DRAFT

Presenting Evidence to Justify Data Exclusion as an Exceptional Event

Ideas based on how EPA has recently documented events to support regulatory decisions

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USEPA /OAQPS / AQAD

For Presentation at WESTAR State/EPA Exceptional Events Implementation Meeting

February 25-26, 2009

Recent EPA Actions and Support

- San Joaquin Valley
  - PM10 attainment reaffirmation.
  - http://www.epa.gov/region09/air/sjvalleypm/
- PM2.5 Designations
  - To document technical basis for final decisions
  - http://www.epa.gov/pmdesignations/2006standards/state.htm
- DataFed (Washington University)
  - To provide general tools to assist event analysis
  - http://wiki.esipfed.org/index.php/Evidence_for_Flagging_Exceptional_Events

U.S. ENVIRONMENTAL PROTECTION AGENCY

Area Designations for 2006 24-Hour Fine Particle ($PM_{2.5}$) Standards

Bookmark

Contact Us **Search:** ○ All EPA ◉ This Area Go

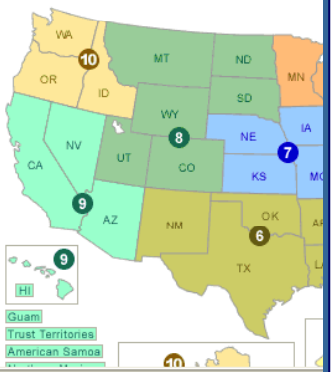
You are here: EPA Home » Air & Radiation » Six Common Air Pollutants » Particulate Matter » Fine Particle ($PM_{2.5}$) Designations » Area Designations for 2006 24-Hour Fine Particle ($PM_{2.5}$) Standards » State Recommendations and EPA Responses

- Area Designations for 2006 24-Hour Fine Particle ($PM_{2.5}$) Standards Home
- Fine Particle ($PM_{2.5}$) Designations Home
- Basic Information
- Regulatory Actions
- Where You Live
  - State Designations
  - Tribal Designations
  - $PM_{2.5}$ Conditions
  - Air Quality Forecast
- Frequent Questions
- $PM_{2.5}$ and Human Health

State Recommendations and EPA Responses

EPA plans to designate geographic areas as attaining or not attaining the 2006 24-hour $PM_{2.5}$ standards by December 18, 2008. EPA has requested that states and tribes submit recommendations to EPA for PM attainment and nonattainment areas by December 18, 2007.

The following map groups the states submitted to EPA by the states or tr



2006 24-Hour $PM_{2.5}$ Standards — Region 4 Recommendations and EPA Responses

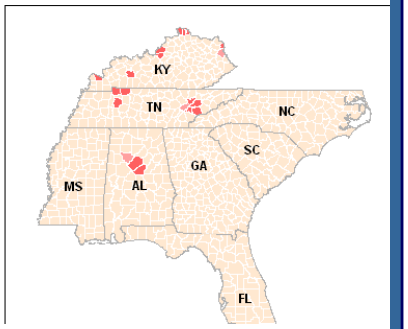
EPA plans to designate geographic areas as attaining or not attaining the 2006 24-hour $PM_{2.5}$ standards by December 18, 2008. EPA has requested that states and tribes submit recommendations to EPA for $PM_{2.5}$ attainment and nonattainment areas by December 18, 2007.

State recommendations are presented below.

Tribal information is available on the Tribal Recommendations page.

EPA Intended Designations (Not Final)

EPA will make official designations by the end of 200



Recommendations received by EPA Region 4

State	State Recommendation	EPA Response	S
Alabama	Letter (PDF) (91 pp, 4.1MB) Addendum (PDF) (4 pp, 140KB)	Letter (PDF) (98 pp, 4.7MB)	
Florida	Letter (		
Georgia	Letter (Letter (		
Kentucky	Letter (Addend		
Mississippi	Letter (		
North Carolina	Letter (		
South Carolina	Letter (		
Tennessee	Letter (Letter (		

Enclosure 1

$PM_{2.5}$ Exceptional Events Technical Support Document

U.S. Environmental Protection Agency
Region 4

State of Georgia: Atlanta-Sandy Springs-Marietta, GA and Albany, GA Metropolitan Statistical Areas

2007

http://www.epa.gov/pmdesignations/2006standards/state.htm

Exceptional Events
What the Rule Says

- Eligible Data
  - Data showing exceedances or violations
- Rule Requirements
  - Event satisfies the definition of exceptional
  - There is a clear causal relationship
  - Event is associated with measured concentration in excess of normal fluctuations including background
  - No exceedance or violation but for the event
- Demonstration to justify data exclusion
  - Any reliable and accurate data

The Required EE Evidence
derived from the preamble

- In general, the type, amount, and detail level for presentation of evidence will vary by the circumstances for each event.
- The more extreme the measured event day concentration, the less evidence would generally be needed to justify that the concentration was exceptional.
- Exceptional event data claims that are near average concentration levels will require very detailed documentation.
- When concentrations are frequently greater than the level of the NAAQS and they are affected by a diverse set of emission sources, more detailed documentation is likely required.

Types of Data to Consider

for EE evidence, as discussed in preamble

- Event characteristics: type, size, location, duration, estimated emissions, press accounts, response agency records, photos, videos, etc.
- Comparisons to the concentration history at that monitor.
- Comparisons to nearby monitors.
- Diurnal patterns of concentrations, if available.
- PM2.5 composition data, if available.
- Satellite data products and related models.
- Weather data.
  - Wind direction and speed.
  - Weather maps.
  - Trajectories (HYSPLIT or other).
- Wind roses and pollution roses.
- Statistical models relating air pollutant to weather.

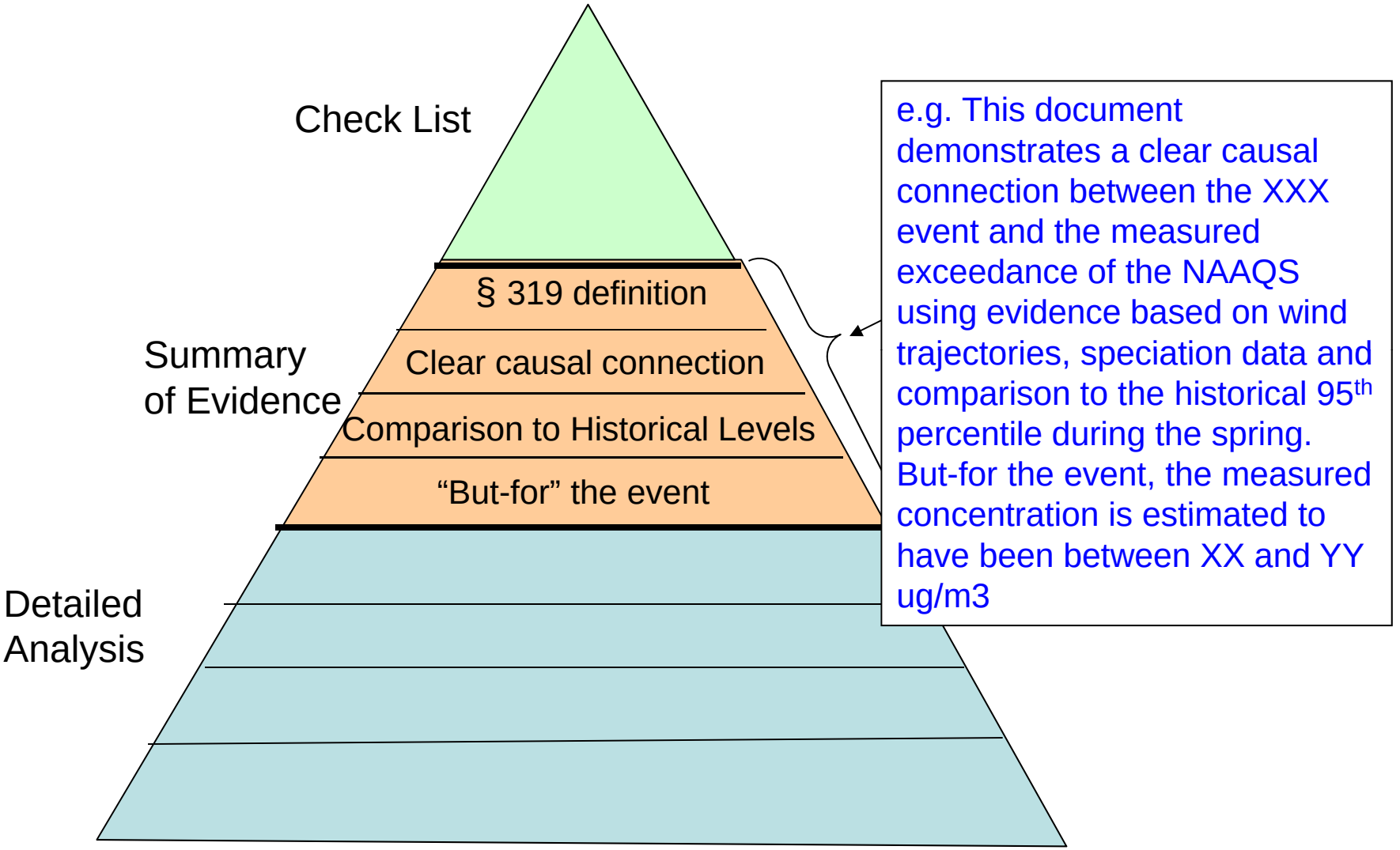
Organization of the Demonstration

- Make it easy for EPA and the public to review the evidence!

