Operational use of numerical dispersion/fallout models at the USGS to advise partner agencies and the public of ashfall hazards

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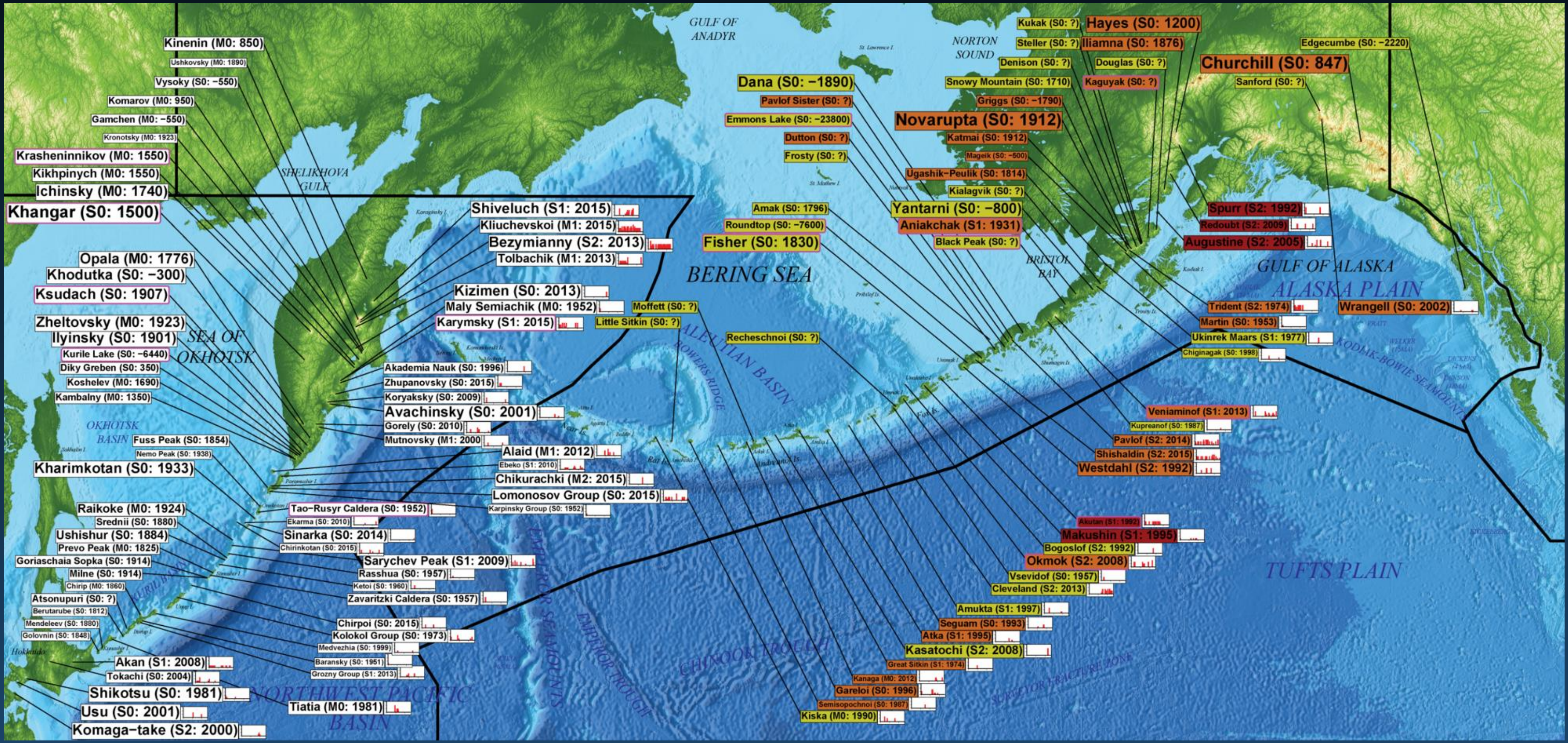
WMO 7th International Volcanic Ash Workshop
Anchorage, AK

Outline

- USGS use of dispersion models
- Communicating to agency partners
- Communicating to general public
- Challenges bringing a research tool into broad operational use

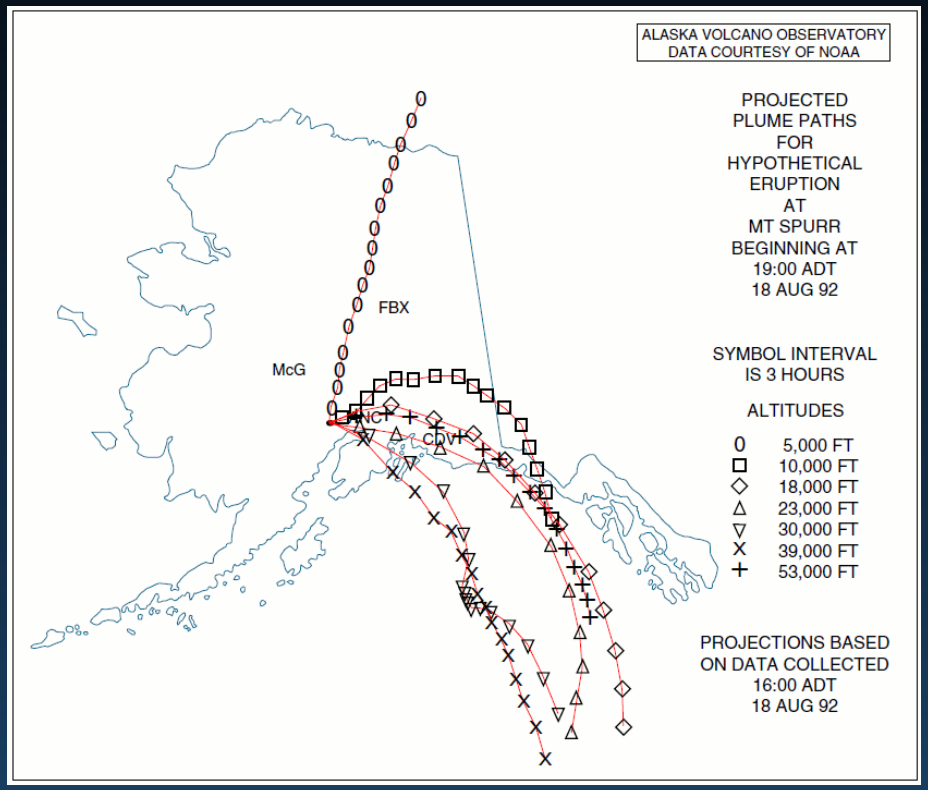
Volcanism in the North Pacific Rim



Dispersion models

Trajectory Models

- Hysplit (NOAA)
  - Used operationally by AVO since early 1990's (internally)
  - Publically available

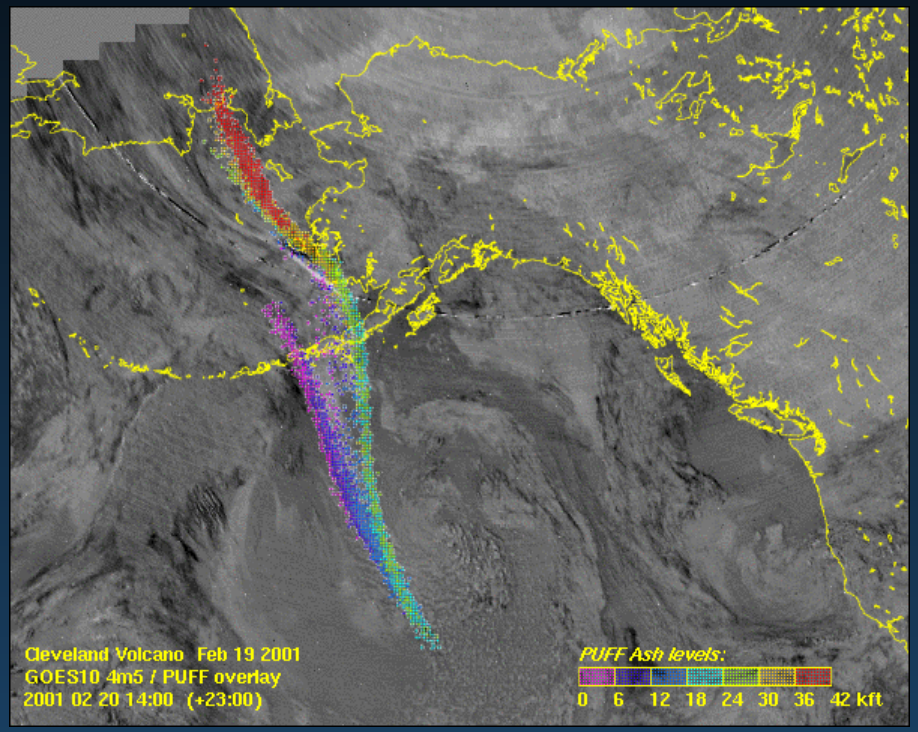


http://ready.arl.noaa.gov/READY_traj_Alaska.php

Dispersion models

Particle Models

- Puff (UAF-GI)
  - Used operationally by AVO since late 1990's (internally)
  - Automatic runs posted publically via UAF/AVO webpages
  - Interface to model is publically available

