An overview of HYSPLIT's science and applications development

Dr. Ariel Stein
NOAA's Air Resources Laboratory

Roland Draxler, Glenn Rolph, Barbara Stunder, Mark Cohen, Fantine Ngan, Tianfeng Chai, and Alice Crowford

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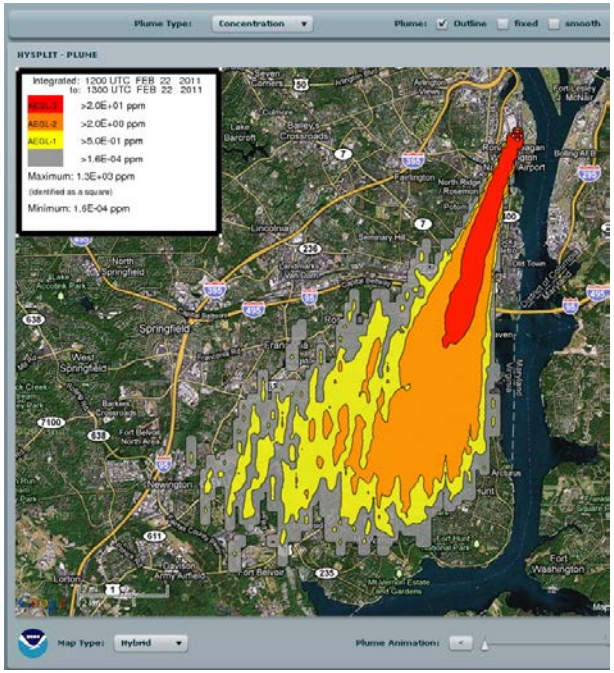
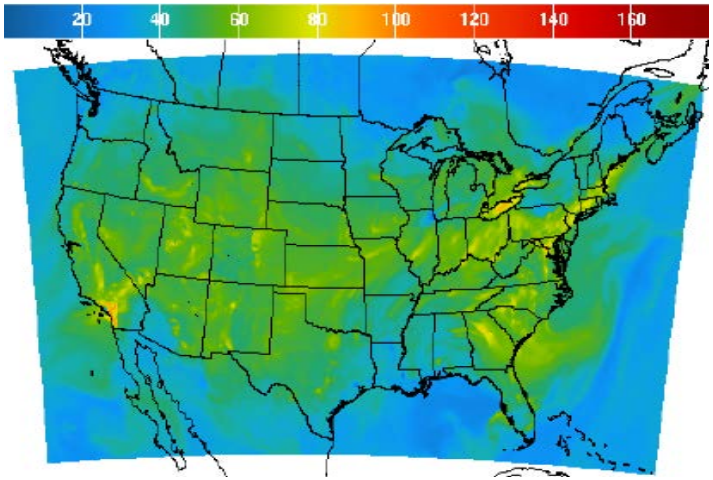
Atmospheric Dispersion and Boundary Layer

- Goals
  - Improve dispersion predictions and understanding of those predictions through dispersion research, models, and tools
  - Improve measurement and prediction of the boundary layer and the underlying land-surface
- Major Activities
  - Boundary-layer characterization and prediction
  - Dispersion modeling
  - Decision support tools
  - Model evaluation
  - Renewable energy
  - Support for DOE, NASA, DOD, DHS, WMO



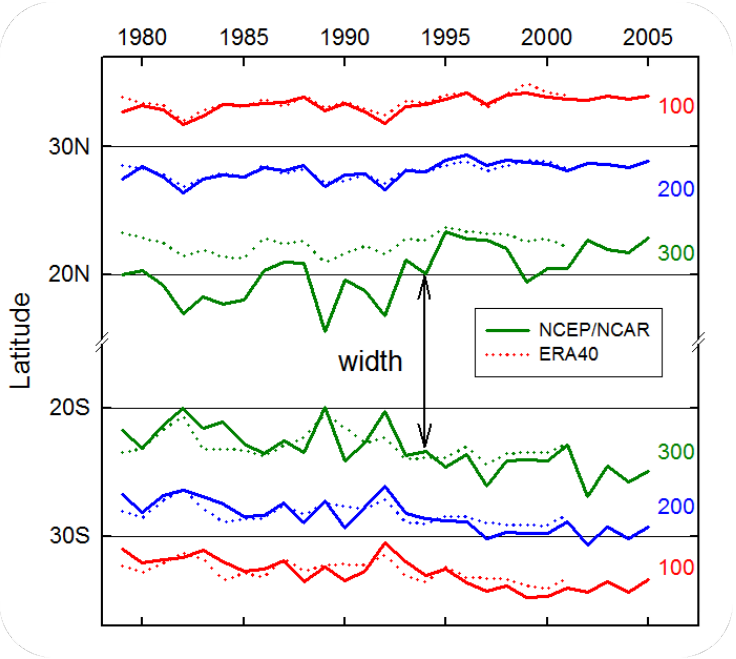
Air Quality



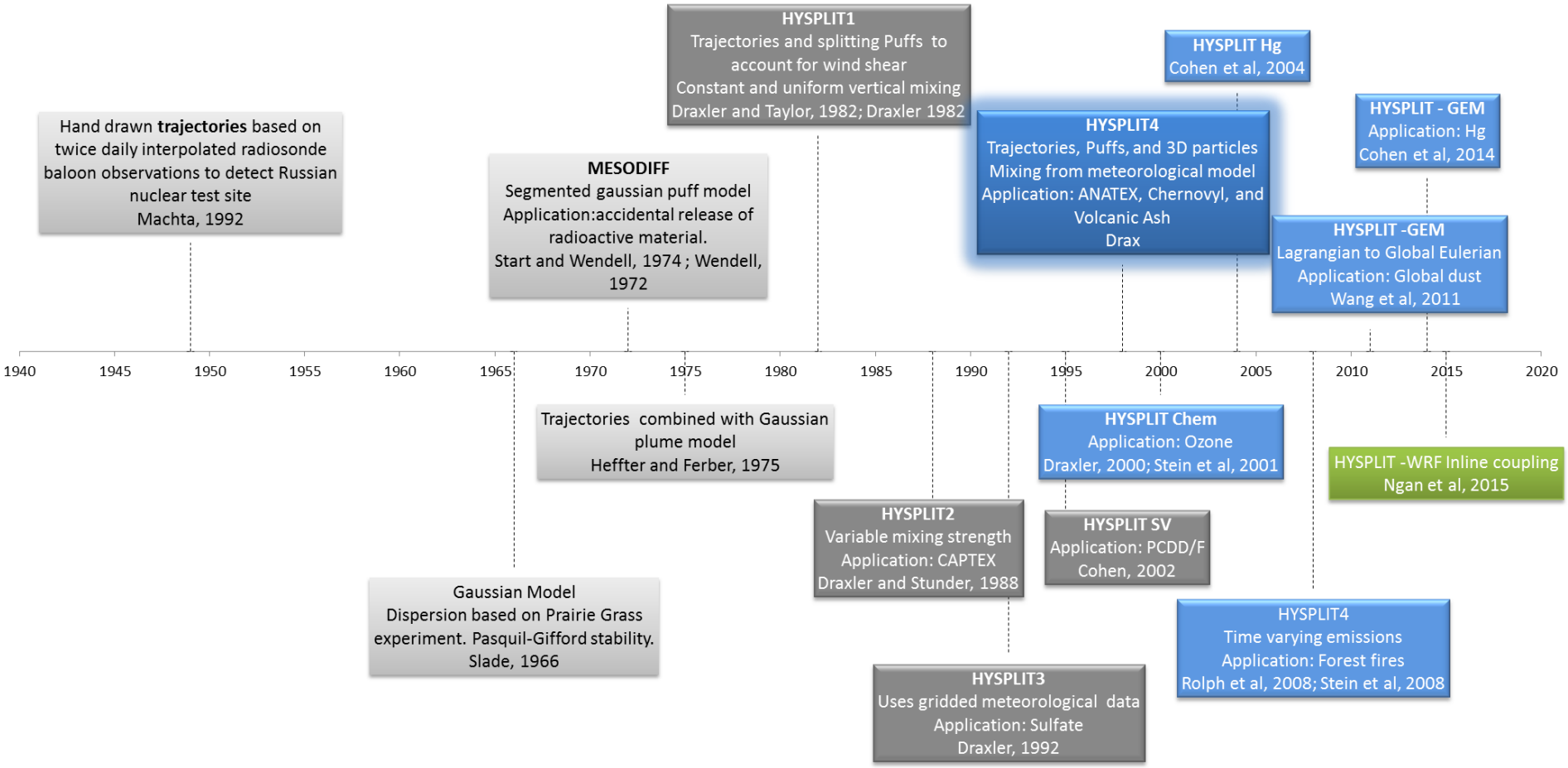
- Goals
  - Improve NOAA's operational air quality predictions
  - Improve understanding of ecosystem-relevant air pollution, including mercury and nutrients
- Major Activities
  - Air quality forecast system R&D
  - Monitoring and process studies
  - Assessment of mercury and nutrient fluxes to/from ecosystems