- Suggested Contents
  - General check list of the information provided
  - Summary of the evidence and
  - Detailed analysis and data which explains the evidence and justifies the conclusions
    - Organized in accordance with the four required elements of the exceptional events rule.

  - The informational items that are mentioned in this briefing include a non-exhaustive listing of those that one might typically expect to see in a technical support analysis

Visualization of How to Organize the EE Demonstration



Example check list of included evidence

- Date(s) of the event caused exceedance or violation, by monitor
- Monitor location – AQS site id, address, city, county, state
- Brief description of event, including news clippings, media coverage.
- Site specific event day evidence
  - Measured FRM concentration
  - Speciation data
  - Current season and historical values.
  - Diurnal profile – event day vs typical high day during same season
- Satellite images - HMS fire pixels, AOD, OMI
- Air trajectories between suspected source region and event receptor
- Nearby site and adjacent State data for comparisons, relative to the general air trajectories.

Suggested Template with examples

Detailed Discussion of the Evidence

(A) *Does it meet the § 319 definition?*

(A) Event Description

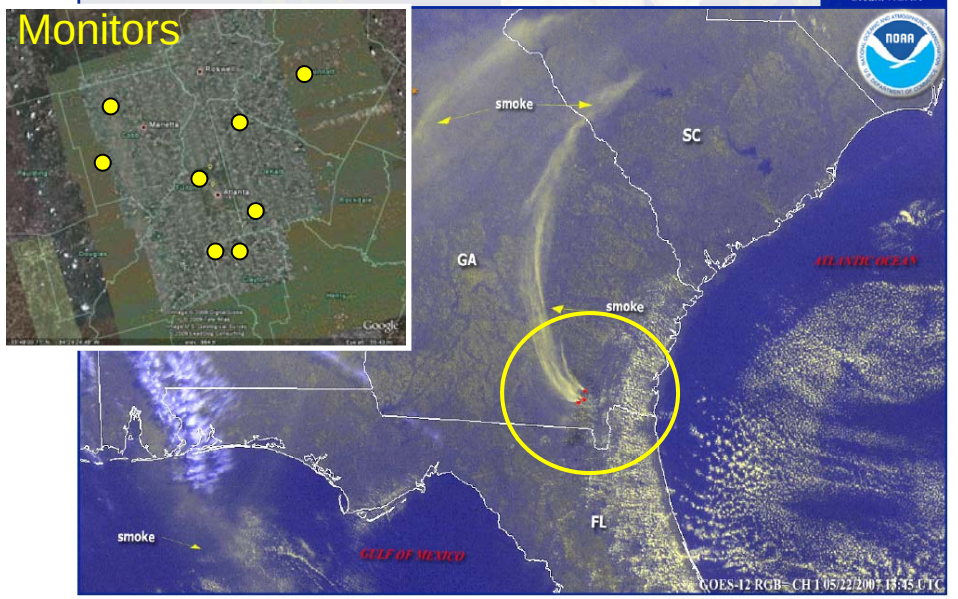
- Newspaper or media report of the event
- Map showing location of monitor site and suspected source area
- Discuss controllability, if natural and/or recurring event
- Met records when needed

Figure 1a: Big Turnaround fire April 29, 2007 Blaine Eckberg, USFWS

Figure 1b: Georgia Forestry Commission - Aerial View of Sweat Farm Road Fire on April 28, 2007.

Hotspots (detections) can be seen as red dots.

Credit: NOAA



http://www.epa.gov/airexplorer/monitor_kml.htm

Detailed Discussion of the Evidence

(B) Was there a causal connection between the event and air quality?

Did the event affect ambient concentrations?

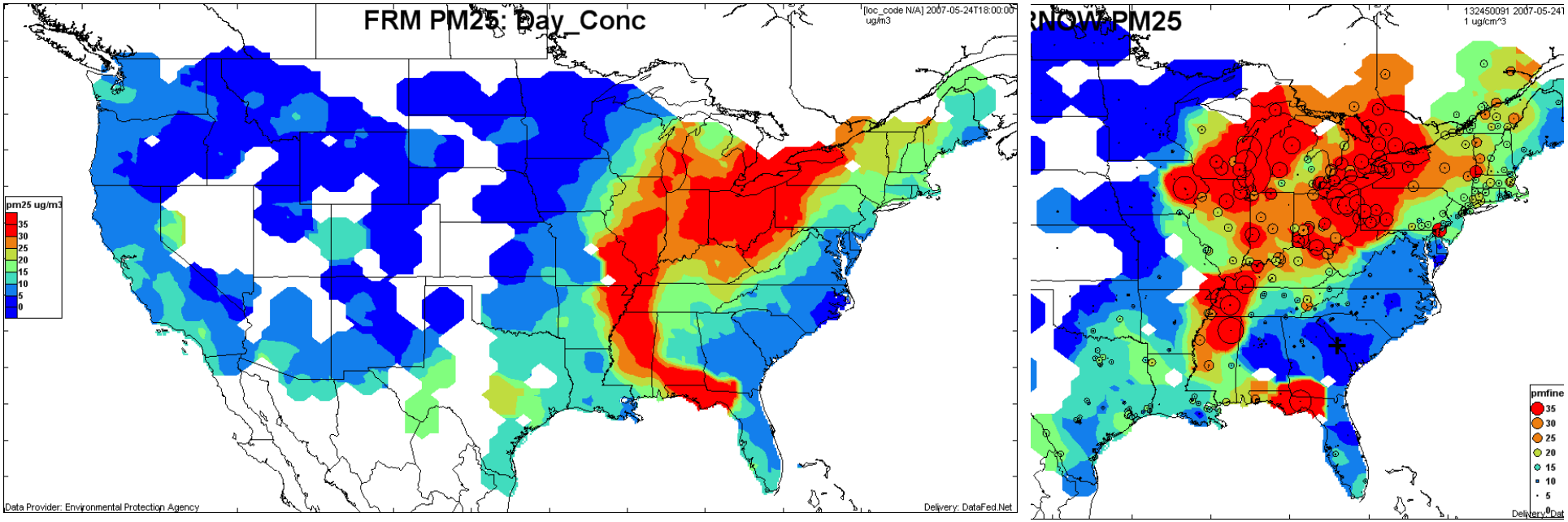
(without regard to magnitude at this point of the analysis)

- Satellite imagery – potential evidence of broad smoke or dust impacts
  - NOAA HMS fire pixels, AOD , NO2 and Aerosol Index from OMI
  - See Exceptional Event Console
- Determine (a) whether plume crosses monitor locations, and (b) whether elevated PM2.5 readings are observed at these monitors.
- Back trajectory analyses from location of monitor (e.g. using CATT or HYSPLIT back trajectory tools)
  - Extend back 24-48 hours.
- Ideally use varying release heights, say of 100, 500 and 1000 meters for air parcels, and at different starting periods for the day.
- Do back trajectories intersect with location of fire or other source of emissions?
  - *Trajectories that do not travel from the source to receptor can be viewed as contrary evidence. Different heights may yield different results and may be needed.*
- Forward trajectories from suspected source region to monitor(s)