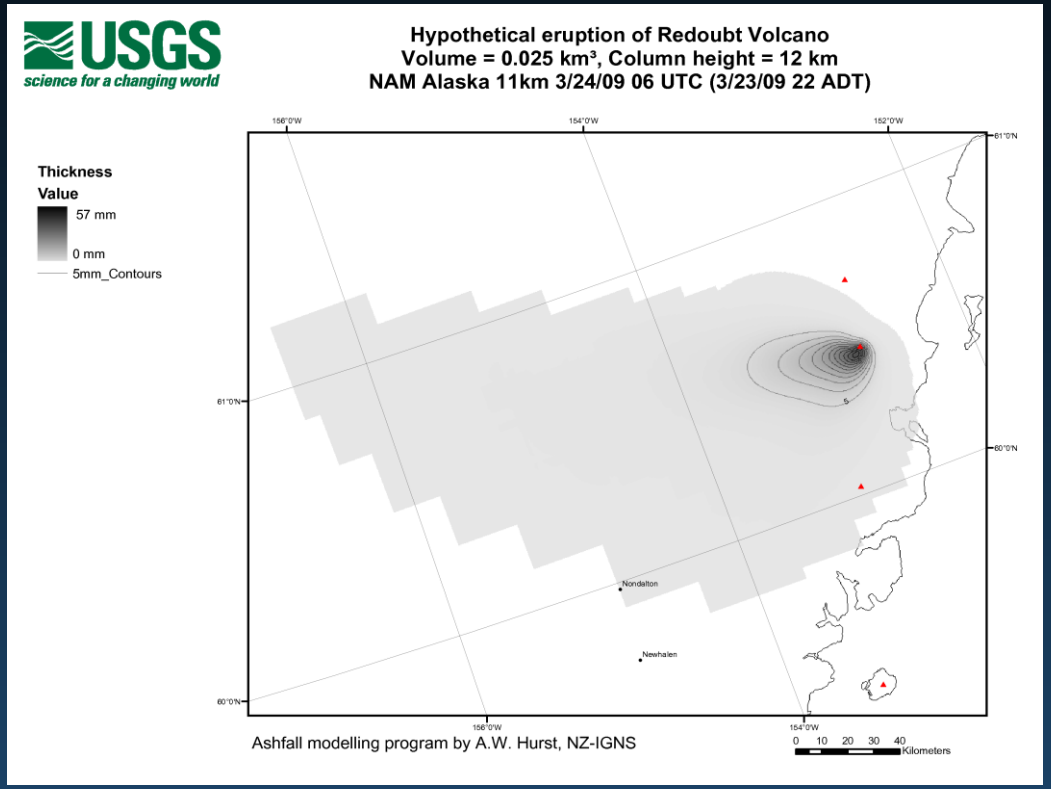


http://volcview.wr.usgs.gov/puff/main.pl

Fallout models

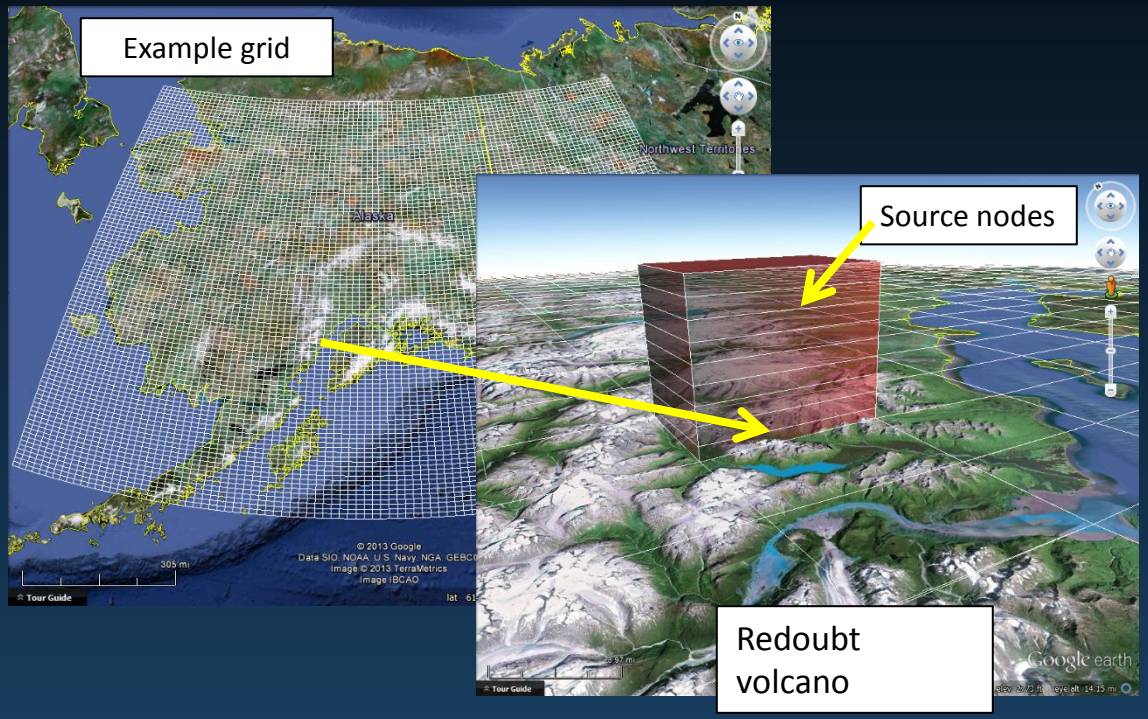
Ashfall

- Used operationally at CVO for MSH in 2004
- Used at AVO for Redoubt 2009
- Used internally to inform staff for communicating hazard assessment



The Ash3d dispersion model

- Developed in 2010
  - Both a research tool and used in operations
- Calculates airborne ash concentration and deposit thickness
- Used during unrest to anticipate
- Used during eruptions to forecast
- Runs on linux systems
- Web-based interface