Climate

- Goals
  - Improve the understanding and prediction of climate variability and change
- Major Activities
  - Reference observations
  - Atmosphere-land surface interactions
  - Climate variability and change analysis
  - Assessment of regional climate impacts



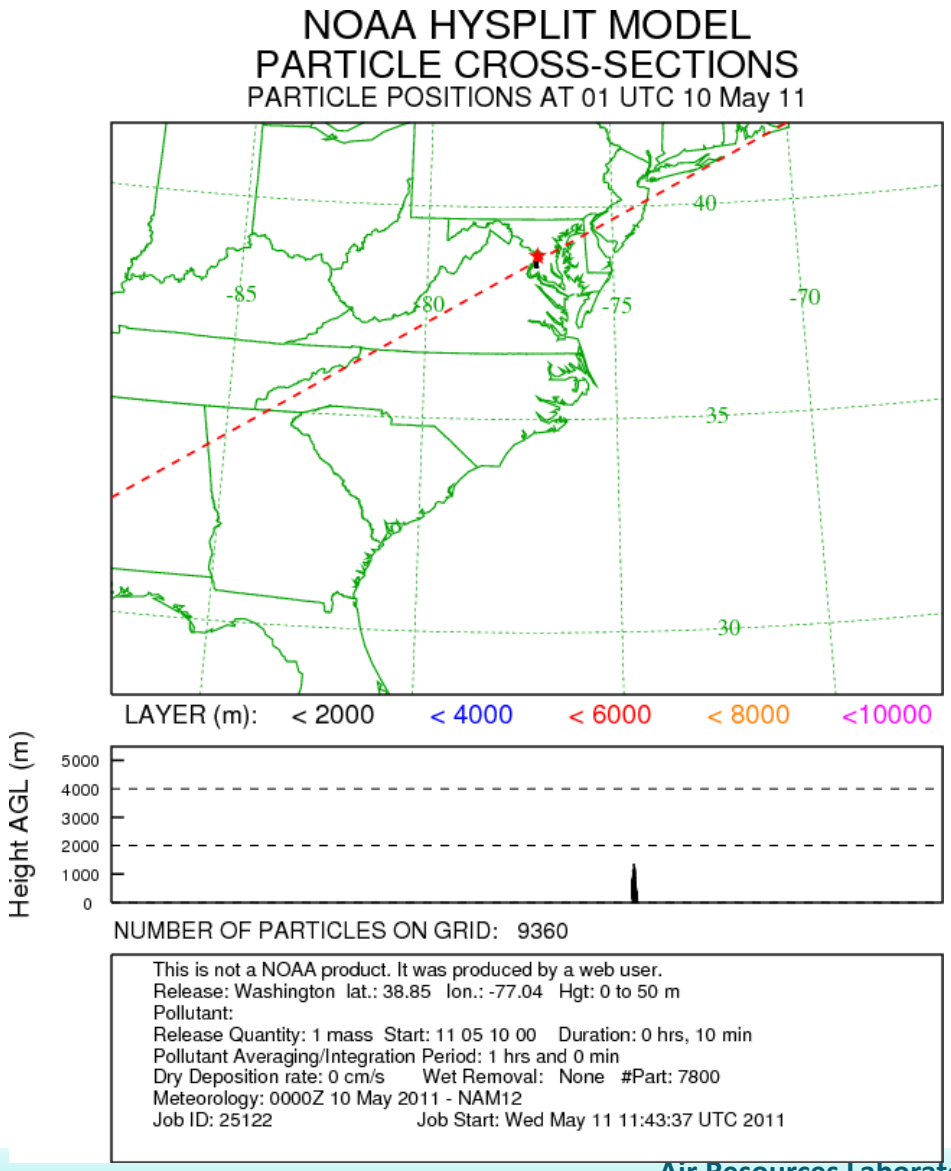
History of the HYSPLIT model



HYSPLIT
Research to Applications

- **Emergency Response**
  - Radiological releases
  - Improvised nuclear devices
  - Chemical releases
  - Volcanic eruptions
- **Model Evaluation**
  - Data Archive of Tracer Experiments and Meteorology
- **Decision Support**
  - Dispersion model training
  - Real-time Environmental Applications and Display sYstem
- **Air Quality**
  - Fire smoke
  - Global pollutant transport
  - Wind-blown dust

HYSPLIT Description and History



- **Numerical Approach**
  - Follows particle motion
  - Off-line
  - Requires meteorological fields
  - Particle or puff solutions
  - UNIX, PC, Mac, Web
- **History**
  - 1970's used charts and dividers
  - 1980's used only soundings
  - 1990's switched to model fields
  - 2000's incorporate 3D turbulence
- More than 3000 registered users worldwide
- **Future Directions**
  - In-line and multi-cpu
  - Evaluate TKE partition
  - Shared memory optimization