Spatial Pattern of High Concentrations

FRM PM2.5

AirNow PM2.5

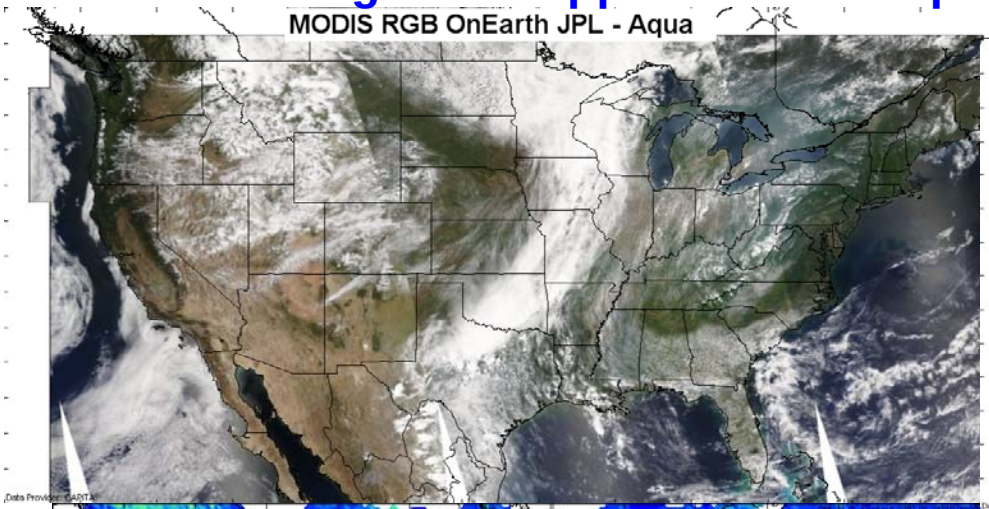


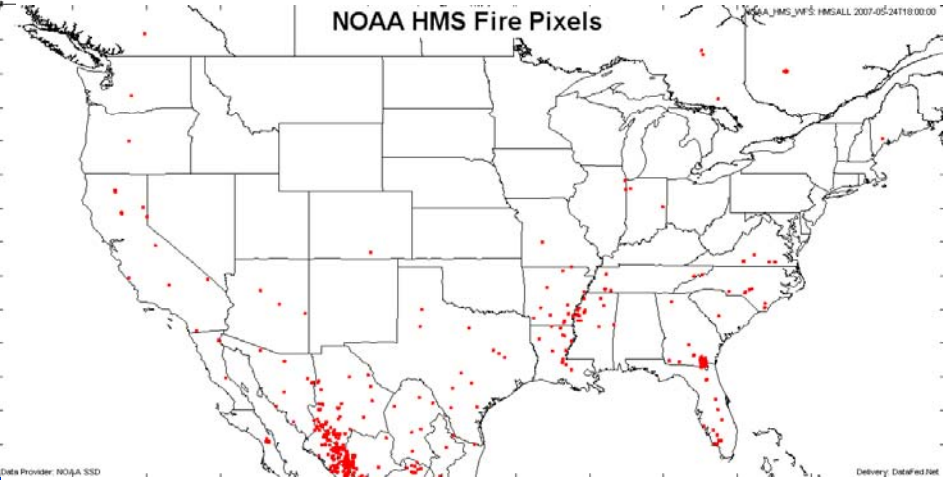
May 24, 2007

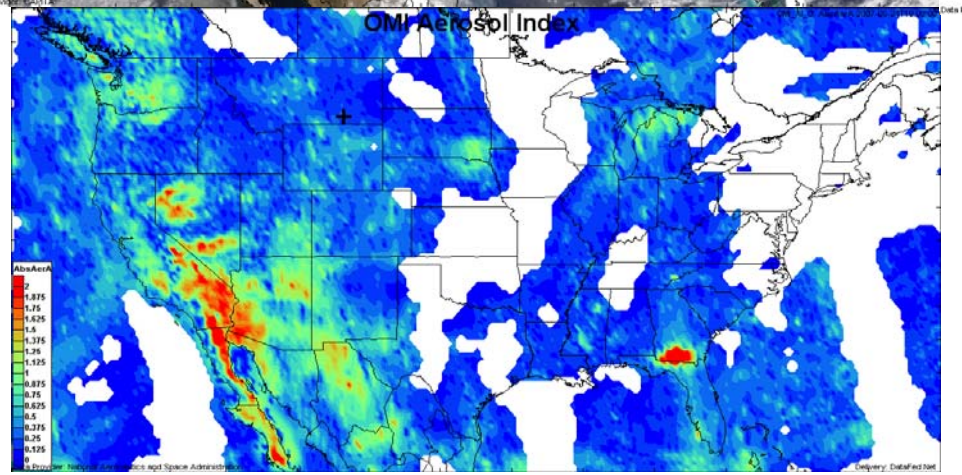
http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/FRMPM25_Day_map,ARC/AIRNOW_PM25_map,ARC/NOAA_HMS_FirePix_map,ARC/OMI_AI_map,ARC/MODIS_AOT_map,ARC/MODIS_Terra_RGB_OnEarthJPL_map,ARC/MODIS_Aqua_RGB_OnEarthJPL_map,ARC/OMI_NO2Trop_map,ARC/CATT_FRMPM25_Traj_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map,ARC/NAAPS_NoAm_Sulf_map,ARC/NAAPS_NoAm_Smok_map,ARC/FRMPM25_30DayMedian_map,ARC/FRMPM25_diff_map&datetime=2007-05-24T18:00:00&Title=070524_GA_Smoke

Analyst's Console.

Satellite Images to Support Smoke impacts from SE GA Fire





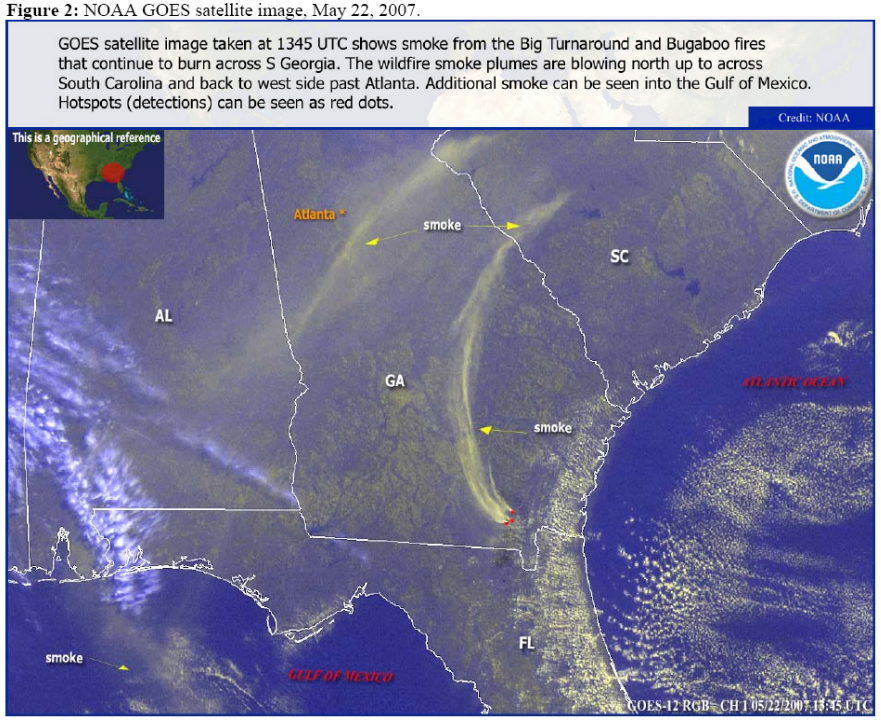


May 24, 2007

From "Evidence for Flagging Exceptional Events"
http://wiki.esipfed.org/index.php/Evidence_for_Flagging_Exceptional_

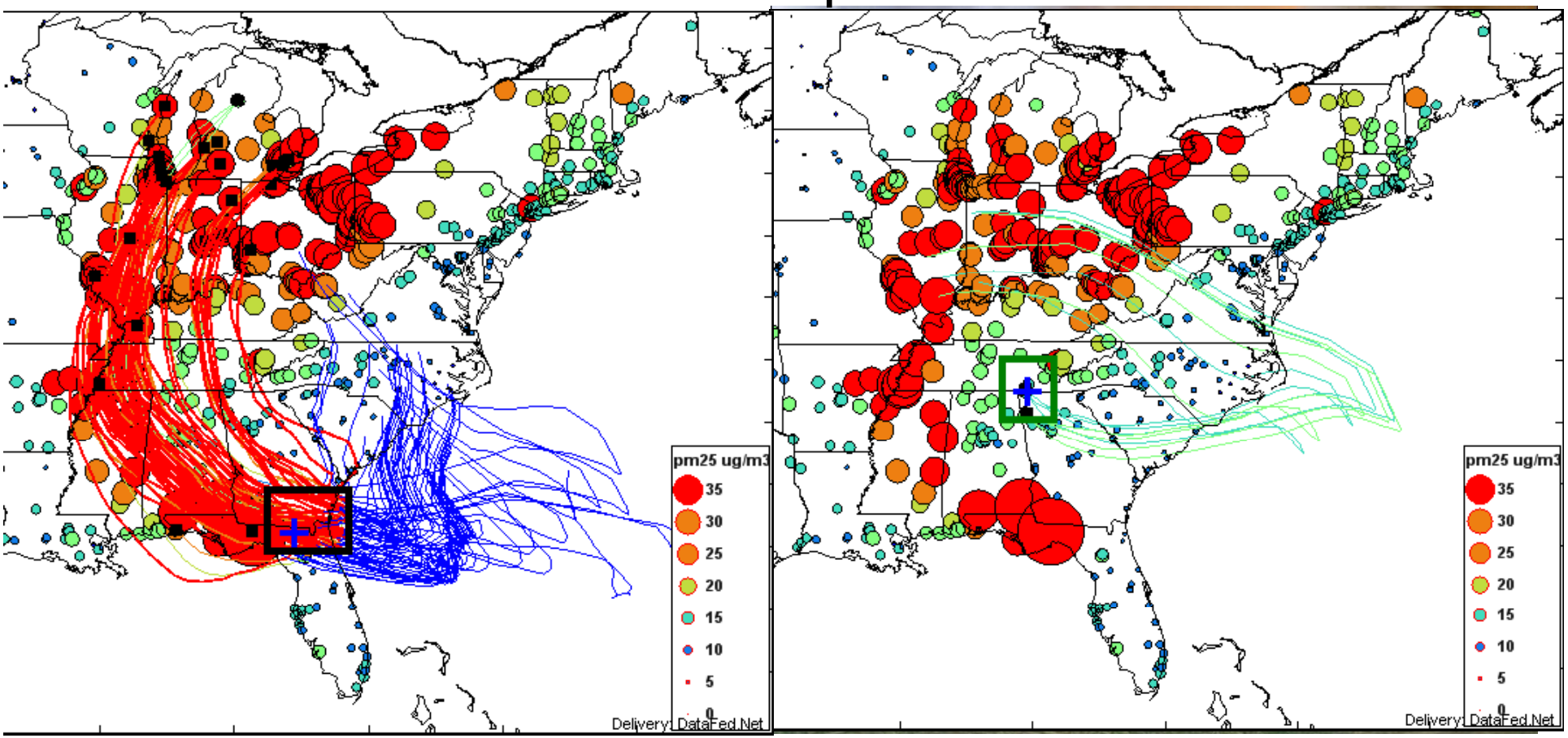
Events
Analyst's Console.

Figure 2: NOAA GOES satellite image, May 22, 2007.