The Ash3d web interface

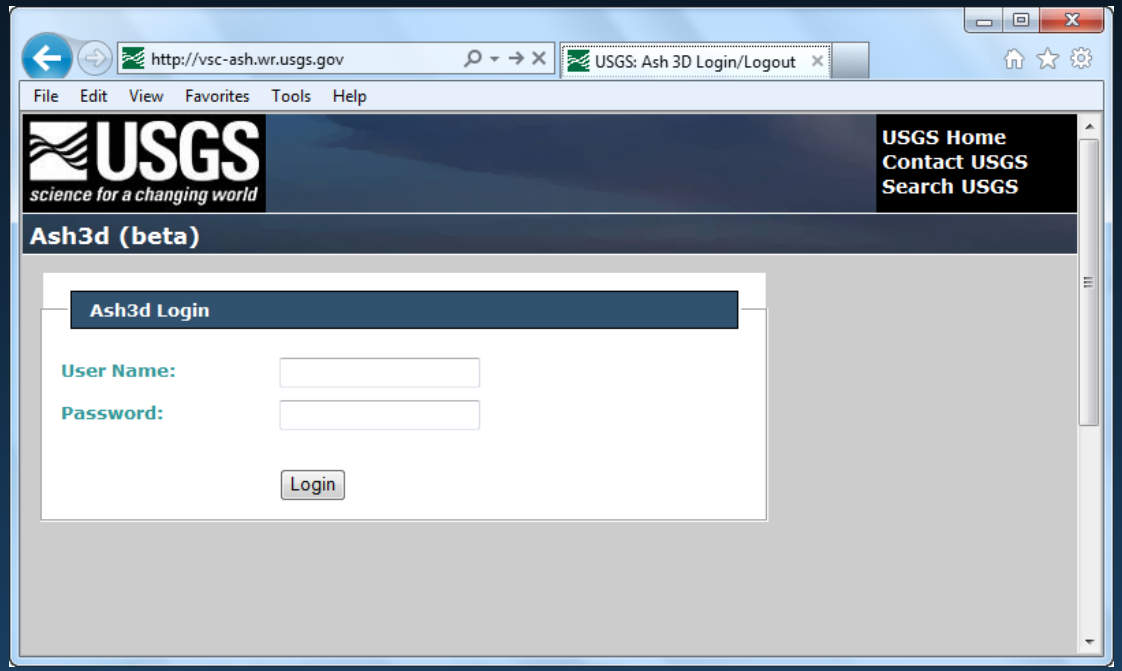
- Password-controlled site

  http://vsc-ash.wr.usgs.gov

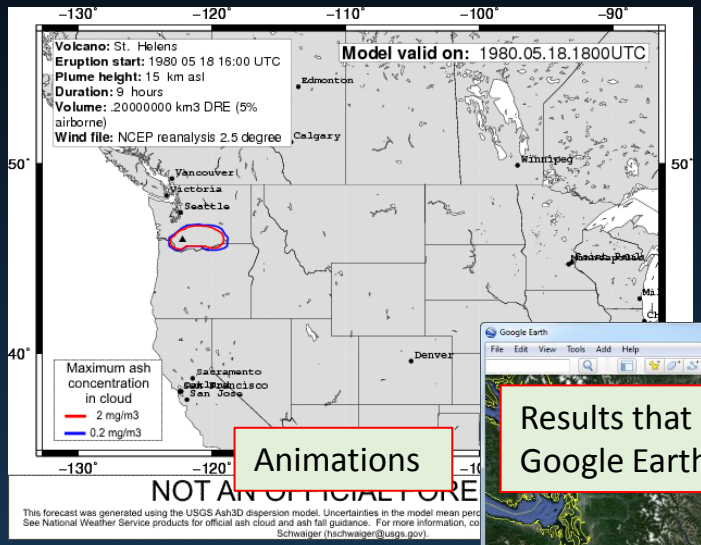
- Public site

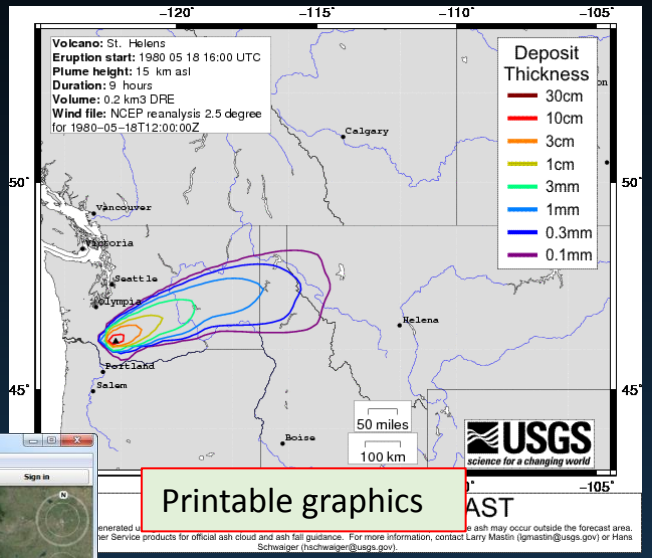
  http://vsc-ash.wr.usgs.gov/public.php

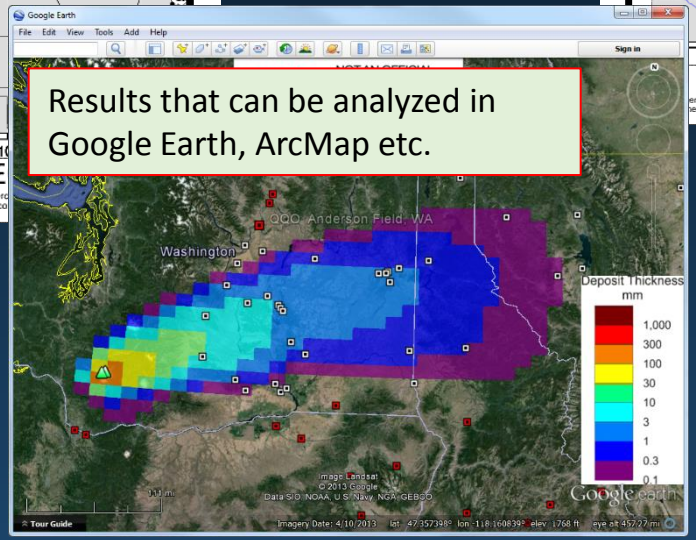
- 3 Servers
  - AVO, CVO, Menlo Park

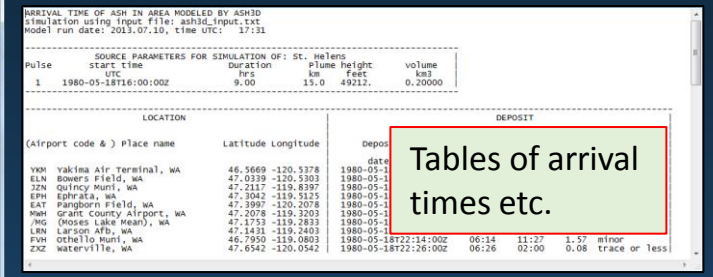


Ash3d output



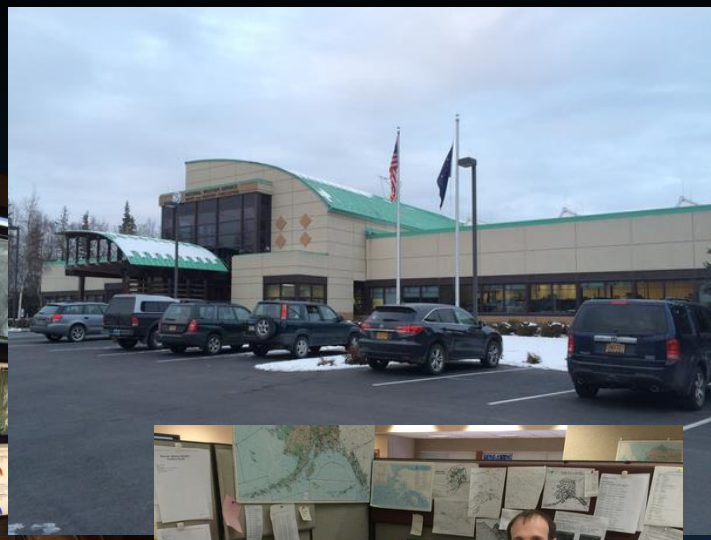


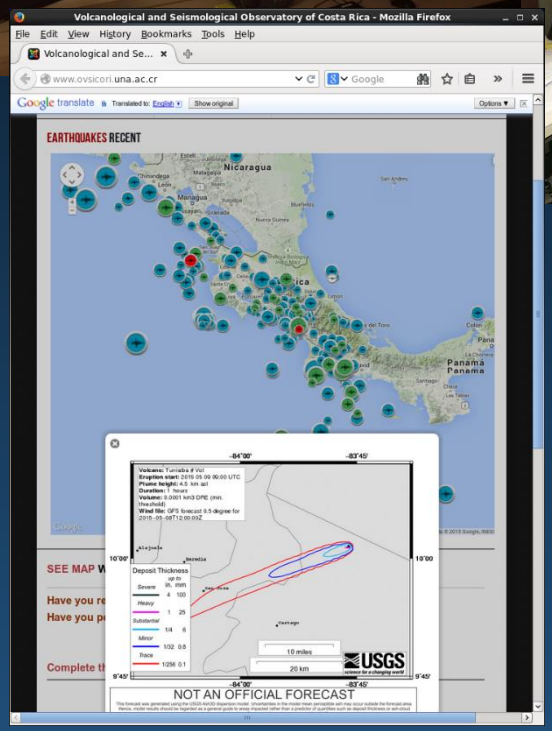




Ash3d users

- ~175 users
- Used operationally at AVO and CVO
- Local and national government agencies
- International users
  - volcano observatories
  - Geological/Meteorological offices
  - VDAP
- Individual researchers





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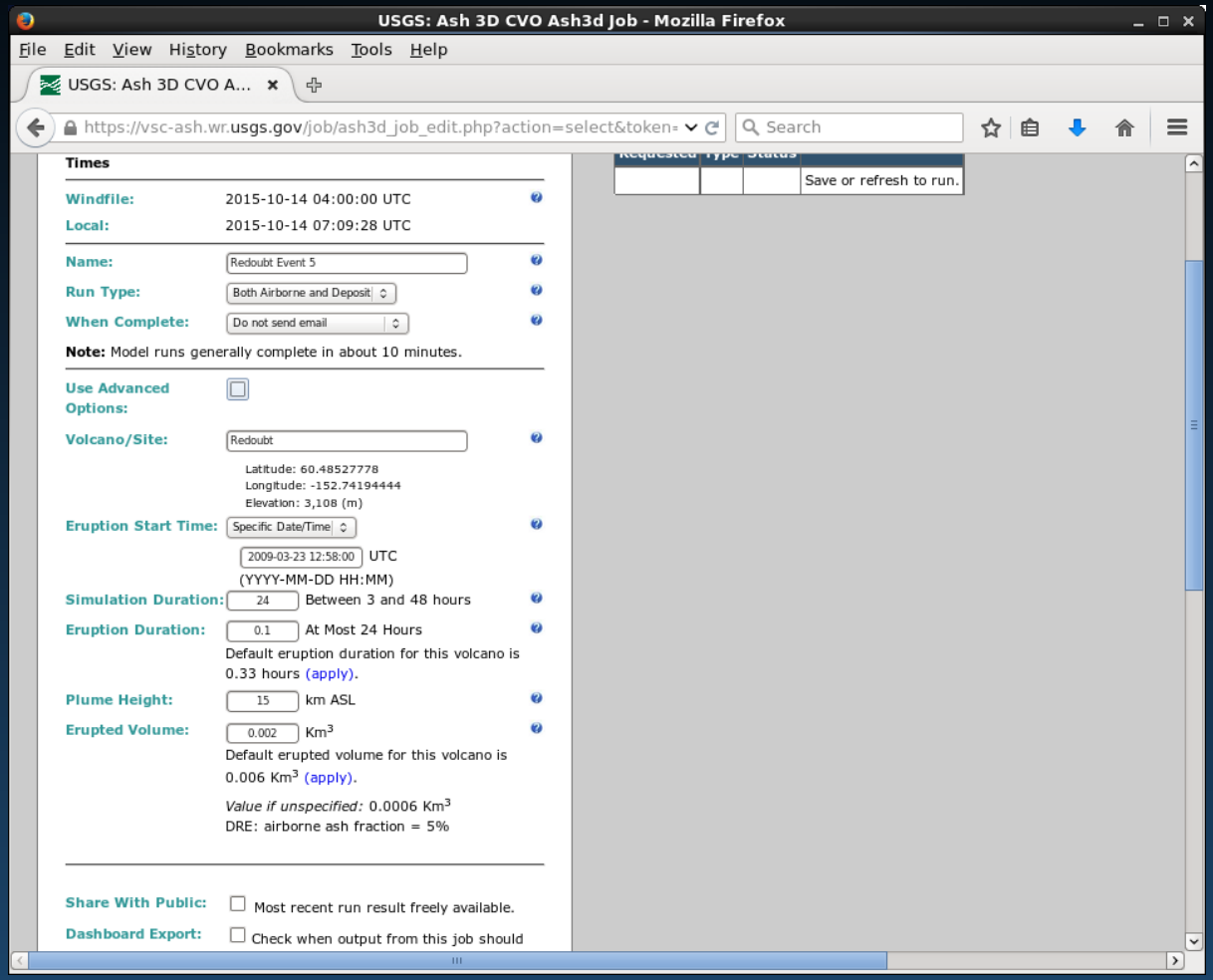
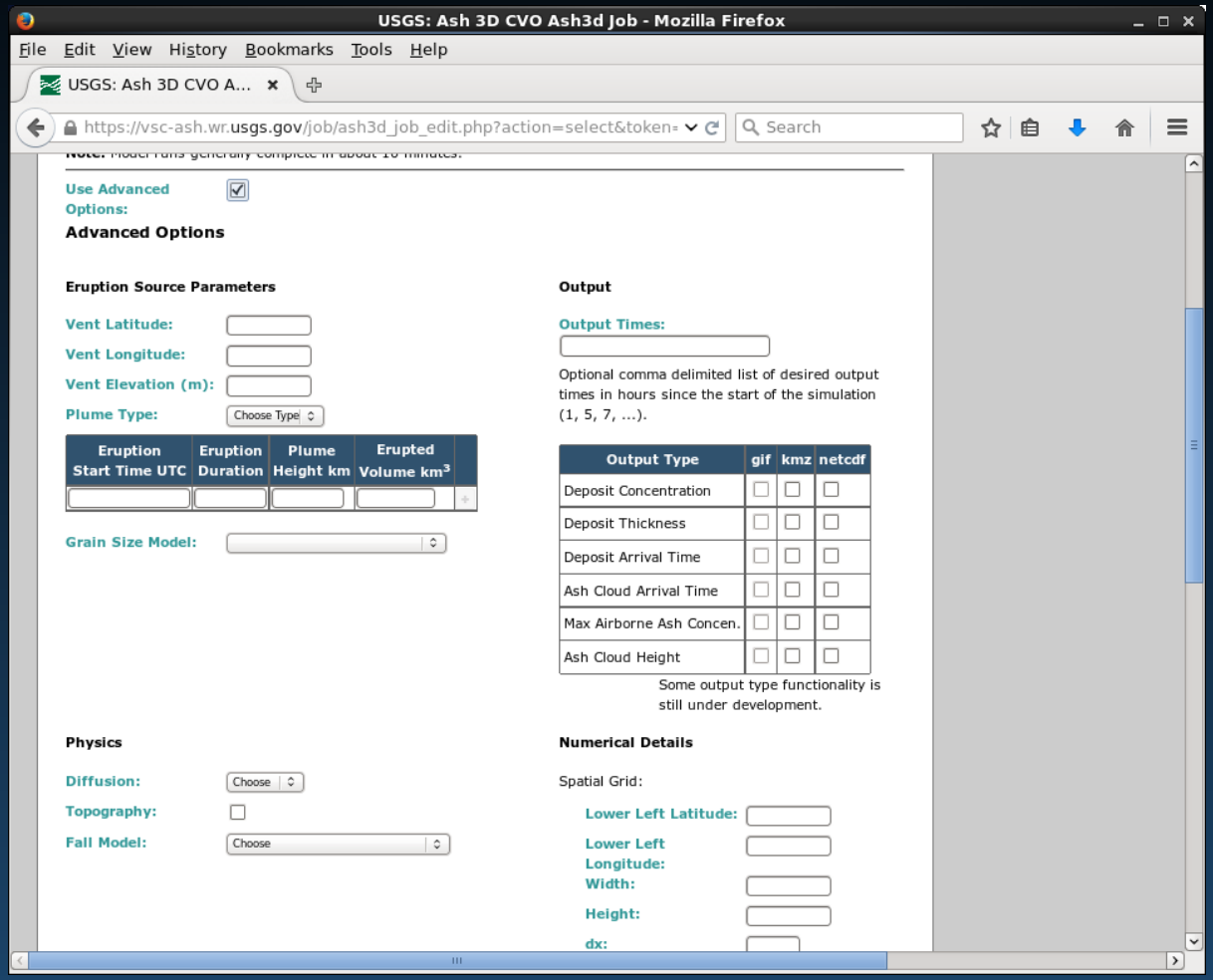
ALASKA GEOLOGICAL AND GEOPHYSICAL SURVEYS

