The Need for An Evaluation Database for Volcanic Ash Dispersion Models

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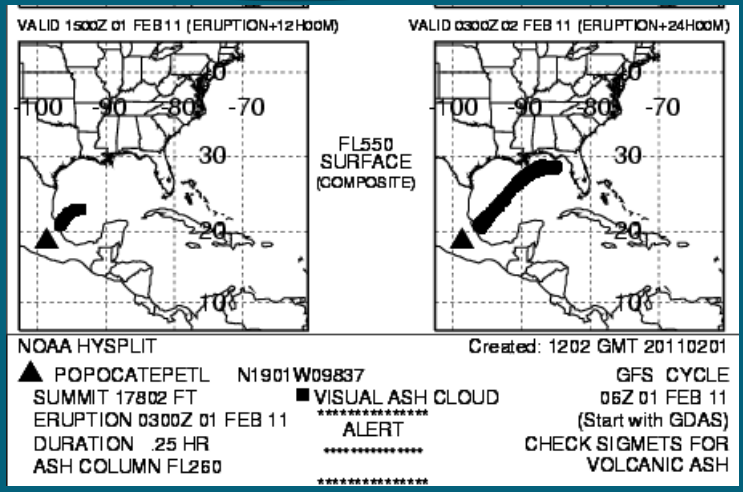
AMS 92nd Annual Meeting
28th Conference on Interactive Information Processing Systems
International Applications Session:
The Impact and Meteorological Challenges of Volcanic Eruptions - Part II

January 25, 2012

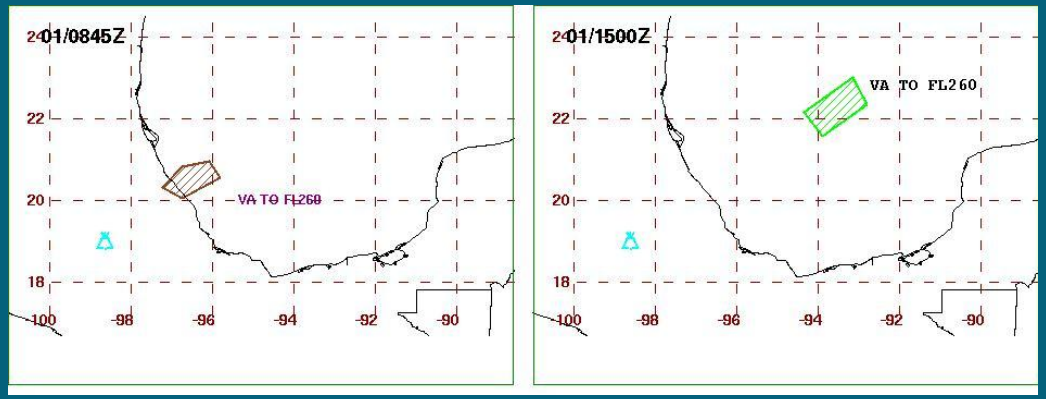
Nomenclature

- dispersion model results
  - = guidance
  - = model output



(http://www.ssd.noaa.gov/VAAC/vaftad.html)

- forecasts
  - = forecast portion of the Volcanic Ash Advisory



(http://www.ssd.noaa.gov/VAAC/ARCH11/archive.html#POPO)

Background

- volcanic ash forecasts need to be as accurate as possible for safe air flight because of the economics of re-routing flights
  - brought strongly to light with European airspace closure, 2010

- network of global Volcanic Ash Advisory Centers have been issuing forecasts for ~15 years

- some model inter-comparisons and some evaluation against observations done; but little systematic evaluation vs. observations

- more evaluation needed to help mitigate risks to air traffic

Evaluation database is needed to systematically compare model results to observations, which should lead to . . .

- improved understanding of effects of model inputs and model processes (e.g. removal)
- improved model results
- estimates of uncertainties of model results (the 'accuracy')
- better understanding of the results by users

