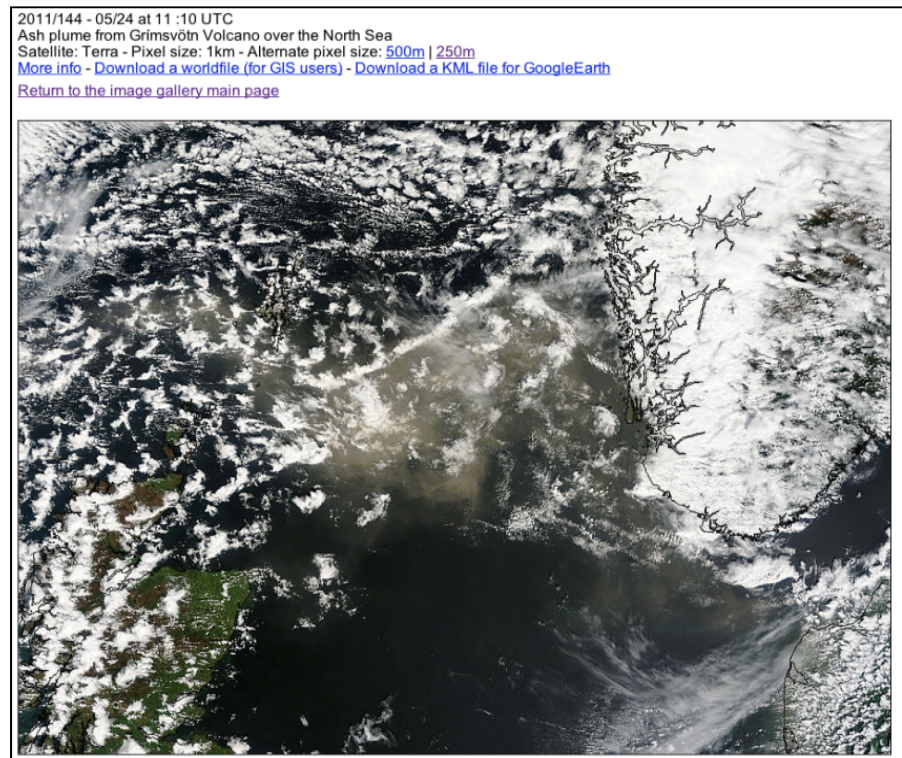
Ash plume approaching Norway

Tuesday 24 May 2011

SEVIRI satellite retrieval



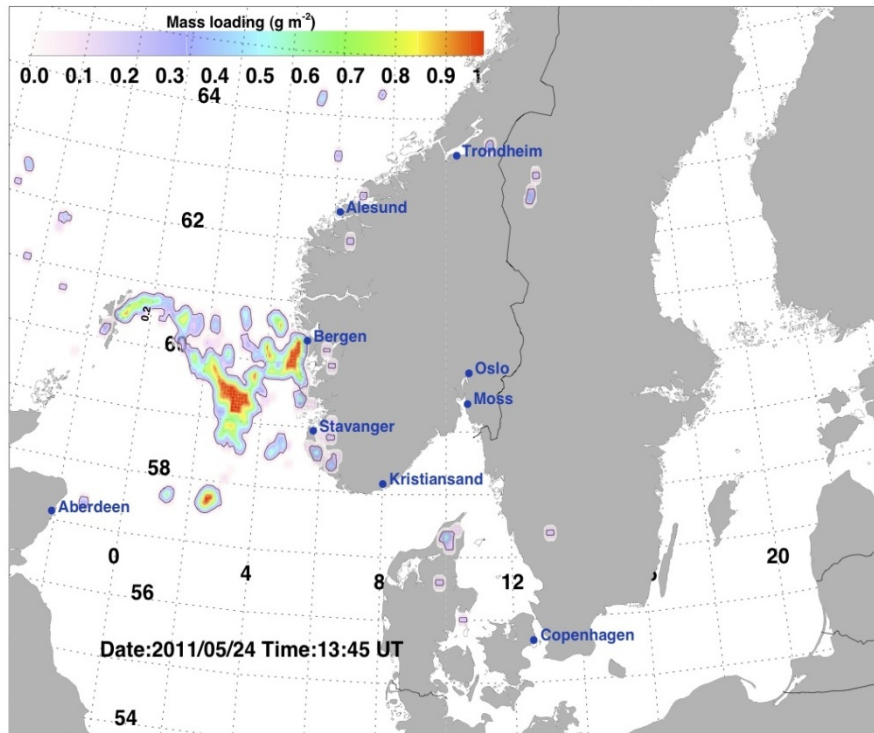
MODIS true color image



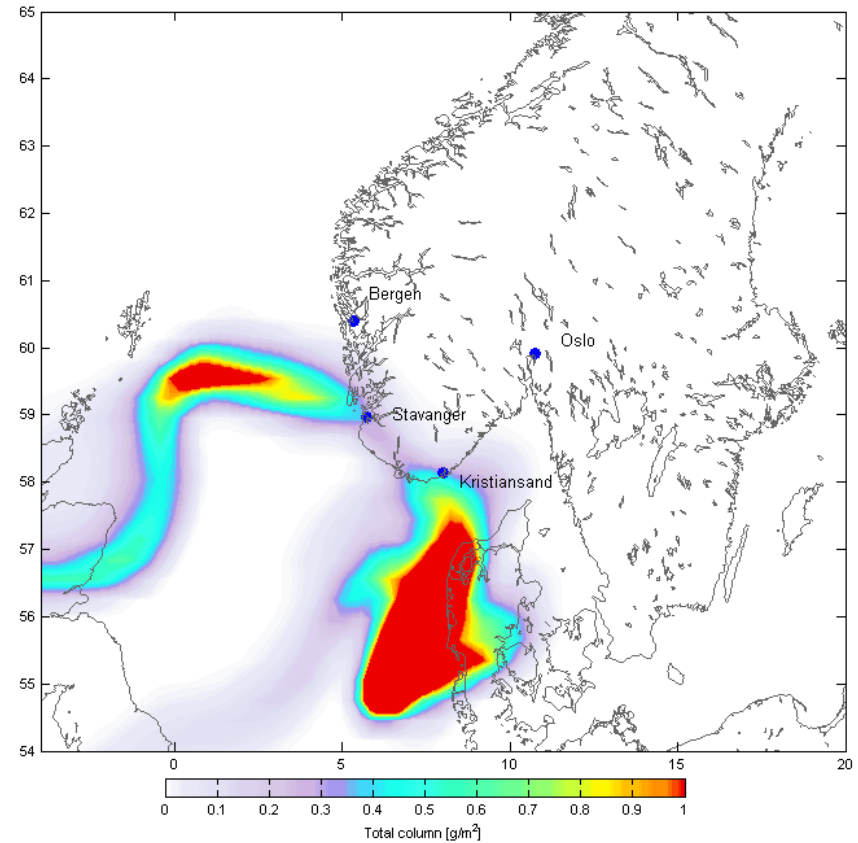
Ash plume over Norway

Tuesday 24 May 2011

SEVIRI satellite retrieval



