

The Puff VATD model, forecasting ash clouds in
North Pacific and its ability to
provide situational awareness of ash cloud
hazards

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or Puff VATD model and what it can do

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What is the Puff model?

- Specifically tailored for volcanic ash and 3D tracking of volcanic ash particles
- Ash particles released over volcano and tracked over time
- Uses meteorological wind fields (GFS, NAM216, Reanalysis, WRF)
- Initialization parameters include
 - Volcano name and location
 - Number of particles
 - Mean Particle size and spread
 - Plume dimensions (height, width and shape)
 - Length of model prediction and length of eruption
 - Output time step
 - Horizontal and Vertical Diffusion (constant or varying)
 - Wind field model

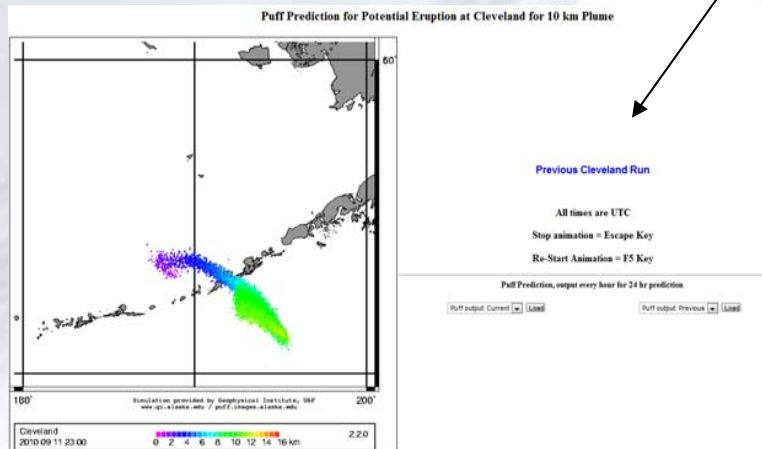
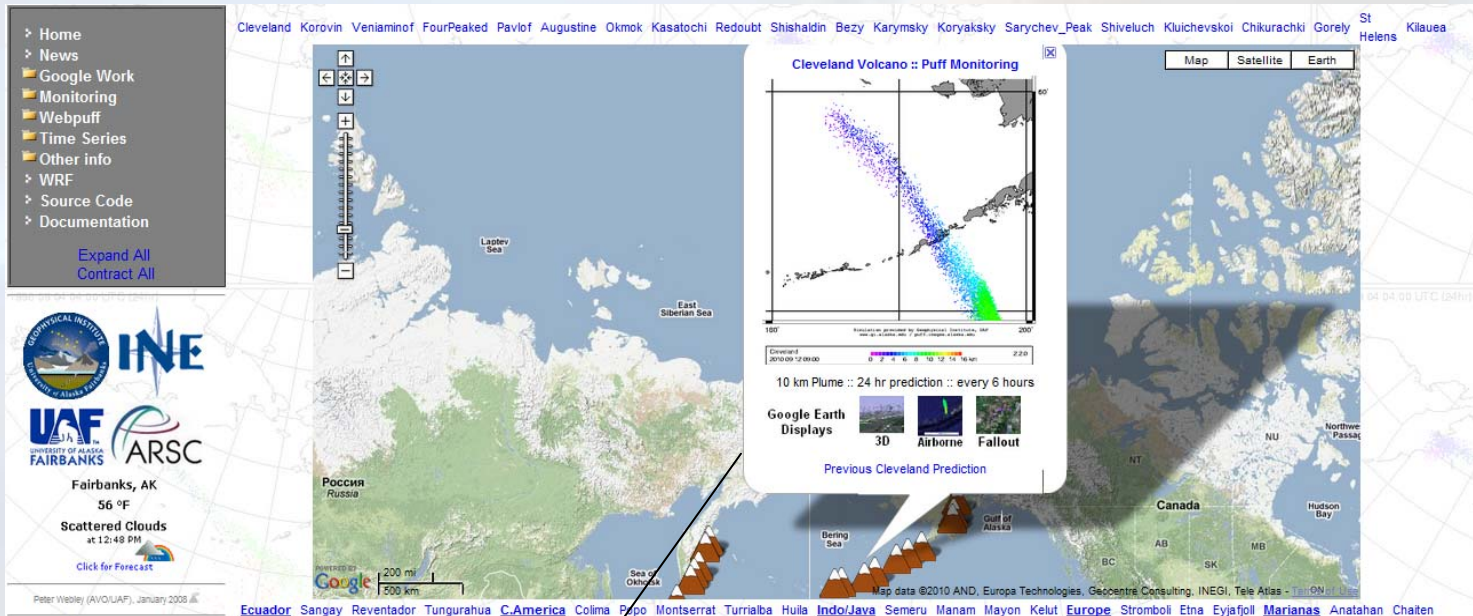


(<http://puff.images.alaska.edu>)



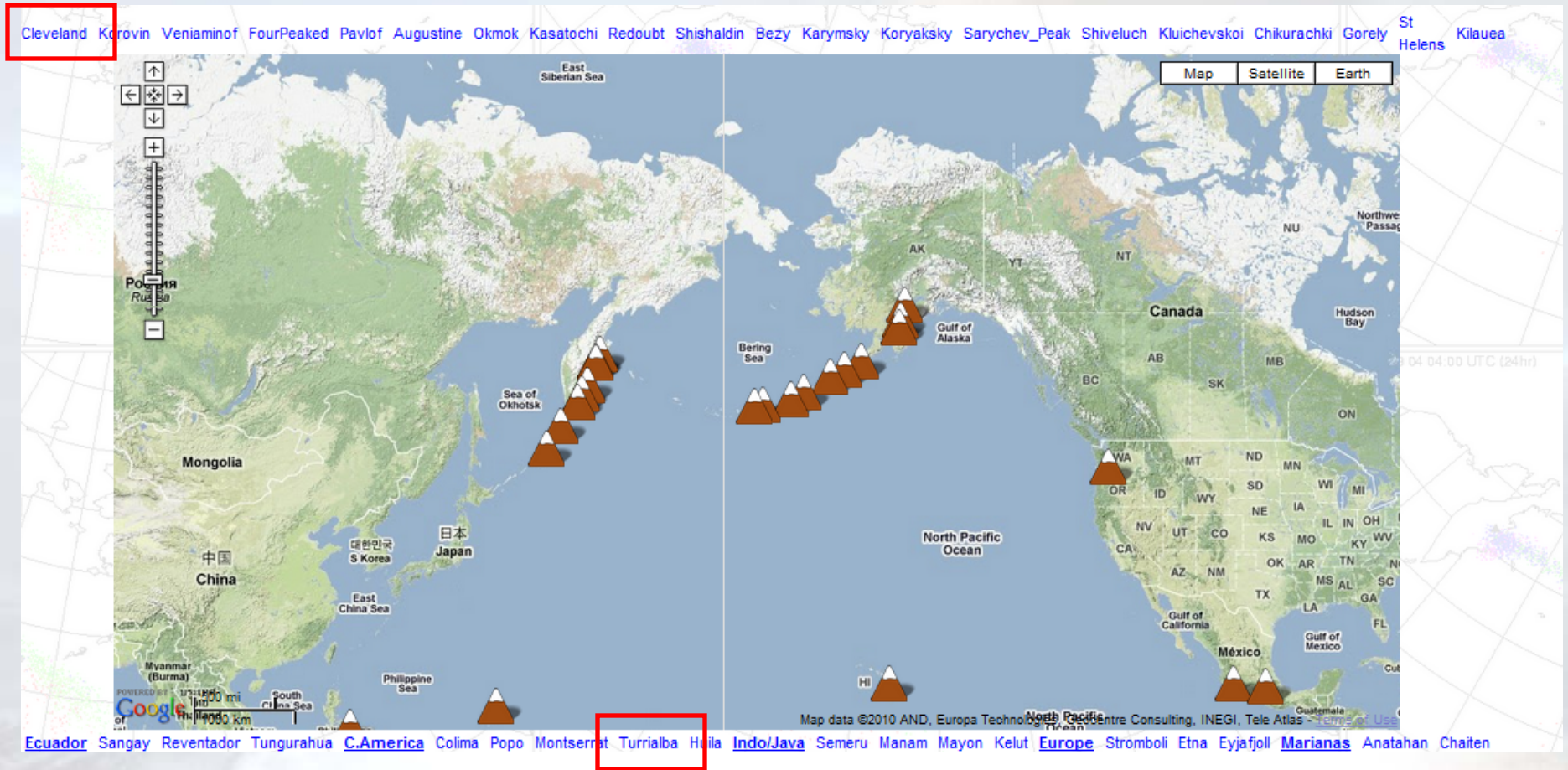
Puff – Volcanic Ash Tracking and Dispersion model

