Operational Predictions of Atmospheric Dispersion at National Oceanic and Atmospheric Administration (NOAA)

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NOAA operational predictions of atmospheric dispersion

Routine predictions:

1. Smoke predictions nationwide
2. Dust predictions over contiguous 48 states (CONUS)

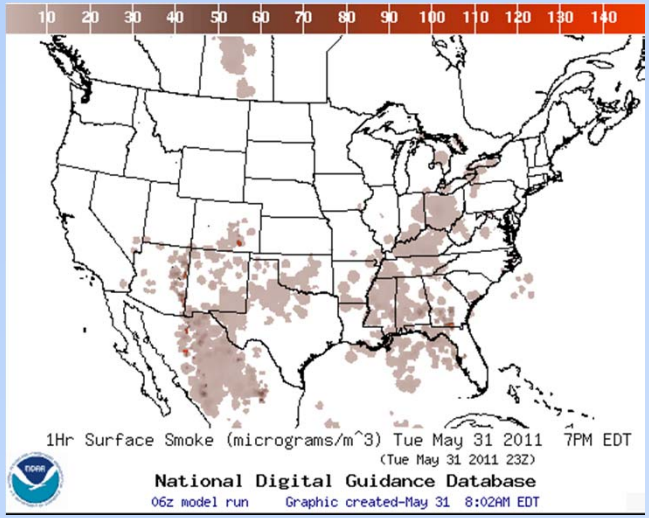
http://airquality.weather.gov/

Incident support:

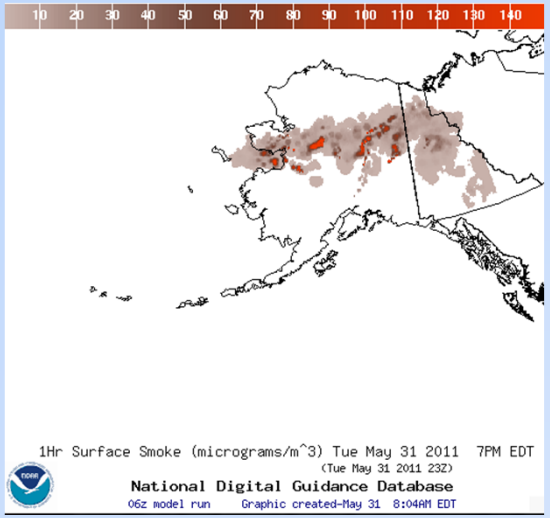
3. Volcanic ash
4. Radiologic contamination
5. Chemical releases

Smoke predictions

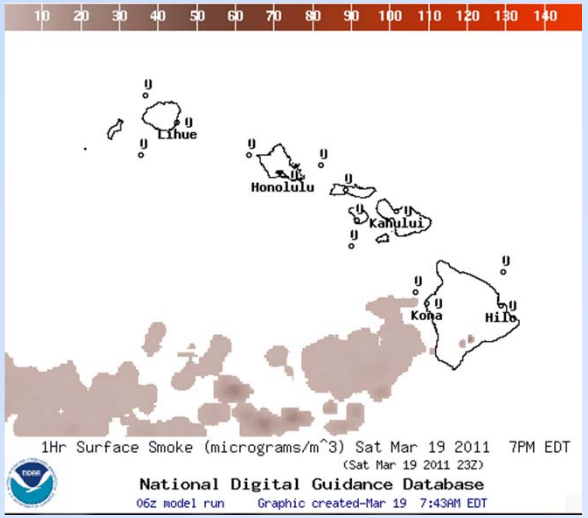
Operational predictions at http://airquality.weather.gov