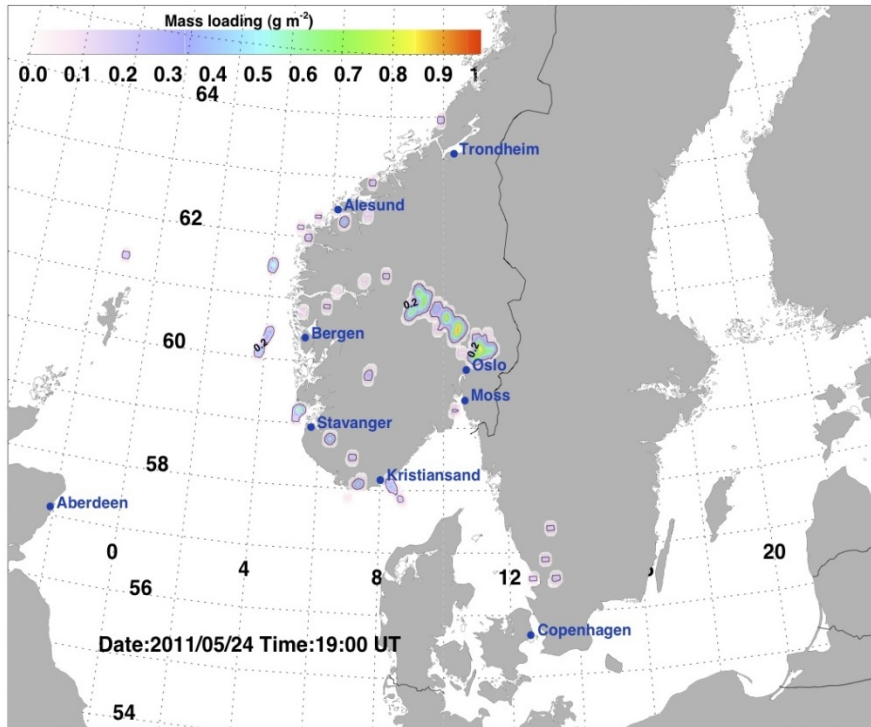
FLEXPART modelled ash plume



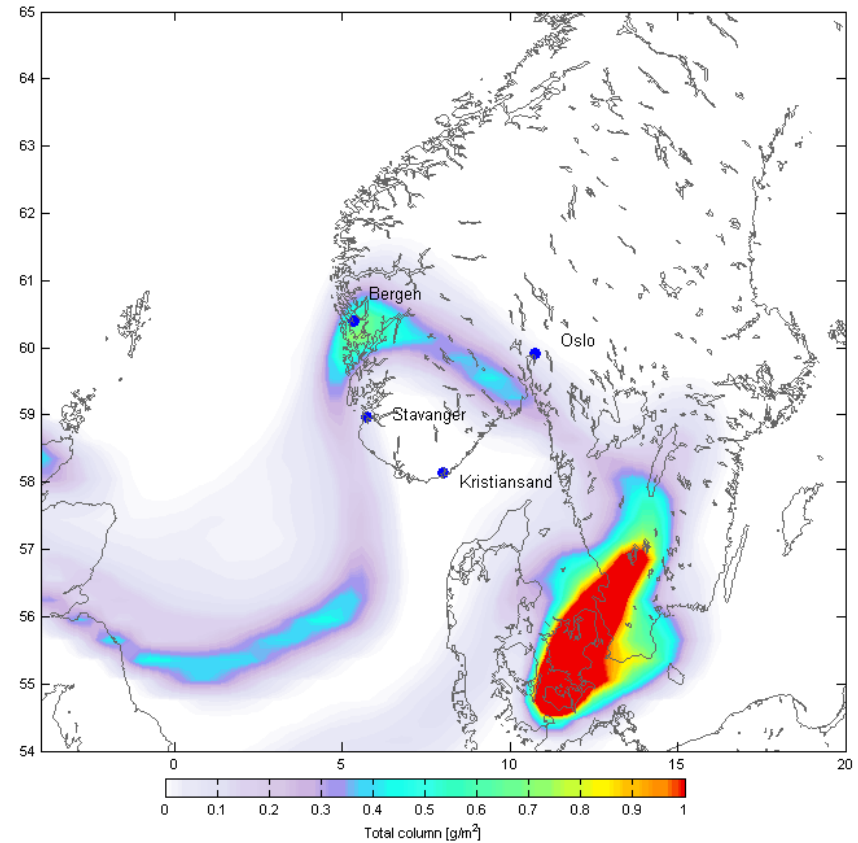
Ash plume over Norway

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:

$$H = 2.00x(M/\rho)^{0.241}$$

H= observed plume height (usually from radar)

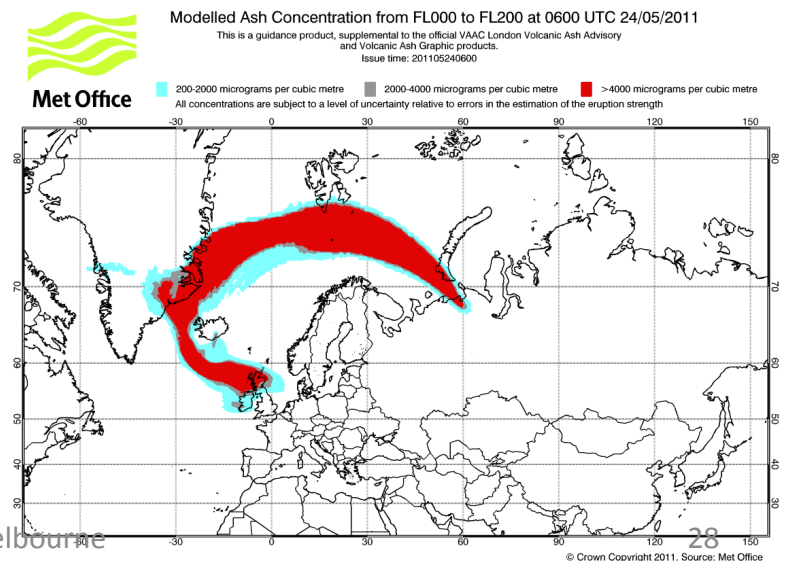