<http://puff.images.alaska.edu>



- Automated forecasts for 37 volcanoes worldwide
- Forecasts for initial plumes from 4 – 16 km ASL
- 24 hour forecasts, updated every 3 – 6 hours
- Standardized displays to reduce hazard assessment time
- Two-dimensional and Three-dimensional visualizations
- NWP vertical profiles to assist plume height determination

Worldwide Volcanoes

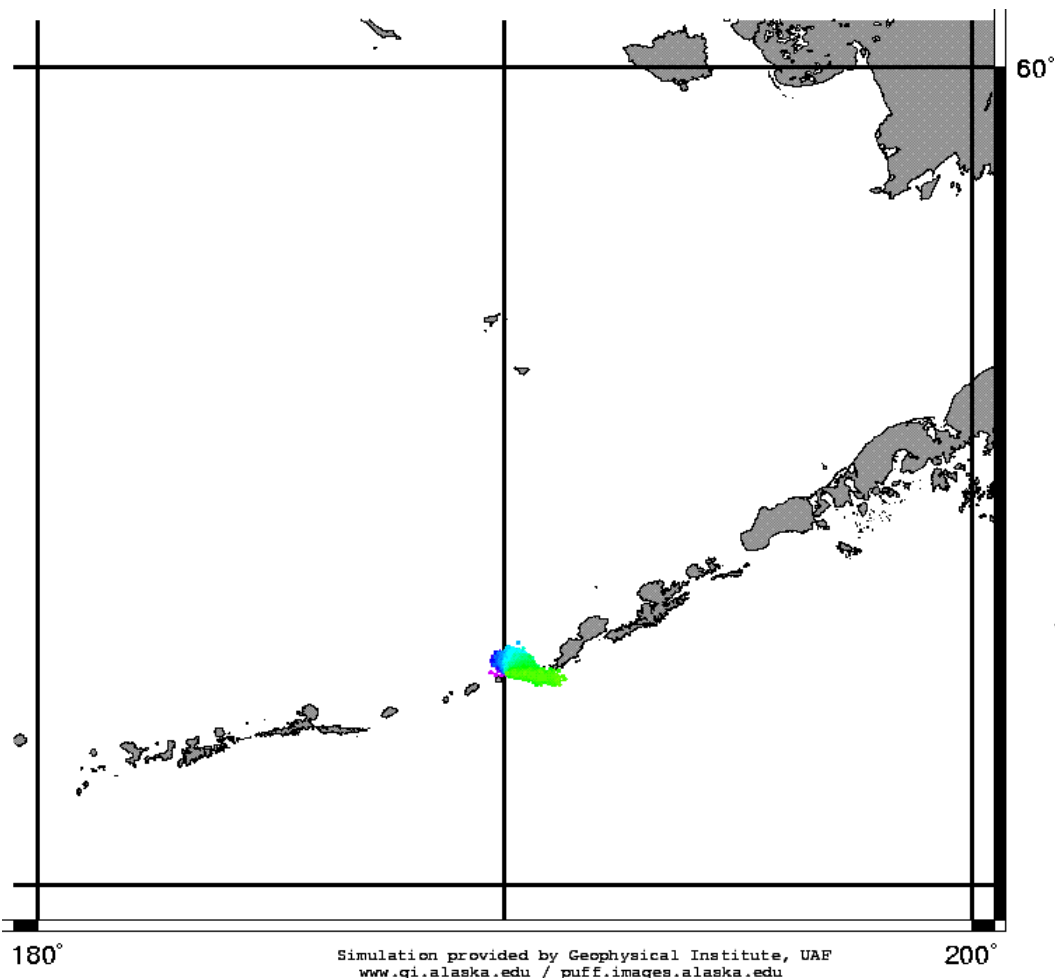




Cleveland, Alaska



Puff Prediction for Potential Eruption at Cleveland for 10 km Plume



[Previous Cleveland Run](#)

