Satellite retrievals and transport modeling of
Volcanic eruption clouds

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INTRODUCTION

We can retrieve important information about the volcanic eruption column, that is estimate **how much ash and gas is released by the volcanic eruption, and to which heights above the volcano.**

We do this by using satellite observations of the volcanic eruption clouds together with transport simulations of the emissions. The estimation is then performed using an analytical inversion algorithm described in Seibert (1999), Eckhardt (2008), Kristiansen (2010).

With this height and mass information we can **accurately simulate the transport of the volcanic emission cloud over several days after the eruption**.

These transport simulations can be used to forecast the movement of hazardous volcanic ash clouds, and warn the airline traffic of areas to avoid.

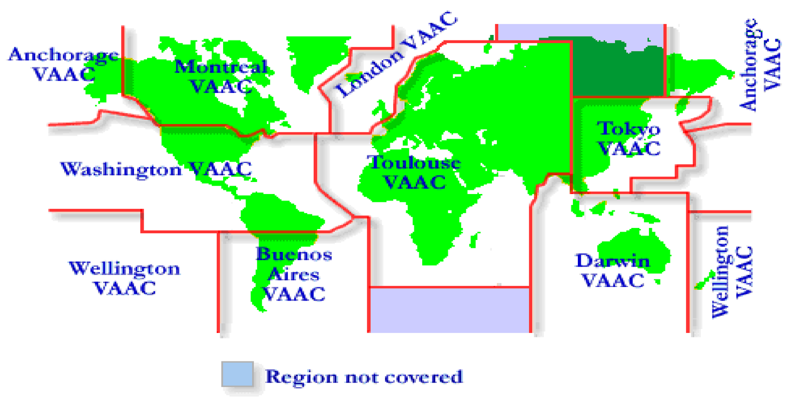

Figure 1: The nine Volcanic Ash Advisory Centers (VAACs) and their area of responsibility. London VAAC is responsible for the Icelandic volcanoes (e.g. Eyjafjallajökull).

TRANSPORT MODELS

– for modeling the dispersion of volcanic emissions

FLEXPART: Lagrangian particle dispersion model (Stohl et al., 1998, 2005). Ash particles with sizes 0.25–250 µm diameter are released according to the *a priori* and *a posterori* emission rates (Figure 2) and tracked in the atmosphere. Gravitational particle settling, wet and dry deposition are accounted for. The model is operational at NILU.

NAME: Numerical Atmospheric dispersion Modeling Environment. Lagrangian particle dispersion model. The same set up as FLEXPART is used. The model is operational at the UK MetOffice (London VAAC).

SATELLITE SENSORS

– for volcanic ash/gas detection

SEVIRI: Spin-stabilised Enhanced Visible and Infrared Imager. Geostationary over Europe/Africa, 15 min time resolution. The retrievals of ash rely on measurements made at 10.9 µm and 12.0 µm (Prata, 1989)

IASI: MetOp Infrared Atmospheric Sounding Interfero meter. Sunsynchronous polar orbiting infrared sounder. A measure for the total ash column is based on the brightness temperature difference between the channels at 1231.5 cm-1 and 1160 cm-1 (Clarisse et al., 2010).

EYJAFJALLAJÖKULL ERUPTION 2010

Volcano location:
Iceland
Explosive eruption period:
14 April - 23 May 2010

Continuous emissions of volcanic ash, also some sulphur dioxide (SO_2)

The eruption plume caused closure of airspaces over large parts of Europe.

We estimated the ash release as a function of time and height (Figure 2) which we used for transport simulations of the ash emissions with both FLEXPART (Stohl ,2011) and NAME (Figure 3)