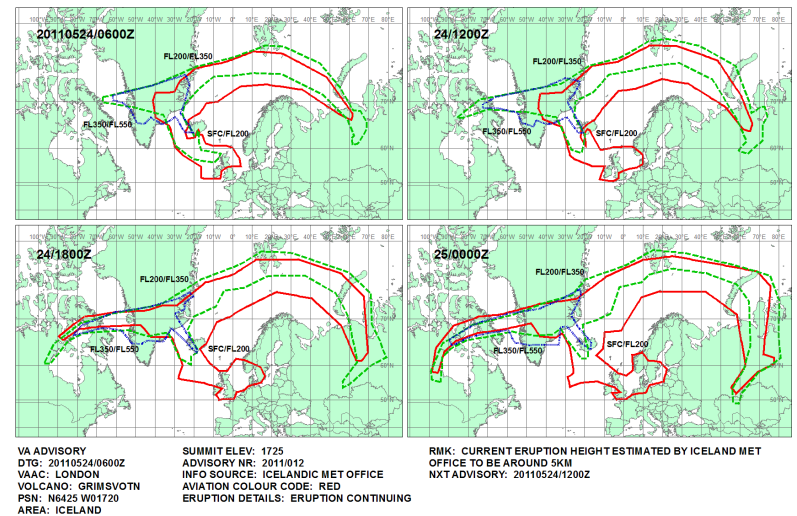
M=total ash mass (kg/s)

ρ =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.

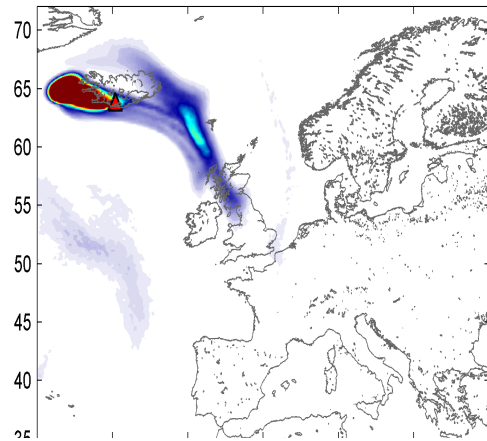
Vary the ash release when new observations on the plume heights are available.



Improvements using the new source term?

