Attachment 1

Kentucky
Area Designations For the
24-Hour Fine Particle National Ambient Air Quality Standard

The table below identifies the counties in Kentucky that EPA has designated as nonattainment for the 2006 PM2.5 NAAQS.[1] A county (or part thereof) is designated as nonattainment if it has an air quality monitor that is violating the standard or if EPA determines that the county is to be contributing to the violation of the standard in another nearby area.

Area	Kentucky Recommended Nonattainment Counties	EPA's Intended Nonattainment Counties
Cincinnati-Middletown, OH-KY-IN (formerly Cincinnati-Hamilton, OH-KY-IN)	None	Boone Campbell Kenton
Clarksville, TN-KY	None	Muhlenberg (partial)
Huntington-Ashland, WV-KY-OH	None	Boyd Lawrence (partial)
Louisville, KY-IN	None	Bullitt Jefferson
Paducah-Mayfield, KY-IL	None	McCracken

EPA has designated the remaining counties in the state as "unclassifiable/attainment."

EPA Technical Analysis for Cincinnati-Middletown

Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment both those areas that violate the NAAQS and those nearby areas that contribute to the violations. This technical analysis for the Cincinnati-Middletown area identifies the counties with monitors that violate the 24-hour PM2.5 standard and evaluates other nearby counties for contribution to fine particle concentrations in the violating area. EPA

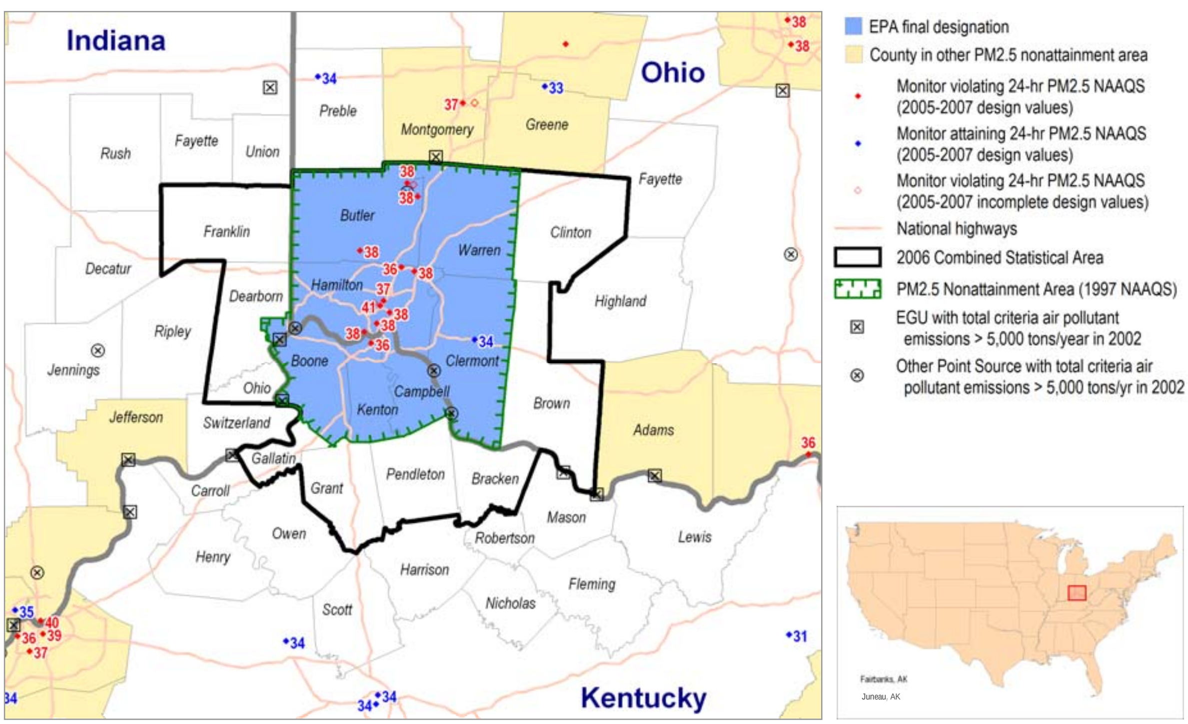
[1] EPA designated nonattainment areas for the 1997 fine particle standards in 2005. In 2006, the 24-hour PM2.5 standard was revised from 65 micrograms per cubic meter (average of 98^{th} percentile values for 3 consecutive years) to 35 micrograms per cubic meter; the level of the annual standard for PM2.5 remained unchanged at 15 micrograms per cubic meter (average of annual averages for 3 consecutive years).

has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

Figure 1 is a map of the counties in the area and other relevant information such as the locations and design values of air quality monitors, the metropolitan area boundary, and counties recommended as nonattainment by the State.

Figure 1. Cincinnati-Middletown, OH-KY-IN MSA



For this area, EPA previously established PM2.5 nonattainment boundaries for the 1997 $PM_{2.5}$ NAAQS that encompassed 7 full and 1 partial counties, including 3 full counties located in Kentucky.