Operational: Simplified web interface



To facilitate widespread use, we provide a simplified web interface with instructions and pre-set parameters

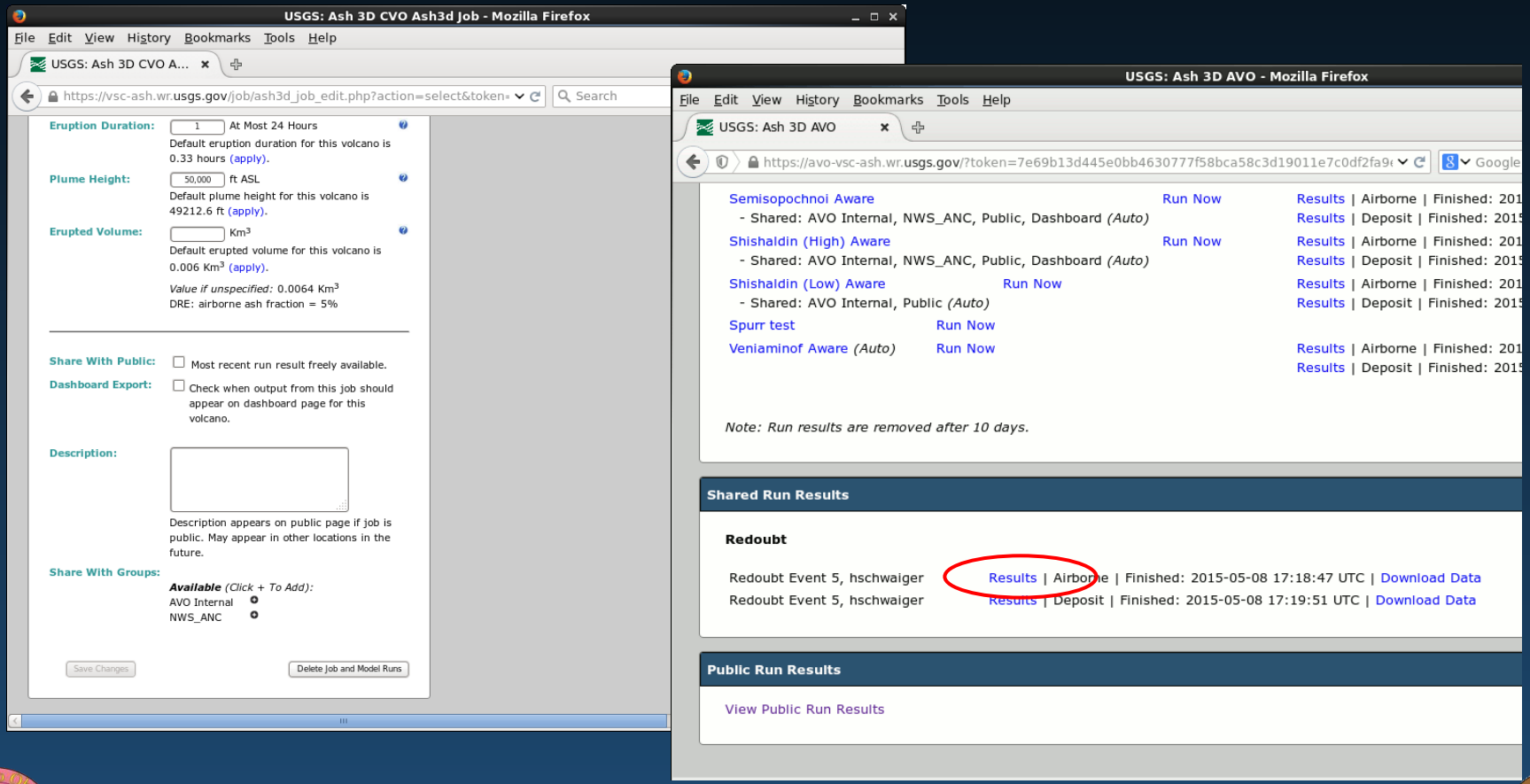
Research: full-featured web interface



Select users can access 'advanced' options for research investigations

Most research investigations use Ash3d directly (i.e. not through the web interface)

Communicating results with partner agencies



Results page (airborne)

USGS: Ash 3D AVO Detailed Run Information - Mozilla Firefox

File Edit View History Bookmarks Tools Help

USGS: Ash 3D AVO De...

https://avo-vsc-ash.wr.usgs.gov/run/ash3d_run_info.php?ash3d_run_id=54872&toker

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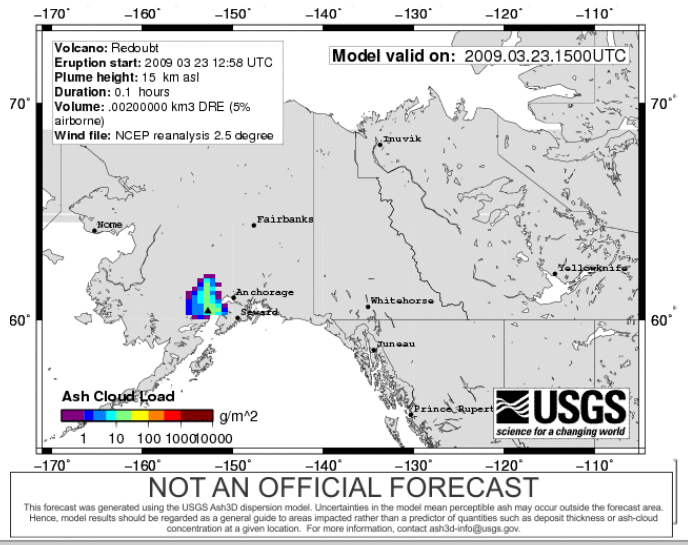
Ash3d AVO

Ash3d Home >> Detailed Run Information

Run Results For Redoubt Event 5

Job Name:	Redoubt Event 5
Run Type:	Airborne Ash
Requested:	2015-05-08 17:17:52 UTC
Run By:	Hans Schwaiger
Run Start:	2015-05-08 17:17:57 UTC
Run End:	2015-05-08 17:18:47 UTC
Volcano/Site:	Redoubt
Vent Elevation:	10,197 ft
Eruption Start Time:	2009-03-23 19:58:00 UTC
Simulation Duration:	24 (hours)
Eruption Duration:	0.1 (hours)
Plume Height:	15 km
Erupted Volume:	0.002 Km^3

Download Data



Ash Arrival Times

ARRIVAL TIME OF ASH IN AREA MODELED BY ASH3D
simulation using input file: ash3d_input.txt
Model run date: 2015.05. 8, time UTC: 17:16

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Results page (deposit)

USGS: Ash 3D AVO Detailed Run Information - Mozilla Firefox

File Edit View History Bookmarks Tools Help

USGS: Ash 3D AVO De...

https://avo-vsc-ash.wr.usgs.gov/run/ash3d_run_info.php?ash3d_run_id=54873&toker

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Ash3d AVO

Ash3d Home >> Detailed Run Information

Run Results For Redoubt Event 5

Job Name:	Redoubt Event 5
Run Type:	Ash Deposit
Requested:	2015-05-08 17:17:52 UTC
Run By:	Hans Schwaiger
Run Start:	2015-05-08 17:18:02 UTC
Run End:	2015-05-08 17:19:51 UTC
Volcano/Site:	Redoubt
Vent Elevation:	10,197 ft
Eruption Start Time:	2009-03-23 19:58:00 UTC
Simulation Duration:	24 (hours)
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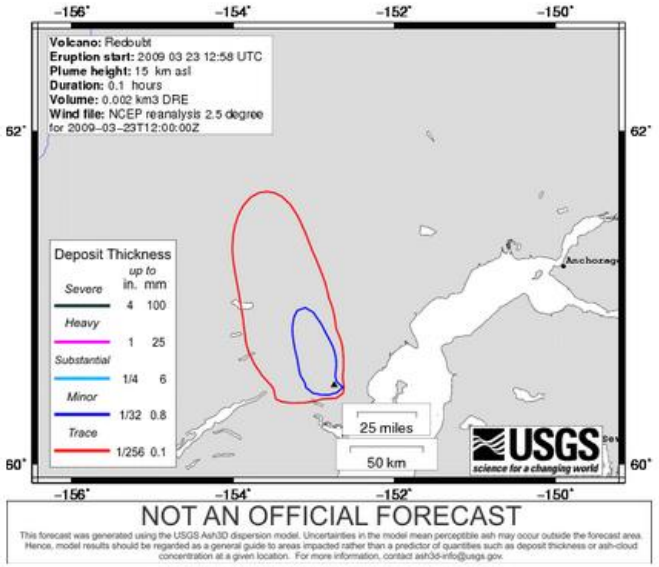
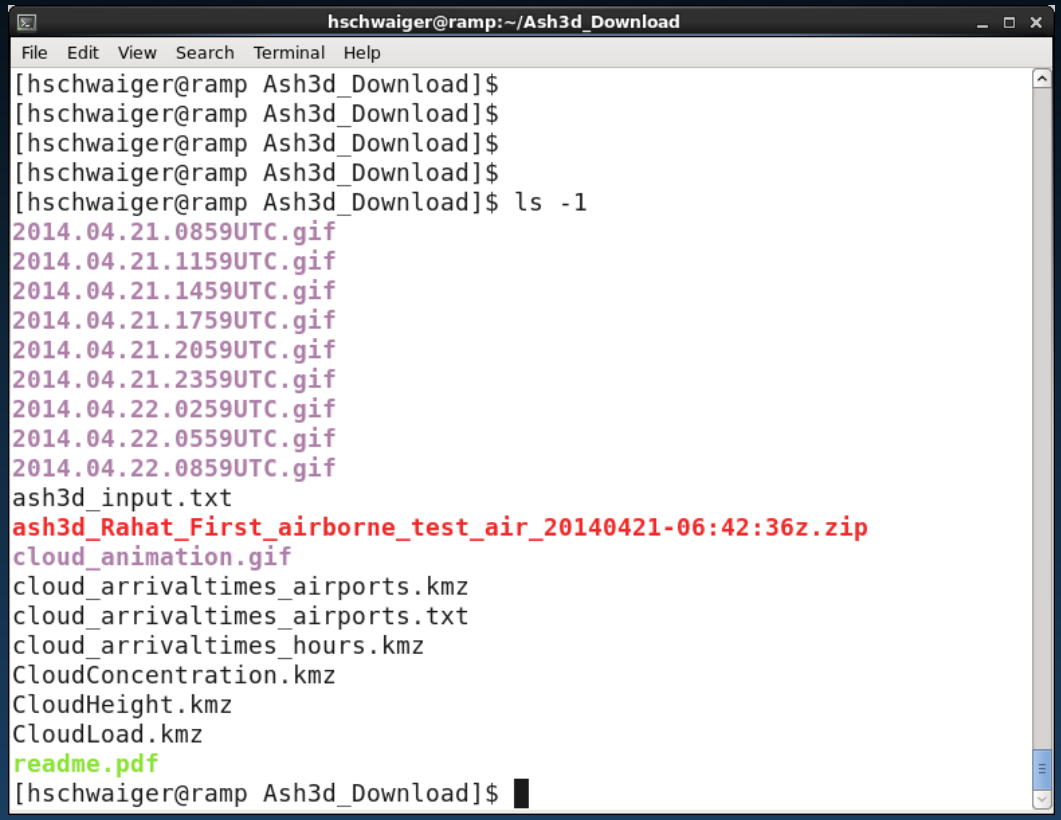