Surface Smoke

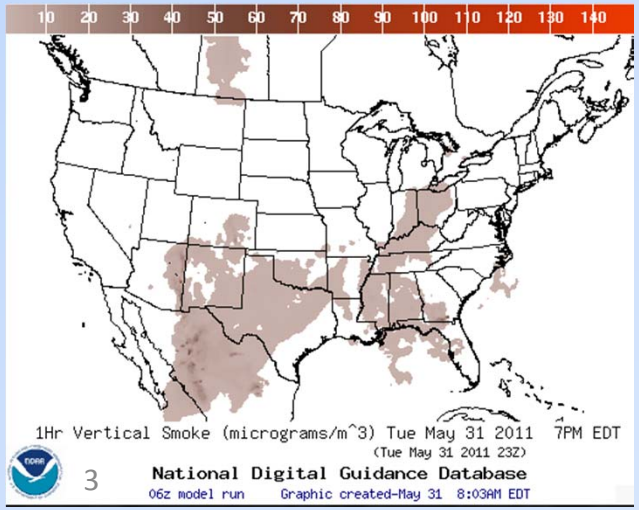


Surface Smoke

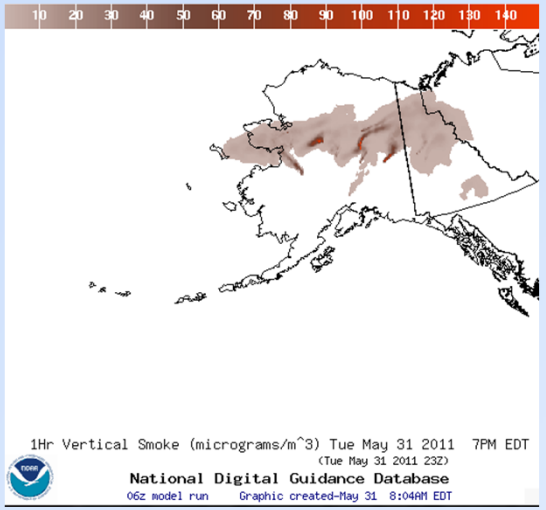


Surface Smoke

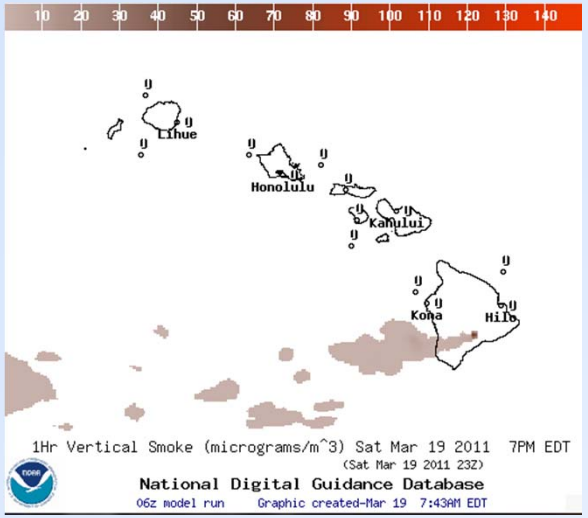
Vertical Smoke



Vertical Smoke



Vertical Smoke



Smoke Forecast Tool

Major Components

NWP Model

NAM/NMMB

NOAA/NWS

Weather Observations

NOAA

USFS

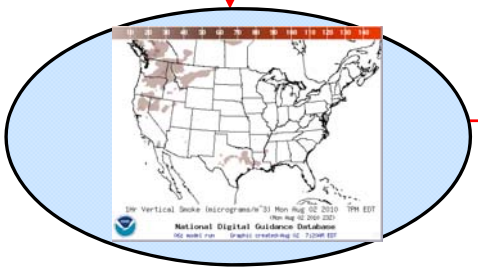
NESDIS HMS Fire Locations

HYSPLIT Module:

NOAA/OAR

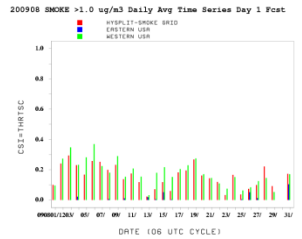
USFS's BlueSky Emissions Inventory:

USFS



Verification:

NESDIS/GASP Smoke

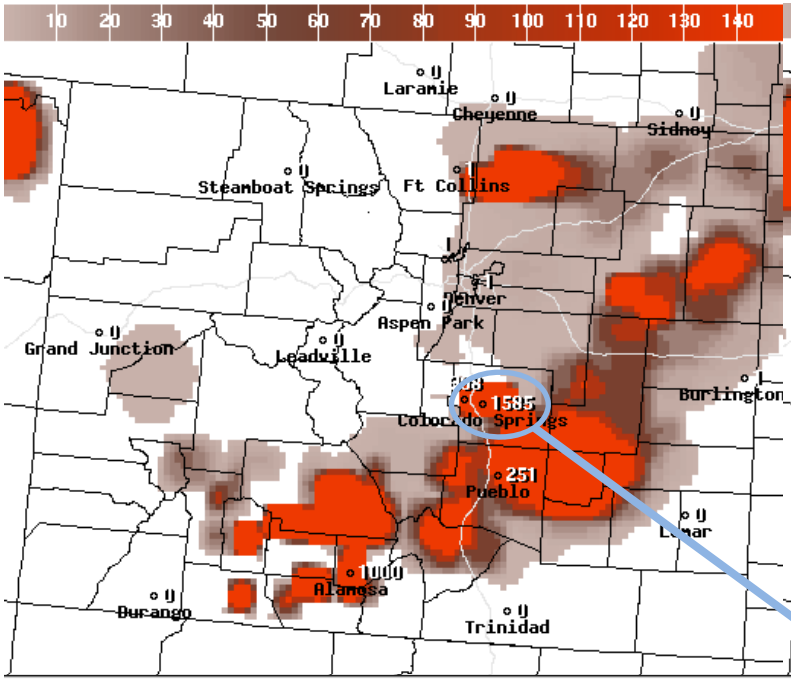


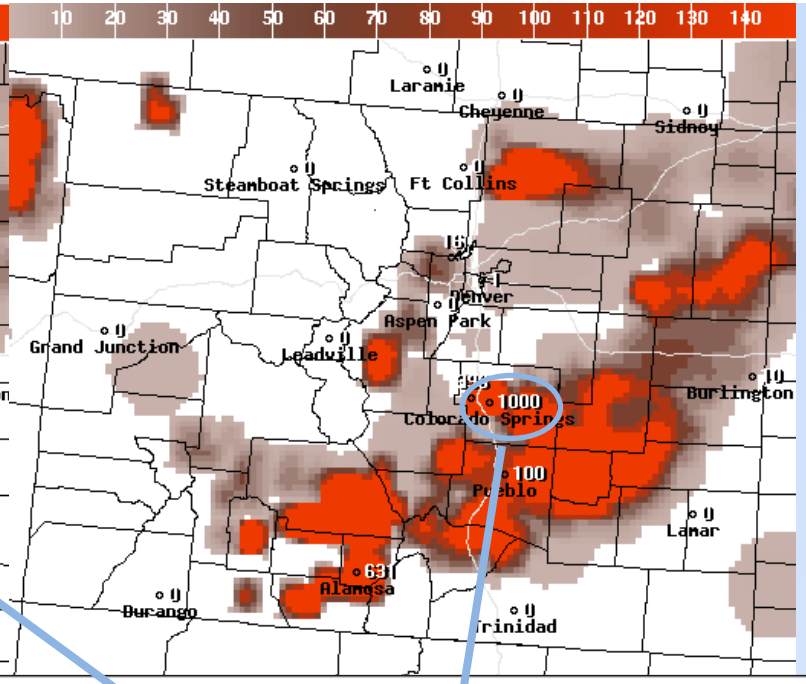
http://airquality.weather.gov/

Waldo Canyon Fire, CO

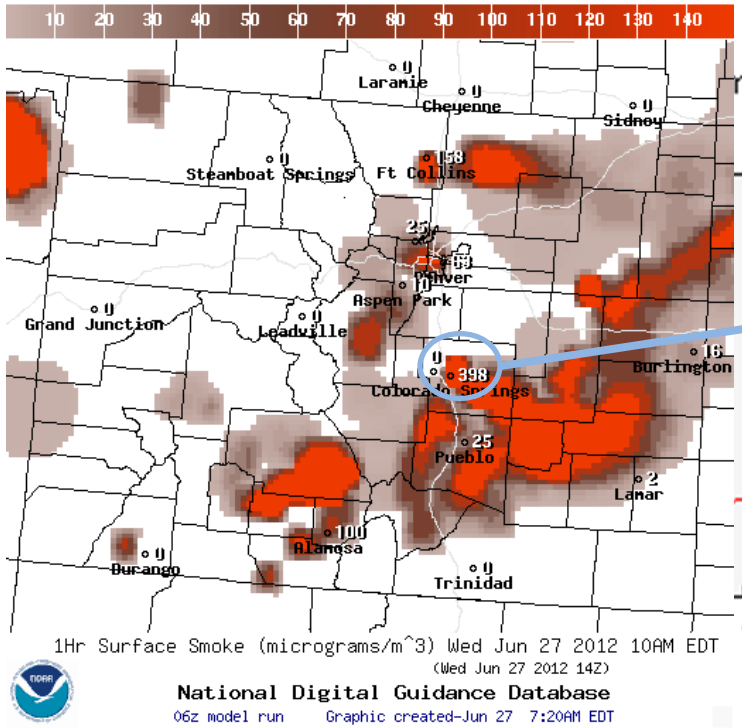
- Began on June 23, 2012 west of Colorado Springs
- Close to 19,000 acres burned
- Smoke plume reached heights of 20,000 feet
- More than 32,000 people evacuated
- Many homes burned
- Fire 100% contained as of July 17

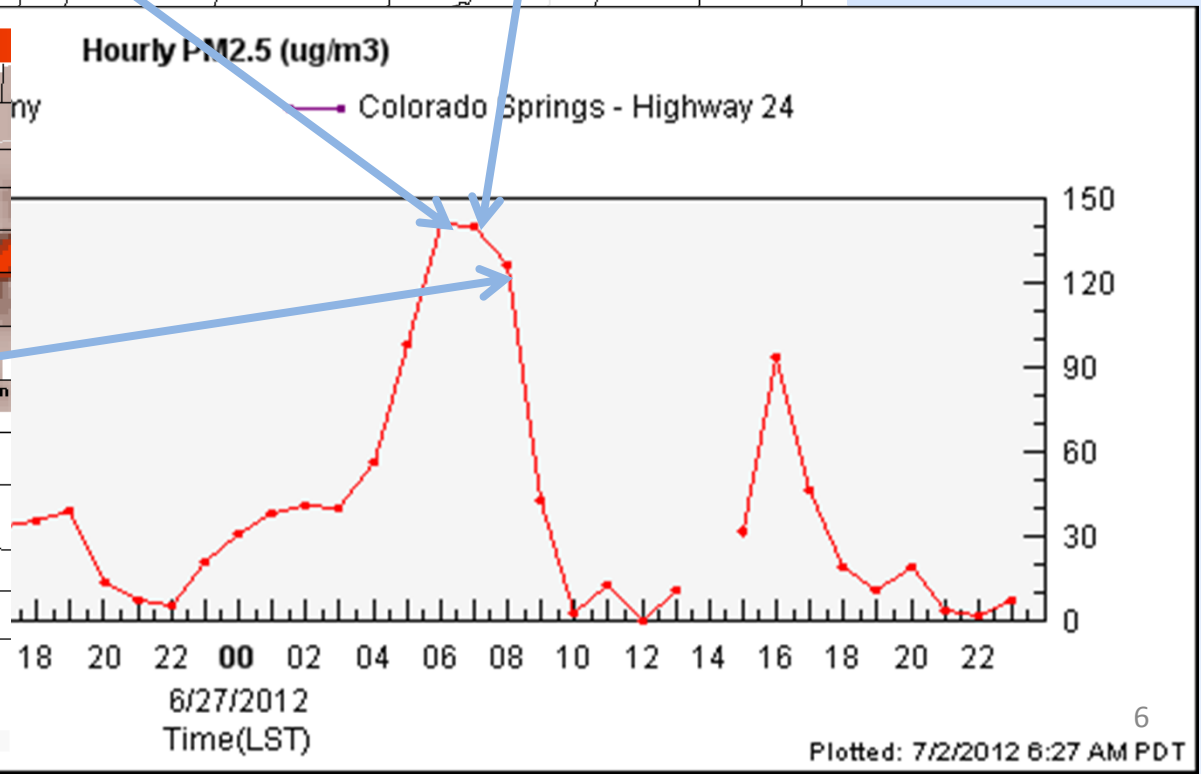
Waldo Canyon fire on June 26 in Colorado Springs





NOAA's smoke predictions correctly predicted observed downward trend in PM2.5 due to Waldo Canyon fire, but concentrations were overestimated