To Describe Causal Connection (Transport)

Source and Receptor Area Tools



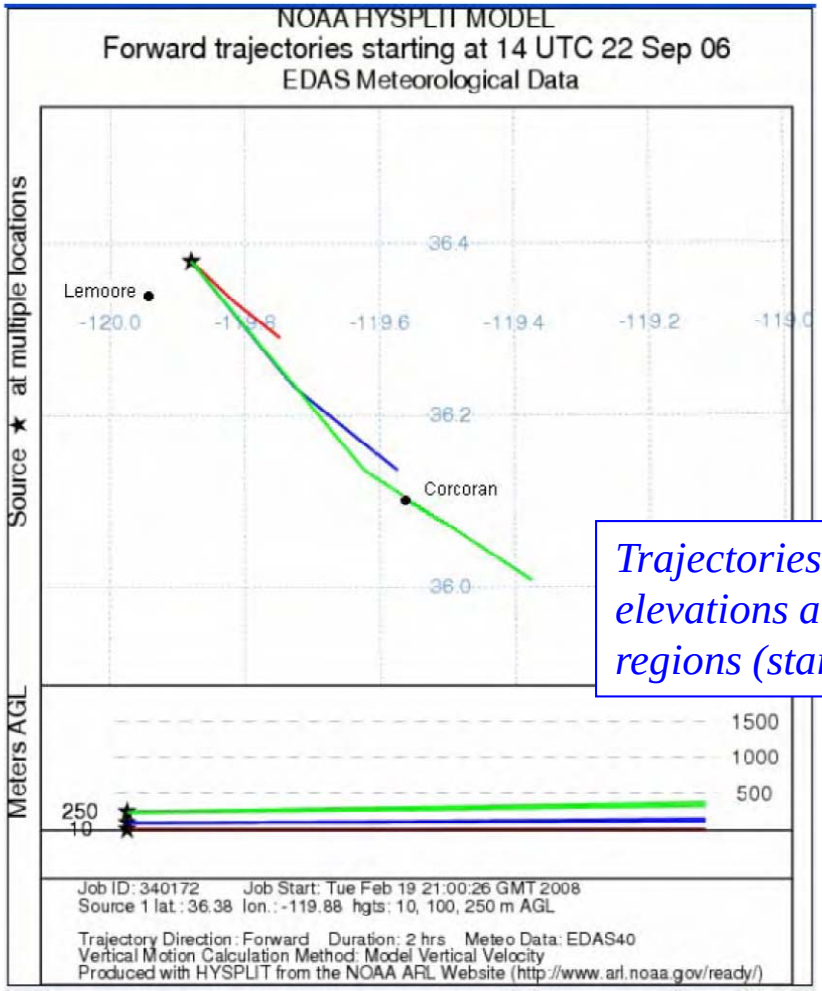
The user can move the rectangles

http://webapps.datafed.net/datafed.aspx?page=0705GAFire/CATT_AQS_D

http://webapps.datafed.net/datafed.aspx?page=0705GAFire/CATT_AQS_D_Rec

Figure 1. Forward Trajectories at 10, 100, & 250 meters, Lemoore Area to Corcoran, September 22, 2006, 6:00 am to 8:00 am PST

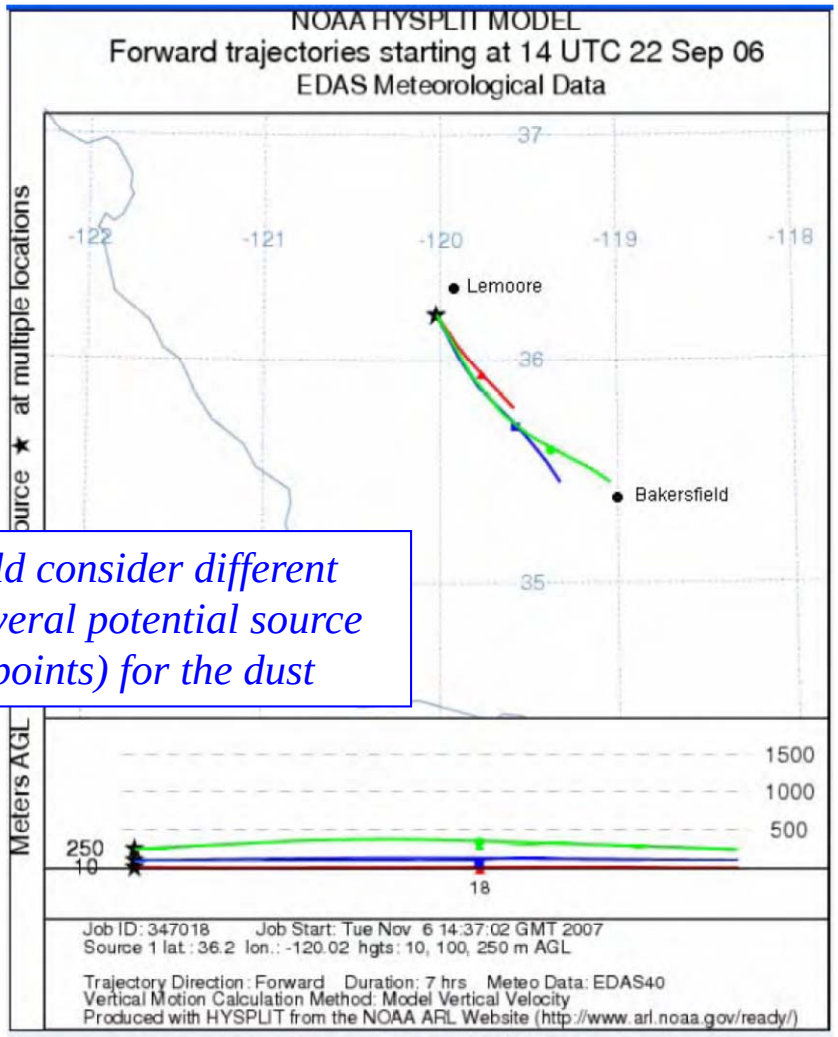
Forward trajectories starting at 6 am PST, Sept. 22, 2006 from just northeast of Lemoore. Runtime is 2 hours. Trajectory start heights are at 10 meters in red, 100 meters in blue and 250 meters in green. These trajectories show the likelihood of windblown dust entrained from the Lemoore area reaching Corcoran within 1 to 2 hours (7 am to 8 am PST) at the 100 meter and 250 meter height levels.



March 6, 2008

Figure 3. Forward Trajectories at 10, 100, & 250 meters, Lemoore Area to Bakersfield, September 22, 2006, 6:00 am to 1:00 pm PST

Forward trajectories starting at 6 am PST, Sept. 22, 2006 from just southwest of Lemoore. Runtime is 7 hours. Trajectory start heights are at 10 meters in red, 100 meter in blue and 250 meters in green. These trajectories show the likelihood of windblown dust entrained from the Lemoore area reaching Bakersfield within 7 hours (1 pm PST) a the 250 meter height level.



March 6, 2008

Trajectories should consider different elevations and several potential source regions (starting points) for the dust

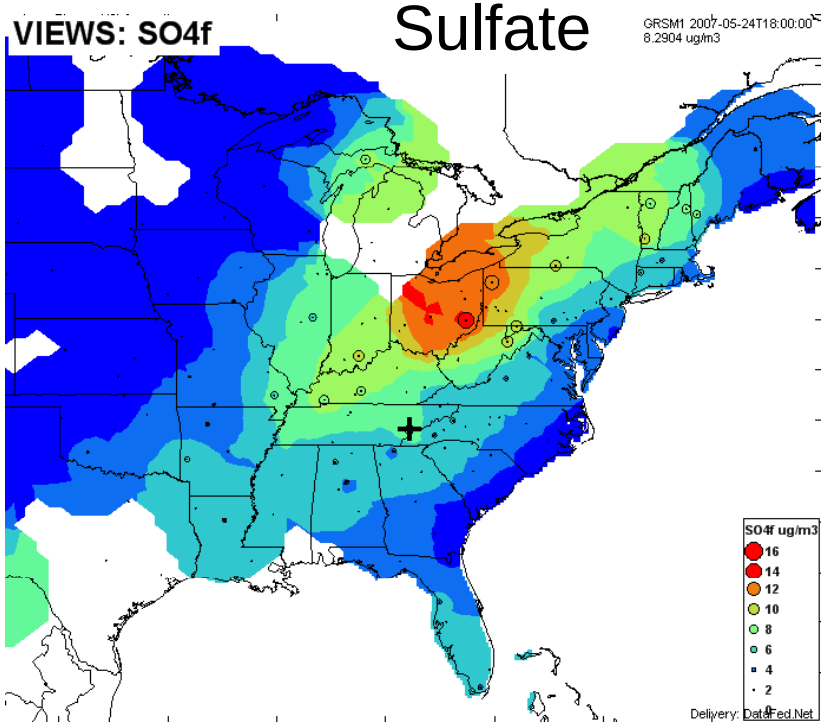
From: Final Affirmation of Determination of Attainment for the San Joaquin Valley Nonattainment Area
http://www.epa.gov/region09/air/sjvalleypm/