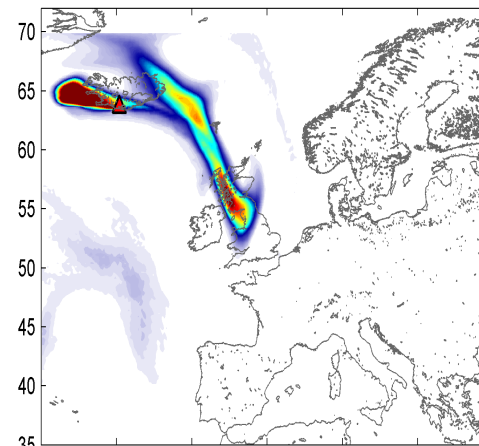
14 May 2010 12:00 UTC

Modelled ash plume with
first guess emissions

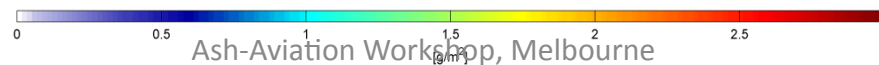
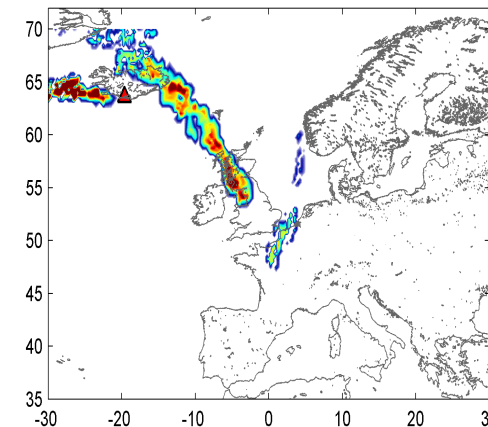
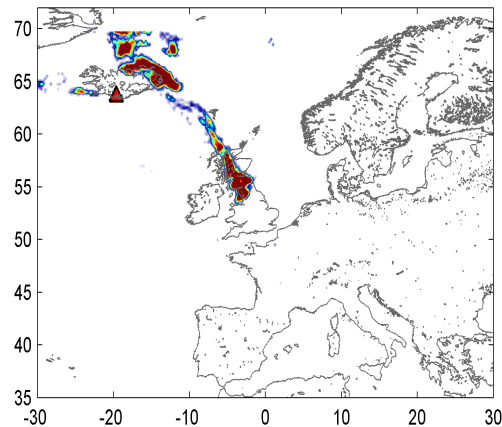


SEVIRI

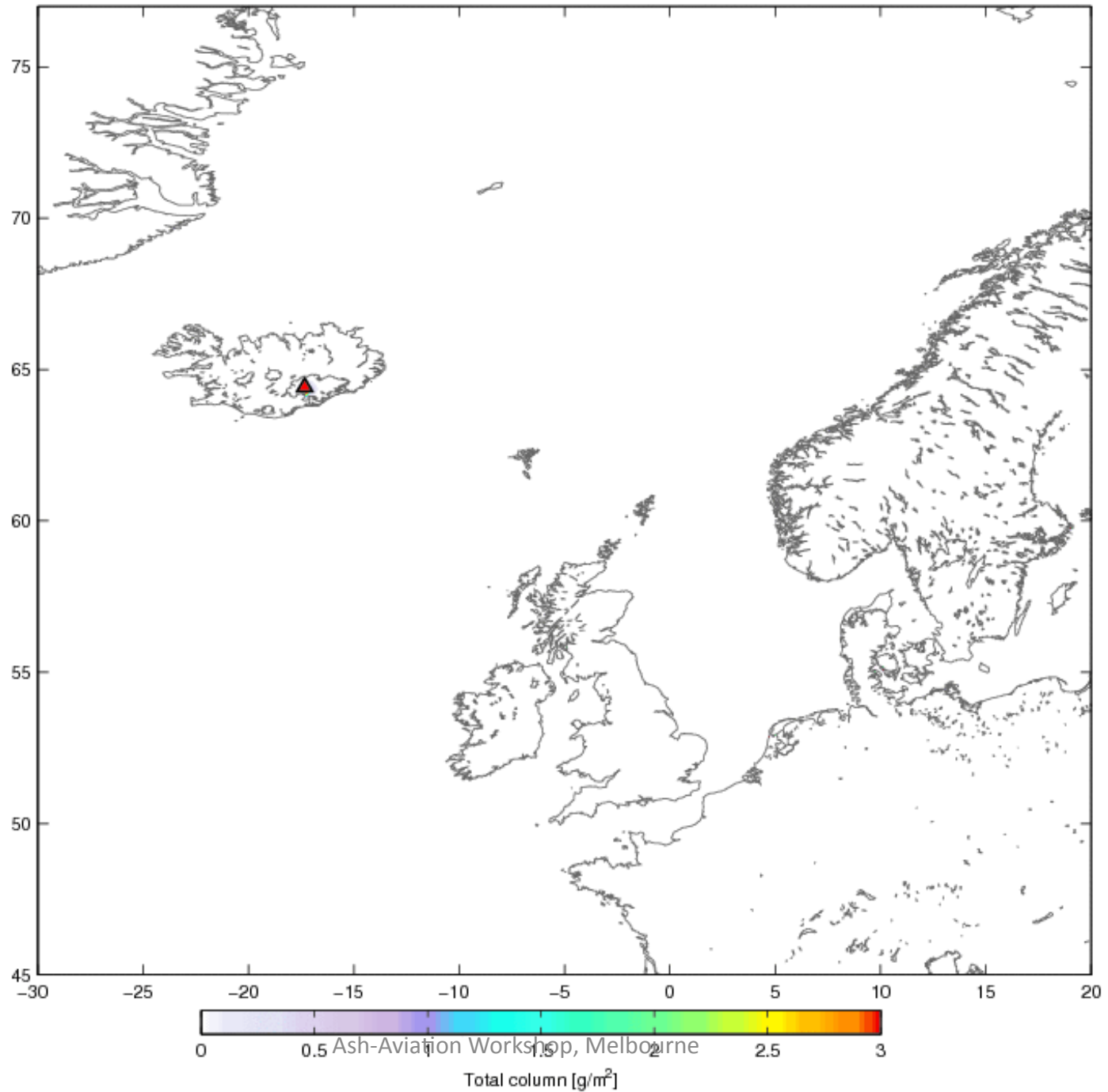
Modelled ash plume with
new emissions from inversion