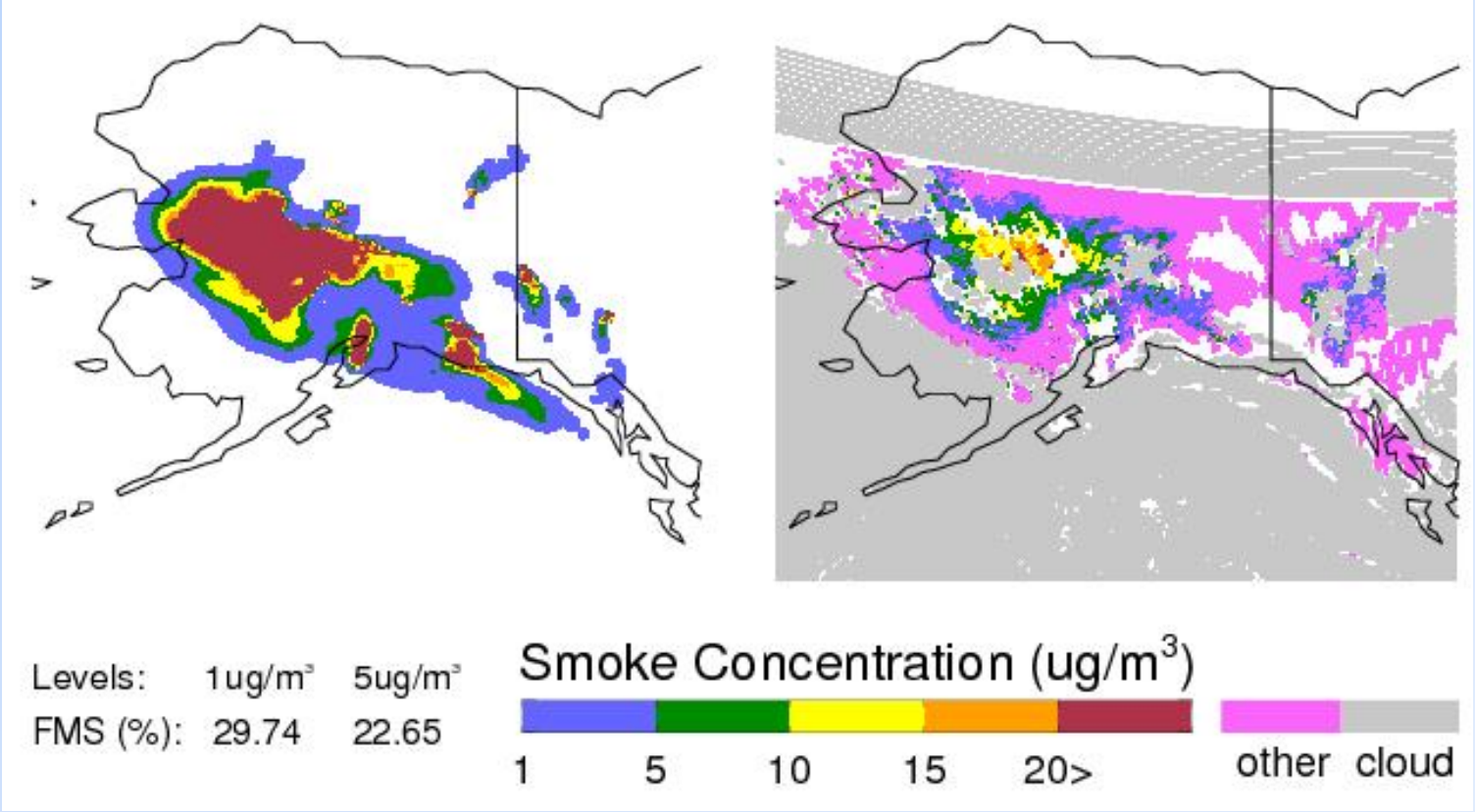
Smoke Verification Example

7/13/09, 17-18Z, Prediction:

7/13/09, 17-18Z, Observation:

GOES smoke product: Confirms areal extent of peak concentrations

FMS = 30%, for column-averaged smoke > 1 ug/m^3

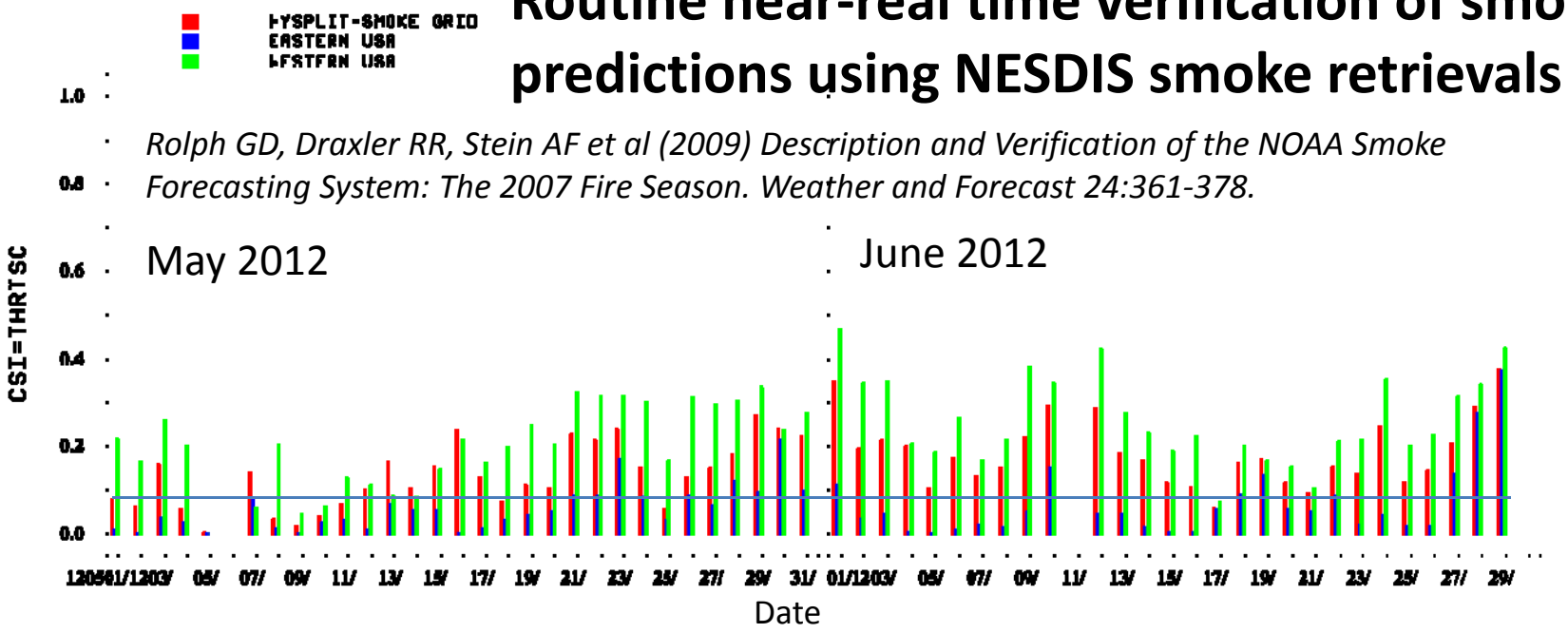


Smoke Prediction Improvements

- Resolution of smoke predictions for Hawaii refined from 12 km to 3 km grid since October 2011
- Meteorological model used to drive dispersion predictions transitioned from the WRF/NMM to NMMB meteorological model in October 2011
- CONUS smoke predictions are currently done at 12 km resolution. Updates to plume rise and deposition parameters are in progress.

Routine near-real time verification of smoke predictions using NESDIS smoke retrievals

Rolph GD, Draxler RR, Stein AF et al (2009) Description and Verification of the NOAA Smoke Forecasting System: The 2007 Fire Season. Weather and Forecast 24:361-378.



Dust Forecast Tool for CONUS

Major Components

NWP Model

NMMB

NOAA / NWS

Weather Observations

NWP Post-processors for AQ Modules

HYSPLIT Module:

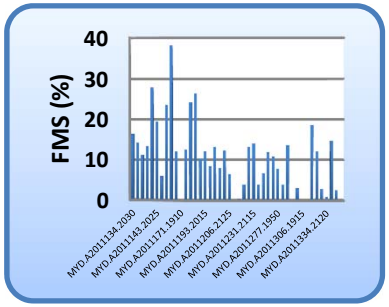
NOAA / OAR

NOAA / GFDL

Map of possible dust sources

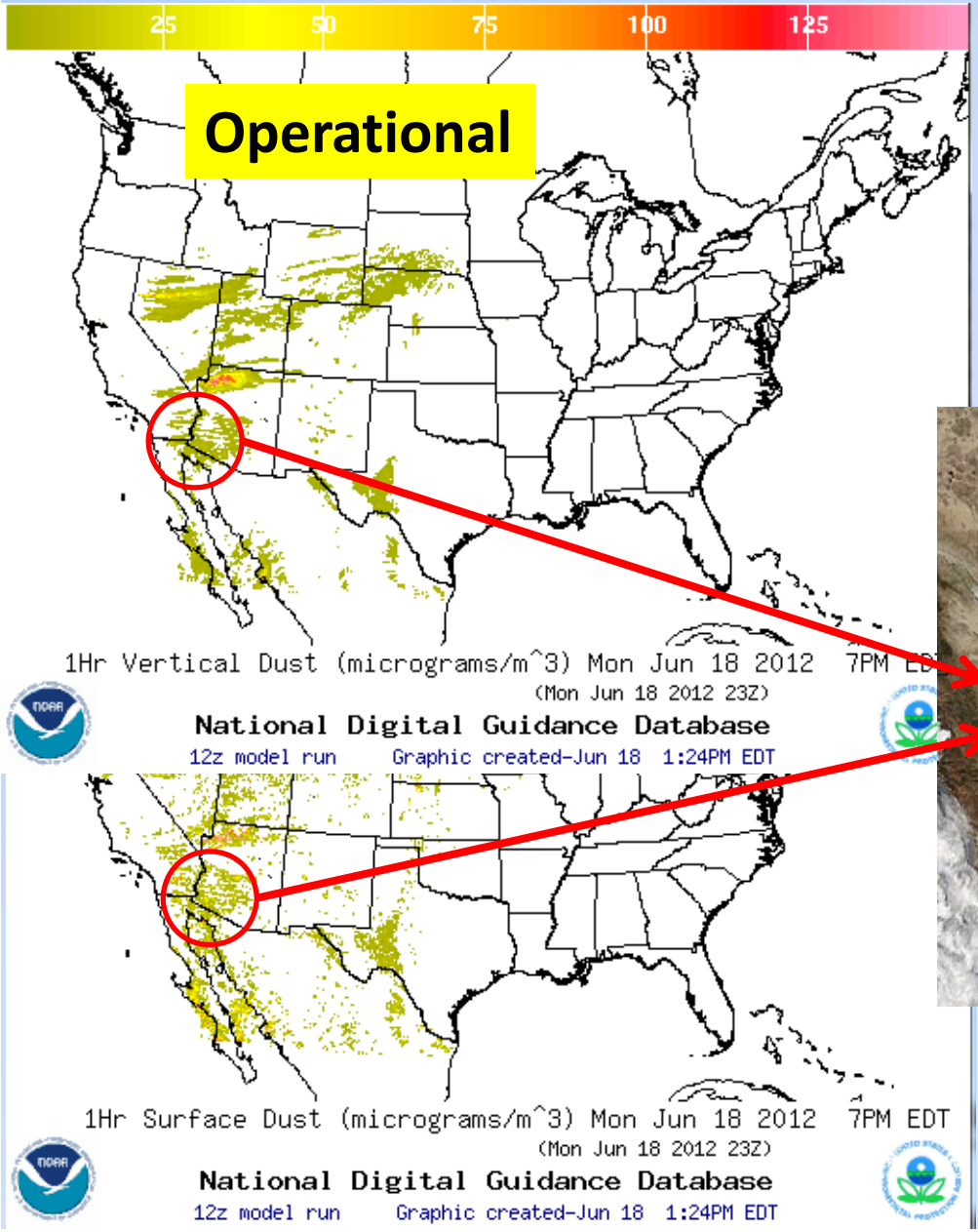
Verification:

NESDIS Dust

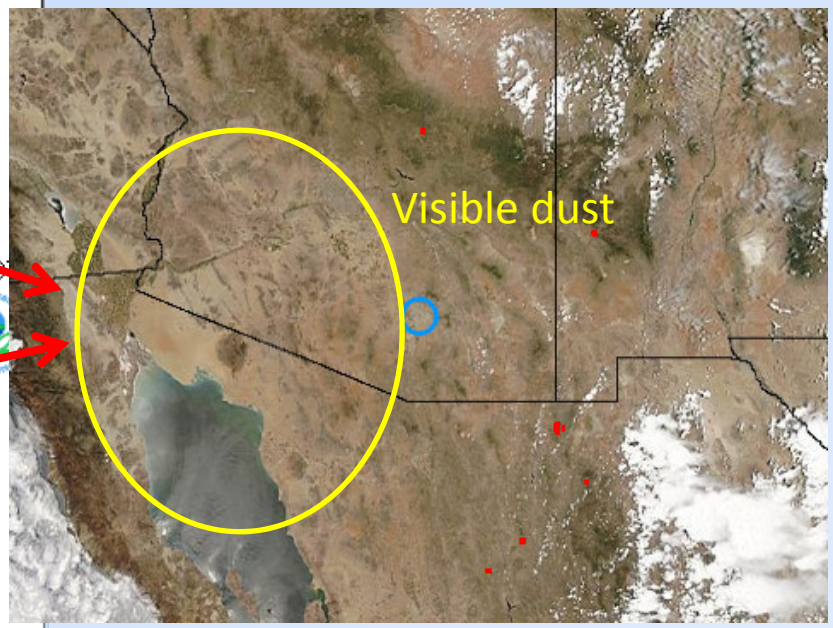


http://airquality.weather.gov/

Dust prediction over CONUS



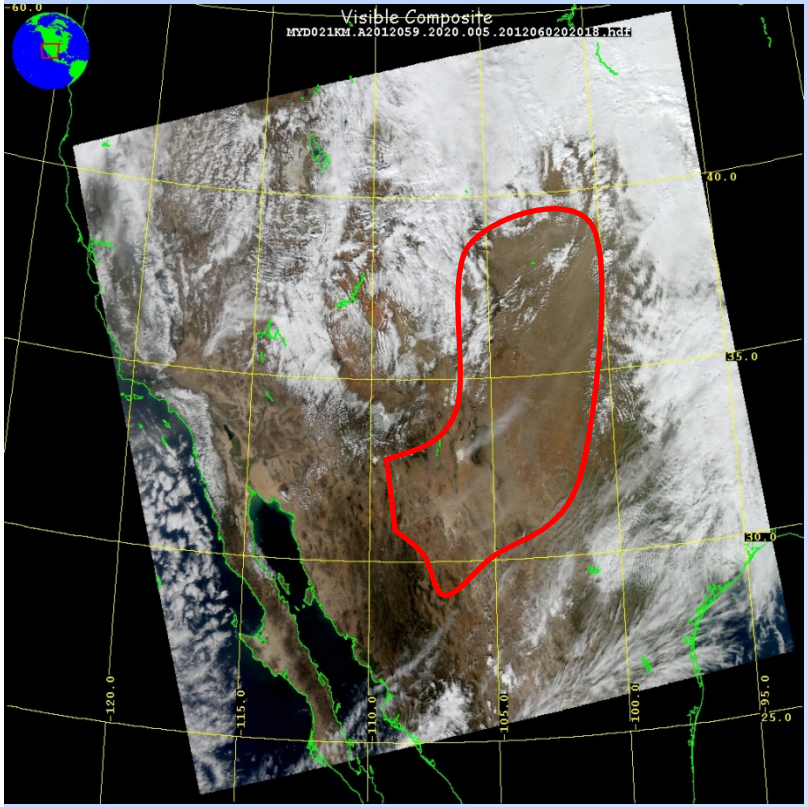
- Wind-driven dust emitted where surface winds exceed thresholds over source regions. Emissions modulated by real-time soil moisture information
- Source regions with emission potential estimated from monthly MODIS deep blue climatology (2003-2006)
- HYSPLIT model for transport, dispersion and deposition. Time step increased in 2012 to reduce time necessary to produce predictions.



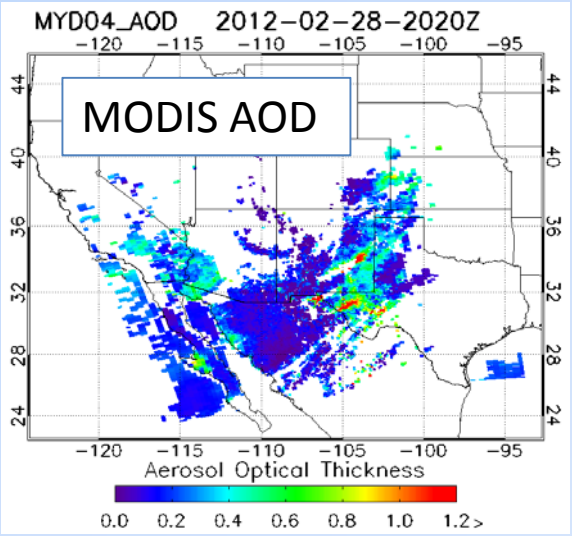
AQUA MODIS image on June 18, 2012

Draxler, R. R., P. Ginoux, and A. F. Stein (2010), An empirically derived emission algorithm for wind-blown dust, J. Geophys. Res., 115, D16212, doi:10.1029/2009JD013167.