Emergency Response

Radiological Releases

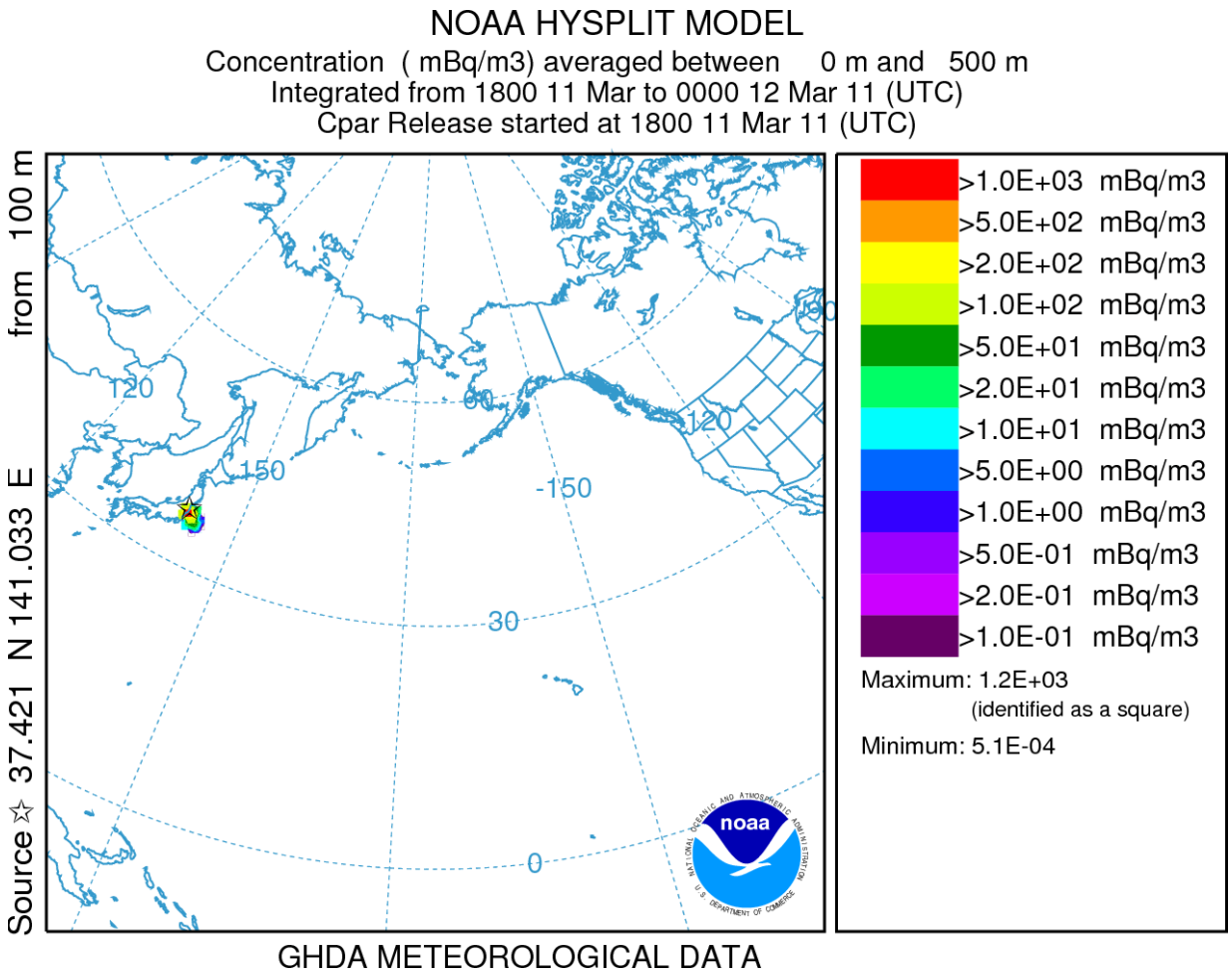
- **History**
  - Chernobyl accident (IAEA)
  - WMO Regional Specialized Meteorological Center (RSMC)
  - Support NMS in WMO Regions III and IV (Americas)

- **Accomplishments**
  - HYSPLIT installed in Australia (BoM), China (CMA) and Argentina (SMN)
  - Model based source-attribution applied at CTBTO

- **Approaches**
  - Web exchange of graphics and model fields
  - Communicating uncertainty through multiple dispersion products

Fukushima Simulations

- Cs-137 air concentrations
- 5000 particles per hour
- 0.5 degree NOAA GDAS meteorological data



Emergency Response

Improvised Nuclear Devices

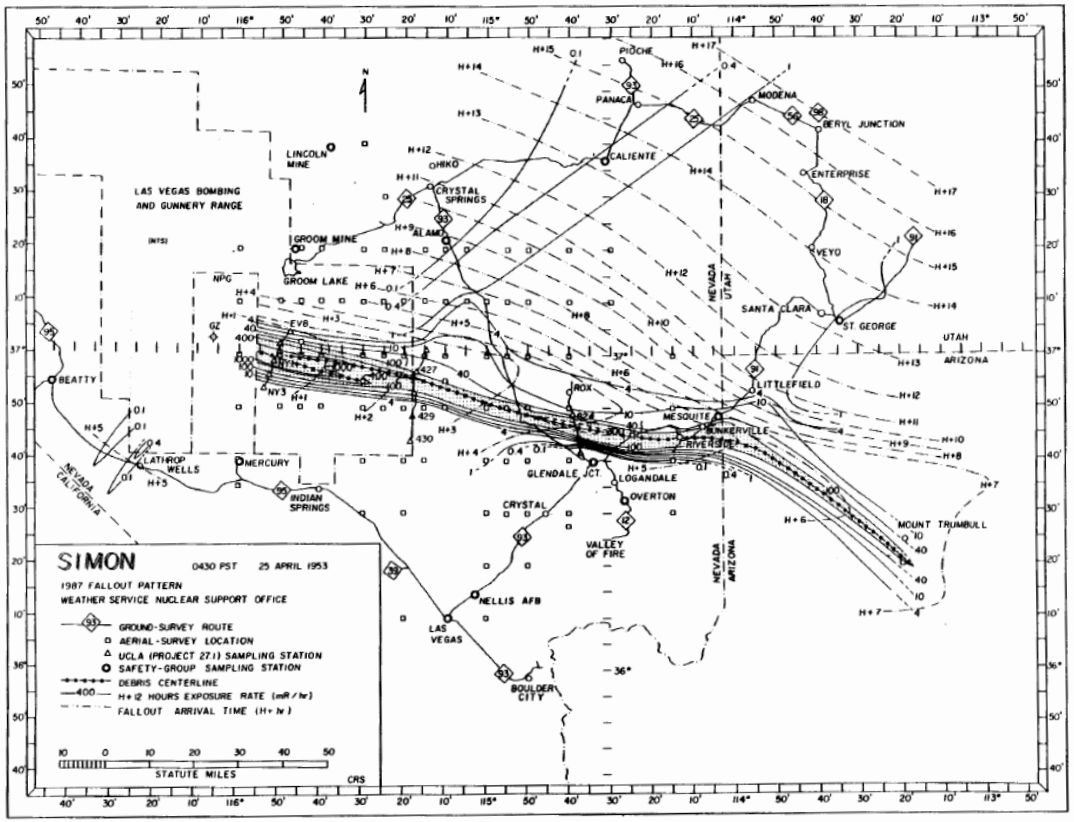
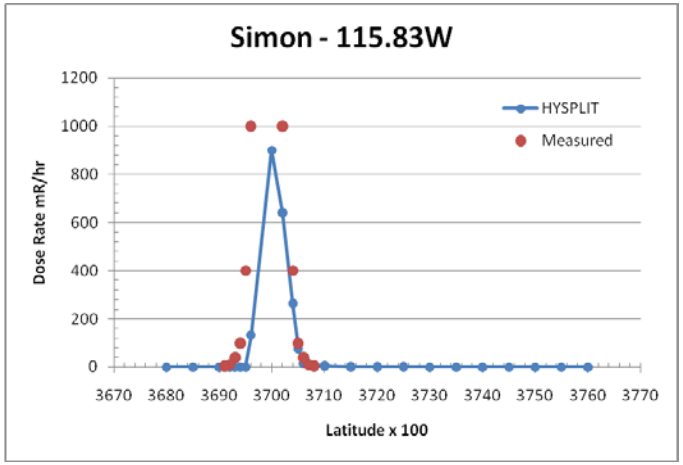
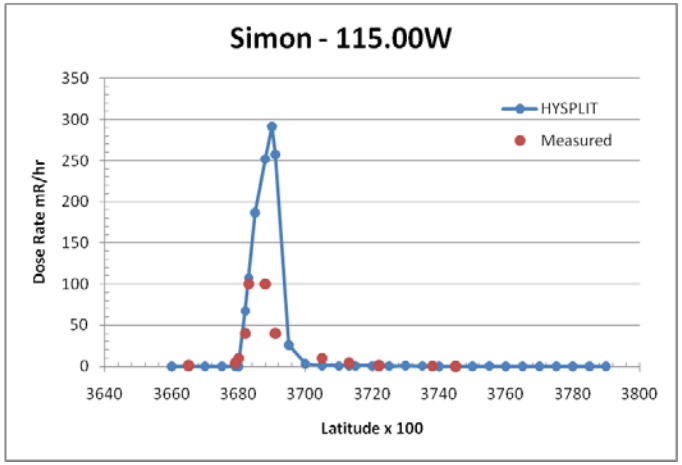