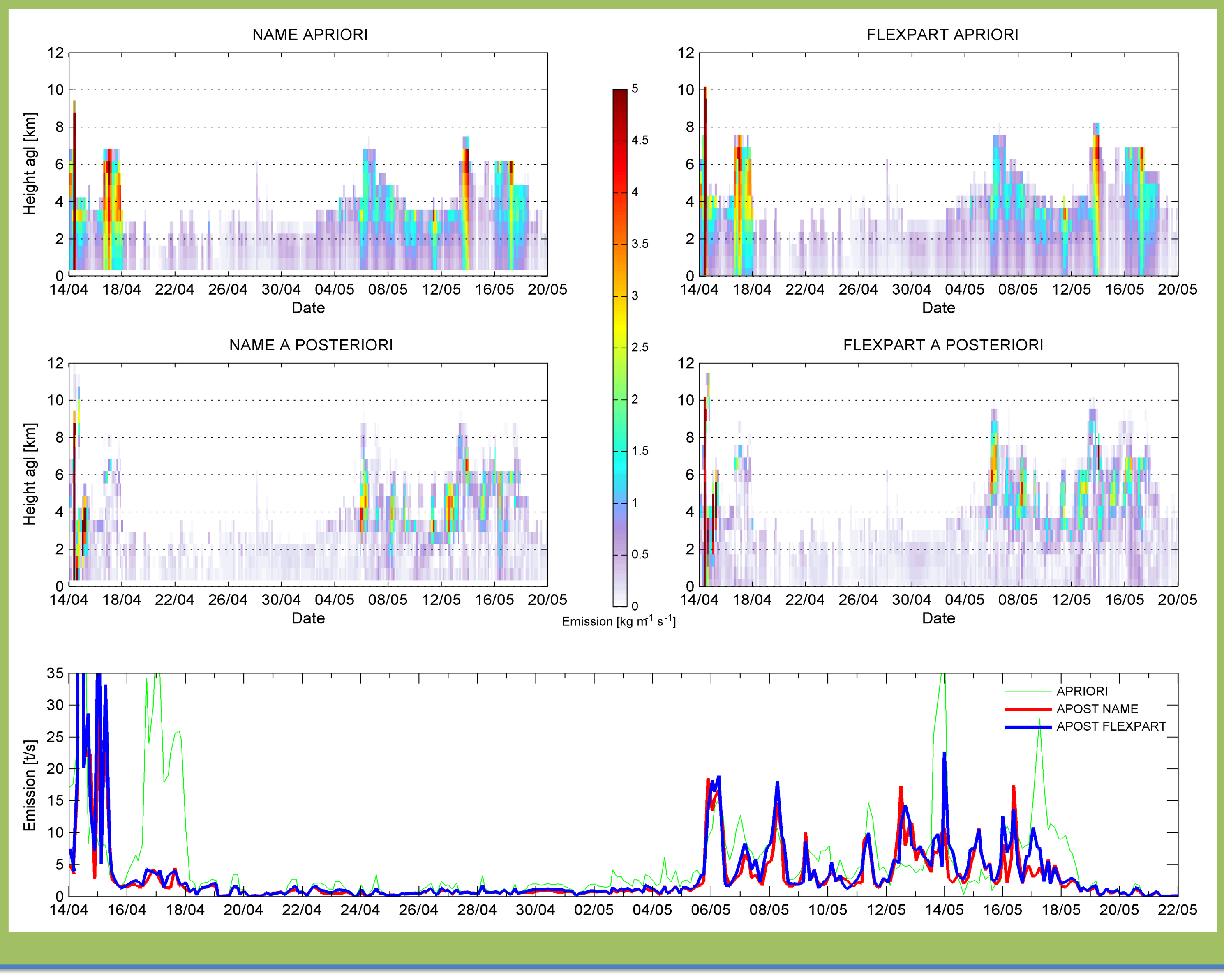

Figure 2

Volcanic ash emissions as a function of height (above the volcano vent) and time for two different model simulations (NAME and FLEXPART)

A priori emissions are obtained by radar observations of the top plume heights and calculations of the distribution of the ash in the vertical column using a 1D model PLUMERIA.

A posteriori emissions are obtained by inversion calculations where the modeled a priori ash emissions are constrained by satellite observations.

These emission rates are used for the different model simulations shown in Figure 3.

NAME model

FLEXPART model (run on ECMWF met data)

FLEXPART model (run on GFS met data)

A PRIORI **model runs** (before inversion)

A POSTERIORI **model runs** (with improved ash emission rate)

Satellite retrievals (SEVIRI and IASI)