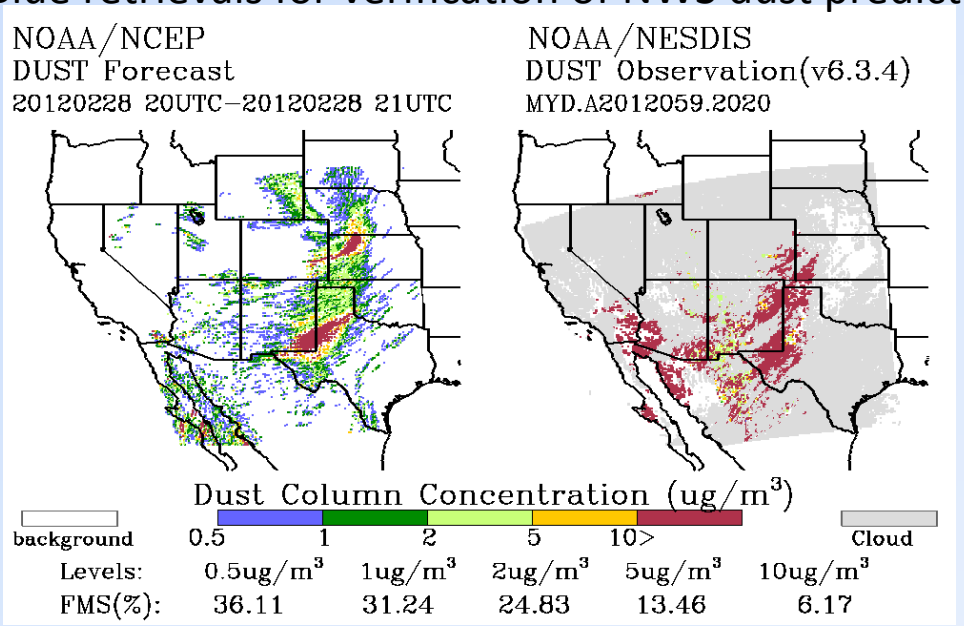
Dust Event and Verification on 02/28/2012



- Large dust storm occurred in Central Plains resulting in large swath of blowing dust
- Generated from eastern New Mexico, Western Texas, Texas Panhandle, southeast Colorado, Oklahoma Panhandle, and Western Kansas

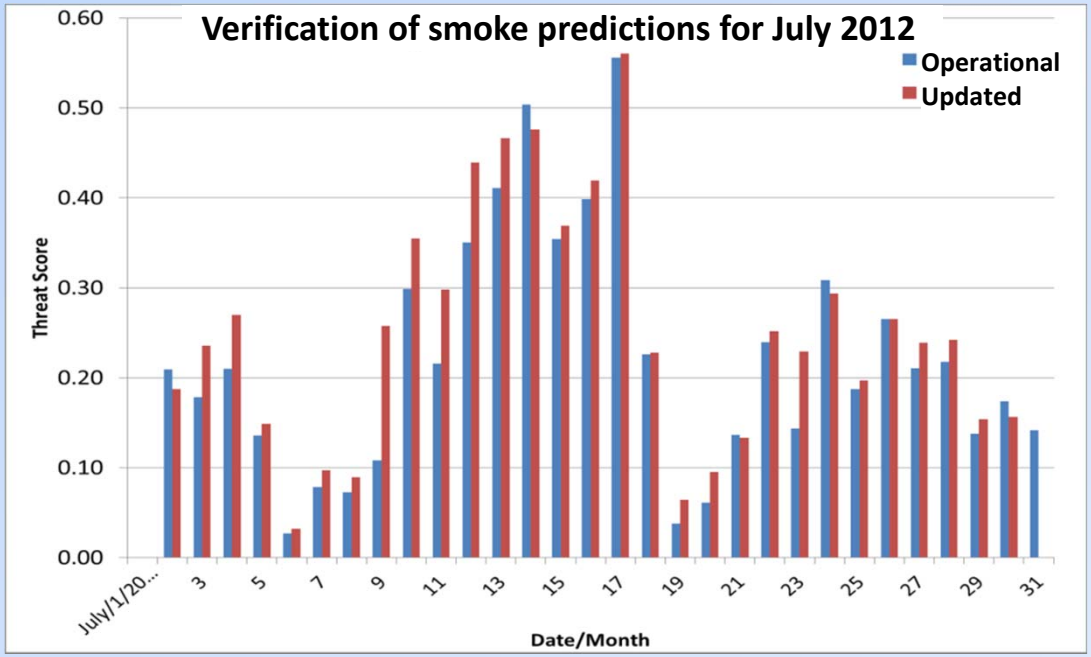


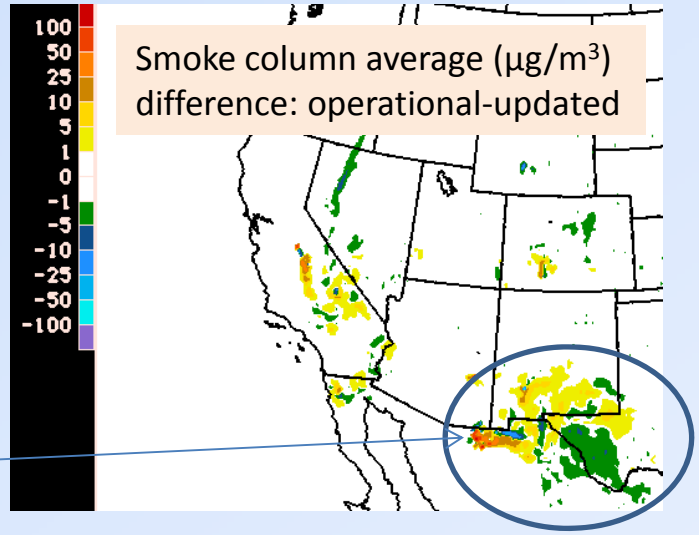
NESDIS developed dust retrieval using MODIS Deep Blue retrievals for verification of NWS dust predictions