In December 2007, Kentucky recommended that EPA designate no Kentucky counties as "nonattainment" for the 2006 $PM_{2.5}$ NAAQS based on air quality data from 2004-2006. These data are from Federal Reference Method (FRM) and Federal Equivalent Method (FEM) monitors located in the state. In August 2008, EPA notified the State of its intention to modify that recommendation by inclusion of three Kentucky counties in this area, Boone, Campbell, and Kenton. In October 2008, Kentucky provided additional information to support its initial recommendation for an attainment designation for these counties. (Kentucky Division for Air Quality (KDAQ) letters dated December 7, 2007, June 25, 2008, and October 17, 2008)

Based on EPA's evaluation described below, EPA has concluded that Boone, Campbell and Kenton Counties in Kentucky should be designated nonattainment for the 2006 24-hour $PM_{2.5}$ NAAQS as part of the Cincinnati-Middletown nonattainment area, based upon currently available information. These counties are listed in the table below.

Cincinnati-Middletown	State-Recommended Nonattainment Counties	EPA-Recommended Nonattainment Counties
Kentucky	None	Boone Campbell Kenton

The following is a summary of the 9-factor analysis for the Kentucky portion of the Cincinnati-Middletown, OH-KY-IN area.

The Cincinnati-Middletown, OH-KY-IN metropolitan statistical area (MSA) contains the Kentucky counties of Boone, Bracken, Campbell, Gallatin, Grant, Kenton, Pendleton, the Indiana counties of Dearborn, Franklin, and Ohio, and the Ohio counties of Brown, Butler, Clermont, Hamilton, and Warren. Of these counties, Boone, Campbell, and Kenton, Counties were previously designated in 2005 as counties contributing to violations of the 1997 PM2.5 NAAQS in the Cincinnati area. For the 2006 PM2.5 NAAQS, EPA's evaluation has examined these counties with respect to their contribution to violations of the 24 hour standards in adjacent Hamilton County, Ohio, which is located directly across the Ohio River from Boone and Kenton Counties, and nearby to Campbell County. Kenton County currently has a monitor attaining the 24-hour standard with 2005-2007 data with a design value of 35 $\mu g/m^3$. The map included above incorrectly lists the value as 36 $\mu g/m^3$. Boone has a moderate level of $PM_{2.5}$ and SO_2 emissions and population growth for 2000-2005 was 22%. All three have moderate levels of population and commuting within the area.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.]

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Cincinnati-Middletown. Counties that are part of the Cincinnati-Middletown nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State	State Recom-mended Non-attainment	CES	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SO_2 (tpy)	NOx (tpy)	VOCs (tpy)	NH_3 (tpy)
Hamilton	**OH**	**Yes**	**100**	**6,489**	**1,244**	**5,245**	**88,139**	**50,060**	**38,552**	**2,359**
Clermont	**OH**	**Yes**	**36**	**5,399**	**733**	**4,665**	**90,341**	**35,748**	**6,982**	**407**
Butler	**OH**	**Yes**	**24**	**2,269**	**563**	**1,706**	**10,636**	**16,661**	**12,734**	**1,105**
Dearborn	**IN**	**No**	**22**	**2,780**	**288**	**2,492**	**47,908**	**12,881**	**3,268**	**229**
Boone	**KY**	**No**	**6**	**1,629**	**615**	**1,014**	**5,383**	**10,852**	**5,883**	**286**
Warren	**OH**	**Yes**	**5**	**1,304**	**535**	**768**	**568**	**7,244**	**7,278**	**792**
Kenton	**KY**	**No**	**3**	**537**	**269**	**268**	**1,300**	**6,316**	**5,606**	**266**
Campbell	**KY**	**No**	**2**	**412**	**179**	**233**	**731**	**4,231**	**2,923**	**196**
Jefferson	IN	No	7	1,265	168	1,097	75,319	25,214	2,272	341
Adams	OH	No	6	5,970	494	5,476	126,316	33,822	1,918	837
Carroll	KY	No	6	2,652	253	2,399	50,856	17,443	4,181	201

Montgomery	OH	other	6	1,555	637	919	9,468	21,109	21,905	1,314
Mason	KY	No	3	2,019	200	1,818	41,088	11,199	1,099	440
Clinton	OH	No	1	671	220	451	198	2,739	2,496	1,169
Franklin	IN	No	1	448	118	331	163	1,224	1,687	812
Greene	OH	other	1	984	265	719	1,798	8,499	5,712	682
Jennings	IN	No	1	1,818	575	1,242	7,764	6,352	2,154	1,465
Preble	OH	No	1	733	224	509	169	2,737	2,723	999

Note that the table may not include all counties considered in the 9-factor analysis, and that those counties not shown had no factors that indicated that they should be candidates for a nonattainment status.

