



Putting the Volcanic Ash Hazard in Perspective

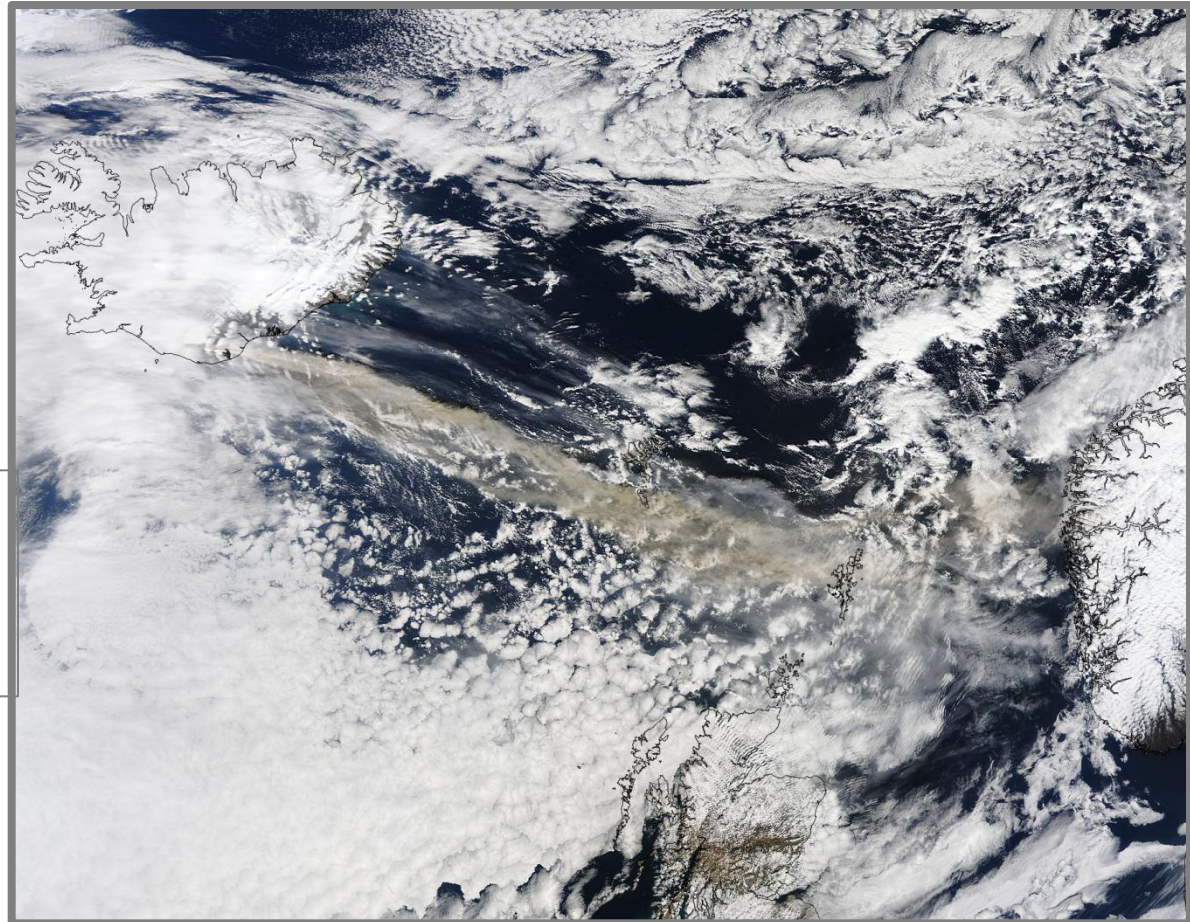
Delta Air Lines & London VAAC warning
information during Iceland volcano
Eyjafjallajokull eruption 14 April – May 2010

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Atlantic Conference on Eyjafjallajokull & Aviation, Keflavik, Iceland
15-16 September 2010**

Putting the hazard in perspective

- Evolution of London Volcanic Ash Advisory Center (VAAC) Ash Advisories During the Event
- Comparison of Delta Meteorology & London VAAC Ash Hazard Information

**1130z Thursday
15 April 2010
Visible Image from a Polar
Orbiter Satellite**





Putting the hazard in perspective

- **Volcanic Ash can be a Significant, Immediate Aviation Hazard when concentrations approach 2 g/m^{-3}**
 - Ex.: December 1989, Alaska, USA, Volcanic Ash Encounter, B747, FL250, approx. 90NM downwind from Mt Redoubt.
 - The estimated concentration of the ash cloud : **2 grams per cubic meter** (Przedpelski, Z.J., & Casadevall, T.J., 1994)
- **Volcanic Ash can increase Aircraft Maintenance Requirements & Costs at lower concentrations .**
- **VACC Products during the Eruption 14 April– May 2010**
 - 15 April -19 April, London VAAC began issuing warning areas based on a theoretical dispersion model for estimated concentrations **10,000 times less (2×10^{-4} grams per cubic meter)** than those that caused catastrophic engine failure.
 - 20 April, VAAC added 2nd area **1,000 times less ($2 \times 10^{-3} \text{ g/m}^{-3}$)** than those that have caused catastrophic engine failure.
 - 18 May VAAC added a 3rd area **500 times less ($4 \times 10^{-2} \text{ g/m}^{-3}$)**. than those that have caused a catastrophic engine failure.