Ash Arrival Times

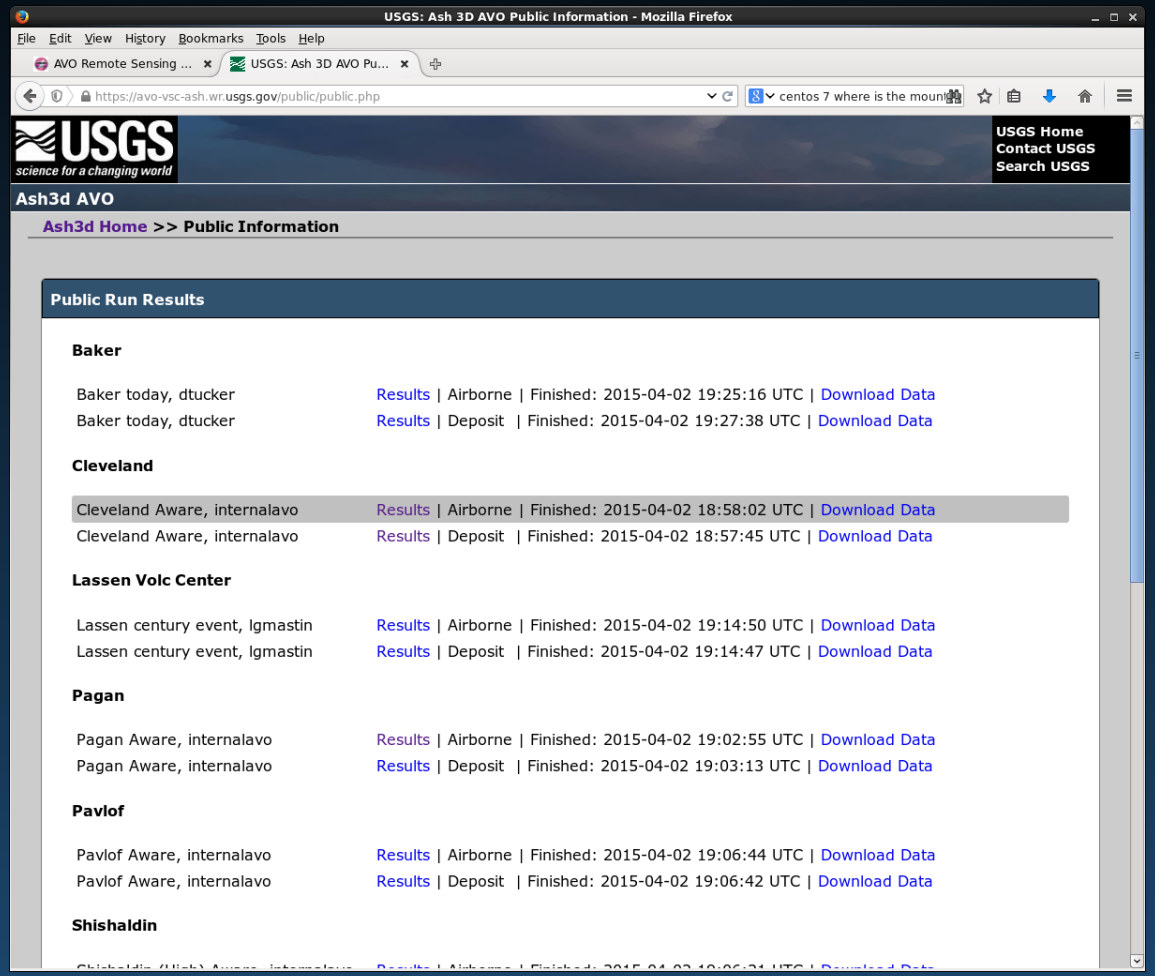
Full data bundles

- Airborne run zip file contain
  - Individual graphics
  - Input files
  - Kmz files of additional variables
  - Text files of affected airports
  - documentation
- Deposit run zip file can be downloaded separately



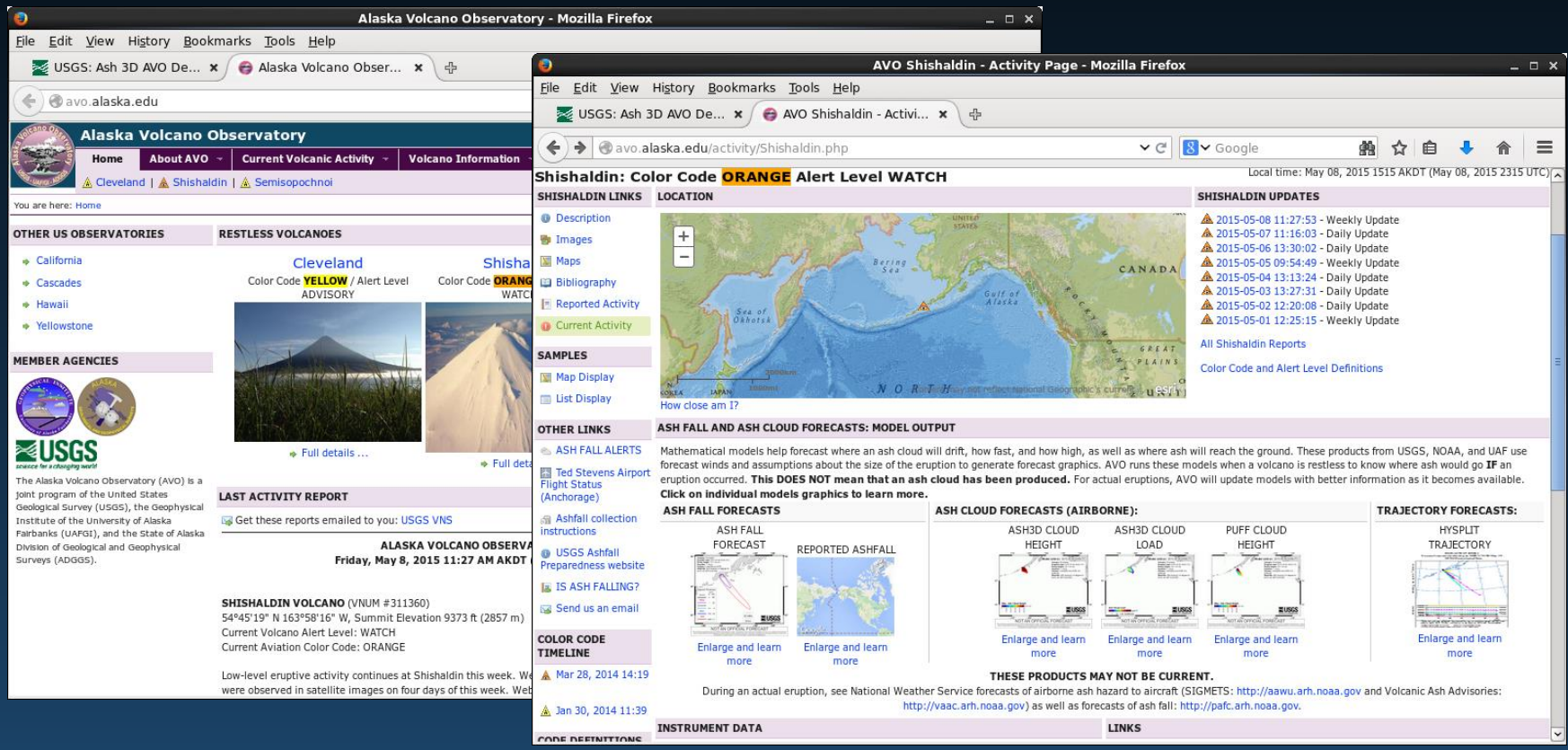
Communicating results with public

- No log-in credentials are needed
- Full download bundles are available for airborne and deposit simulations