Boone, Campbell, and Kenton Counties contribute 8, 2, and 3 percent of the direct $PM_{2.5}$ emissions for the MSA, respectively. These percentages are individually low, compared to other counties in the area as a whole, but they nevertheless are occurring in an area nearby and generally upwind of the violating monitors in Ohio. The emissions of PM2.5 precursors including SO2, NOx, and VOCs are also cumulatively adding to the mix of ambient PM2.5 in this area. The main precursor pollutant emissions in Boone, Campbell, and Kenton Counties is NOx, with Boone County contributing 10,852 tpy compared to Campbell and Kenton Counties contributing 4,231 and 6,316 tpy, respectively. Although these amounts of emissions are relatively low by comparison to emissions in other counties in this area, EPA believes that these emissions contribute to the ambient PM2.5 at the violating monitors in adjacent Hamilton County, Ohio. Moreover, the relatively high amounts of NOx and VOC emissions are consistent with EPA's conclusion that the contribution from these three counties in Kentucky are in part due to mobile source emissions, including emissions from commuters who travel throughout the larger designated nonattainment area. Based on emission levels and CES values, Boone, Campbell, and Kenton Counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in $\mu g/m^3$) for air quality monitors in counties in the Cincinnati-Middletown area based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35 $\mu g/m^3$ or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Cincinnati-Middletown area are shown in Table 2.

Table 2. Air Quality Data

County	**State**	**State Recommended Nonattainment**	**Design Values 2004-06 ($\mu g/m^3$)**	**Design Values 2005-07 ($\mu g/m^3$)**
Hamilton	OH	Yes	40	41

Clermont	OH	Yes	--	34
Butler	OH	Yes	38	38
Kenton	KY	No	35	35

In Region 4, Kenton County, Kentucky is not violating the 24-hour $PM_{2.5}$ standard with 2005-2007 data. However, the absence of a violating monitor alone is not a sufficient reason to eliminate counties as candidates for nonattainment status. No monitoring data was available for Boone or Campbell Counties. Each county has been evaluated based on the weight of evidence of the nine factors and other relevant information.

Kentucky submitted a request to flag data for several days at the Kenton County monitor. EPA has approved some of these days and adjusted the Kenton County design value accordingly. See Attachment 3 of this document for the full report on exceptional events for Kenton County.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with a FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM or Alternative Reference Method (ARM) which has operated for more than 24 months is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the area being evaluated, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

The 2005 populations in Boone, Campbell and Kenton Counties are significantly lower when compared to other MSA counties such as Hamilton and Butler. Of the MSA population, 43 percent reside in Hamilton County compared to 17 percent living in Boone, Campbell and Kenton Counties combined. However, the population density of Hamilton County (2007) is only roughly twice that of Kenton County (930), meaning that Kenton County is still relatively densely populated. Of the three Region 4 counties in the MSA, Kenton County has the highest population and is the most densely populated, almost twice that of Campbell County. Boone and Campbell Counties have moderate populations and densities. Although all of the Kentucky counties have less population than several of the individual Ohio counties in this area, Boone, Campbell, and Kenton each have relatively high population, and EPA believes that this is reflective of higher emissions activities that are contributing to the aggregate mix of ambient PM2.5 in this area. This in conjunction with other information, supports the conclusion that emissions from these counties are contributing to violations in Ohio.

Table 3. Population

County	State	State Recommended Nonattainment	2005 Population	2005 Population Density (pop/sq mi)
Hamilton	OH	Yes	828,487	2007
Clermont	OH	Yes	190,329	417
Butler	OH	Yes	349,966	745
Dearborn	IN	No	48,930	160
Boone	KY	No	106,278	414
Warren	OH	Yes	196,793	484
Kenton	KY	No	153,314	930
Campbell	KY	No	87,048	547

Note that the table may not include all counties considered in the 9-factor analysis, and that those counties not shown had no factors that indicated that they should be candidates for a nonattainment status.

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Cincinnati-Middletown, OH-KY-IN area, the percent of total commuters in each county who commute to other counties within the Cincinnati-Middletown, OH-KY-IN area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State	State Recommended Nonattainment	2005 VMT (millions of miles)	Number Commuting to any violating counties	Percent Commuting to any violating counties	Number Commuting into and within the statistical area	Percent Commuting into and within the statistical area
Hamilton	OH	Yes	8,132	364,380	92	391,410	98
Butler	OH	Yes	3,059	143,800	90	153,070	96
Kenton	KY	No	1,647	51,980	68	74,830	99
Clermont	OH	Yes	1,799	45,070	51	86,620	98
Warren	OH	Yes	1,692	41,510	54	62,590	82
Campbell	KY	No	1,000	21,460	50	42,160	99
Boone	KY	No	1,074	17,300	39	43,420	98
Dearborn	IN	No	708	8,920	40	20,700	92

The listing of counties on Table 4 reflects a ranking based on the number of people commuting to other counties. The counties that are in the nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface.