All times are UTC

Stop animation = Escape Key

Re-Start Animation = F5 Key

Puff Prediction, output every hour for 24 hr prediction

Puff output: Current

Puff output: Previous

Cleveland
2010 09 15 16:00

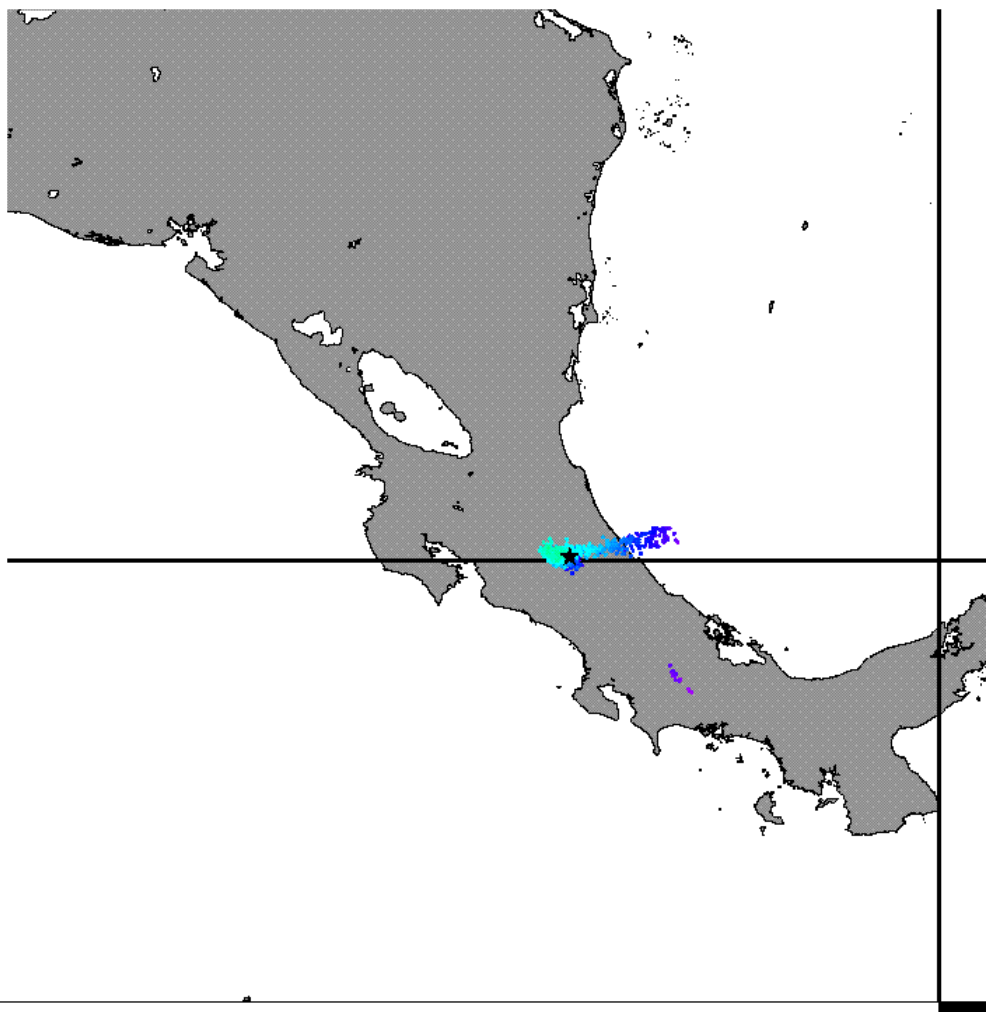
0 2 4 6 8 10 12 14 16 km

2.2.0



Turrialba, Costa Rica

Puff Prediction for Potential Eruption at Turrialba for 10 km Plume



[Previous Turrialba Run](#)

This page will refresh in 4:56 mins

To manually refresh, use the F5

All times are UTC

Stop animation = Escape Key

Re-Start Animation = F5 Key

Puff Prediction, output every hour for 24 hr prediction

Puff output: Current

Puff output: Previous

Simulation provided by Geophysical Institute, UAF
www.gi.alaska.edu / puff.images.alaska.edu

Turrialba
2010 09 14 17:00

0 2 4 6 8 10 12 14 16 km

2.2.0



Online WebPuff

http://puff.images.alaska.edu/cgi-bin/login_agu.pl

Version: 2.2.0 session ID: Eyfa_Webley

1. Choose Volcano →

2. Set start time →

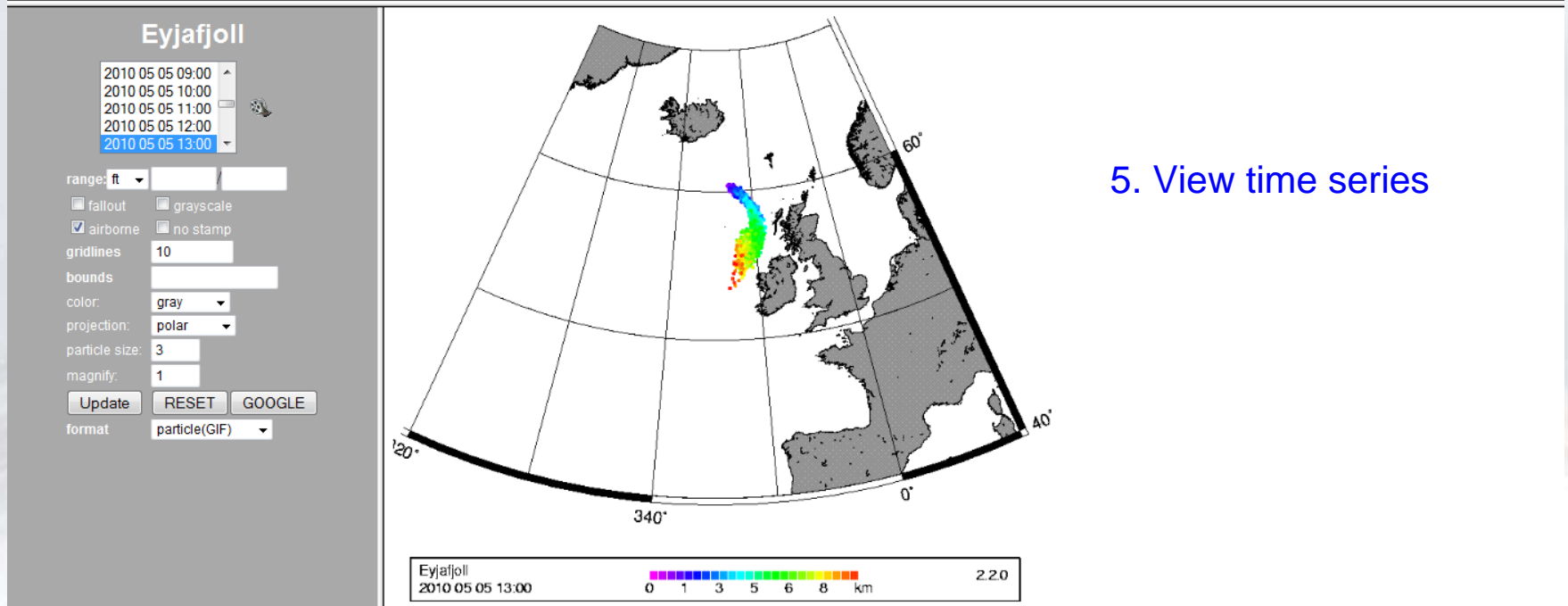
Volcano Name		N. Lat	Eruption start UTC:	Previous
Esjufjoll		63.63	YYYY MM DD HH:mm	Eyjafjoll
Esmeralda bank		E. Lon	2010 05 05 00:00	Delete
Etna		19.62		
Eyjafjoll				
Region: Iceland-S				