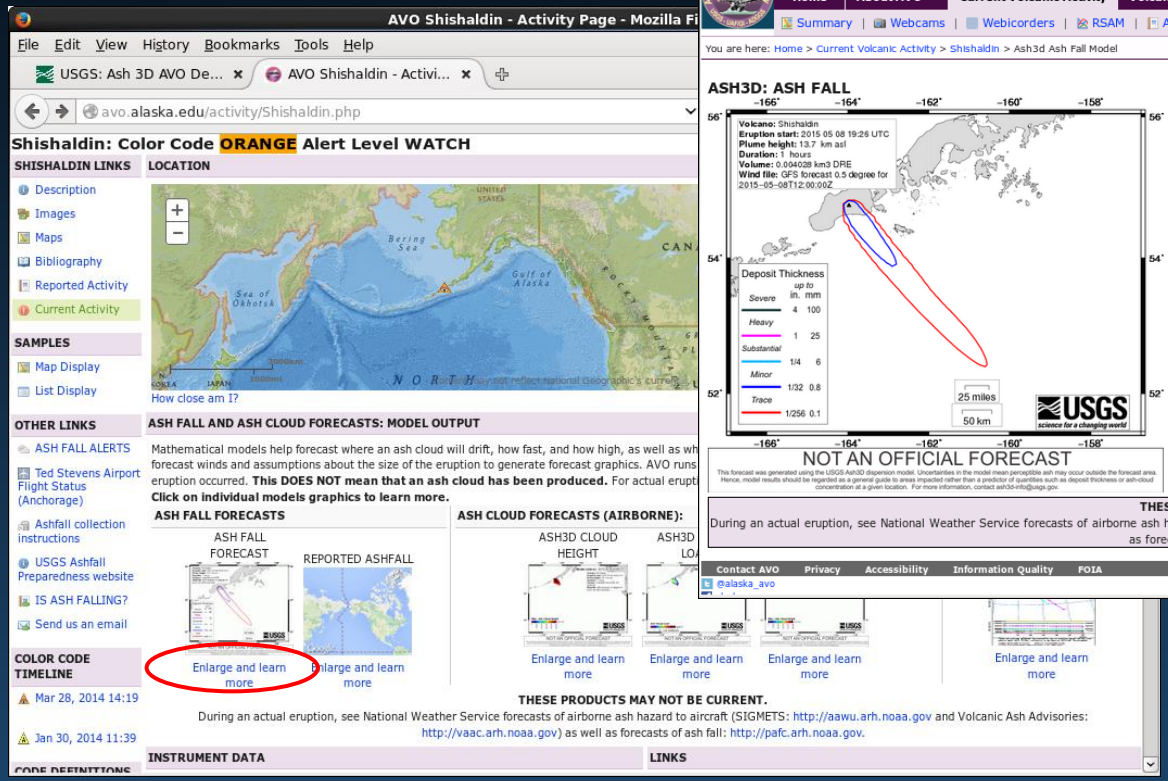
http://vsc-ash.wr.usgs.gov/public.php

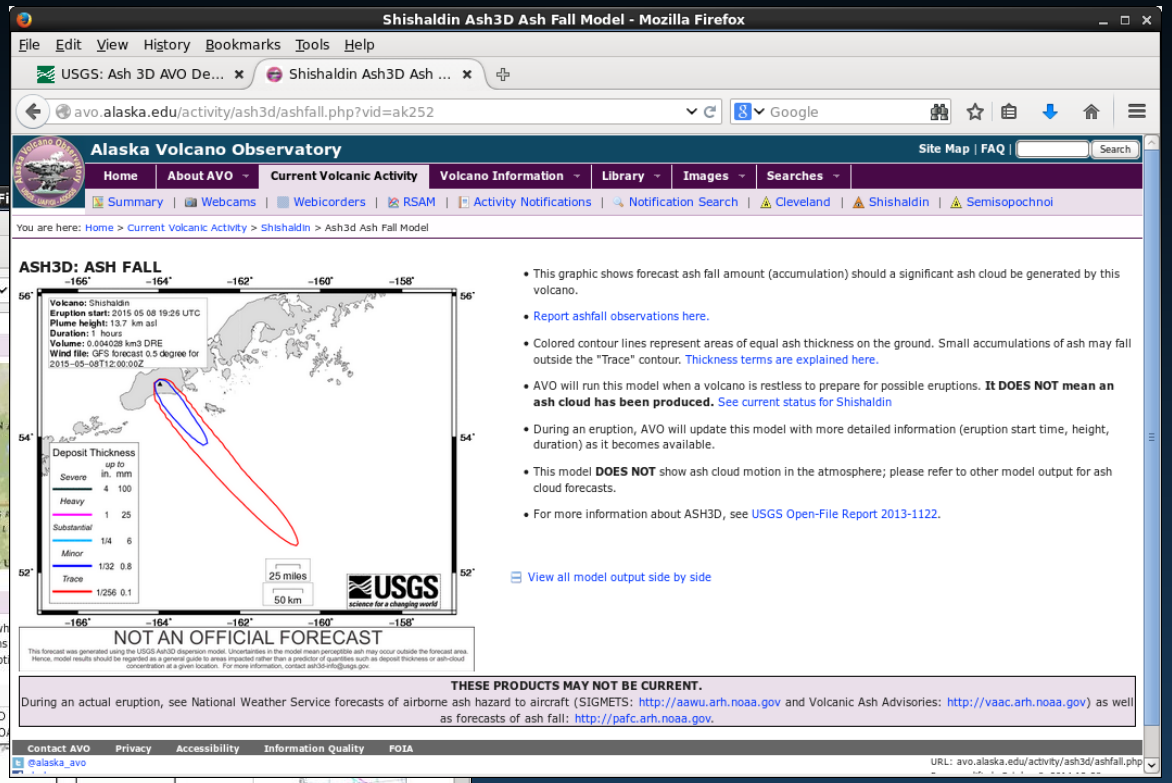
Communicating results with public: AVO homepage



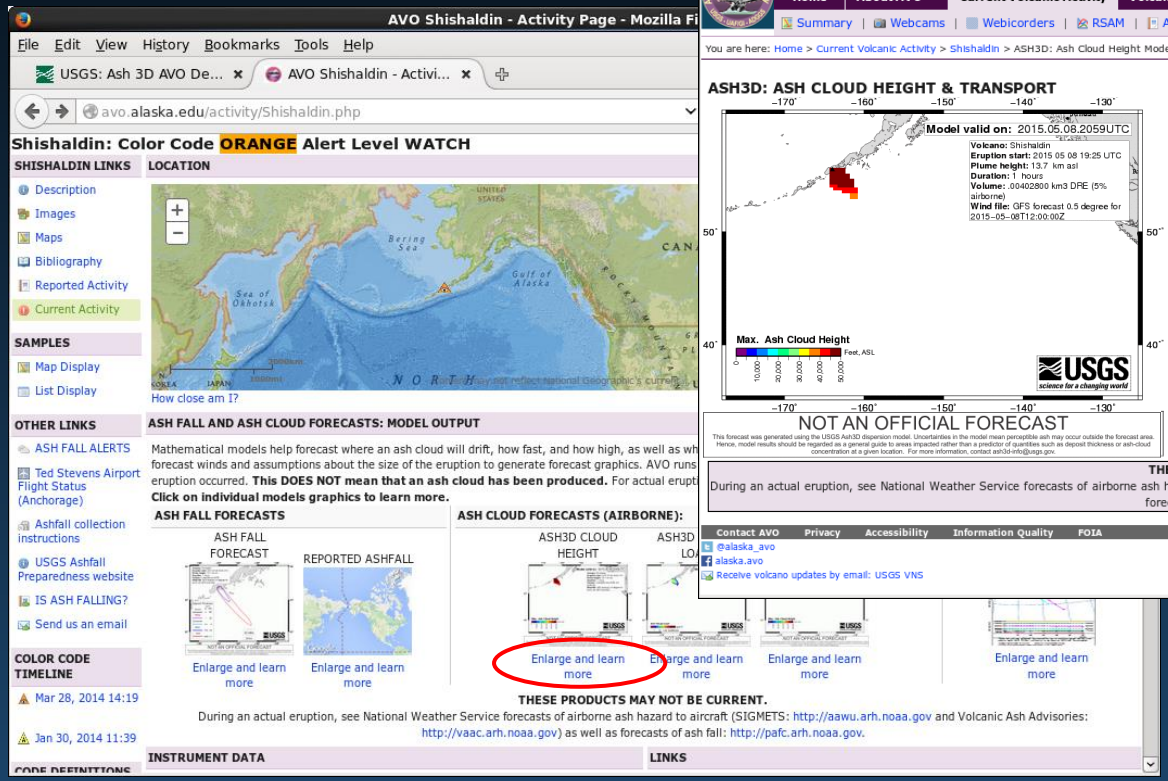
http://avo.alaska.edu

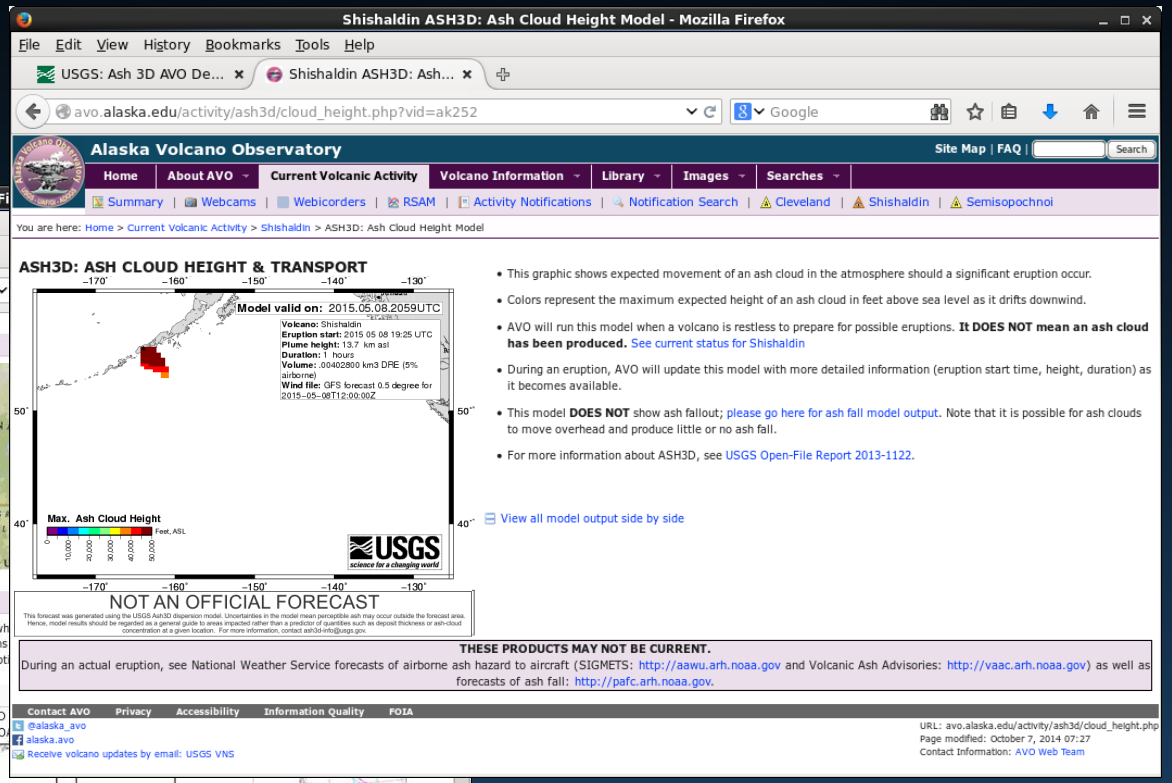
Communicating results with public: AVO homepage