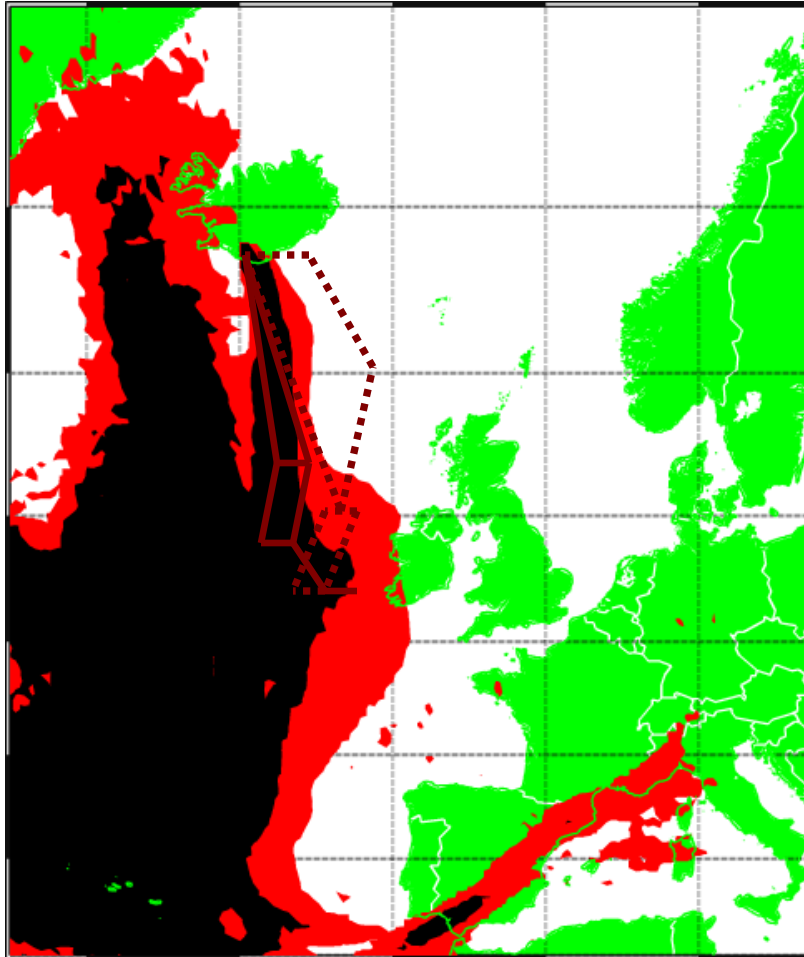
•Progress in increased definition of the Hazard was made during the eruption.
•But, more progress is necessary & continuing.



Potential For improving Models

- **Both the VAAC & Delta Meteorology use similar tools & procedures for identifying ash hazard:**
 - **Observations from Satellite Imagery**
 - Visible
 - Infra-red split channel
 - Geostationary
 - Polar Orbiters
 - **Observations from Aircraft**
 - **Dispersion Model output**
- **Delta Meteorology also has a Human-in-the-loop procedure that uses a combination of inputs:**
 - **Observational information is primary**
 - **Secondary Inputs:**
 - **Dispersion model(s) where/when observations not available**
 - **General guidelines for duration of the hazard based on the age of the ash cloud & height of the eruption.**