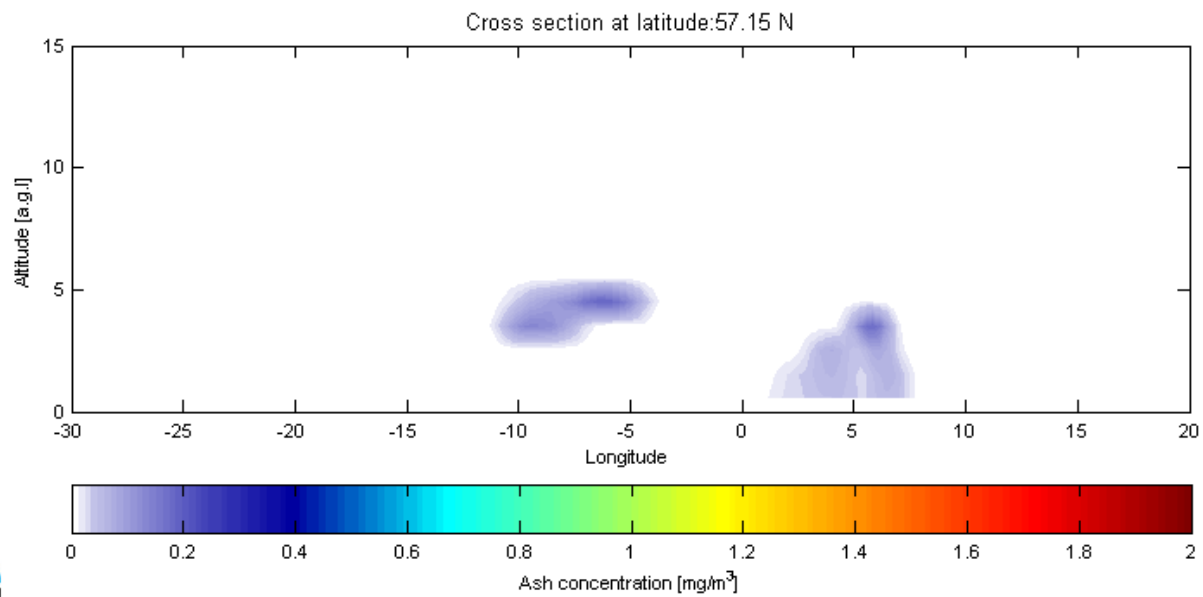
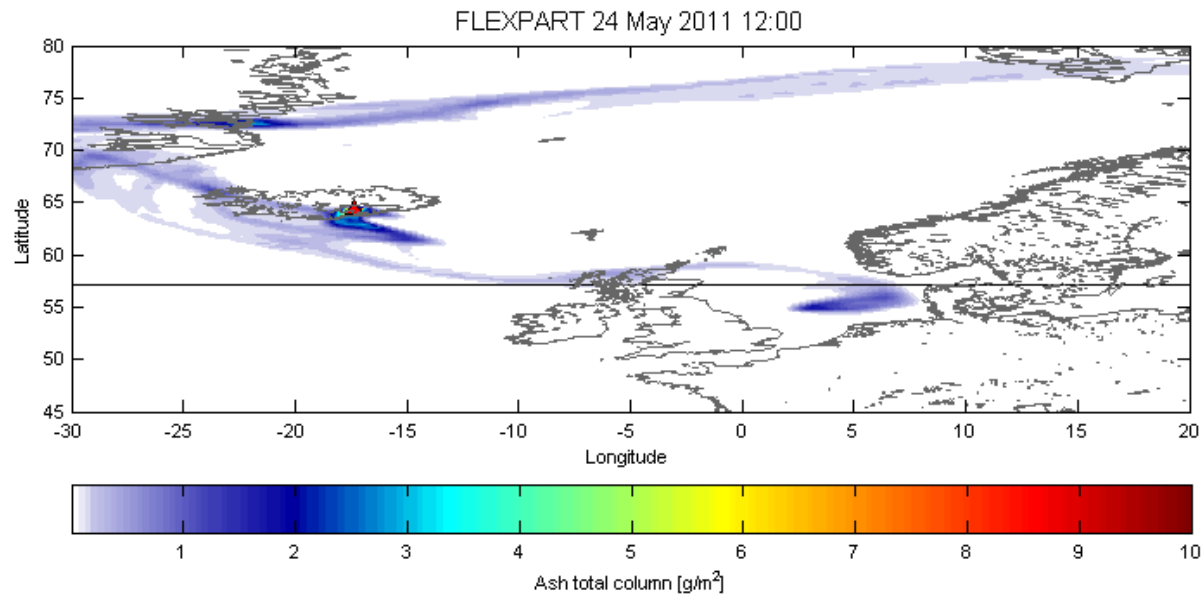