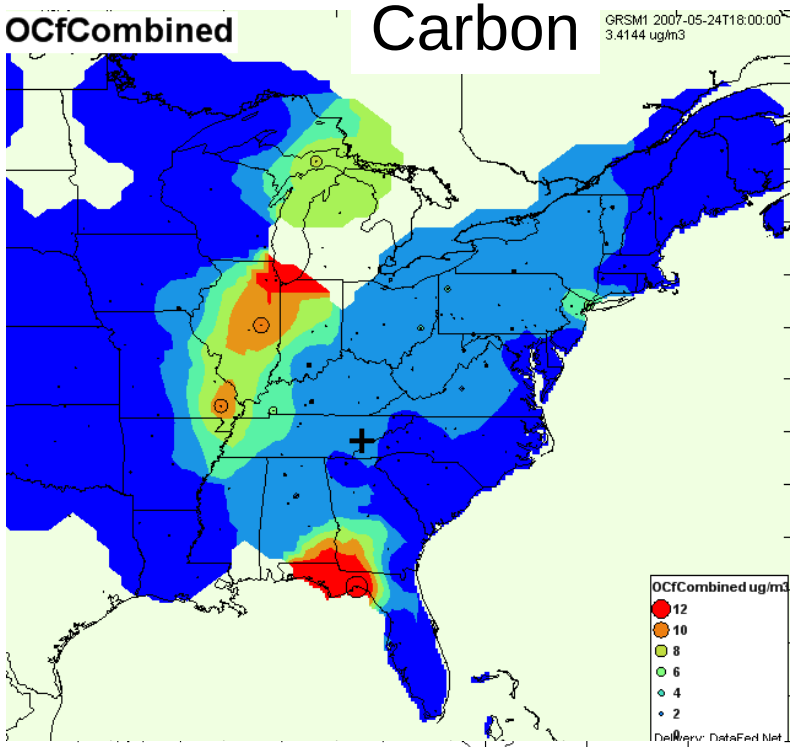
Detailed Discussion of the Evidence

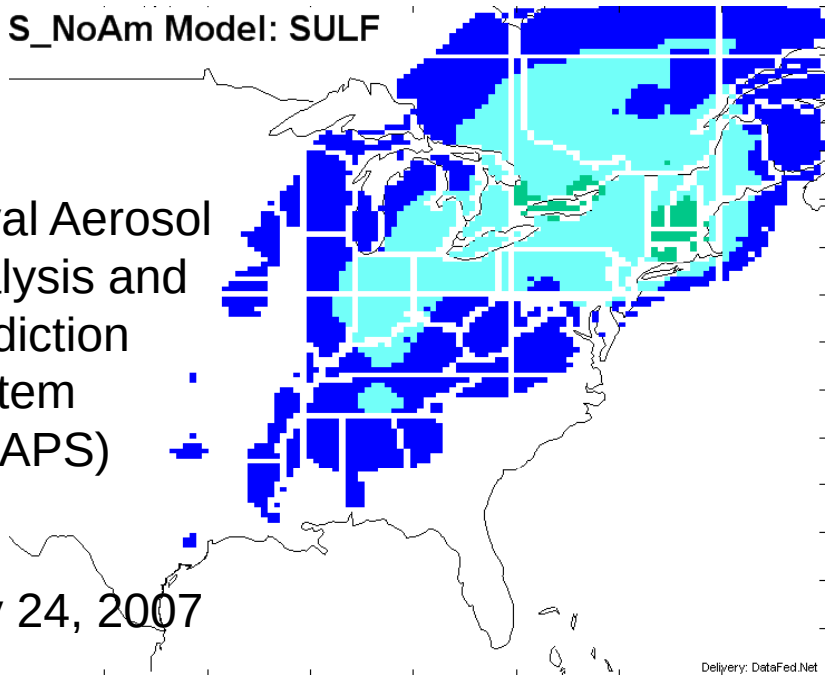
[B] Was there a causal connection between the event and air quality? (continued)

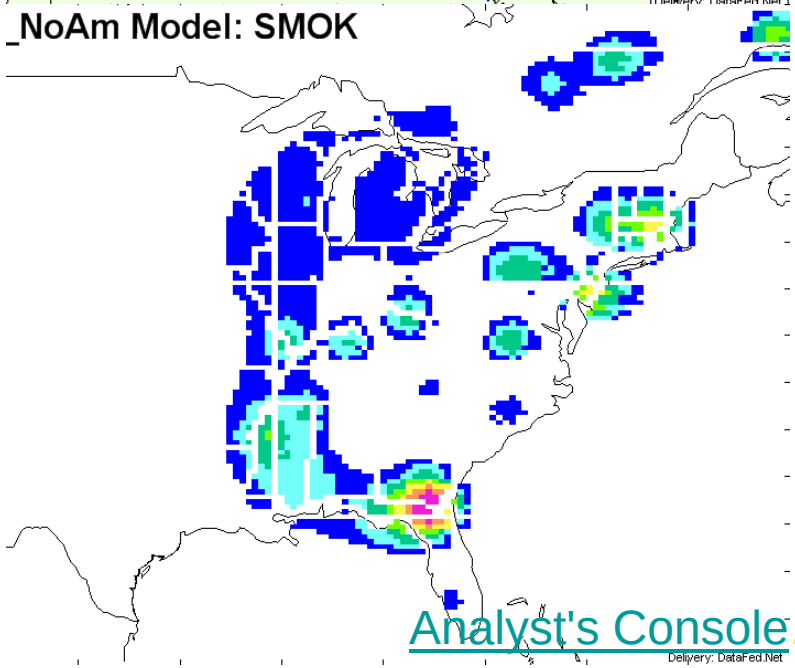
- For smoke impact, evidence of high carbon concentrations, relative to typical and extreme historical levels.
  - using speciation data, if available
    - high OC, high OCMmb, high OC/EC ratio
    - high K+ and non-soil potassium
  - with NAAPS model to show evidence of smoke (Note: this is not necessarily evidence of ground level impact)
  - *for some event assessments, chemical analysis of the FRM Teflon filter may be needed.*
  - Estimated OC on days without STN measurements. Developed from an equation using NAAPS and days with STN data.
- Lack of contrary evidence, such as high sulfates*
- For local event, was the concentration higher than surrounding monitors? For regional event, were ambient concentrations consistently high?
  - Show PM2.5 mass measured at nearby monitors on that day
  - Display in map form if possible
- For claimed fireworks impact, high concentrations of fireworks markers (Sr, K, Cu, Ba, etc)
- For dust, evidence of unusual crustal and other coarse PM.

* *Such information is important to included when available. Partial submittals can be misleading!*









Naval Aerosol Analysis and Prediction System (NAAPS)

May 24, 2007

Analyst's Console.

Detailed Discussion of the Evidence

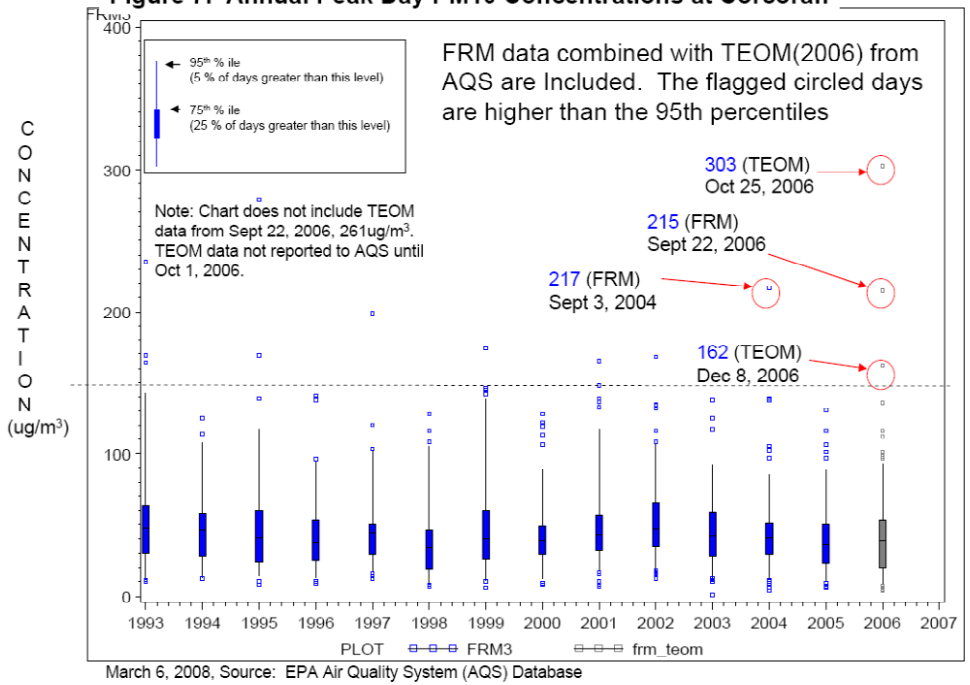
(C) Was the concentration higher than typical air quality, including background?