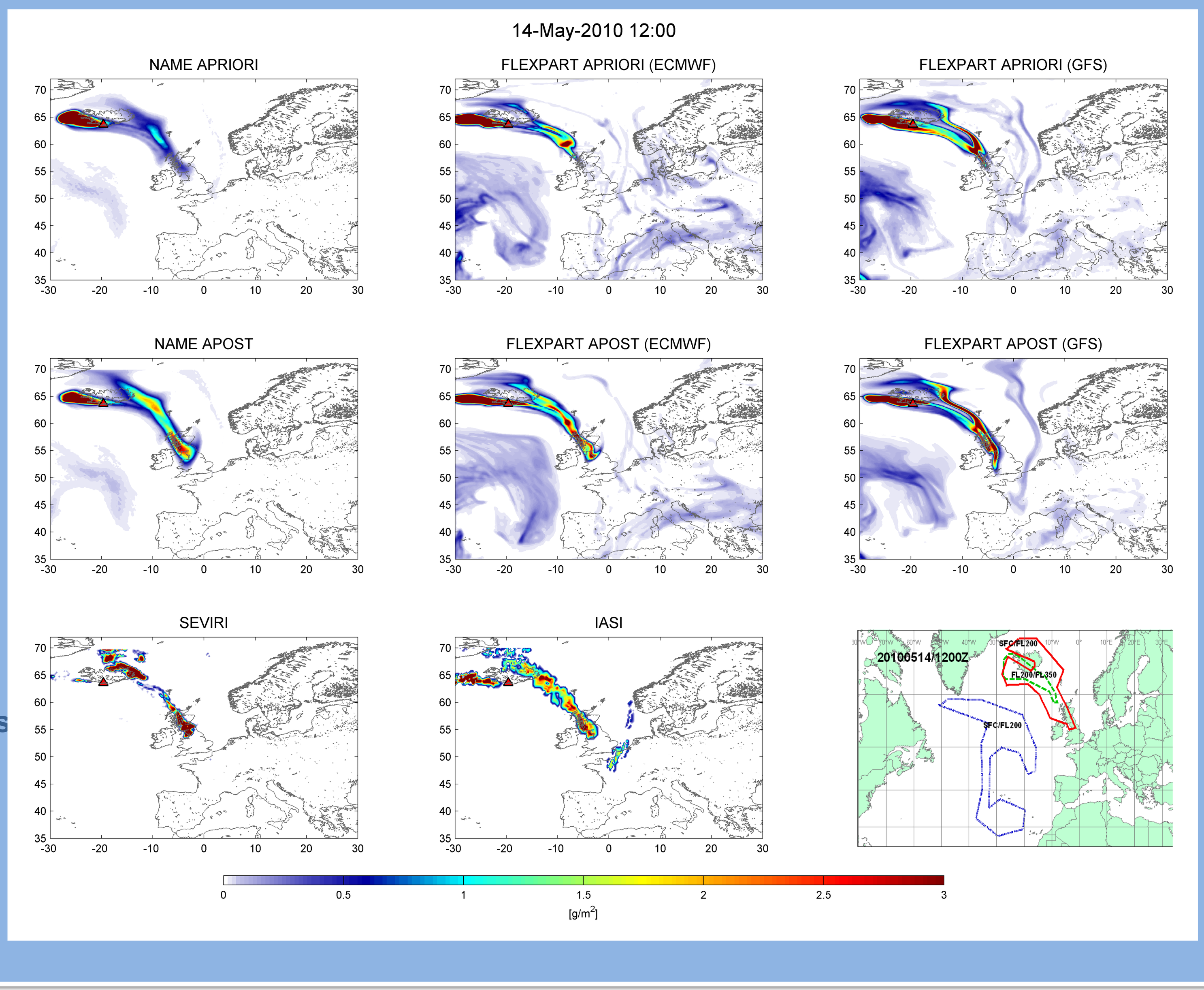

Figure 3

Volcanic ash from Eyjafjallajökull as simulated by models and observed by satellites for 14th May 2010.

The ash emissions are simulated with two different models (FLEXPART and NAME) and with different meteorological data sets for FLEXPART (ECMWF and GFS).

Two simulations are shown for each model (A PRIORI and A POSTERIORI) using different ash emissions.

Two different satellite sensors observed the ash clouds; SEVIRI and IASI.

Also the volcanic ash advisory issued 14/05/2010 1200 by the London VAAC is shown (lower right).

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ACKNOWLEDGEMENT

The PhD study is carried out in the context of the project ***Support to Aviation for Volcanic Ash Avoidance*** *(SAVAA, http://savaa.nilu.no/), financed in the European Space Agency's Earth Observation Envelope Programme (EOEP) – Data User Element.*

PP 4/2011 NIK