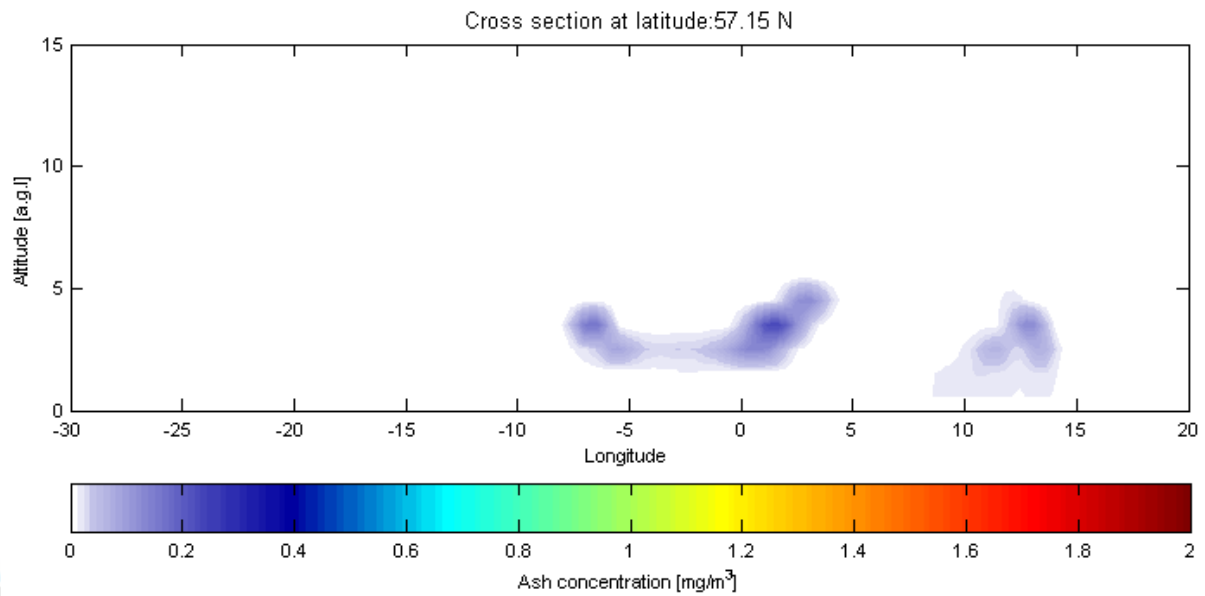
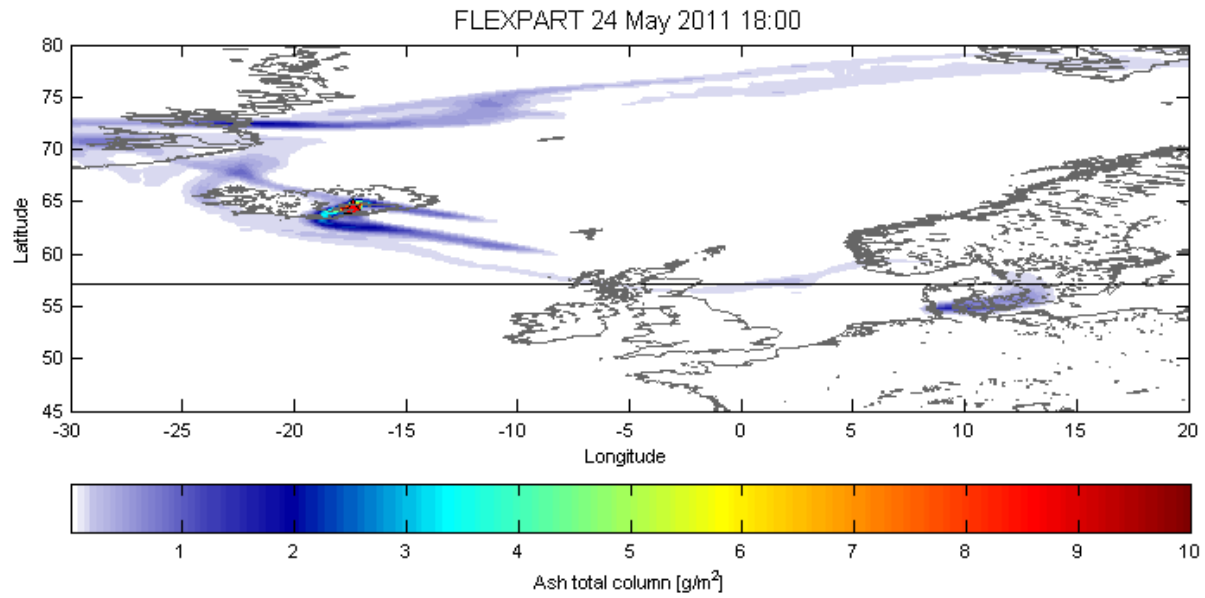
IASI