3. Set input parameters →

4. Run model ←

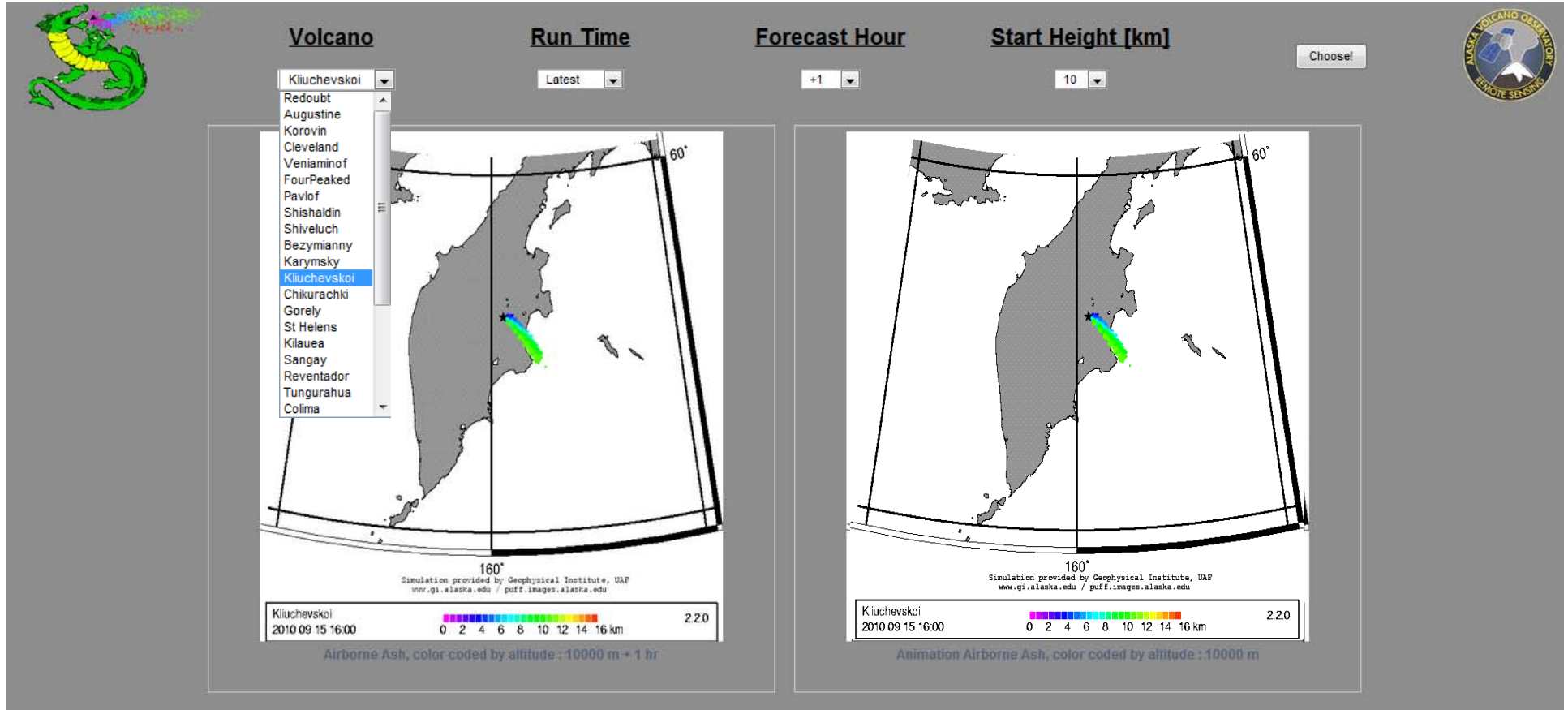
Simulation hours 24	Eruption hours 3	Wind Model reanalysis
Save every [hrs] 1	# particles 1000	DEM none
Plume height[m] 10000	Plume bottom[m] 1666	Plume Shape poisson
Restart File none		

logout Run Puff here Help



Run for any volcano worldwide in real time or retrospectively from 1970 – present