Hamilton and Butler Counties had the highest number of commuters traveling to both violating counties and statistical areas. Kenton County had a relatively high percentage (68 percent) commuting to violating counties and 99 percent commuting to a statistical area. Campbell and Boone Counties each have more than 40,000 commuters, with roughly 40-50% commuting to violating counties.

Based on this factor, Boone, Campbell, and Kenton Counties had traffic and commuting patterns that warrant inclusion in the nonattainment area. The relatively large amount of commuting from these counties to other parts of the nonattainment area supports the conclusion that emission activities in these areas add to the aggregate ambient level of PM2.5 at the violating monitors in Ohio. This is confirmed by other information, such as the CES scores and the pollution roses that indicate that these counties are impacting the violating monitors in the area..

Note: The 2005 VMT data used for table 4 and 5 of the 9-factor analysis has been derived using methodology similar to that described in "Documentation for the final 2002 Mobile National Emissions Inventory, Version 3, September 2007, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002_mobile_nei_version_3_report_092807.pdf
The 2005 VMT data were taken from documentation which is still draft, but which should be released in 2008.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled (VMT) for 1996-2005 for counties in the Cincinnati-Middletown area, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Cincinnati-Middletown area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

County	State	Population (2005)	Population Density (2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Hamilton	OH	828,487	2007	-2	8,132	3
Clermont	OH	190,329	417	7	1,799	16

Butler	OH	349,966	745	5	3,059	28
Dearborn	IN	48,930	160	6	708	30
Boone	KY	106,278	414	22	1,074	48
Warren	OH	196,793	484	22	1,692	34
Kenton	KY	153,314	930	1	1,647	3
Campbell	KY	87,048	547	-2	1,000	4

Boone and Warren Counties had high population growth between 2000 and 2005 as well as a sizable increase in VMT from 1996 to 2005, an increase greater than Kenton, Campbell and Hamilton Counties in the Cincinnati-Middletown area.

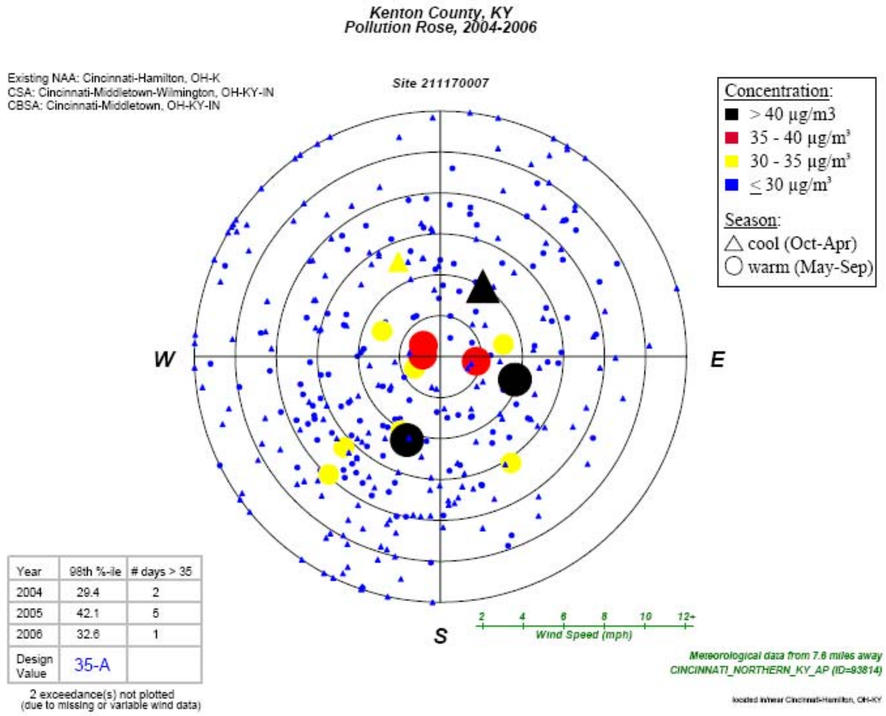
Based on this factor, Boone County had relatively high population growth between 2000 and 2005, and warrants inclusion in the nonattainment area based on this and other information related to emissions and commuting and the CES.