How unusual was the air quality concentration (and its chemical constituents)

- ***time series or trend plots***
  - *permitting comparison of specific day with other days in current and previous years. Generally, this comparison should focus on the same calendar month or a 30 day window surrounding the event day.*
  - *PM2.5 mass and chemical constituents could be compared to the historical concentration frequency distribution, to judge against 84th and 95th percentiles.*

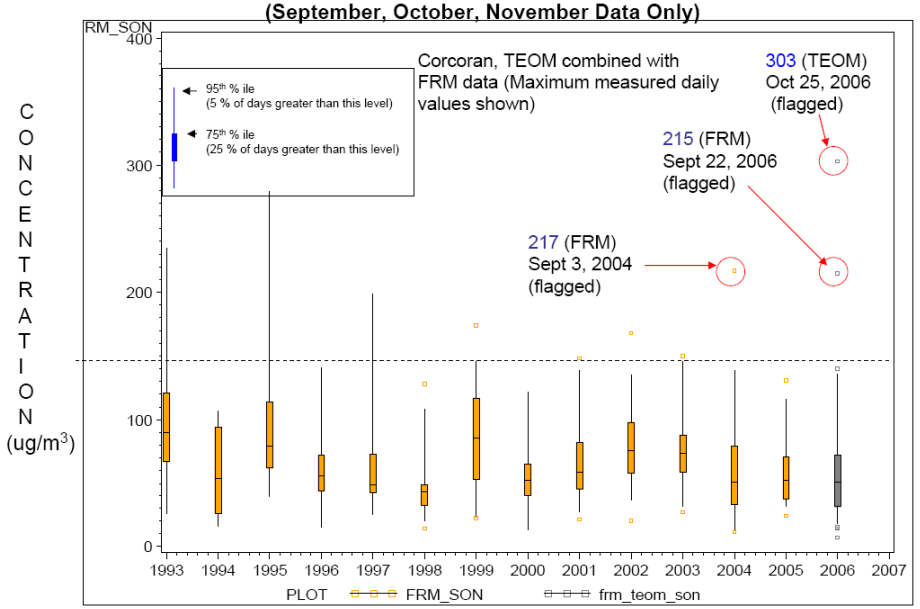
Comparison to Historical PM10 Concentrations – San Joaquin Examples

Figure 7. Annual Peak Day PM10 Concentrations at Corcoran



March 6, 2008, Source: EPA Air Quality System (AQS) Database

Figure 10. Annual Peak Fall Day PM10 Concentrations at Corcoran (September, October, November Data Only)



March 6, 2008, Source: EPA Air Quality System (AQS) Database

From: Final Affirmation of Determination of Attainment for the San Joaquin Valley Nonattainment Area
http://www.epa.gov/region09/air/sjvalleypm/

Detailed Discussion of the Evidence

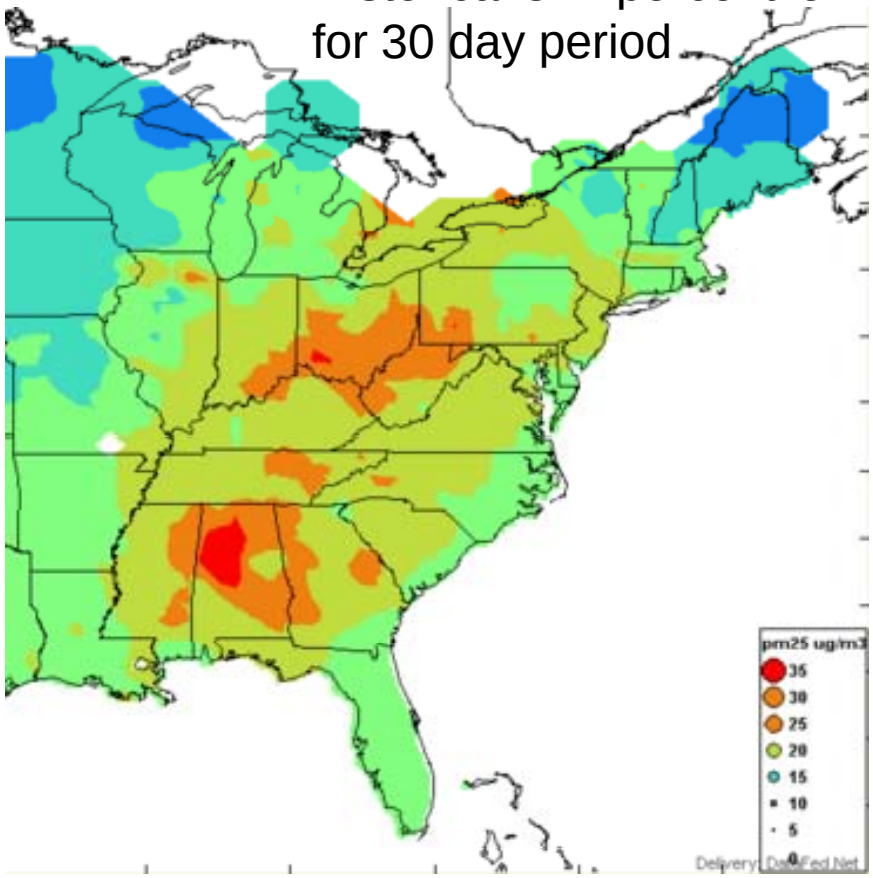
(C) Was the concentration higher than typical air quality, including background? (continued)

- *Spatial patterns*
  - *To further describe the impact of the event*
  - *Look at the increment above the 50th, 84th and 95th percentiles spatially.*
  - *See http://wiki.esipfed.org/index.php/Help:Using_the_Concentration_Anomaly_Tool*