Delta No Fly Zones Compared



Key Dispersion Model Estimate

■ 1,000 less concentration
than engine failure

■ 10,000 less concentration
than engine failure

Delta No Fly Zones

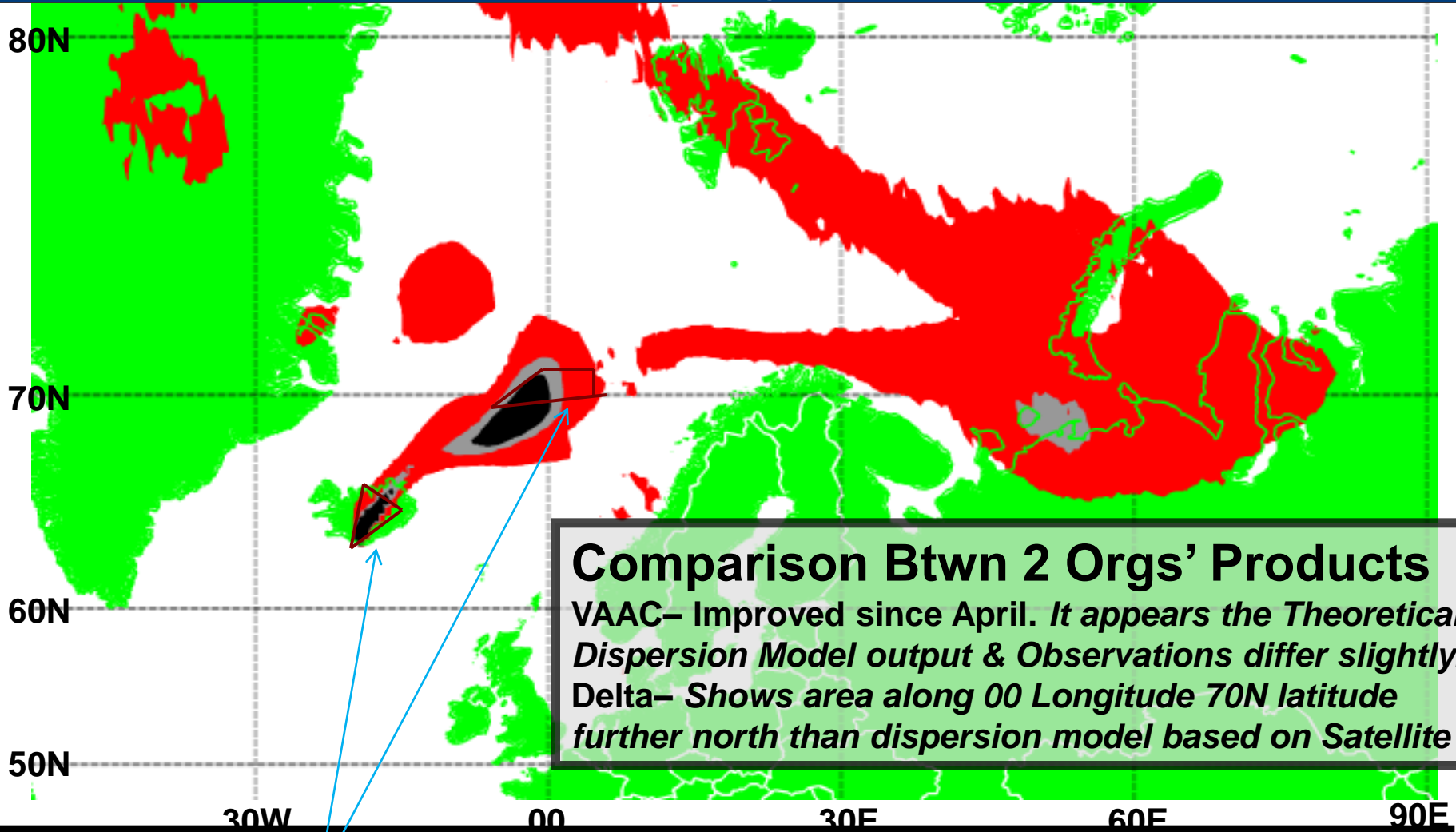
— 19Z 11 May'10 Observed

..... 06z 12 May'10 Fcsted

Based on Observations & Age of Plume

Delta No Fly Zones Compared

20 May 2010



Comparison Btwn 2 Orgs' Products
VAAC– Improved since April. *It appears the Theoretical Dispersion Model output & Observations differ slightly.*
Delta– *Shows area along 00 Longitude 70N latitude further north than dispersion model based on Satellite*

Delta No Fly Ash areas eff 15z

VAAC 18z		10,000 - 1,000 times less concentration than engine failure		1,000 - 500 times less concentration than engine failure		>= 500 times less concentration than engine failure
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Meeting Summary

Prepared by Tom Fahey & Distributed 21 September 2010

Executive Summary

Two main questions prompted Delta's attendance at the conference:

- 1. The volcanic Ash Hazard: What needs to be avoided?**
- 2. Decision making process: Who should be responsible for the avoidance decision?**

Neither were completely resolved, but there was some progress made.

It appeared that there was unanimous agreement that ICAO was the appropriate body to complete the process of answering the two main questions.

I would expect that when ICAO completes the process we will arrive at a conclusion that falls along the lines of the following:

- 1. What needs to be avoided?** Ash that is visible to the human eye &/or detectable via weather satellites is recommended to be avoided. Computer dispersion models should be used to supplement the observed info rather than over ride the observed information.
- 2. Who should be responsible for the avoidance decision?** While the final authority & responsibility for safe operation of an individual aircraft rests with the captain of an individual aircraft, there are numerous additional resources that must be marshaled to ensure that the individual flight plan that is prepared for the captain, as well as the systematic air traffic flows are designed with passenger safety as the primary goal followed by operational efficiency. The additional resources that must be included are reps from Air Navigation Service Provider(s) (ANSP) organization(s) and operators(s).