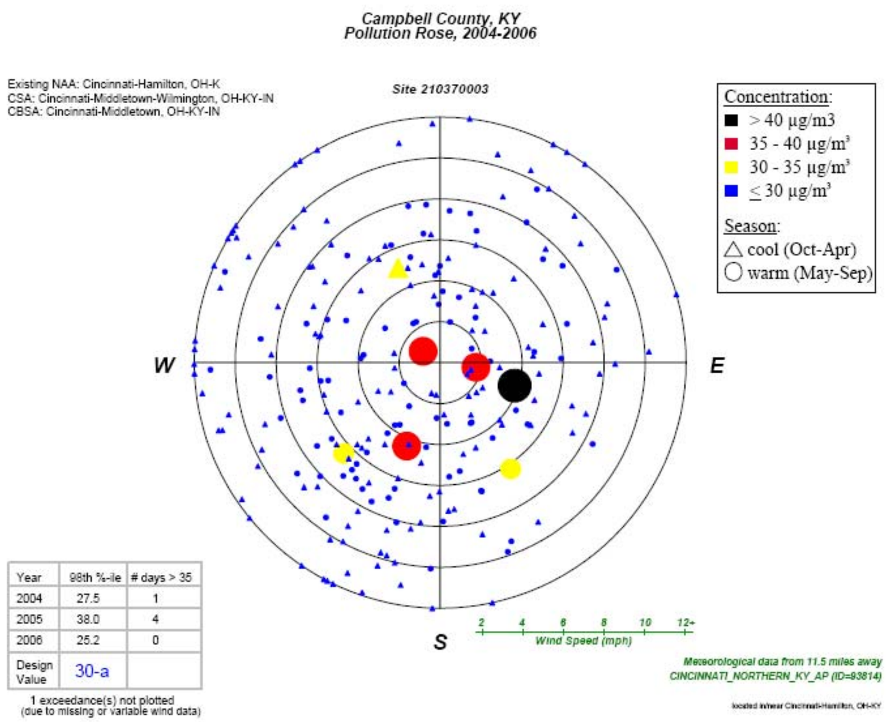
Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on "high $PM_{2.5}$ days" for each of two seasons (an October-April "cold" season and a May-September "warm" season). These high days are defined as days where any FRM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a "pollution rose" to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. Pollution roses for Kenton and Campbell Counties





As shown in the pollution roses in Figure 2, high PM2.5 days occur almost exclusively in the warm season. It also shows that violations occur under both stagnant conditions, indicative of a buildup of area-wide PM2.5-related emissions, and on days with stronger prevailing surface winds. The winds are least likely to come from a northeasterly direction (toward central Ohio). On high PM2.5 days with stronger winds (4+ mph) the prevailing direction is most often southerly, from ESE to SW (from direction of Campbell, Kenton, and Boone Counties). High PM2.5 days rarely occur under high-wind conditions that would be suggestive of longer-range transport, leading to the conclusion that violations are highly influenced by sources of emissions in the immediate area.

Based on the pollution rose information, the emissions from the Kentucky counties nearest to the Ohio violating monitors and in the path of prevailing winds on high $PM_{2.5}$ days in the Cincinnati-Middletown area are likely to contribute to violations, and warrant consideration based on this factor. This includes Campbell, Kenton, and Boone Counties.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Cincinnati-Middletown, OH-KY-IN area.

The Cincinnati-Middletown, OH-KY-IN area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. Therefore, the absence of topographical and geographical barriers in this area supports our conclusion that emissions from Boone, Campbell, and Kenton Counties can be contributing to violations in the area.

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

In evaluating the jurisdictional boundary factor, EPA gave special consideration to areas that were already designated nonattainment in 2005 for violating the 1997 fine particle standards. Analysis of chemical composition data in these areas indicates that the same components that make up most of the PM2.5 mass in the area on an annual average basis (such as sulfate and direct PM2.5 carbon in many eastern areas) also are key contributors to the PM2.5 mass on days exceeding the 24-hour PM2.5 standard. These data indicate that in many cities, the same source categories that contribute to violations of the annual standard also contribute to exceedances of the 24-hour standard.

Most areas that were originally designated nonattainment for the PM2.5 standards still have not attained the standards. Thus, EPA has generally concluded that counties that were designated as having emissions sources contributing to fine particle concentrations which continue to exceed the 1997 standards (all areas violated the annual standard, two also violated the previous 24-hour standard) also contribute to fine particle concentrations on the highest days. For this reason, EPA believes that for most existing nonattainment areas, the nonattainment area for the 2006 24-hour standard should be the same. Consideration also should be given to existing boundaries and organizations as they may facilitate air quality planning and the implementation of control measures to attain the standard. Areas already designated as nonattainment represent important boundaries for state air quality planning.

For Cincinnati-Middletown, OH-KY-IN area, the MSA Counties in the nonattainment area for the 1997 $PM_{2.5}$ NAAQS include Boone, Kenton, and Campbell Counties in Kentucky, Dearborn County in Indiana, and Butler, Clermont, Hamilton, and Warren Counties in Ohio.

For Cincinnati-Middletown, OH-KY-IN area, the MSA Counties in the nonattainment area for the 1997 8-hour ozone standard were Boone, Campbell and Kenton Counties in Kentucky, Dearborn County in Indiana, and Butler, Clermont, Hamilton, Warren and Clinton Counties in Ohio.

The Cincinnati-Middletown, OH-KY-IN metropolitan area (originally the Cincinnati-Hamilton MSA) is composed of several counties including Boone, Bracken, Campbell, Gallatin, Grant, Kenton and Pendleton in Kentucky, Dearborn, Franklin and Ohio Counties in Indiana and in Ohio there is Brown, Butler, Clermont, Hamilton and Warren Counties.