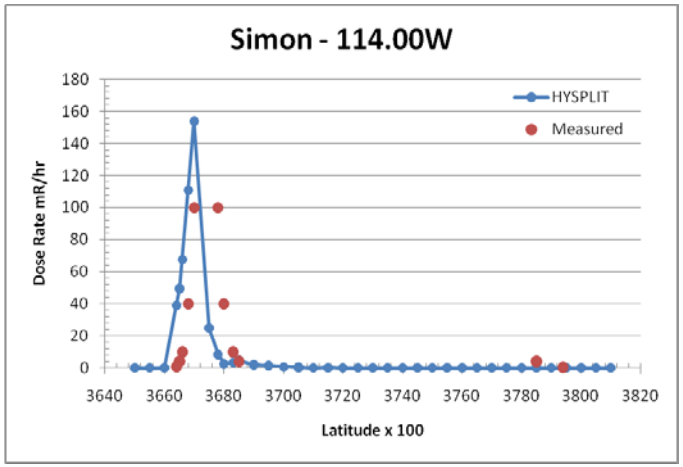
Figure 5.8. The WSNSO 1987 SIMON Fallout Pattern.

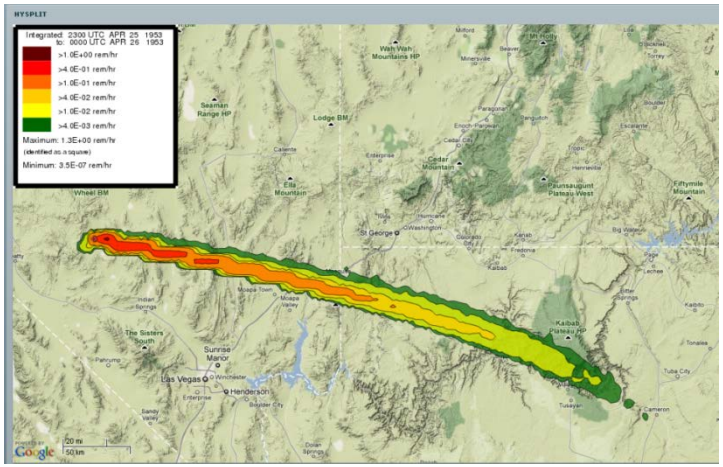
- **History**
  - ARL participated in early atmospheric testing
- **Approaches**
  - Dose based upon fission yields
  - 212 species considered
  - Partitioned between gas and 60 particle size bins
  - Activity distribution with height based upon yield
  - Time-decayed dose post-processing