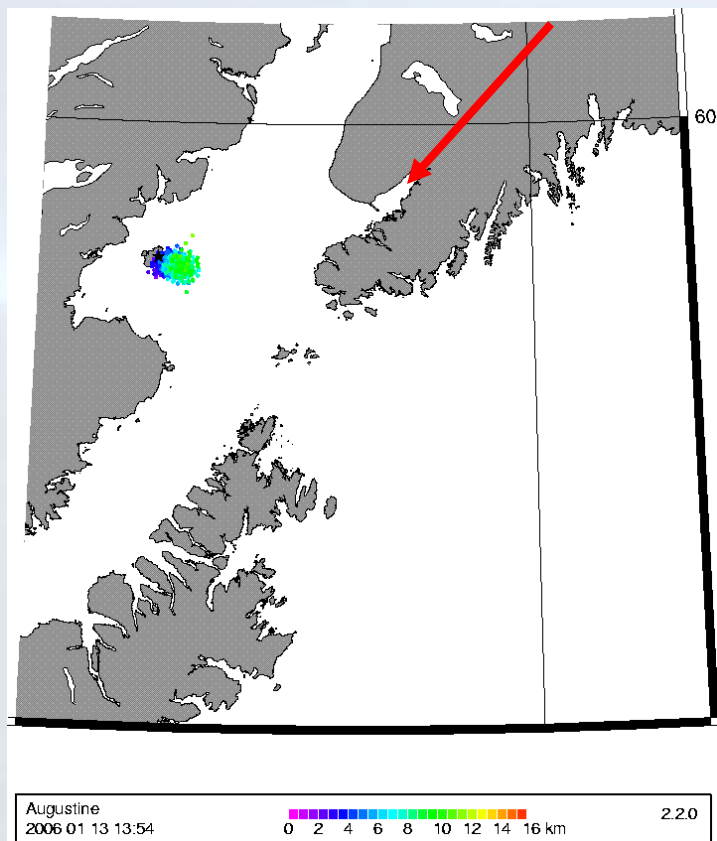
Auto forecasts page



http://puff.images.alaska.edu/auto_forecasts.php

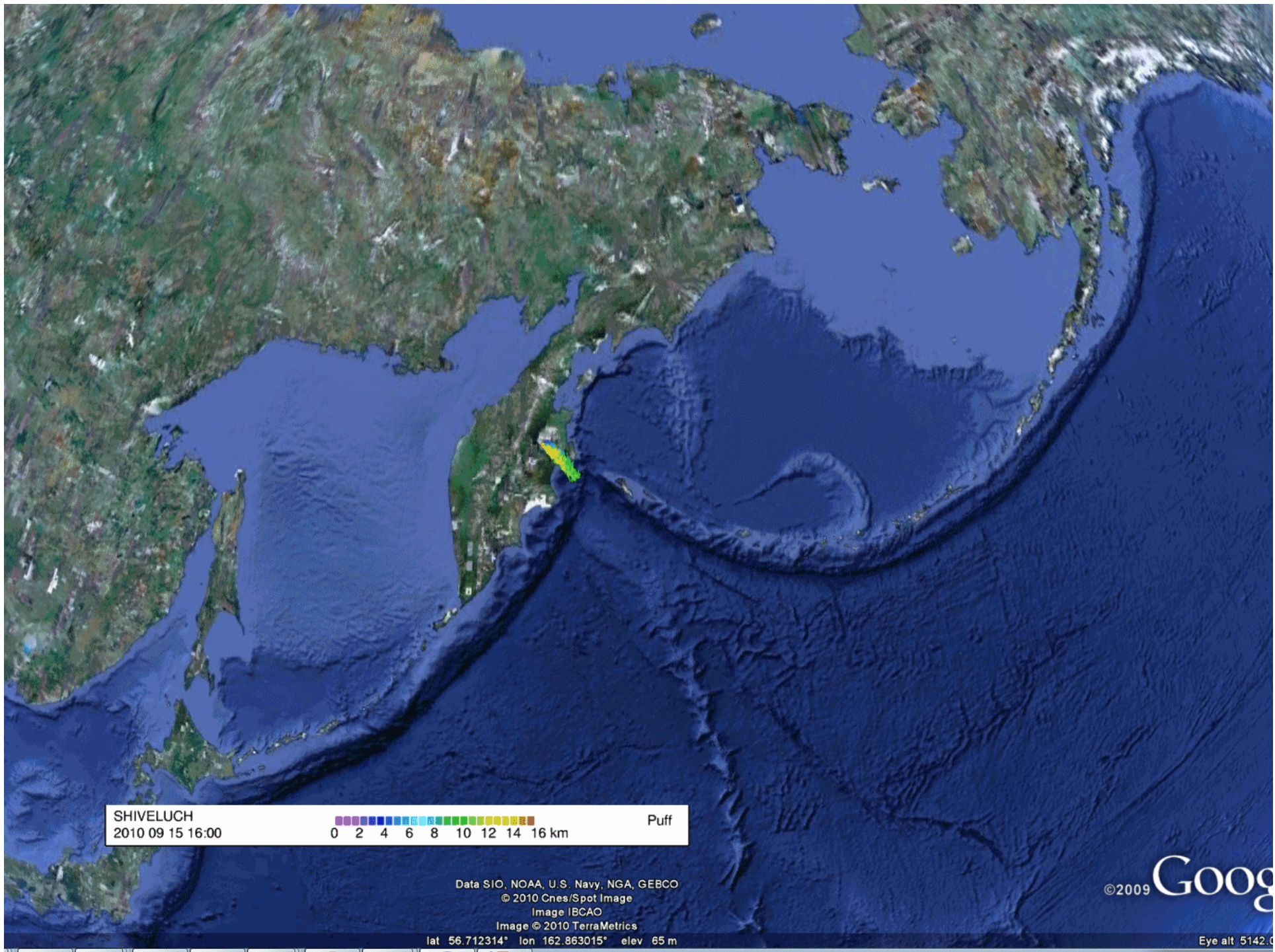


Current method for 3D Puff in Google Earth



Mt Augustine 2006 eruptive event





SHIVELUCH
2010 09 15 16:00

0 2 4 6 8 10 12 14 16 km

Puff

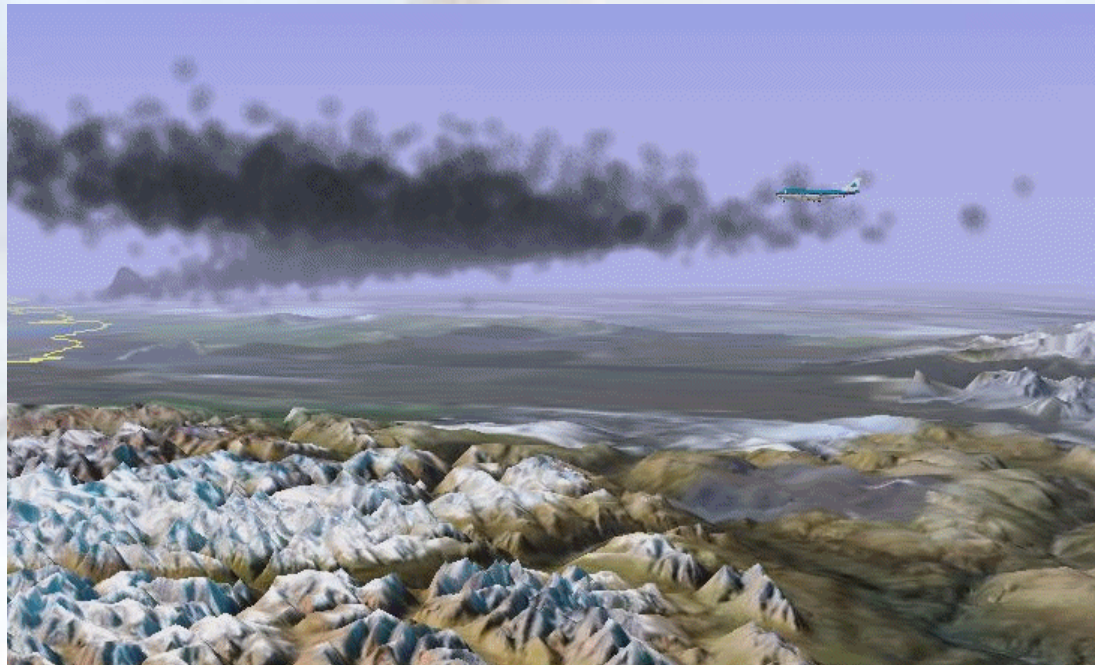
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
© 2010 Cnes/Spot Image
Image IBCAO
Image © 2010 TerraMetrics
lat 56.712314° lon 162.863015° elev 65 m

©2009 Google

Eye alt 5142.0

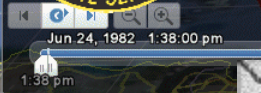
Redoubt-KLM ash encounter

- Dec 1989, Mount Redoubt volcano produced numerous volcanic eruptions.
- Aircraft entered an ash cloud at approx. 25,000 ft, 150 miles NNE of Mt Redoubt.
- The aircrew increased power and attempted to climb out of the ash cloud.
- The aircraft descended approx. 13,000 ft before the crew restarted the 4 engines.
- Performed an emergency landing at the nearby Anchorage airport.



- Aircraft impacted distal edge
- Able to view both aircraft route and ash cloud in 3D

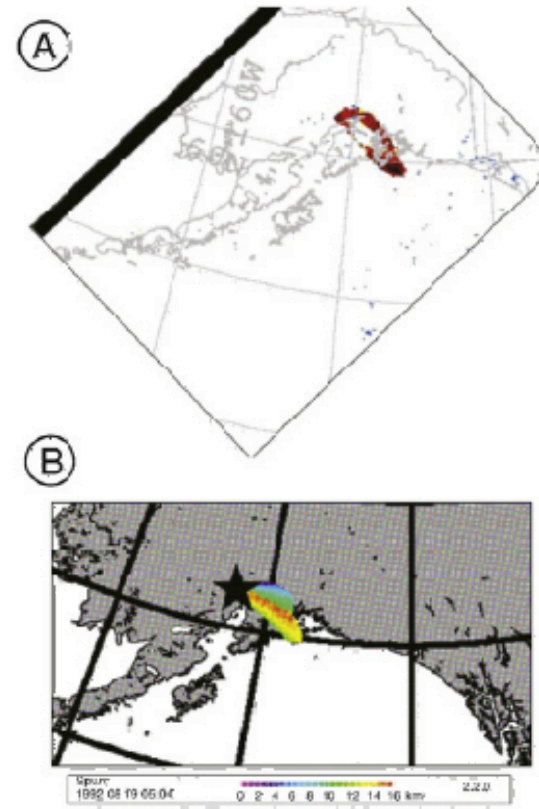
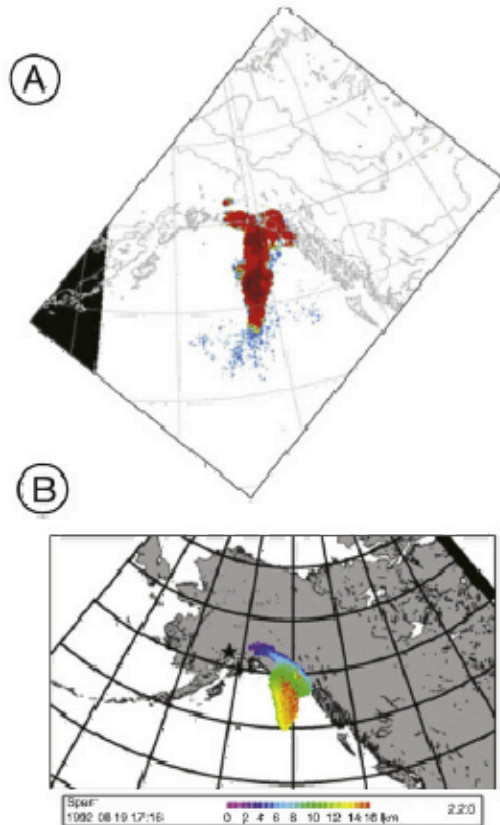
Webley, P.W. (2010). Four Dimensional Volcanic Ash Cloud Predictions in Google Earth, with a special case of an ash-aviation encounter. *Computer and Geosciences S. I.: Virtual Globes*.doi:10.1016/j.cageo.2010.02.005.