Based on jurisdictional boundaries, Boone, Campbell, and Kenton Counties warrant consideration.

Factor 9: Level of control of emission sources

Under this factor, the existing level of control of emission sources is taken into consideration. The emissions data used by EPA in this technical analysis and provided in Table 1 (under Factor 1) represent emissions levels taking into account any control strategies implemented in the Cincinnati-Middletown area before 2005 on stationary, mobile, and area sources. Data are presented for PM2.5 components that are directly emitted (carbonaceous PM2.5 and crustal PM2.5) and for pollutants which react in the atmosphere to form fine particles (e.g. SO_2, NOx, VOC, and ammonia).

In considering county-level emissions, EPA used data from the 2005 National Emissions Inventory, the most updated version of the national inventory available at the beginning of the designations process in late 2007. However, EPA recognized that for certain counties, emissions may have changed since 2005. For example, certain power plants or large sources of emissions in or near this area may have installed emission controls or otherwise significantly reduced emissions since 2005. Some States provided updated information on emissions and emission controls in their comments to EPA. EPA considered such additional information in making final designation decisions.

With regard to nearby power plants, EPA considered information about whether a specific plant installed federally enforceable emission controls by December 2008 resulting in significant emissions reductions. A control requirement is considered to be federally-enforceable if it is required by a State regulation adopted in a State implementation plan, if it is included in a federally-enforceable Title V operating permit, or if it is required by a consent decree which also requires the controls to be included in federally enforceable permit upon termination of the consent decree. In making final decisions, EPA also considered whether a facility would continue to emit pollutants which contribute to PM2.5 exceedances even after emission controls are operational.

A source of emissions in Boone County which affects the monitor in Kenton County is from the Duke Power Plant – East Bend Station near Rabbit Hash, KY. Installed equipment at this site includes a wet lime scrubber, which controls SO_2 emissions, and a modified furnace design with low NO_X burner (LNB) and selective catalytic reduction (SCR) to reduce NO_X emissions. EPA did not receive additional information indicating a significant change in emissions from this source since 2005. The source continues to have relatively large emissions of PM2.5-related pollutants that contribute to the violating area.

Based on this factor, Boone County warrants consideration for the nonattainment area as well as factors 1, 4, 5, 6, and 8.

Conclusion

EPA concludes that the appropriate nonattainment boundary for the 2006 PM2.5 NAAQS for the Cincinnati-Middletown area includes Boone, Campbell, and Kenton Counties in Kentucky based on an assessment of the above factors. Specifically, all have significant PM2.5-related emissions that impact violating monitors across the river in adjacent Ohio, all have traffic and commuting patterns that indicate contribution of PM2.5-related emissions to the ambient levels at the violating monitors, and all are generally upwind of the violating monitors as indicated by the pollution roses for this area. In addition, these counties are already within the existing designated boundary for the nonattainment area for the 1997 PM2.5 NAAQS, and EPA has concluded that the additional information provided by Kentucky did not establish that these counties are not contributing to the violations of the 2006 PM2.5 NAAQS. In particular, EPA notes that Boone County contributes relatively high amounts of PM2.5 precursors to the area, and Kenton County contributes in particular based on its population density and degree of urbanization, indicative of significant emissions of PM2.5-related precursors from population-based activities.

Additional information regarding responses to specific State comments can be found in EPA's Response to Comments document at http://www.epa.gov/pmdesignations/2006standards/tech.htm.