Testing of HYSPLIT updates

- No spatial interpolation of precipitation field
- Both rain and cloud required in the same grid cell for wet removal
- Reduced wet removal coefficients
- Revised horizontal puff dispersion rate to be more consistent with particle dispersion
- Maximum plume rise limits relaxed (from 0.75 of the PBL depth to 1.25 of the PBL depth)
- Modified daily cycling of smoke emissions
- The same executable for all applications



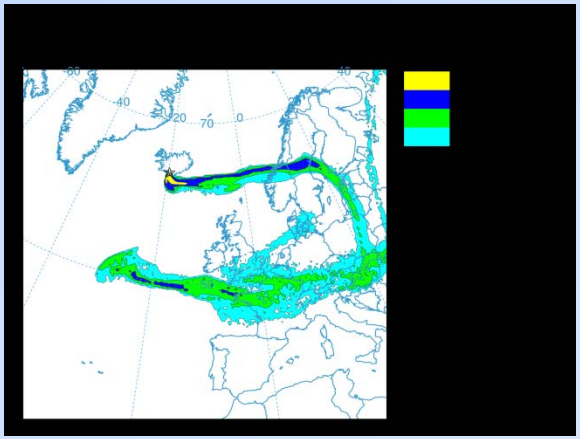


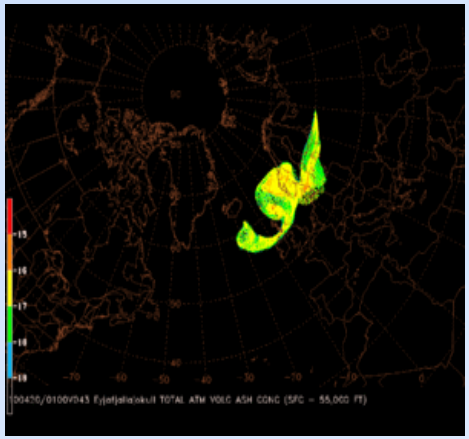
http://www.emc.ncep.noaa.gov/mmb/aq/hysplit/web/html/ shows real-time testing of updated smoke and dust predictions, e.g. higher smoke concentrations near the source in Mexico and lower downwind in operational predictions.

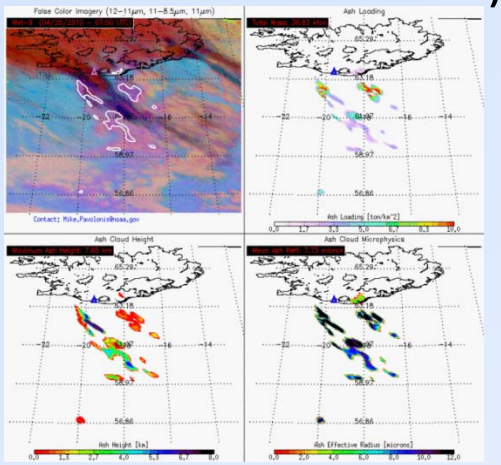
NOAA's Volcanic Ash Assets

Response to the Eruptions of Eyjafjallajokull *Volcano*

- NESDIS (Satellite imagery resources – top and horizontal extent of cloud)
- Washington and Anchorage VAACs (detection/tracking, forecasting)
- NWS/OAR (HYSPLIT) - *Stunder, B.J.B., J.L. Heffter, R.R. Draxler (2007), Airborne Volcanic Ash Forecast Area Reliability, Weather and Forecasting, 22:1132-1139, DOI: 10.1175/WAF1042.1*
- Meteorological Watch Offices (Aviation Warnings for Volcanic Ash – SIGMETs)
  - NWS/NCEP Aviation Weather Center
  - NWS Weather Forecast Office Honolulu
  - NWS Alaska Aviation Weather Unit
- Center Weather Service Unit (1 per FAA Air Route Traffic Control Center)







Dispersion of radioactive material

- NOAA is the home for the U.S. Regional Specialized Meteorological Center under WMO that supports International Atomic Energy Agency (IAEA)

- For the Fukushima Daiichi's nuclear power plant incident:
  - IAEA requested NOAA transport simulations, which were shared with IAEA member countries
  - NOAA worked with DOE to inform the federal community about the transport of radiation. NOAA also responded to requests for support from multiple agencies.
  - NOAA atmospheric modeling group provided estimates of deposition into the ocean for NOAA's ocean radiation simulations
  - HYSPLIT runs were used for these simulations (NOAA/ARL, NOAA/NCEP)
  - Based on lessons learned, NOAA has developed an approach for quickly updating predictions or evaluating multiple emissions scenarios
  - *Draxler, R. R., and G. D. Rolph (2012), Evaluation of the Transfer Coefficient Matrix (TCM) approach to model the atmospheric radionuclide air concentrations from Fukushima, J. Geophys. Res., 117, D05107, doi:10.1029/2011JD017205.*

- NOAA is working on implementation of an on-demand backtracking capability and plans to provide potential source locations to the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) per MOU with the Department of State.

Summary of operational dispersion predictions

Routine predictions:

1. Smoke predictions nationwide
2. Dust predictions over contiguous 48 states (CONUS)

http://airquality.weather.gov/

Incident support:

3. Volcanic ash
4. Radiologic contamination
5. Chemical releases

Recent updates:

- Working on CTBTO support
- Longer time step (reducing run time) for dust predictions was implemented
- Modified smoke plume rise, updated deposition parameters, and transition of all predictions to a new computing system are in real-time testing.