Emergency Response
Improvised Nuclear Devices



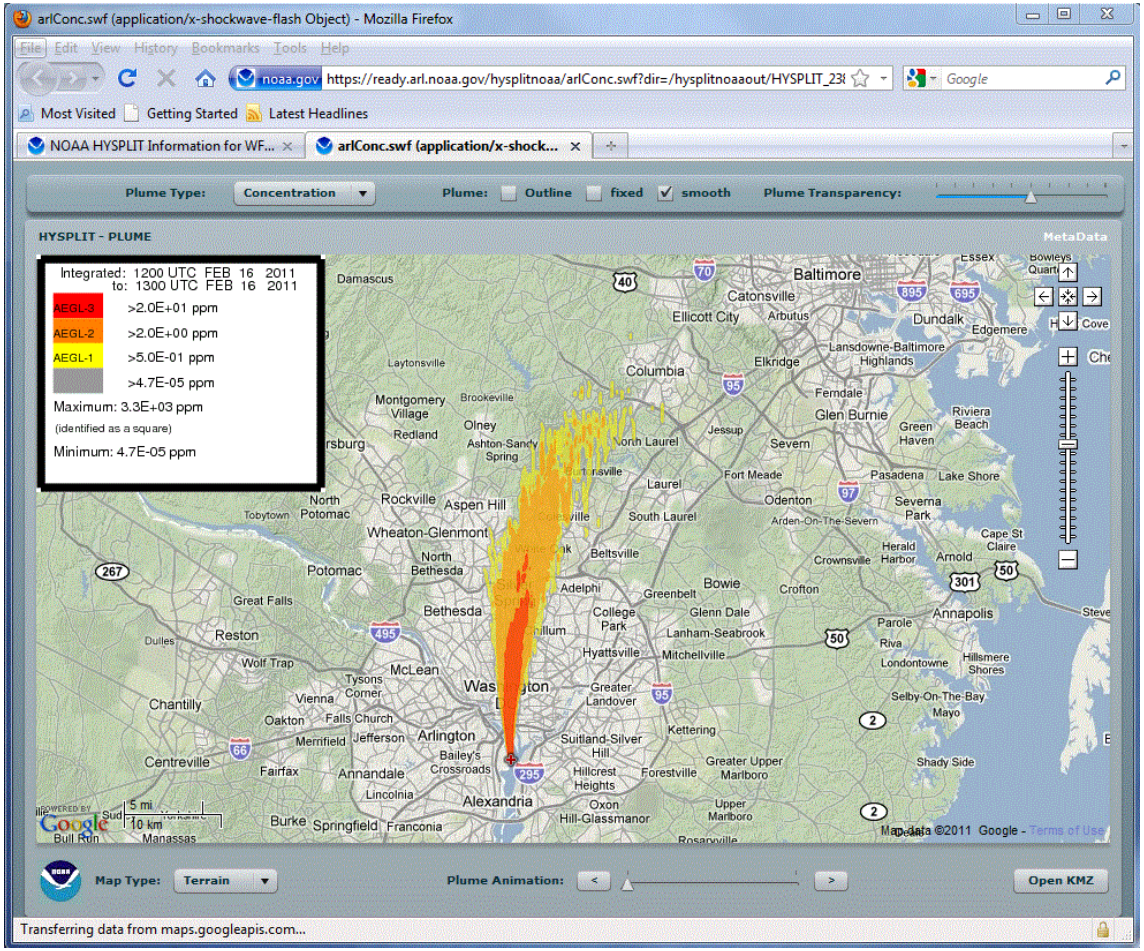






Emergency Response

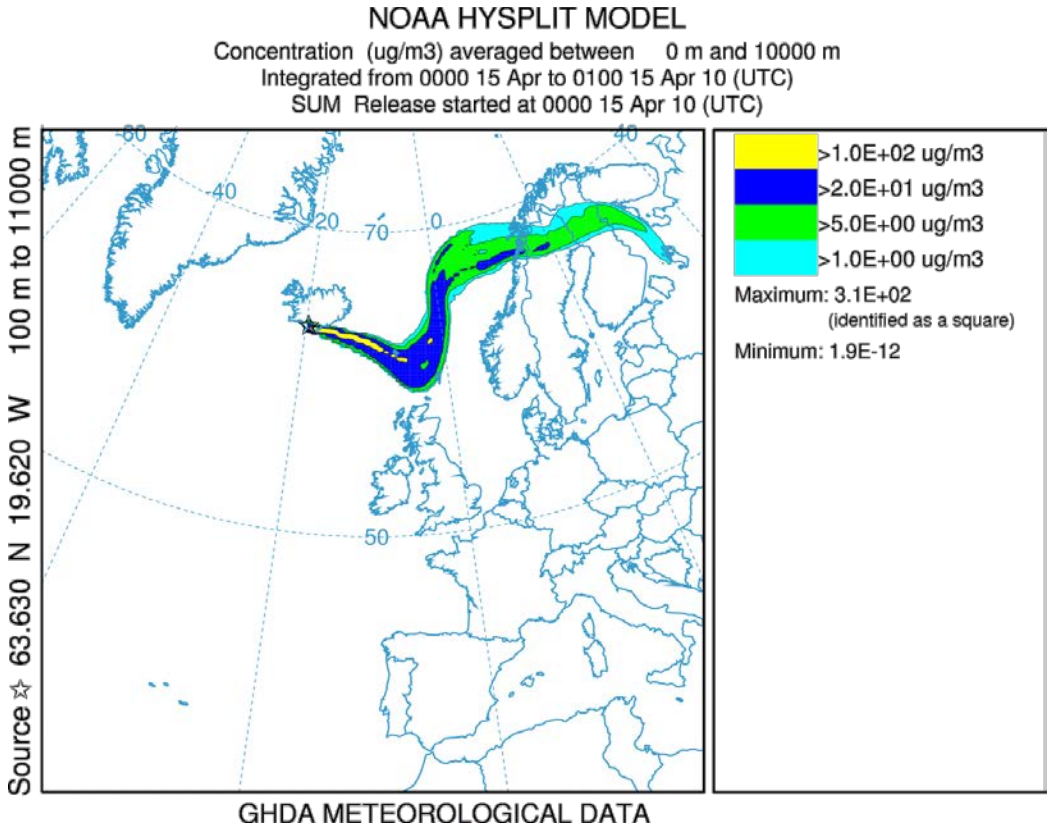
Chemical Releases



- **History**
  - Post 9/11 HLS application for WFOs run at NCEP
  - Initial web interface for NWS WFO
- **Approaches**
  - Link to Computer-Aided Management of Emergency Operations (CAMEO) chemicals data
  - Collaboration with OR&R to include Areal Locations of Hazardous Atmospheres (ALOHA) source model
- **Accomplishments**
  - Incorporating chemical plume modeling capability at WFO

Emergency Response

Volcanic Eruptions

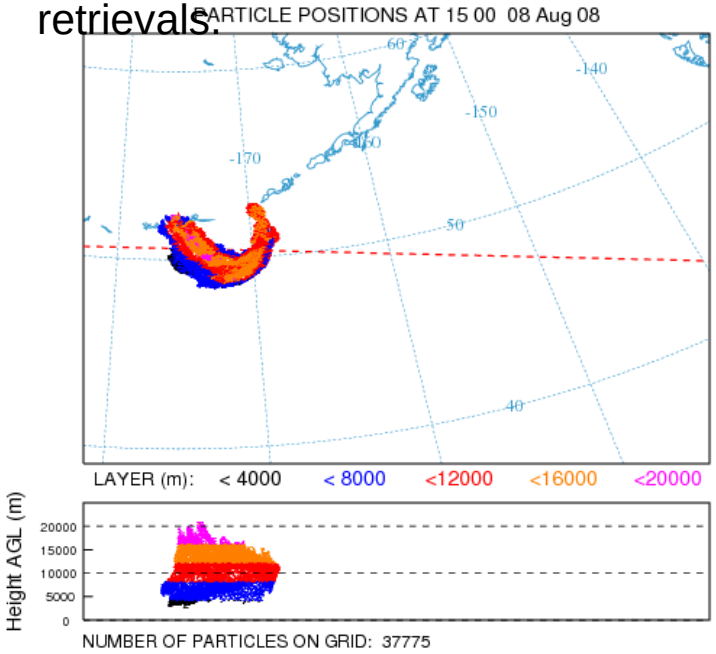


- **History**
  - Mt. St. Helens – forecast trajectories to the USGS
  - Mt. Redoubt – KLM encounter
- **Approaches**
  - Source term uncertainty (mass, particle size, height)
  - New requirement for quantitative air concentration
- **Accomplishments**
  - Primary customer is the Washington Volcanic Ash Advisory Center (NCEP and NESDIS)
  - HYSPLIT installed in Australia, Argentina, and AFWA

POSTER: Producing Quantitative Forecasts of Volcanic Ash using the HYSPLIT Transport and Dispersion Model.

Kasatochi, Aleutian Islands, August 2008

NOAA HYPLIT forecast with source term constructed from satellite retrievals.



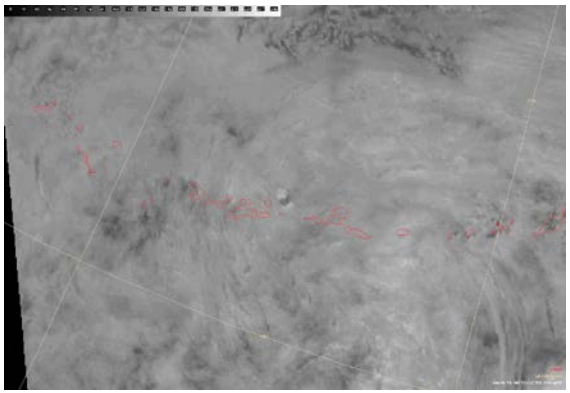
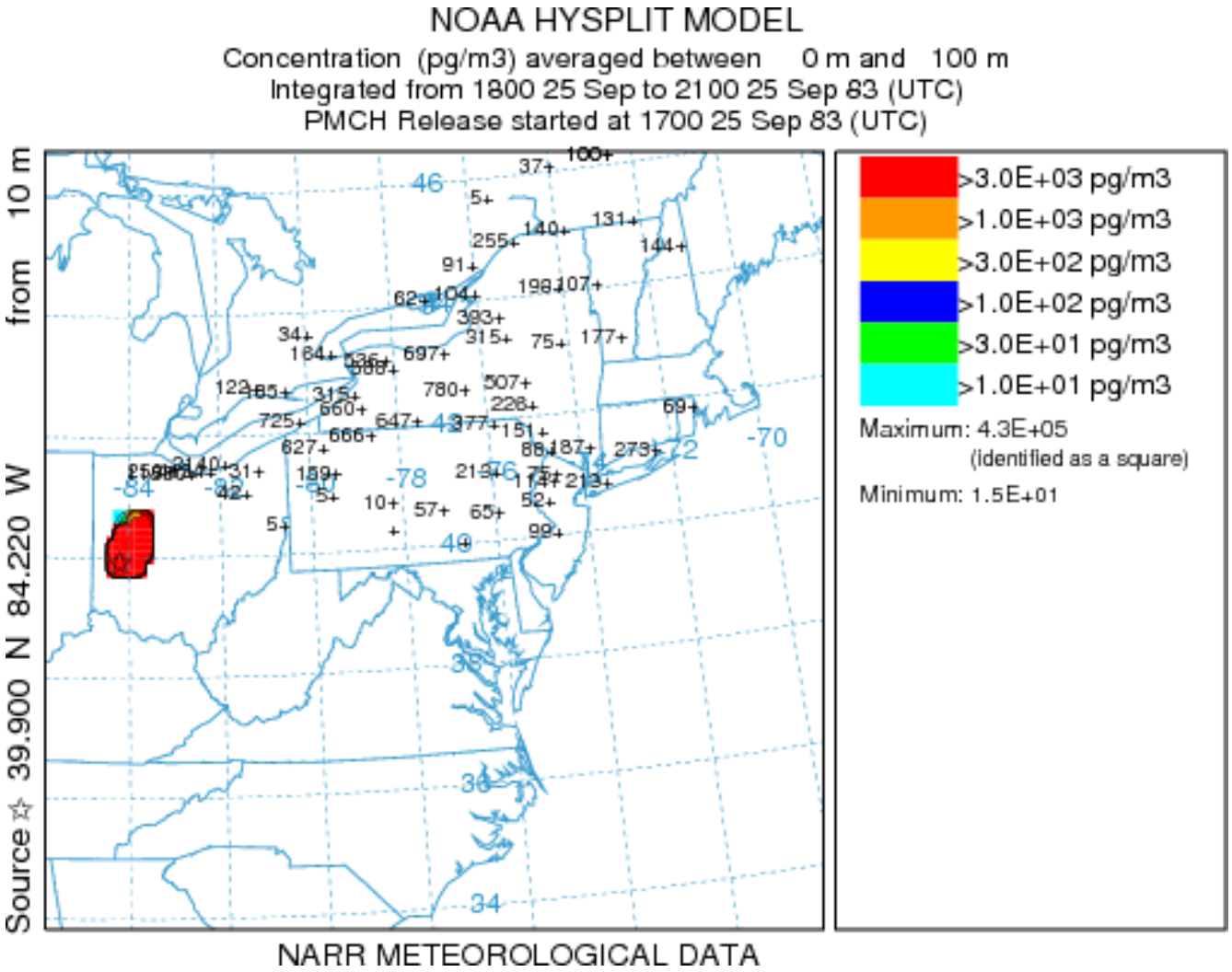