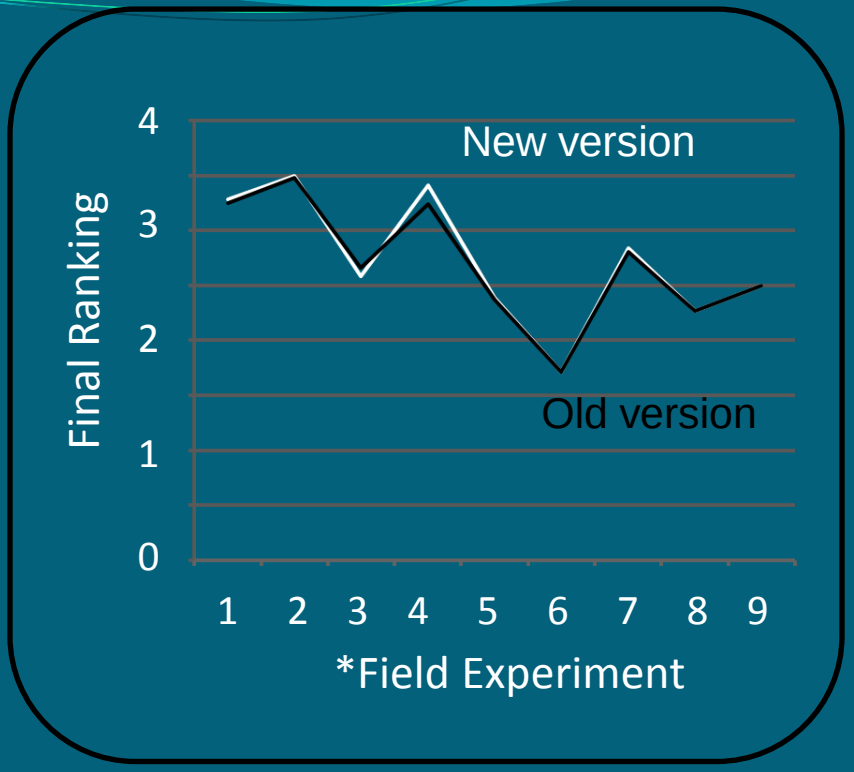
Evaluation should lead to … improved understanding of effects of model inputs and model processes (e.g. removal)

- meteorology file
- initial column height
- grain size distribution (GSD)

- wet deposition
- aggregation
- overall model ‘behavior’

Evaluation should lead to … improved model results

- statistically confirming that model upgrades are improvements
- better forecasts in Volcanic Ash Advisory



Example statistical comparison using DATEM (*not volcanic ash)

Source: http://www.arl.noaa.gov/DATEM_results.php
Accessed Nov. 16, 2011

Evaluation should lead to … estimates of uncertainties of model results (the ‘accuracy’)

- improved forecasts (VAAC/other) by addition of uncertainty qualifier

- improved airline decision-making

Evaluation should lead to … better understanding of the results by users

- from knowing the uncertainties, and
- ‘how good the models are’

What is needed for an evaluation database?

1. Observations
2. Source term (eruption source parameters)
3. Analysis meteorology for input to dispersion model
4. Statistical model evaluation program

. . . from meteorologists, volcanologists, others

. . . MANY eruptions

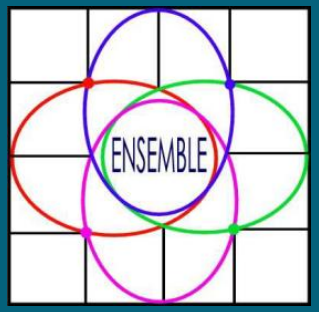
. . . Data formatted for automatic processing

What is needed for an evaluation database?

1. Observations
2. Source term (eruption source parameters)
3. Analysis meteorology for input to dispersion model
4. Statistical model evaluation program

Similar to

- European Commission's ENSEMBLE
  http://ensemble2.jrc.ec.europa.eu/public/
- NOAA Air Resources Laboratory's DATEM
  http://www.arl.noaa.gov/DATEM.php



DATEM
Data Archive of Tracer Experiments and Meteorology

DATEM - Data Archive of Tracer Experiments and Meteorology

Data can come from various sources:

Observations –

- online text Volcanic Ash Advisories
  (e.g. http://www.ssd.noaa.gov/VAAC/archive.html)
- analyzed satellite data (location, quantitative)

Eruption source parameters

- compilation by IAVCEI from various publications for some eruptions (IAVCEI Commission on Tephra Hazard Modeling, http://dbstr.ct.ingv.it/iavcei/results.htm)

IAVCEI = International Association of Volcanology and Chemistry of the Earth's Interior

Evaluation, model results compared to observations, should lead to improved forecasts and better user understanding of forecasts.

Thank you.

Questions, comments . . .

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Extra slides

What is needed for an evaluation database?

1. Observations . . . of ash
   - Volcanic Ash Advisory (polygon ‘footprint’)
   - remote sensing (from satellite, ground)
   - in-situ measurements
   - ashfall ?

What is needed for an evaluation database?