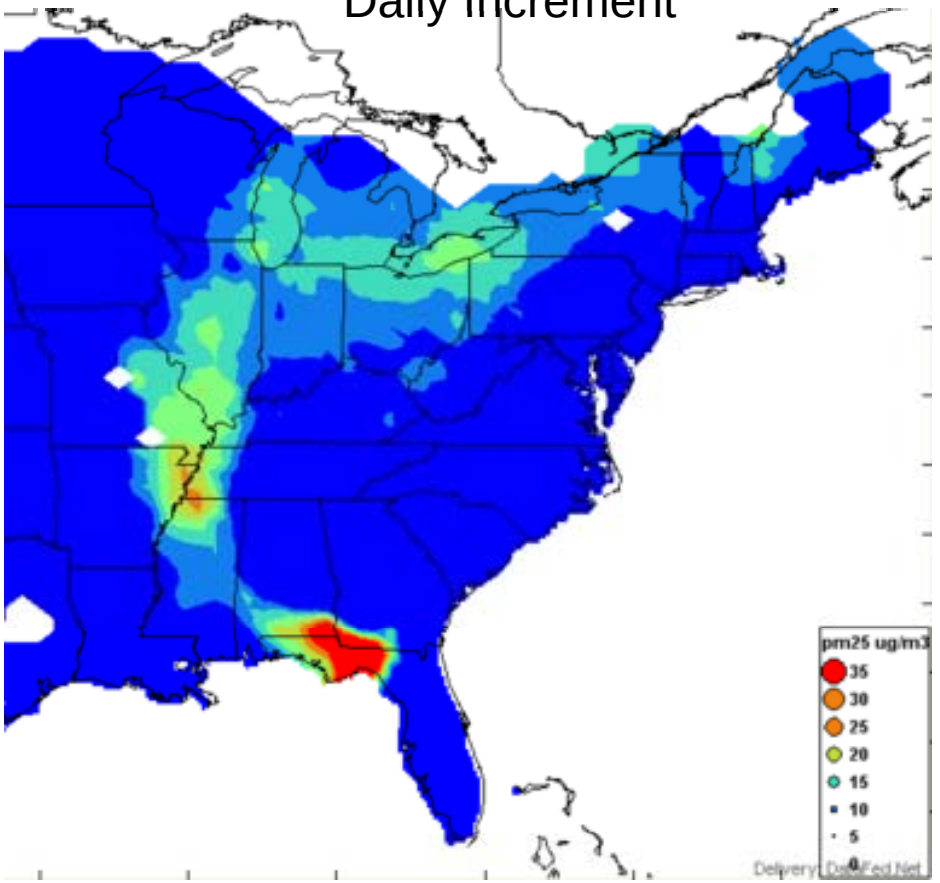
To Compare with Historical Data

Concentration Anomaly Tool

Historical 84th percentile for 30 day period



Daily Increment

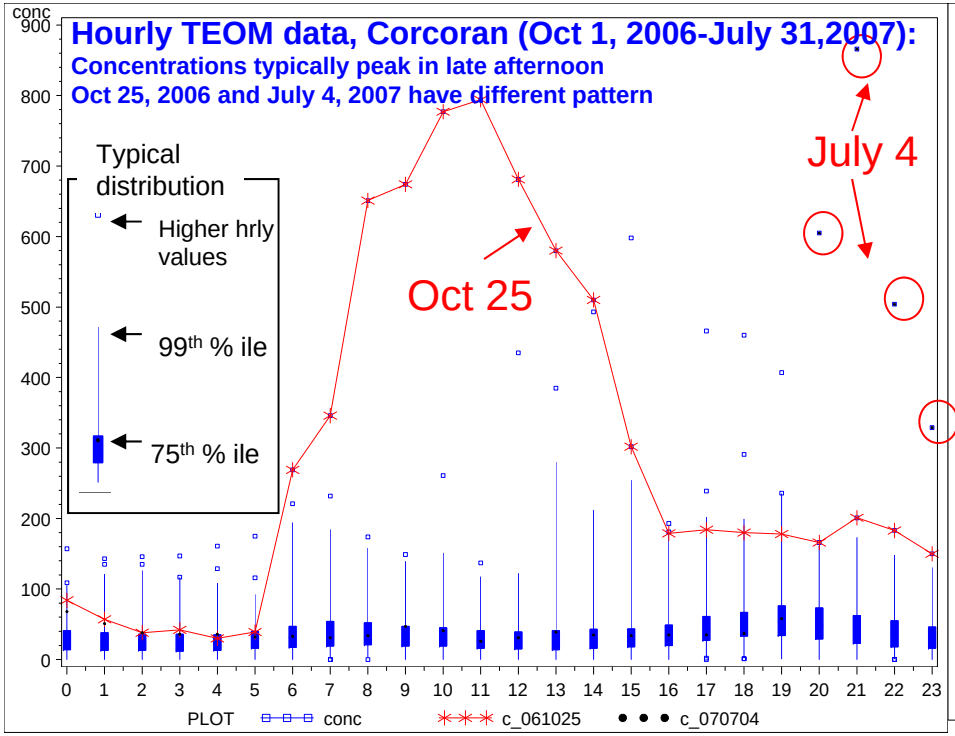


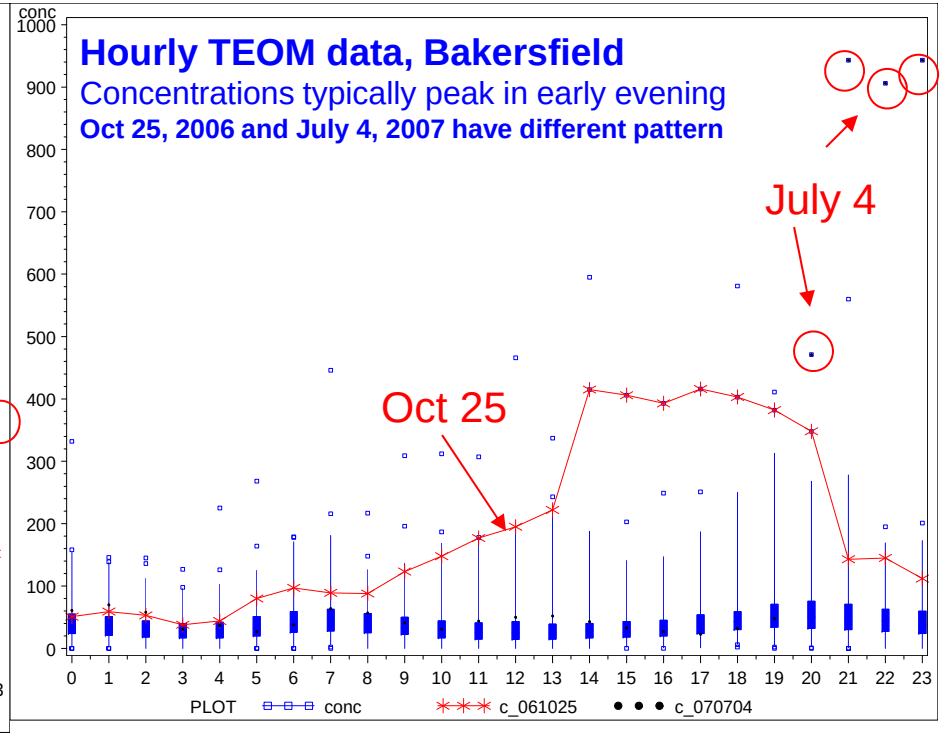
http://wiki.esipfed.org/index.php/Help:Using_the_Concentration_Anomaly_Tool

Detailed Discussion of the Evidence

(C) Was the concentration higher than typical air quality, including background? (continued)

- *Hourly data (when available)*
  - *is the diurnal profile unusual and consistent with the claimed event, e.g. afternoon transport of dust or evening fireworks*





Detailed Discussion of the Evidence

(C) Was the concentration higher than typical air quality, including background? (continued)

- *PM Composition specifics*
  - *For summer time events in eastern US, how does the sulfate and carbon concentrations compare to seasonal average levels?*
  - *How much of the high claimed event-day concentration is due to other reasons, e.g. regional sulfates?* ***This can provide contrary evidence***

Eastern Examples(Hypothetical)

	Event Day	Seasonal Average	Seasonal 95th %ile	Seasonal 99th %ile	
		Comparisons to "Normal"			
PM2.5	**45**	**18**	**30**	**35**	PM2.5: Much higher than normal
Sulfate	8	8	13	18	Sulfate: lower than normal
Carbon	**36**	9	**13**	15	Carbon: much higher than normal
Other	1	1	1	2	
		Comparison to "Normal"			
PM2.5	**28**	**18**	**30**	**35**	PM2.5: Much higher than normal
Sulfate	17	8	13	18	**Sulfate:higher than normal**
Carbon	**10**	**9**	**14**	15	Carbon: comparable to normal
Other	1	1	3	2	

Examples: Comparing PM2.5 mass and constituents to Seasonal Normals
Evidence to show concentrations were abnormally high

Western Examples (Hypothetical)

	Comparison to "Normal"				
	Event Day	Seasonal Average	Seasonal 95th %ile	Seasonal 99th %ile	
PM2.5	**45**	**5**	**7**	**15**	PM2.5: Much higher than normal
Nitrate	2	3	4	4	Nitrate: lower than normal
Carbon	**36**	**2**	**3**	8	Carbon: much higher than normal
Other	1	1	1	2	

	Comparison to "Normal"				
	Event Day	Seasonal Average	Seasonal 95th %ile	Seasonal 99th %ile	
PM2.5	**21**	**6**	**10**	**14**	PM2.5: Much higher than normal
Nitrate	3	3	4	4	Nitrate:similar to normal
Carbon	4	2	5	8	Carbon: comparable to normal
Other(crustal)	**14**	1	1	2	**Crustal: much higher than norm**

Detailed Discussion of the Evidence

(D) "But-For"

Would the exceedance or violation not have occurred, "but-for" the event?

- Comparison of measured PM2.5 mass, and chemical constituents (if available), to seasonal average and seasonal extremes.
- Simple estimate of the "but-for" PM2.5 concentration are the typical values 18-30 ug/m3 (high values to account for day-to-day variability)

Eastern Examples(Hypothetical)

		Comparisons to "Normal"		
	Event Day	Seasonal Average	Seasonal 95th %ile	Seasonal 99th %ile
PM2.5	45	18	30	35

Note: The EE rule says that the event must contribute to an exceedance or violation of the NAAQS.
With this rule, exceedances are PM2.5 values > 15 ug/m3. For concentrations between 15 and 35 ug/m3, the "but for" test can be satisfied by showing that concentrations would have been less than 15 ug/m3 or that there would not have been a NAAQS violation (3-year design value is less than the level of the NAAQS).
If the concentration is greater than 35 ug/m3, it is sufficient to show that "but for" the event the value would have been less than 35 or that there would not have been a violation. Because the 24-hr NAAQS is a 3-year average of annual 98th percentiles, there are situations where it may be sufficient to show that a value less than 35 ug/m3 would have been a few ug/m3 lower.

Detailed Discussion of the Evidence

"But-For" Continued

- Utilize specific chemical constituents associated with the event. For smoke events, use carbon mass.
  - Estimated event day OCM minus seasonal average & extreme values. Using avg and 95th percentile, the estimated excess due to the event is 23-27 ug/m3.*
  - But-For:
    - 45 minus {23-27} → ~18-22 ug/m3
    - In the above example, the evidence is strong based on the large amount of excess carbon.
- For short duration events, like fireworks (or dust), use hourly data to estimate excess PM2.5. The typical high values can be estimated, eg. by the historical 95th percentile of hourly values for the same time of the year.

Eastern Examples(Hypothetical)

Comparisons to "Normal"

	Event Day	Seasonal Average	Seasonal 95th %ile	Seasonal 99th %ile
PM2.5	**45**	**18**	**30**	**35**
Sulfate	8	8	13	18
Carbon(OCM)	**36**	**9**	**13**	15
Other	1	1	1	2

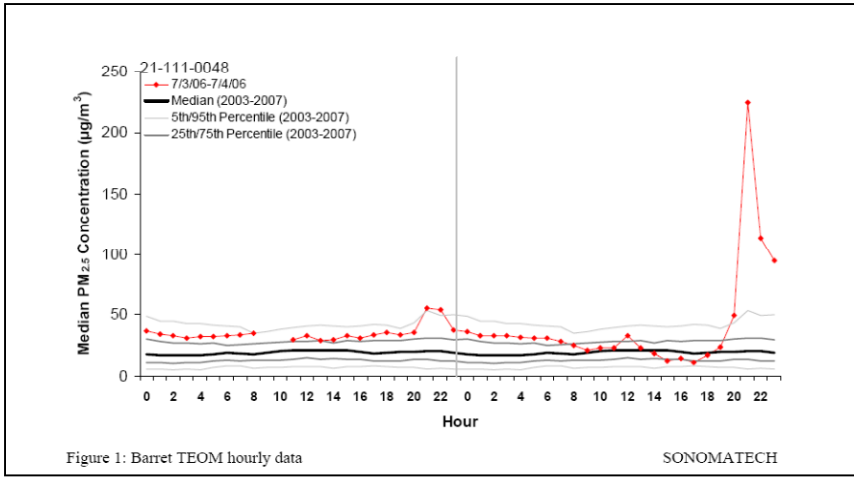


Figure 1: Barret TEOM hourly data SONOMATECH

* An alternative is to look at measured OC and assume excess is all fire-related with mass multiplier of 2.
  - See http://www.epa.gov/pmdesignations/2006standards/rec/region4R.htm

Detailed Discussion of the Evidence

(E) Public Comments

- With the submission of the demonstration, the State must document that the public comment process was followed. Accordingly, the documentation must include the public announcement, description of the public forum in which events were received and the specific public comments, if any.