PHOTO: GOES visible satellite images 2230 to 2340 UTC on 08/07/2008. Dave Schneider. Alaska Volcano Observatory / USGS.

Alice M. Crawford *(a,b), Barbara J.B. Stunder (b), Steven. R. Albersheim , Michael. J. Pavolonis (d)*

(a) Cooperative Institute for Climate and Satellites, University of Maryland, College Park, MD, 20740
(b) NOAA Air Resources Laboratory, College Park, MD 20740
(c) Federal Aviation Administration, Aviation Weather Division, Washington, DC 20591
(d) NOAA Center for Satellite Applications and Research, Madison, WI, 53706

Model Evaluation



Model Evaluation

Data Archive of Tracer Experiments and Meteorology

Information Summary

DATEM - Data Archive of Tracer Experiments and Meteorology

Information on the DATEM project

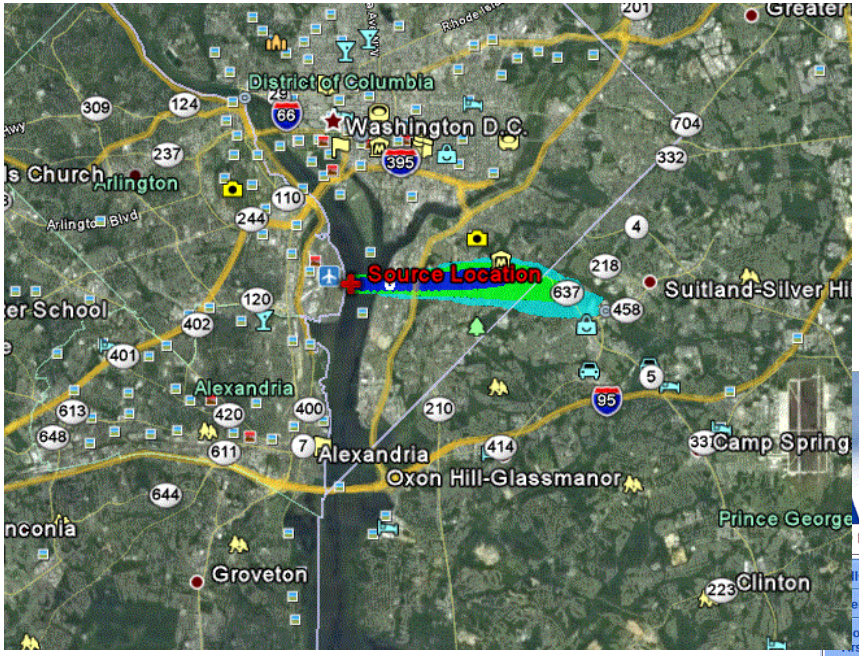
Click on the experiment name for experiment details.

- Cross APpalachian Tracer EXperiment (CAPTEX)
  Release: Dayton, OH: Sep. 18, 25, Oct. 02, 14 1983 & Sudury,ONT: Oct. 26, 29 1983
- Atlantic Coast Unique Regional Atmospheric Tracer Experiment (ACURATE)
  Release: Savannah River Plant, SC: Spr.1982, Sum.1982, Fal.1982, Win.1982/3, Spr.1983,
- Across North America Tracer EXperiment (ANATEX)
  Release: Glasgow, MT and St. Cloud, MN: Jan. through Mar. 1987
- OKlahoma Tracer EXperiment (OKTEX)
  Release: Norman, OK: Jul. 08 1980
- MEtropolitan Tracer EXperiment (METREX)
  Release: metropolitan Washington, DC: Jan. through Dec. 1984
- European Tracer EXperiment (ETEX)
  Release: Rennes, France: Oct. 23 1994

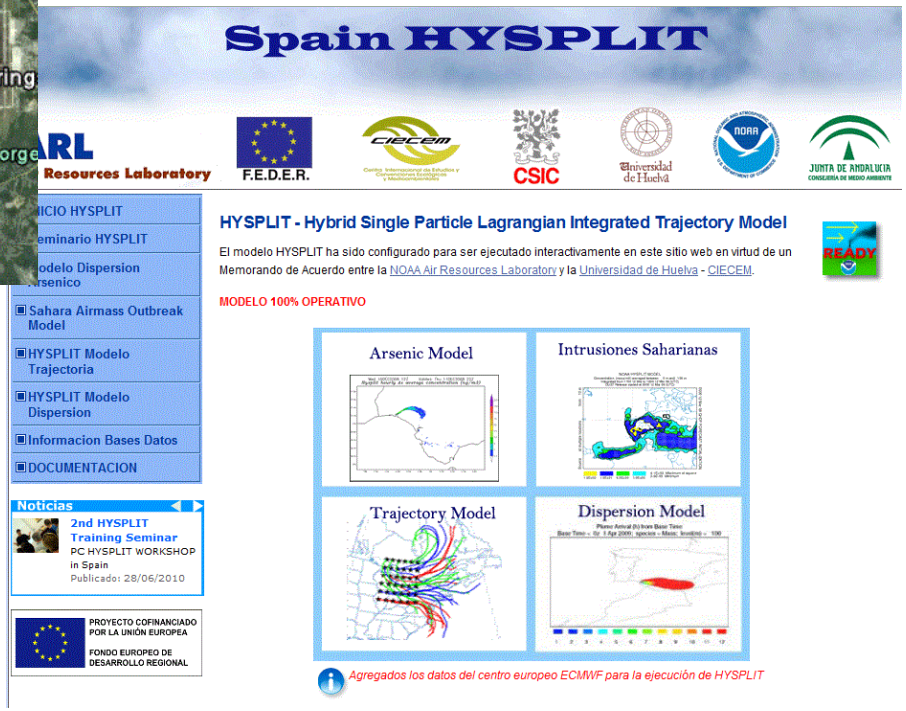
- **Approach**
  - Creation of the North American Regional Reanalysis (NARR)
  - Common statistical evaluation protocols
- **Accomplishments**
  - Web access to run HYSPLIT for each experiment
  - Standardized model change testing in conjunction with version control