EPA Technical Analysis for Clarksville, TN-KY

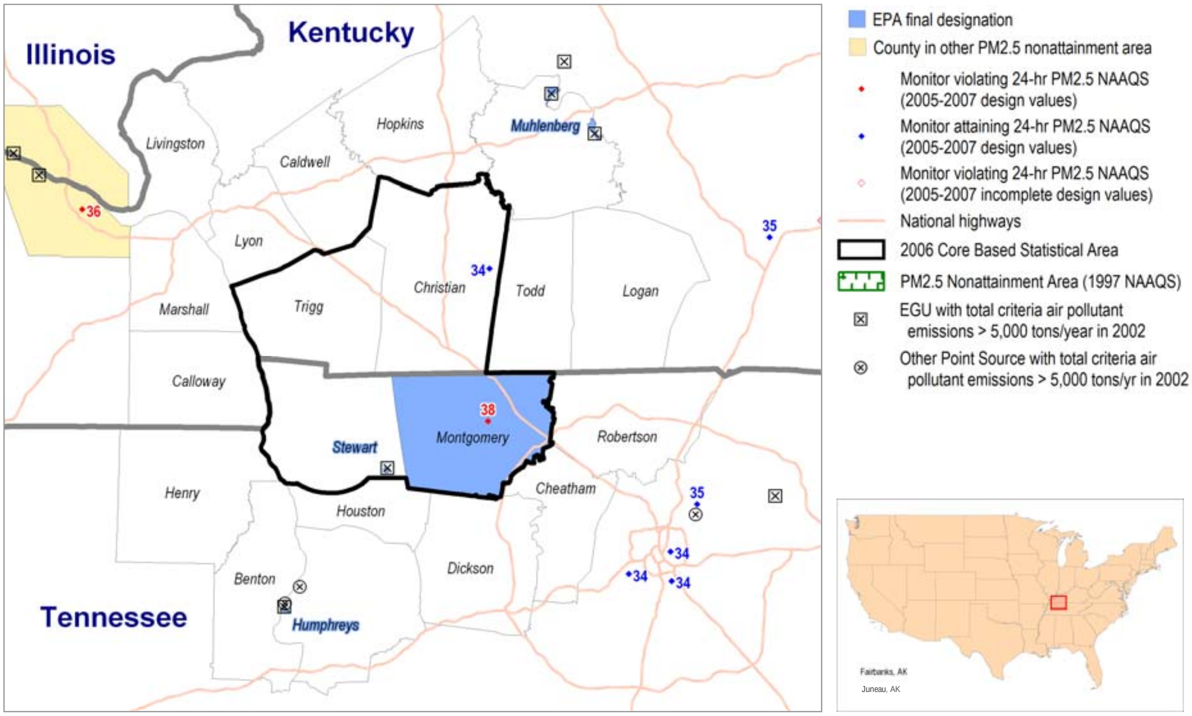
Discussion

Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for Clarksville, TN-KY area identifies the counties with monitors that violate the 24-hour PM2.5 standard and evaluates nearby counties for contributions to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

Figure 1 is a map of the counties in the area and other relevant information such as the locations and design values of air quality monitors, the metropolitan area boundary, and counties recommended as nonattainment by the State.

Figure 1. Clarksville, TN-KY MSA



In December 2007, Kentucky recommended that no areas be designated as "nonattainment" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2004-2006. In summer of 2008, analysis of 2005-2007 Federal Reference Method monitoring data indicated that a monitor in Clarksville, TN (Montgomery County) was violating the standard with a design value of 37 ug/m3.

In August 2008, EPA notified Kentucky of its intent to designate Muhlenberg County, Kentucky as a contributing county in the Clarksville nonattainment area. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the state in making final decisions on the designations. Kentucky submitted a response in October 2008 to confirm its request that Muhlenberg County be designated as "attainment" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2005-2007. Kentucky also provided additional information to support their request for state-wide attainment. (See Kentucky Division for Air Quality (KDAQ) letters dated December 7, 2007, June 25, 2008, and October 17, 2008)

Based on EPA's technical analysis described below, EPA has designated two partial county areas within Muhlenberg County, Kentucky as nonattainment for the 24-hour

$PM_{2.5}$ air-quality standard as part of the Clarksville, TN-KY nonattainment area, based upon currently available information. These counties are listed in the table below.

	State-Recommended Nonattainment Counties	EPA-Final Designated Nonattainment Counties
Clarksville, TN-KY	None	Muhlenberg (partial)

The following is a technical analysis for the Kentucky portion of the Clarksville, TN-KY area.

In general, the Clarksville, TN-KY area is a small metropolitan statistical area (MSA) with four counties. Montgomery county contains a monitor that is violating the PM2.5 standard. Parts of three other nearby counties are included in the nonattainment area on the basis of contributing emissions from power plants. Stewart county, also in the MSA, contains a power plant that has NO_X and SO_2 controls, yet still emits 35,000 tons of NO_X and 20,000 tons of SO_2 annually (based on 2006 emissions.) In addition, two non-MSA counties, Humphreys, TN, and Muhlenberg, KY, also have power plants. Humphreys' 2006 power plant emissions were approximately 20,000 tons of NO_X and 97,000 tons of SO_2, while Muhlenberg's 2006 power plant emissions were approximately 44,000 tons of NO_X and 98,000 tons of SO_2. (Note that these 2006 emissions levels vary to some degree from the 2005 emissions data presented in table 1.)

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.]

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Clarksville. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State Recom-mended Non-attain ment	CES	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SO_2 (tpy)	NO_X (tpy)	VOCs (tpy)	NH_3 (tpy)
Muhlenberg Co, KY	No	100	3,769	226	110	100,828	39,096	1,741	787
Humphreys Co, TN	No	92	6,359	368	249	77,765	23,238	5,458	730
Montgomery Co, TN	No	76	1,424	331	152	2,156	5,555	6,438	485
Stewart Co, TN	No	47	2,614	159	93	17,755	28,776	1,689	154
Dickson Co, TN	No	19	909	219	83	432	3,212	4,375	268
Robertson Co, TN	No	17	703	186	102	560	3,870	3,363	806
Cheatham Co, TN	No	16	484	159	75	325	2,172	3,201	100
Christian Co, KY	No	14	728	140	102	854	3,947	3,833	1,639
Trigg Co, KY	No	7	537	184	67	222	1,332	1,815	451

Based on emission levels and CES values, Muhlenberg County, Kentucky is a candidate for a 24-hour $PM_{2.5}$ nonattainment designation. Christian and Trigg counties rank low for nearby counties under consideration for this area.