Appendix

New On Line Tools

New On-Line Tools

to assist with assembly of evidence

Products of Rudy Husar, Washington University

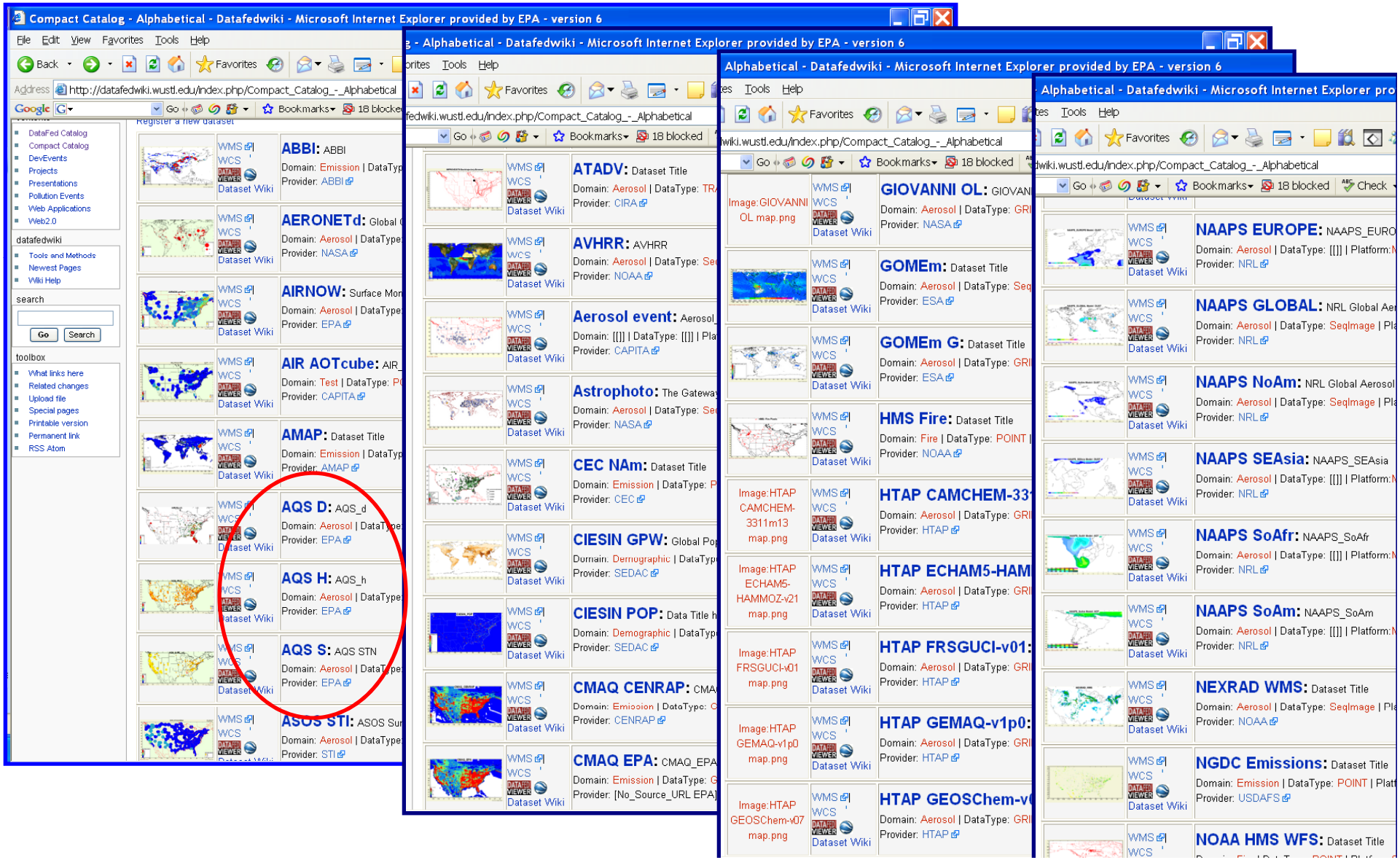
- Graphics and access to relevant EE data sets
  - Trajectories, satellite images, spatial and temporal air quality displays, etc.
- On-line tools are expected to remain operational as part of "DATAFED.NET" and ESIP

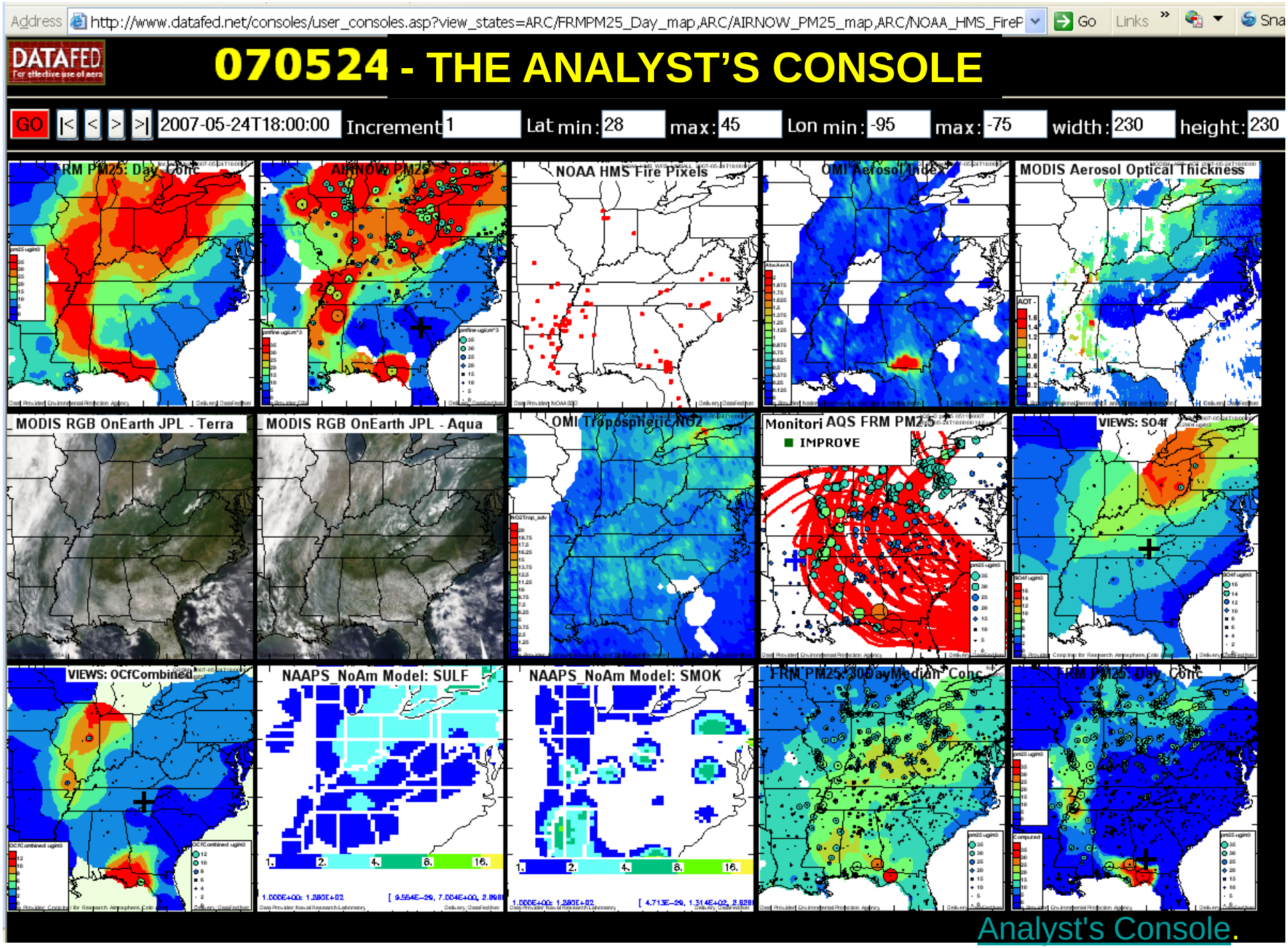
  (Federation Of Earth Science Information Partners)

- In particular, see:
  - Evidence for Flagging Exceptional Events
    - http://wiki.esipfed.org/index.php/Evidence_for_Flagging_Exceptional_Events
    - Analyst's Console.
  - EE Community Work Space
    - http://wiki.esipfed.org/index.php/Exceptional_Air_Pollution_Event_Analysis_Community_Workspace

Catalog of Federated Datasets

Air Quality, Emissions, Meteorology




Address http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/FRMPM25_Day_map,ARC/AIRNOW_PM25_map,ARC/NOAA_HMS_FireP
Go
Links
DATAFED
070524 - THE ANALYST'S CONSOLE
GO
2007-05-24T18:00:00
Increment 1
Lat min: 28 max: 45
Lon min: -95 max: -75
width: 230
height: 230
FRM PM25: Day_Conc
AIRNOW PM25
NOAA HMS Fire Pixels
OMI Aerosol Index
MODIS Aerosol Optical Thickness
MODIS RGB OnEarth JPL - Terra
MODIS RGB OnEarth JPL - Aqua
OMI Tropospheric NO2
Monitori AQS FRM PM2.5
IMPROVE
VIEWS: SO4f
VIEWS: OCfCombined
NAAPS_NoAm Model: SULF
NAAPS_NoAm Model: SMOK
FRM PM25: 30DayMedian_Conc
FRM PM25: Day_Conc
Analyst's Console.

Data Views Catalog:

- CATT_FRMPM25_Traj
- FRMPM25_diff
- FRMPM25_30DayMedian
- FRMPM25_Day
- AIRNOW_PM25
- CATT_FRMPM25
- VIEWS SO4
- VIEWS_OCfCombined
- MODIS_Aqua_RGB_OnEarthJPL
- MODIS_Terra_RGB_OnEarthJPL
- MODIS_AOT
- OMI_AI
- OMI_NO2Trop
- MOPITT_CO
- NAAPS_NoAm_AOT
- NAAPS_NoAm_Sulf
- NAAPS_NoAm_Dust
- NAAPS_NoAm_Smok
- NOAA_HMS_FirePix