Decision Support

Real-time Environmental Applications and Display sYstem

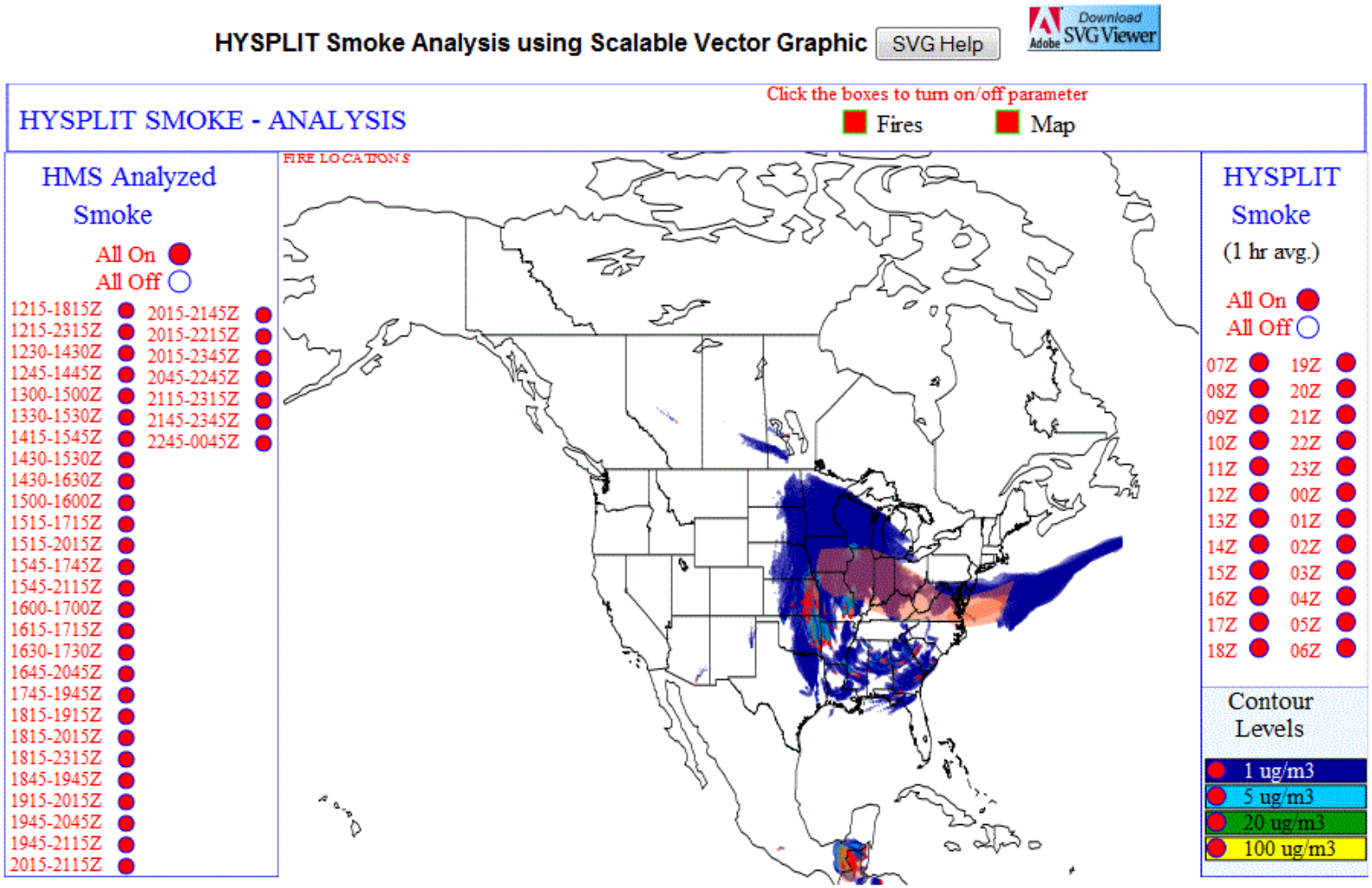


- **Accomplishments**
  - 45,000 unregistered user runs on average per month
  - Mirror and backup capabilities (only one in Spain)



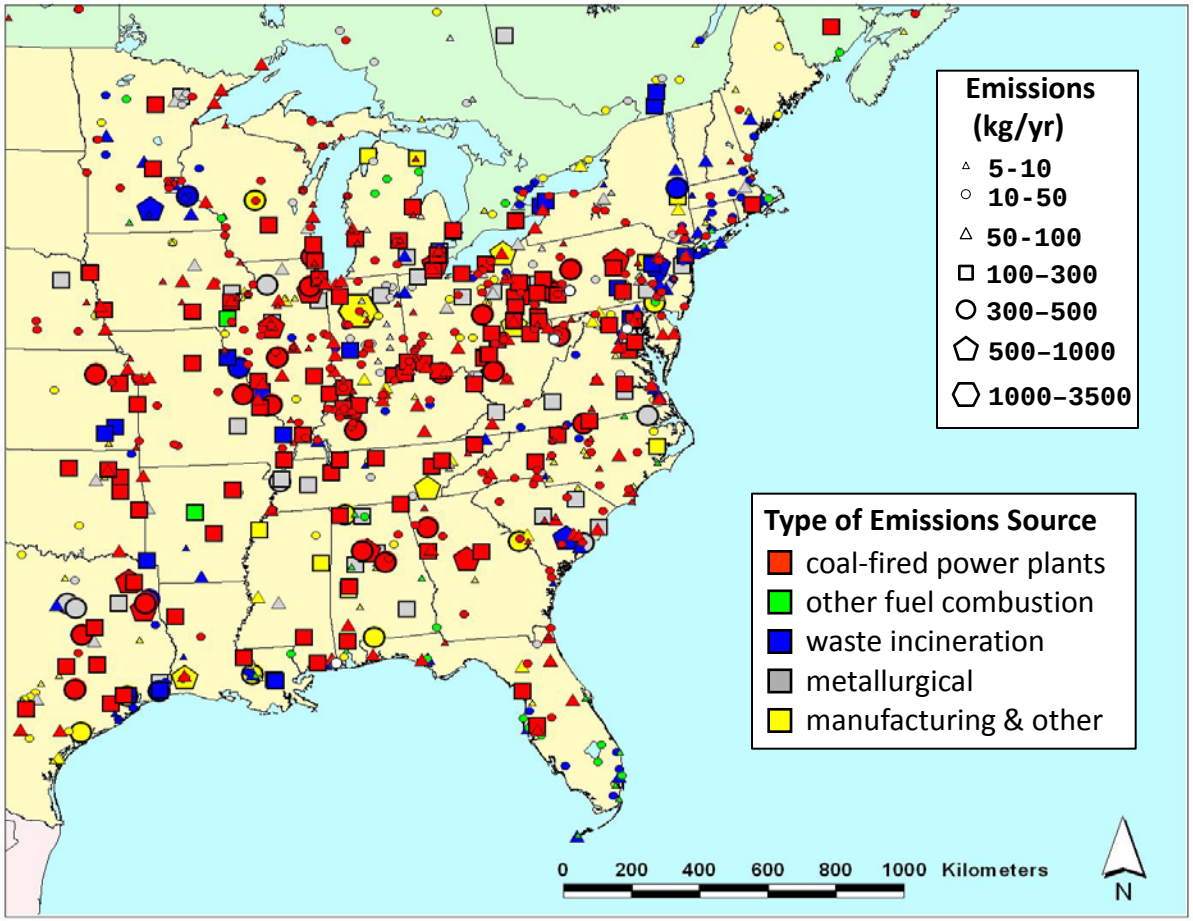
- **Future Directions**
  - Couple with GSD's High Resolution Rapid Refresh at ESRL