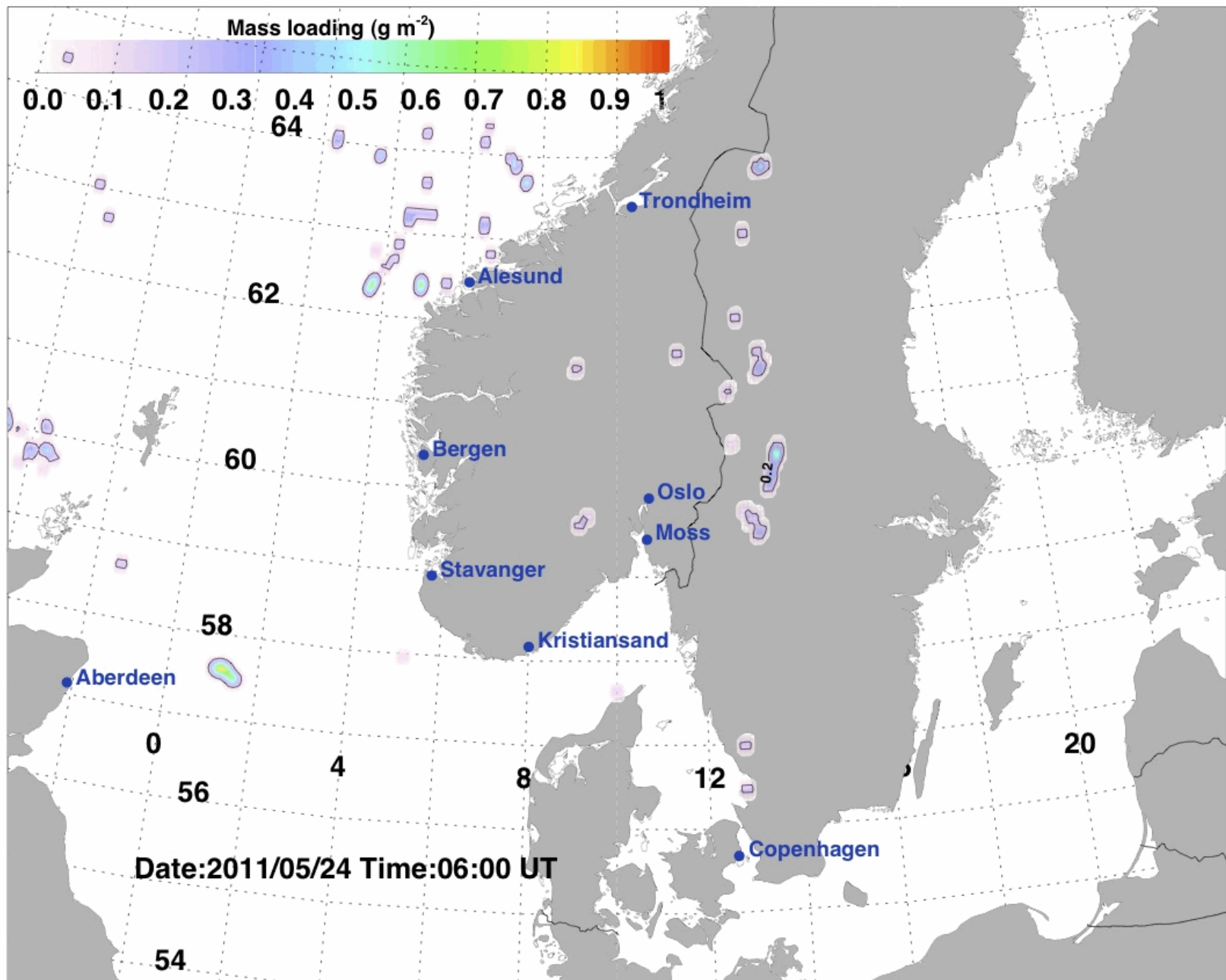


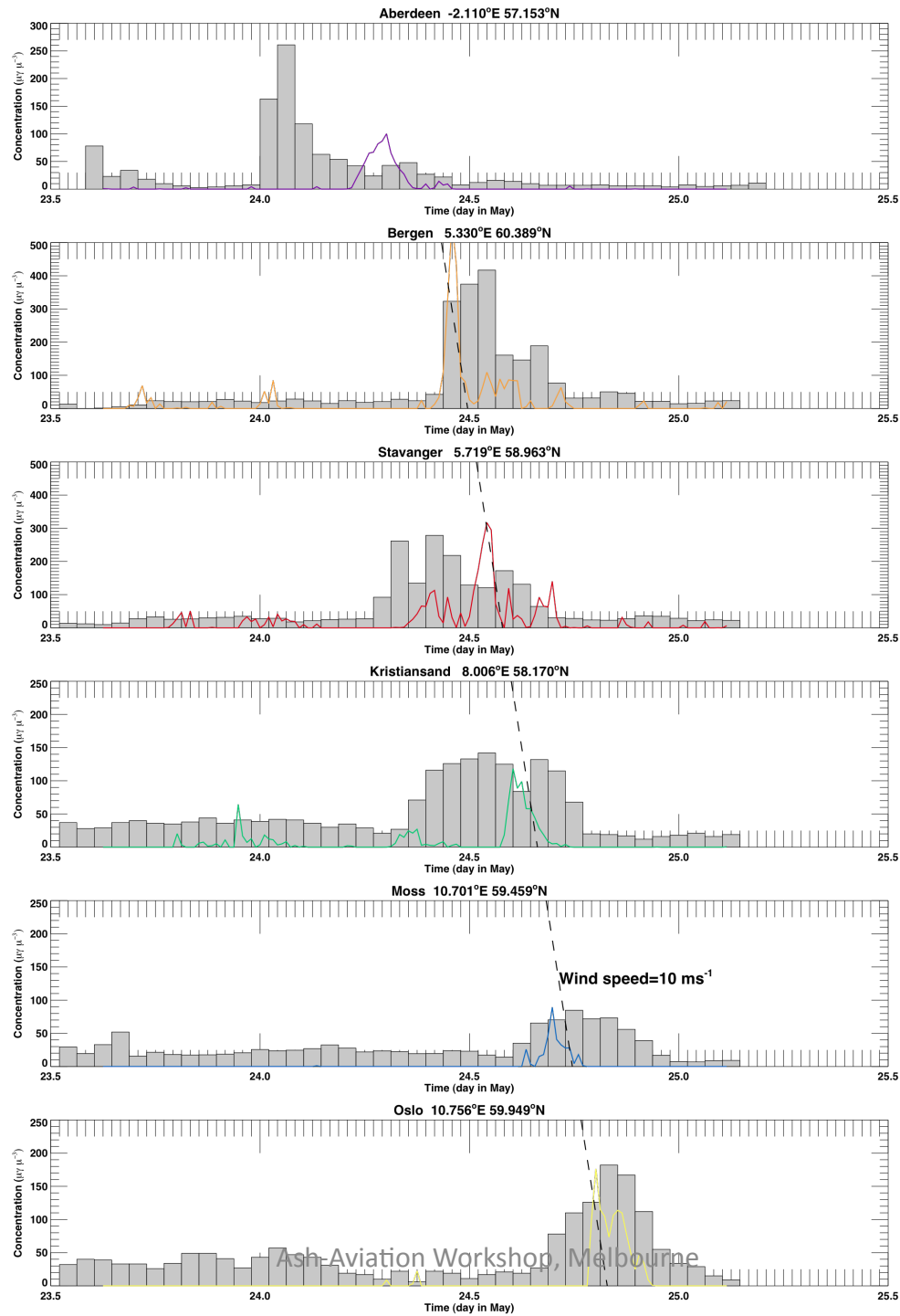
FLEXPART 21 May 2011 20:00

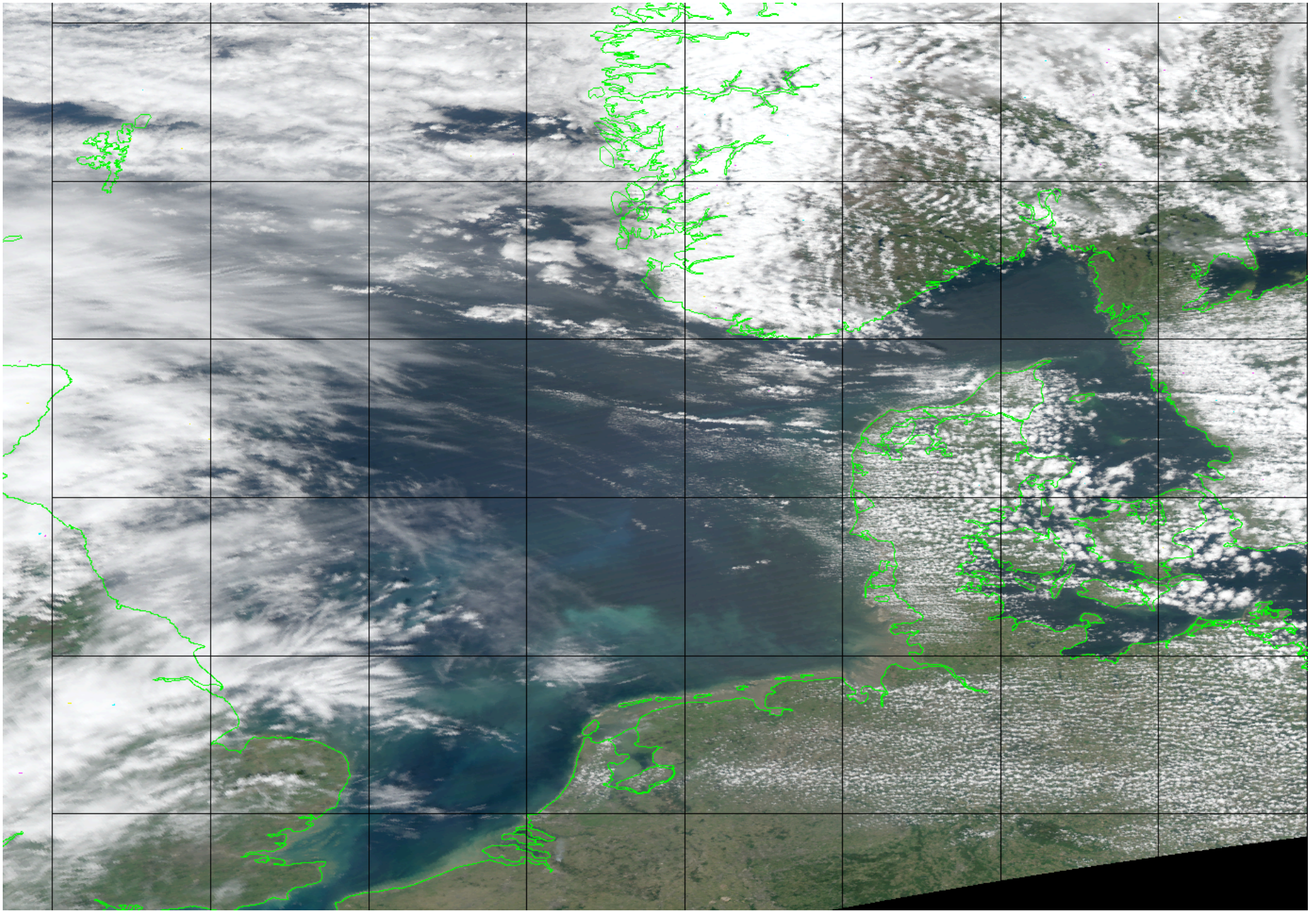












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What about last time?

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

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