S 8°15'



Puff to Satellite comparison



Threat Score from how much over- and under- estimated by model?

Webley, P. W., Stunder, B.J.B., and K.G. Dean (2009). Significant eruption source parameter(s) for operational ash cloud transport and dispersion models. *Journal of Volcanology and Geothermal Research: Special Issue on Volcanic Ash Clouds*, eds. Larry Mastin and Peter Webley, **186** (1 – 2), 108 - 119.



Exposure Rating

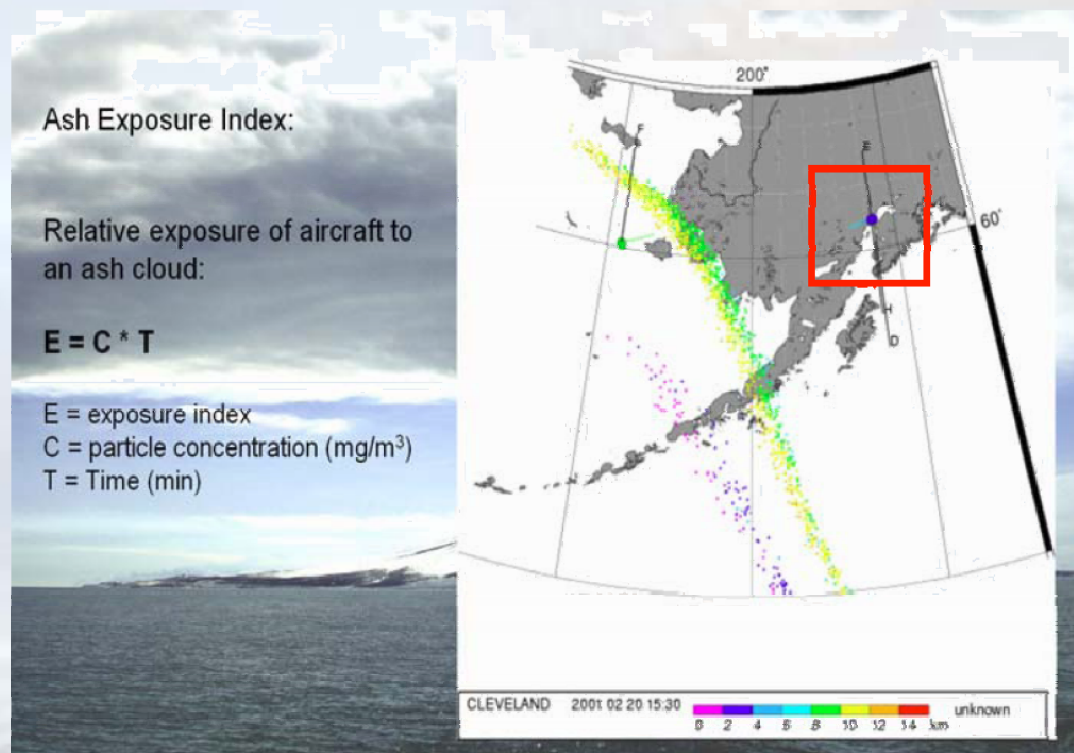
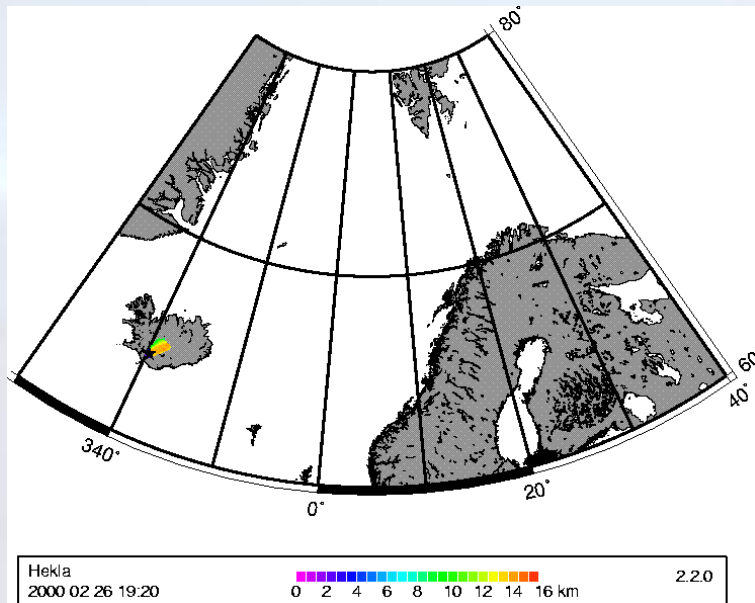


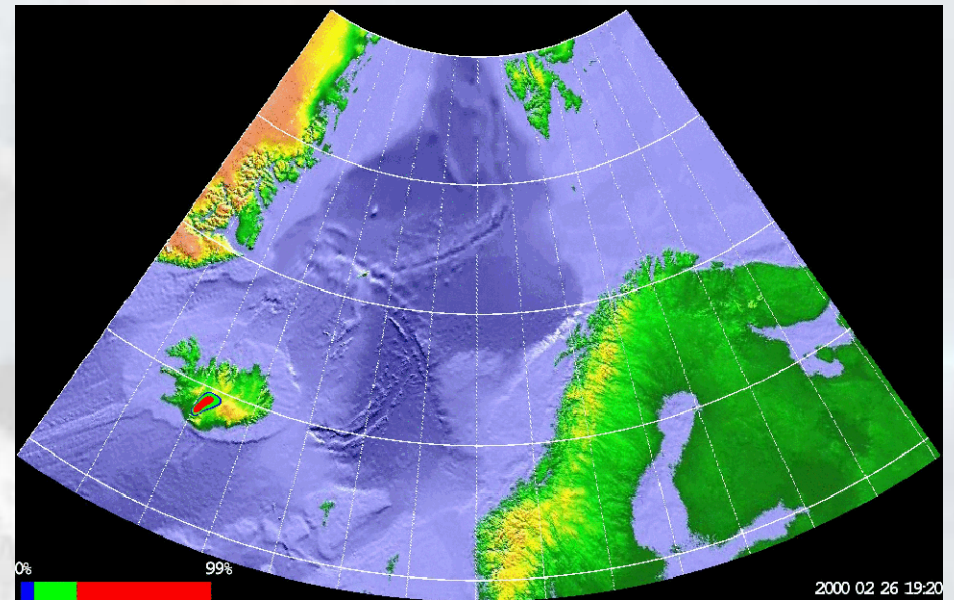
Figure 1. Illustration of the exposure index, incorporating concentration and time within the ash cloud. The Puff model forecast shows the ash cloud and aircraft location, highlighted in red.