2. Source term (eruption source parameters, ESP) of ash being modeled
    - volcano location
    - initial eruption column top/bottom
    - start/stop times of eruption
    - grain size distribution

What is needed for an evaluation database?

3. Analysis meteorology for input to dispersion model (or ash model inline with meteorology model)

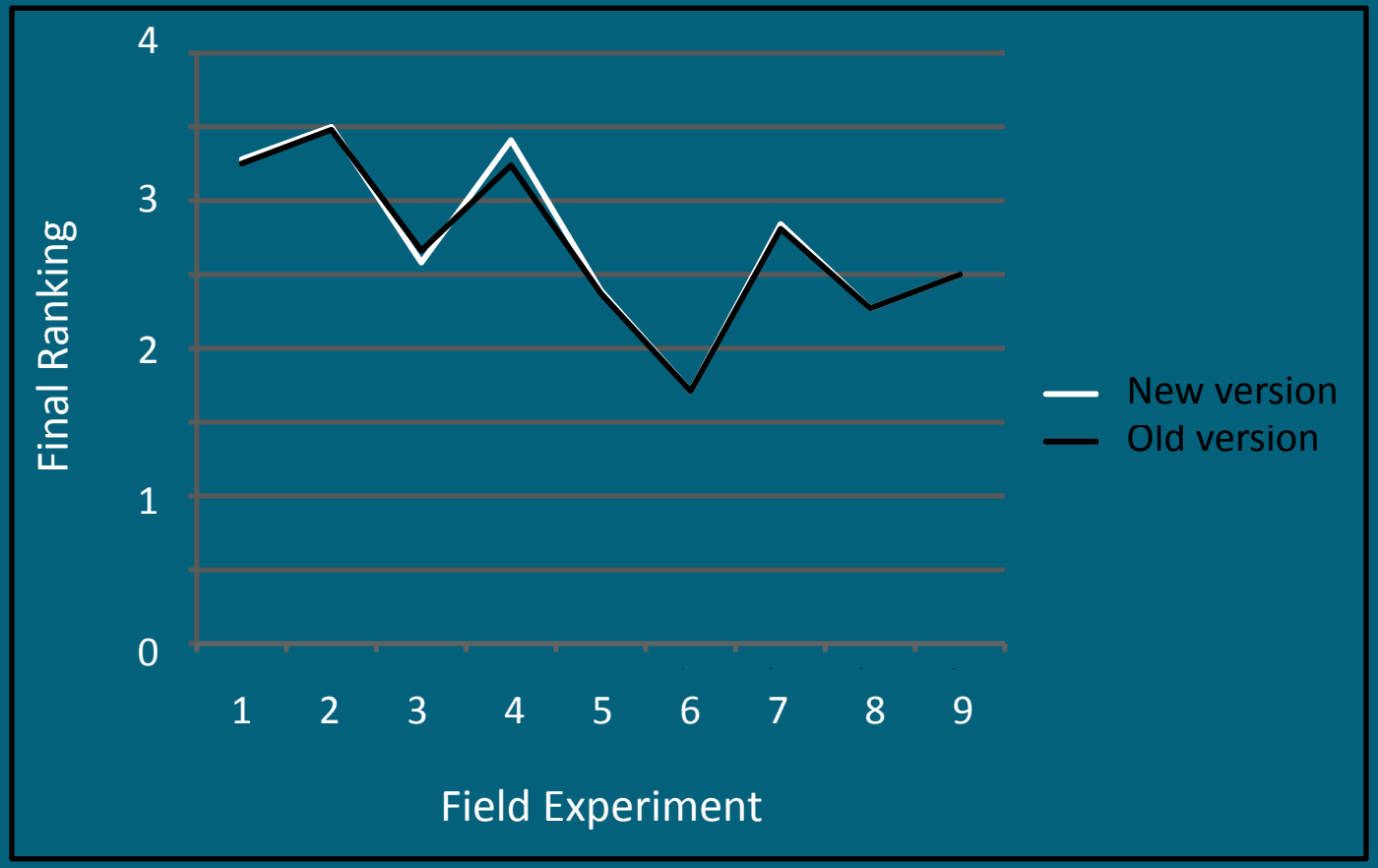
What is needed for an evaluation database?

4. Statistical model evaluation program

   e.g. NOAA Air Resources Laboratory's DATEM
   - scatterplot
   - model bias
   - spatial match
   - concentration distributions

(http://www.arl.noaa.gov/DATEM.php)

Example statistical comparison of HYSPLIT model upgrade using DATEM (not volcanic ash)



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