Air Quality
Fire Smoke



Air Quality

Source-Receptor Analysis for Dioxin and Mercury



- **Approaches**
  - Lagrangian focus to optimize source-receptor capability
  - Specialized receptor accounting algorithms
  - Emission based analyses
- **Accomplishments**
  - Extension to global domain to compute background values

Meteorological Modeling Using WRF-ARW Model for Grand Bay Intensive Studies of Atmospheric Mercury

Fong (Fantine) Ngan[1,2] , Mark Cohen[1], Winston Luke[1], Xinrong Ren[1,2] and Roland Draxler[1]

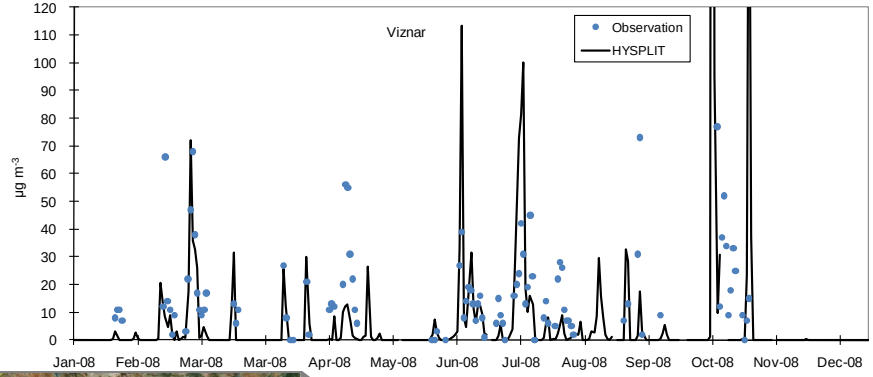
[1] NOAA/ARL, College Park, MD, [2] UMD/CICS, College Park, MD

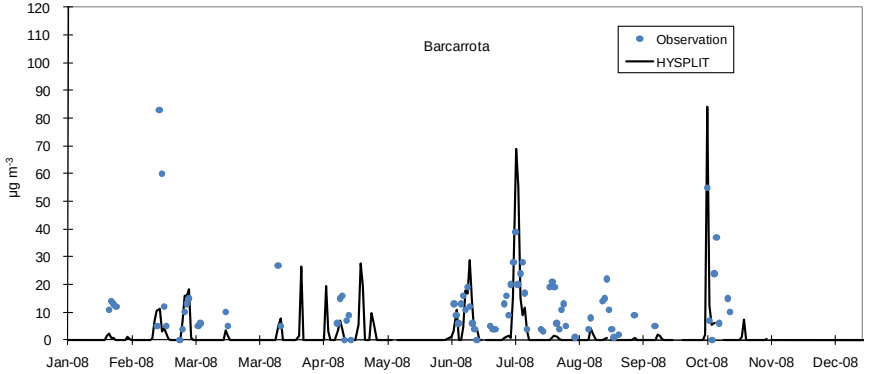
Two sets of sensitivity tests were conducted using WRF-ARW model for the Grand Bay intensive periods, to examine influences on model performance and regional flow predictions:

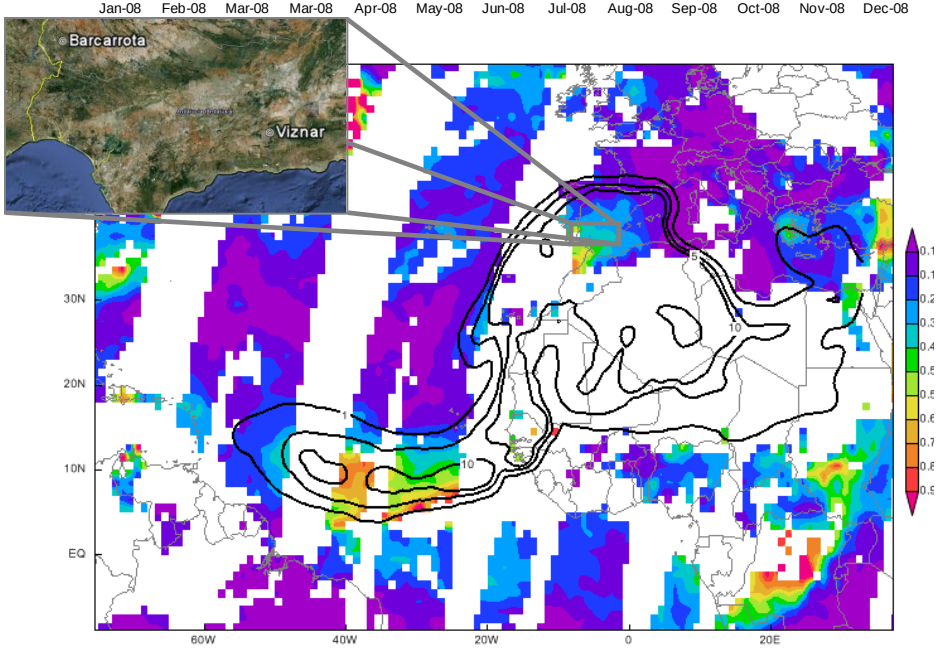
1) Use of different reanalysis data for WRF
The inner most domain inherited differing features of reanalysis data that resulted in generating different regional flow patterns. Larger differences were observed in the WRF results in the summer campaign than the spring period.

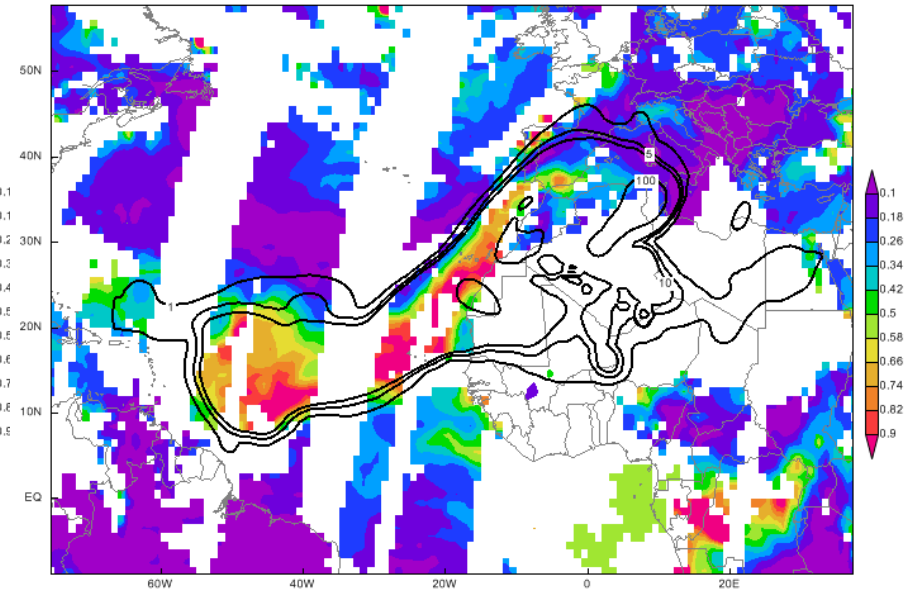
2) Use of different nudging configurations
The grid nudging, together with observational nudging, had a positive effect in wind prediction. But nudging of temperature and moisture led to overestimates of precipitation that would have potentially large impacts on mercury modeling through effects on we deposition.

Dust from North Africa









Part of a Memorandum of Agreement with the University of Huelva, Spain