Communicating results with public: AVO homepage





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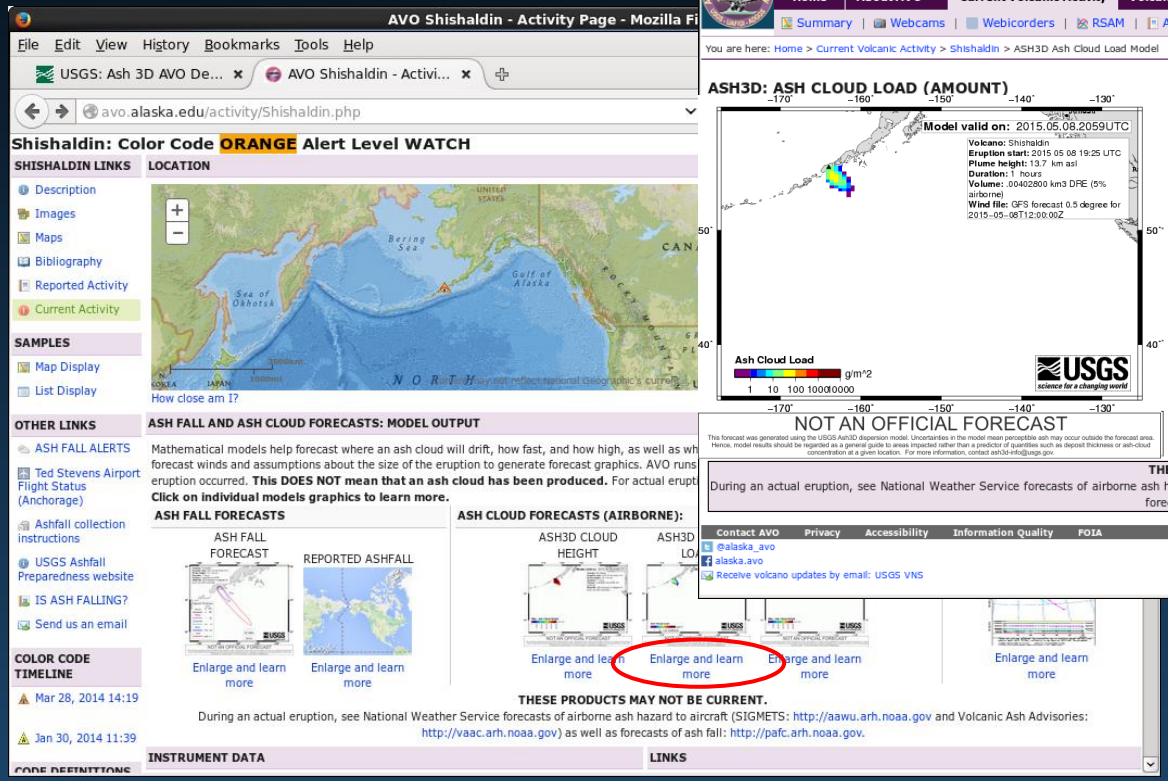
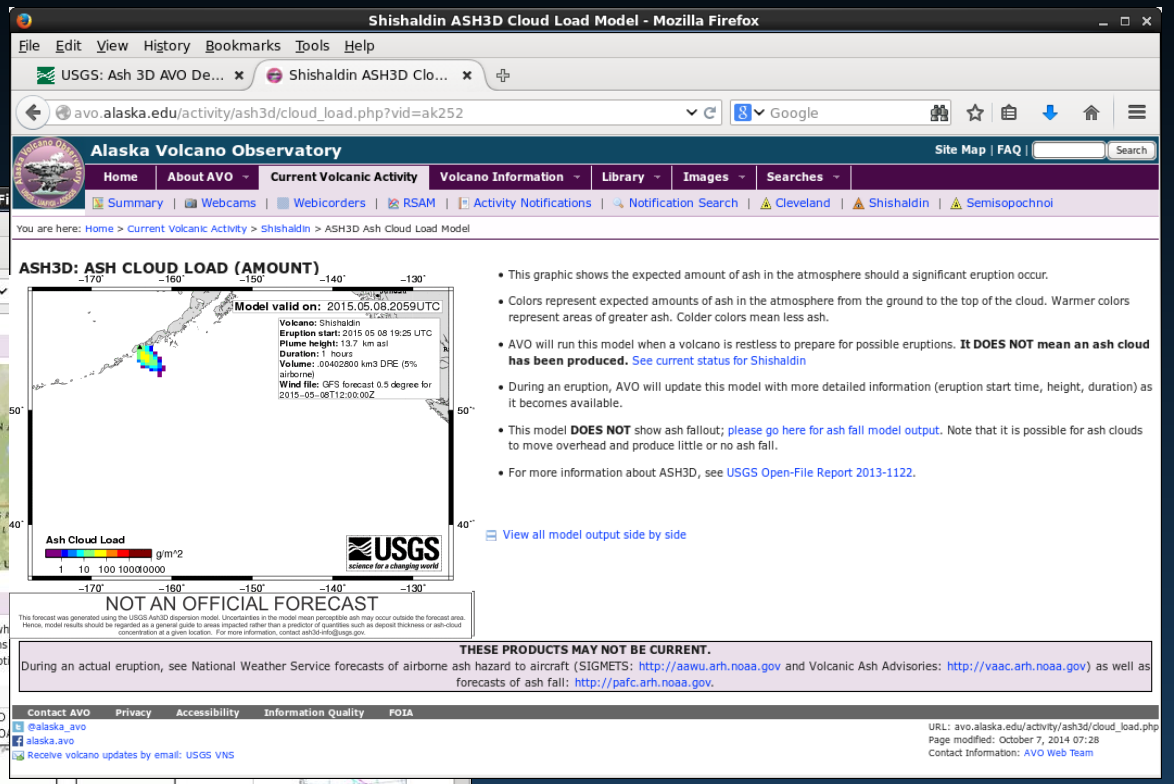
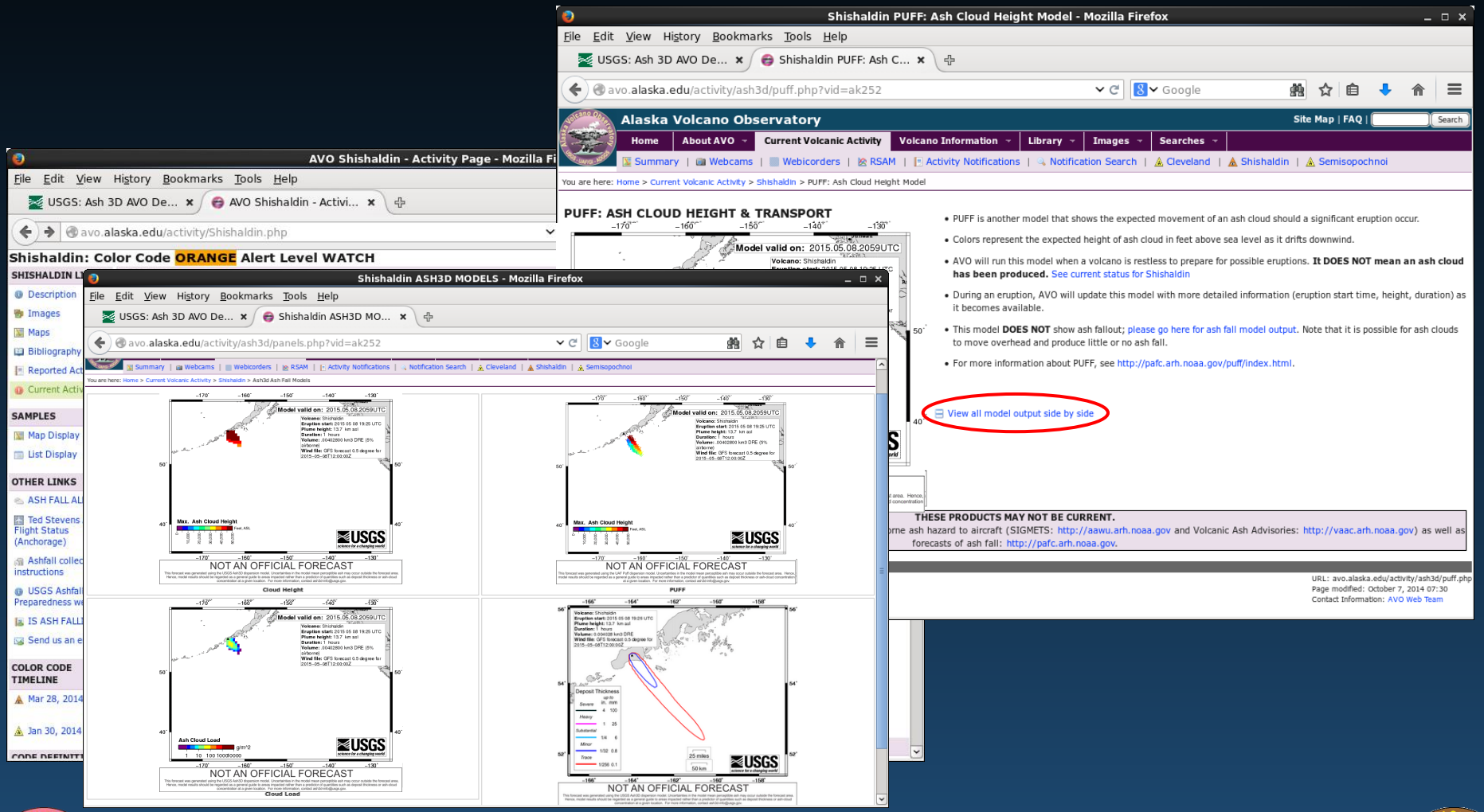
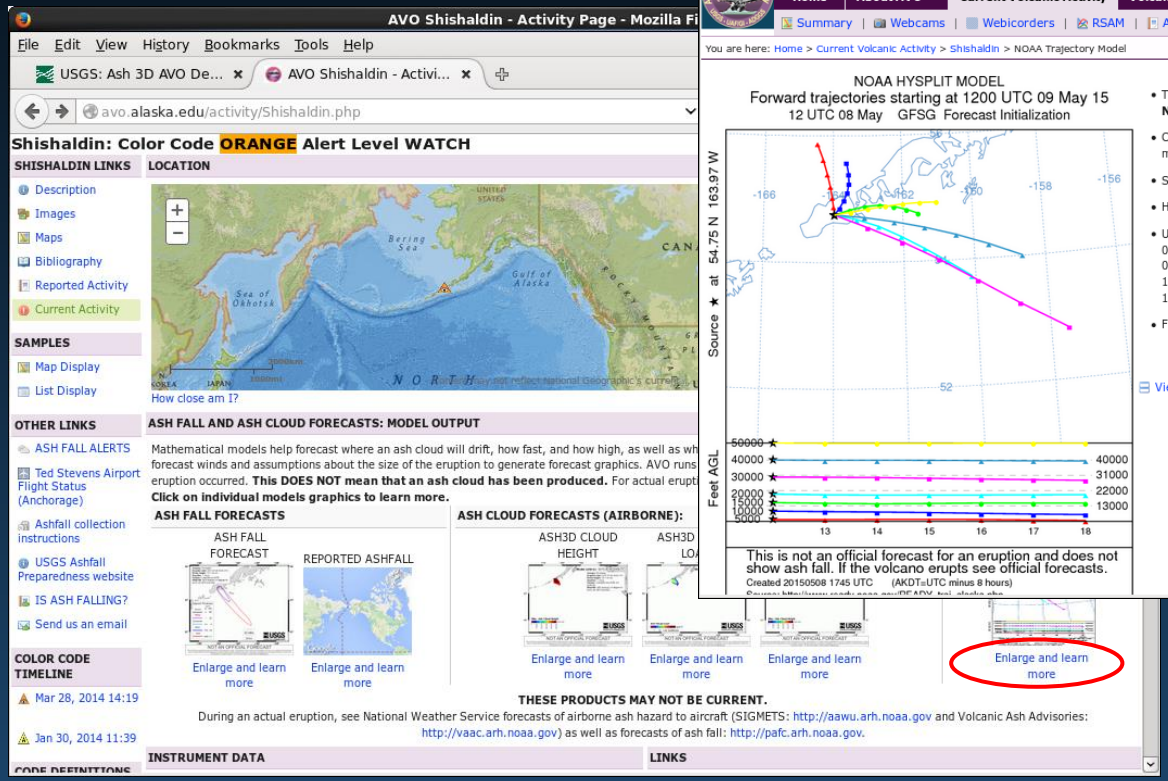