In Figure 1, *E* is the exposure index, *C* is the concentration of ash over the flight path and *T* is exposure time. This emphasizes that concentration alone is not responsible for a change in the exposure and low ash concentrations can create a large exposure given enough time. This model will be put into operation and compared with known events and exposures to calibrate the mass retrieval models in satellite data and concentration forecasts from ash tracking models.

Benchmark case: Hekla 2000



Particles by altitude

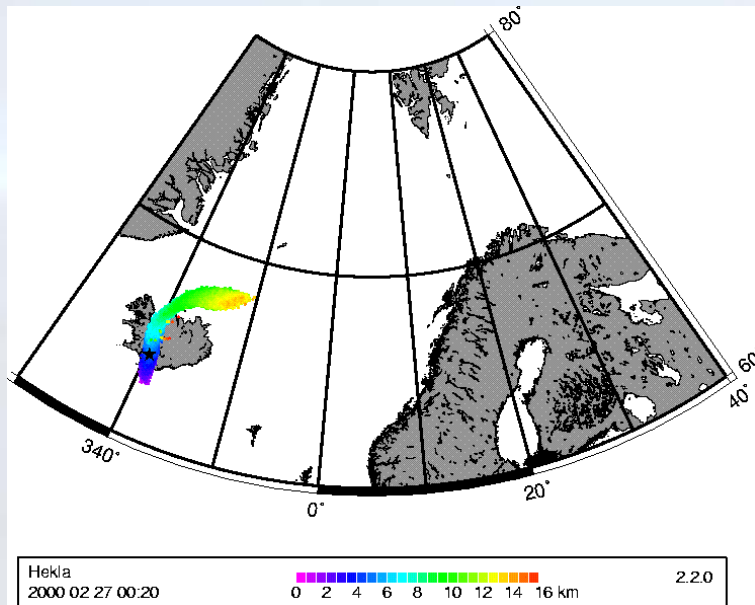


Particles by concentration

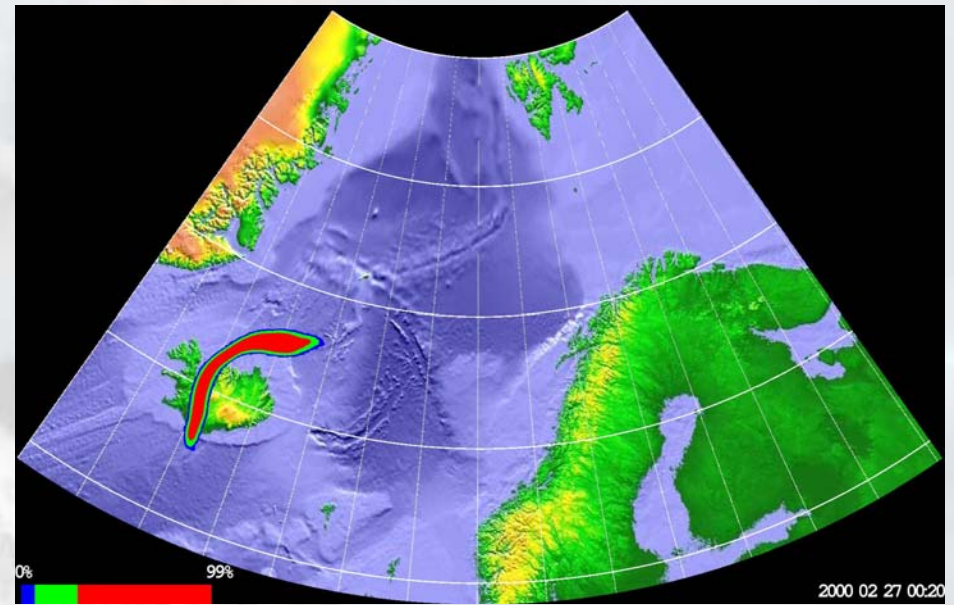
Full column – first 24 hrs



Benchmark case: Hekla 2000



Particles by altitude



Particles by concentration

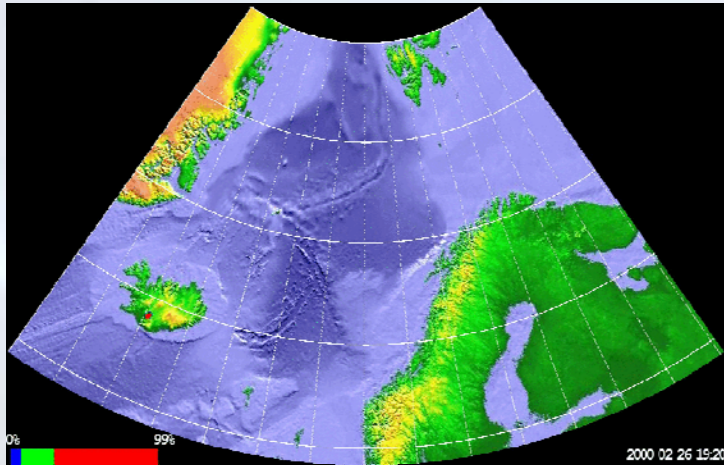
Full column

February 27, 2000
00:20 UTC

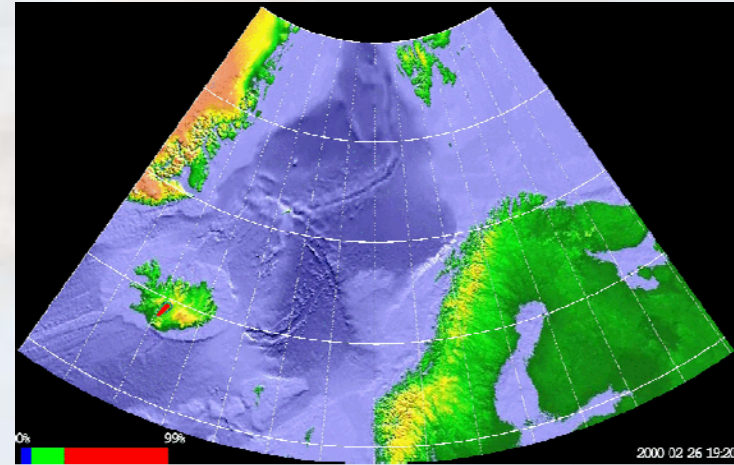




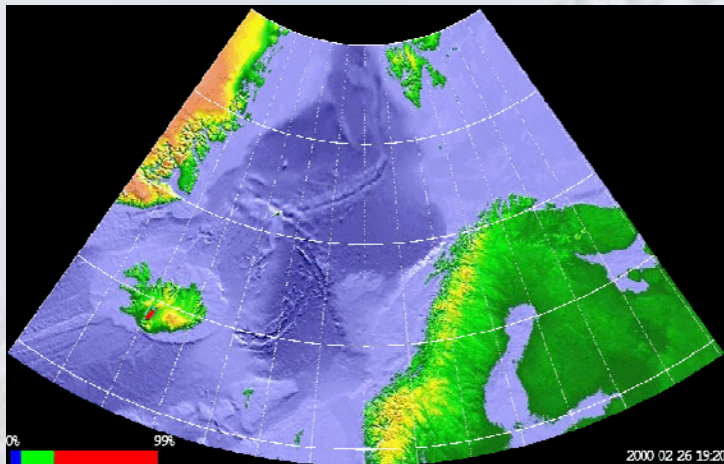
Benchmark case: Hekla 2000



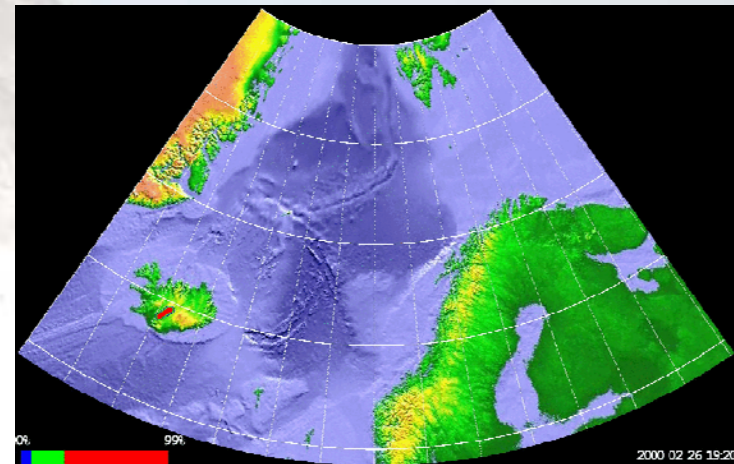