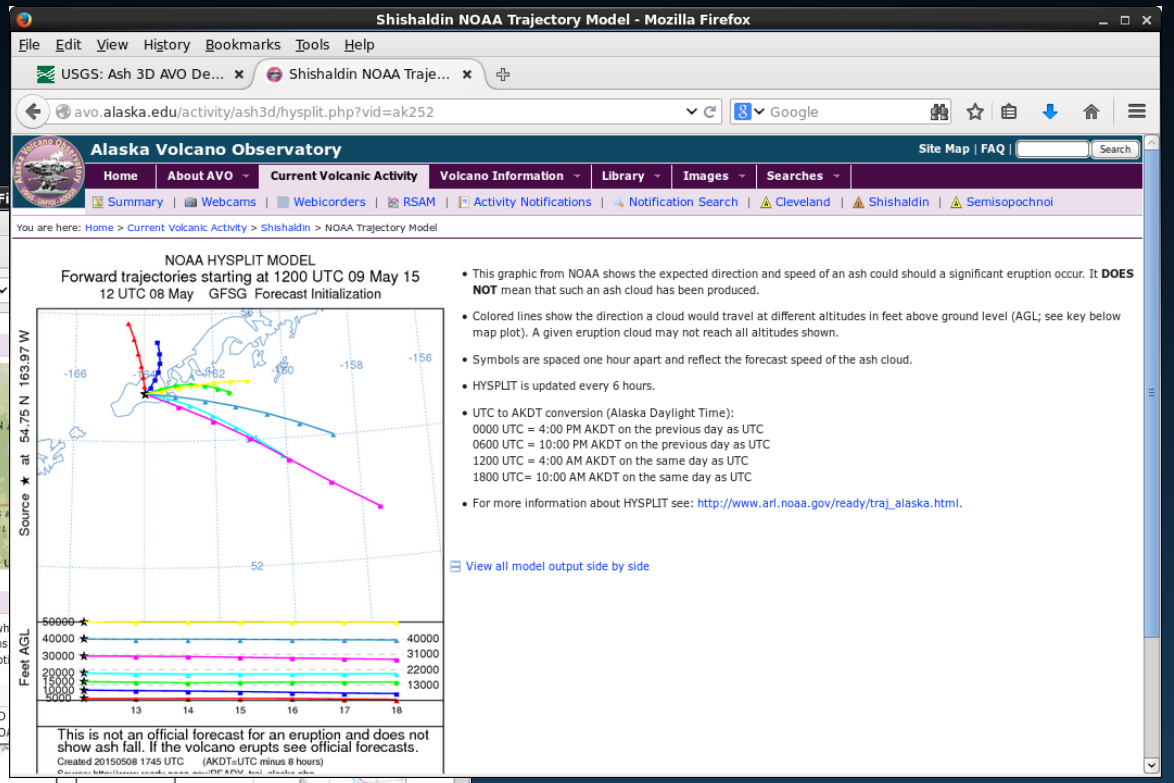


Communicating results with public: AVO homepage



Communicating results with public: AVO homepage





Customer needs/wants from dispersion models

- General Public
  - In anticipation of an event
    - Where might it go?
  - In response to events
    - Where is it going?
    - When is it going to get here?
    - How much?
    - How long?
- Agency partners
  - VAAC/AAWU/FAA
    - Cloud top/bottom in FL
  - Ash Fall Advisory
    - NOAA Impact levels
    - Local time zone
  - Probabilistic/ensemble models
- International partners
  - Metric units
  - Custom locations on maps
  - Limited internet

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Challenges: disseminating model results to public

Distinction between

- automated hypothetical runs
- forecasts based on most recent knowledge of ongoing eruption

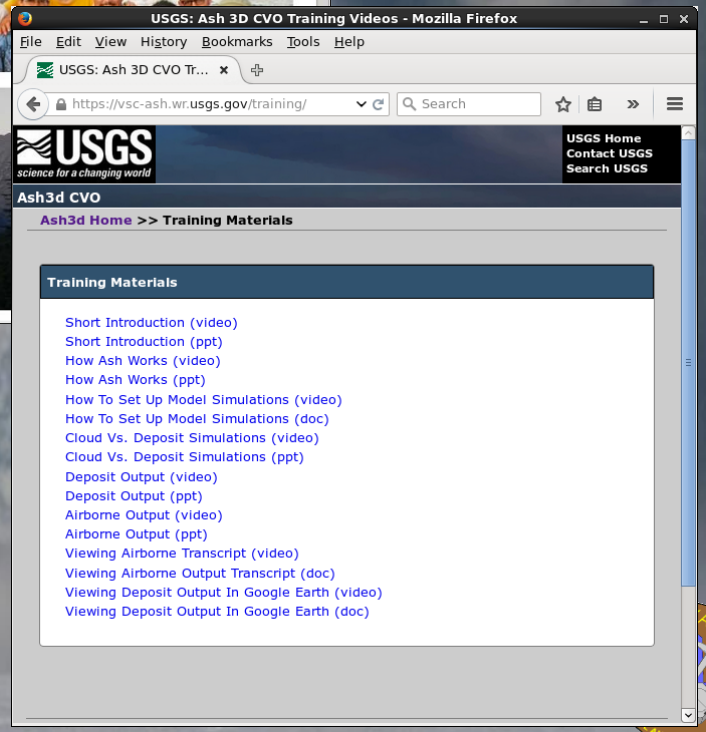
Mitigation efforts

- Activity page will prominently state if an eruption has begun
- Comments are included on all activity pages stating that models will be updated with current information when available
- Provide links to official products

USGS science for a changing world

Challenges: Educating users

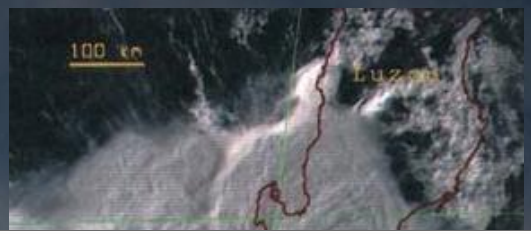
- Usage of interface
  - CSAV course
  - Online training
- Interpretation of results and the limitations of the model
  - Sources of errors
    - Wind data
    - Eruption Source Parameters
      - Plume height
      - Erupted mass
      - Grainsize distribution
      - Start time/duration

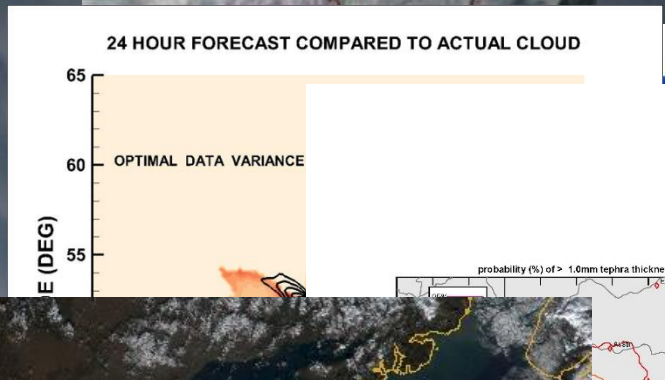


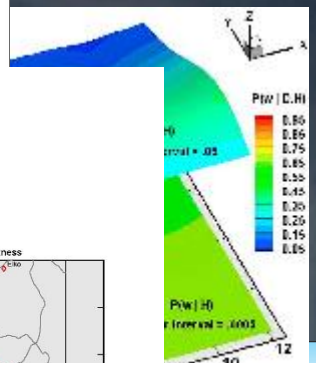
USGS science for a changing world

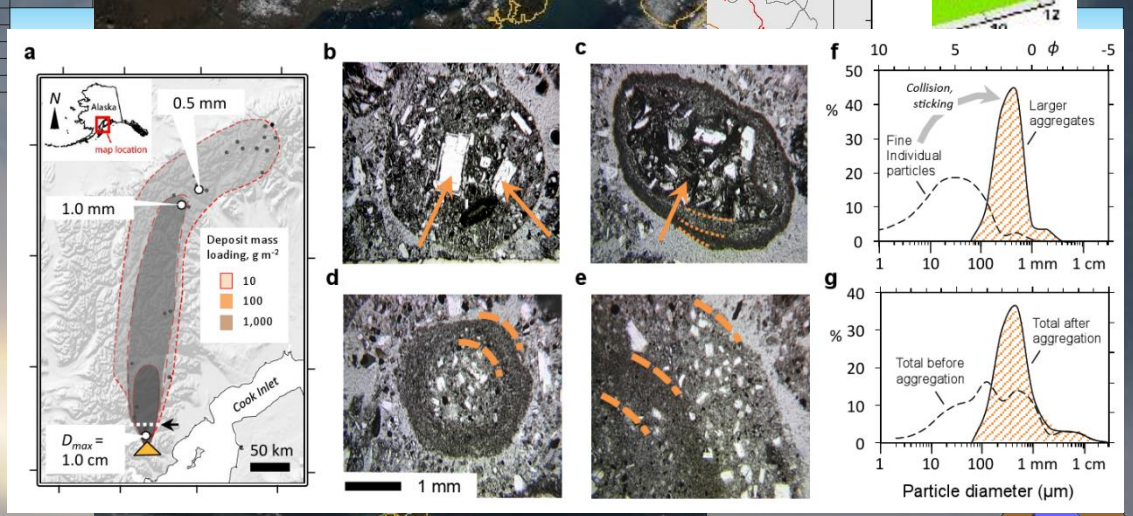
Challenges: Transferring research to operations

- Column models (umbrella cloud)
- Inverse methods
- Satellite data
- Ensembles/probabilistic maps
- Resuspension
- Non-linear processes (aggregation)









Conclusions

- AVO has a long history of internal use of dispersion models
- Communicating results with agency partners is more developed, more frequently reviewed
- Output graphics of automated runs are posted to the AVO webpage with links to more detailed output and supporting documentation
- Largest impediments to transferring research efforts to operations are
  - Training end users
  - Computational resources