10 K ft



30 K ft



20 K ft

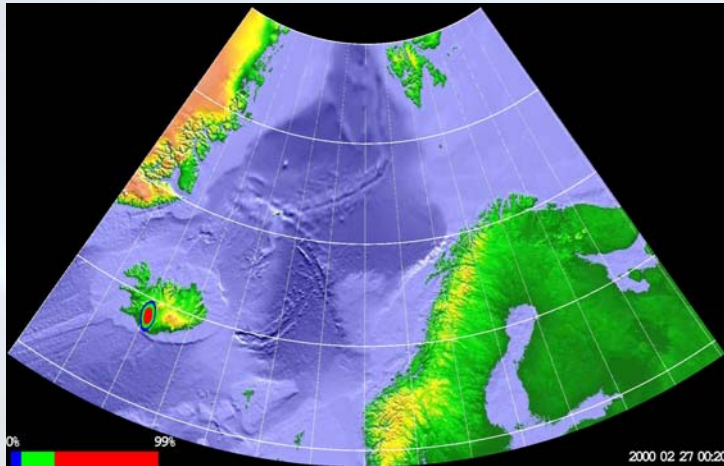


35 K ft

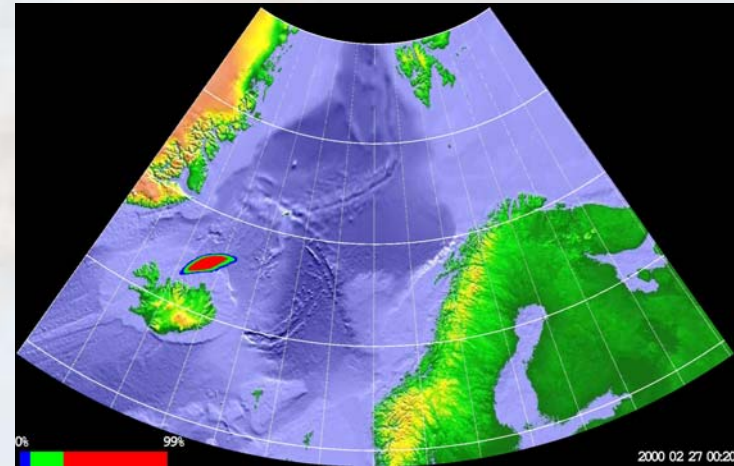
Particles by concentration
First 24 hrs



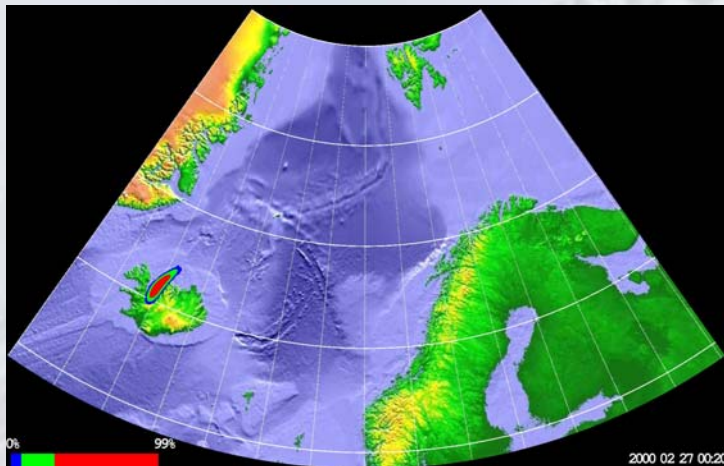
Benchmark case: Hekla 2000



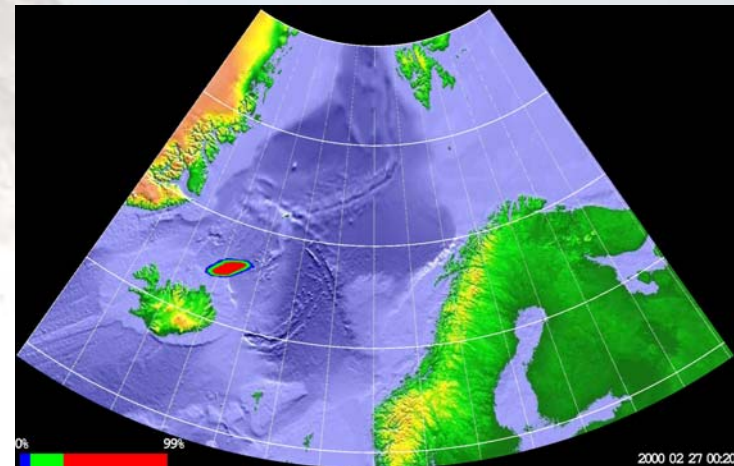
10 K ft



30 K ft



20 K ft



35 K ft

Particles by concentration
February 27, 2000 at 00:20 UTC

Where next

- Statistical analysis of volcanic ash dispersion model forecasts
- Ensemble modeling of volcanic ash clouds
- Forecasting real-time volcanic ash concentrations
- What is the major influence for aircraft: ash concentration or ash exposure? (should we be using 2 mg/m^3 ?)
- Data fusion – compare satellite to modeled forecasts





30 Year Analysis of Ash in the North Pacific



Volcanic Eruptions in North Pacific Region

Puff Volcanic Ash Dispersion Model

Time Series



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Overview

Download from : http://puff.images.alaska.edu/30yrseries_airroutes.shtml