In the designation process for the 1997 $PM_{2.5}$ standards, in some cases EPA identified a nearby county as contributing to a violating monitor, and it was determined that a very high percentage of the county's emissions came from on or more large power plants. In certain cases, EPA concluded based on review of various other factors that only the portion of the county including the source with the contributing emissions needed to be designated as nonattainment. In the August letter EPA requested that if Kentucky believed that a similar situation exists for Muhlenberg County, the Commonwealth should provide EPA the necessary information to demonstrate that one or more sources dominate the overall county emissions and to identify a reasonable partial county boundary. The State indicated that because the TVA Paradise plant had recently installed a scrubber in 2007, it could not reduce emissions any further and should not be included in the nonattainment area. However, EPA has determined that despite the operation of emission controls the current emissions from the plant contribute to nearby exceedances of the PM2.5 standard.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in µg/m^3) for air quality monitors in counties in the Clarksville area based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35 µg/m^3 or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Clarksville area with PM2.5 monitors are shown in Table 2.

Table 2. Air Quality Data

County	State Recommended Nonattainment	24-hr PM2.5 Design Values, 2004-2006 (µg/m^3)	24-hr PM2.5 Design Values, 2005-2007 (µg/m^3)
Montgomery	No	34	38
Christian	No	30	33

No Kentucky counties show a violation of the 24-hour $PM_{2.5}$ standard in the Clarksville area. Therefore, no Kentucky counties are included in the Clarksville nonattainment area based on this factor. However, the absence of a violating monitor alone is not a sufficient reason to eliminate counties as candidates for nonattainment status. Each county has been evaluated based on the weight of evidence of the nine factors and other relevant information.

Under this factor, we also consider fine particle composition monitoring data. Air quality monitoring data on the composition of fine particle mass are available from the EPA Chemical Speciation Network and the IMPROVE monitoring network. Analysis of these data indicates that the days with the highest fine particle concentrations in the Clarksville region occur about 88% in the warm season and 12% in the cool season. In the warm season, the average chemical composition of the highest days is 72% sulfate, 24% carbon, 3% crustal, and 0% nitrate. In the cool season, the average chemical composition of the highest days is 34% sulfate, 34% nitrate, 29% carbon, and 3% crustal. These data indicate that sources of SO2, direct PM2.5, and NOx emissions contribute to violations in the area.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with an FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the Clarksville area, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

Based on this factor, Montgomery County, TN dominates the Clarksville area in terms of population and population density. Christian County, KY has the next highest population and density; however, Christian County has a monitor which shows attainment with the 24-hour $PM_{2.5}$ standards. Nearly 90 percent of the population in the Clarksville MSA is located in Montgomery County, Tennessee and Christian County, Kentucky.

Table 3. Population

County	State Recommended Nonattainment	2005 Population	2005 Population Density (pop/sq mi)
Montgomery	No	146,845	270
Christian	No	69,735	96
Muhlenberg	No	31,562	66
Humphreys	No	18,208	33
Trigg	No	13,329	28
Stewart	No	12,975	26

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Clarksville area, the percent of total commuters in each county who commute to other counties within the Clarksville area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State Recommended Non-attainment	2005 VMT (millions of miles)	Number Commuting to any violating counties	Percent Commuting to any violating counties	Number Commuting into statistical area	Percent Commuting into statistical area

Montgomery	No	1,343	40,570	62	56,550	87
Christian	No	1,002	2,080	6	31,190	95
Stewart	No	122	1,480	30	4,180	84
Trigg	No	262	140	3	5,010	93
Humphreys	No	341	50	1	120	2
Muhlenberg	No	311	20	0	230	2

The listing of counties on Table 4 reflects a ranking based on the number of people commuting to other counties. No Kentucky counties are candidates based on this factor.

Note: The 2005 VMT data used for table 5 and 6 of the 9-factor analysis has been derived using methodology similar to that described in “Documentation for the final 2002 Mobile National Emissions Inventory, Version 3, September 2007, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: atftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002_mobile_nei_version_3_report_092807.pdf
The 2005 VMT data were taken from documentation which is still draft, but which should be released in 2008.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in the Clarksville area, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Clarksville area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

Location	Population (2005)	Population Density (2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Montgomery	146,845	270	9	1,343	20
Christian	69,735	96	(4)	1,002	18
Muhlenberg	31,562	66	(1)	311	29
Humphreys	18,208	33	2	341	43
Trigg	13,329	28	5	262	11
Stewart	12,975	26	4	122	21

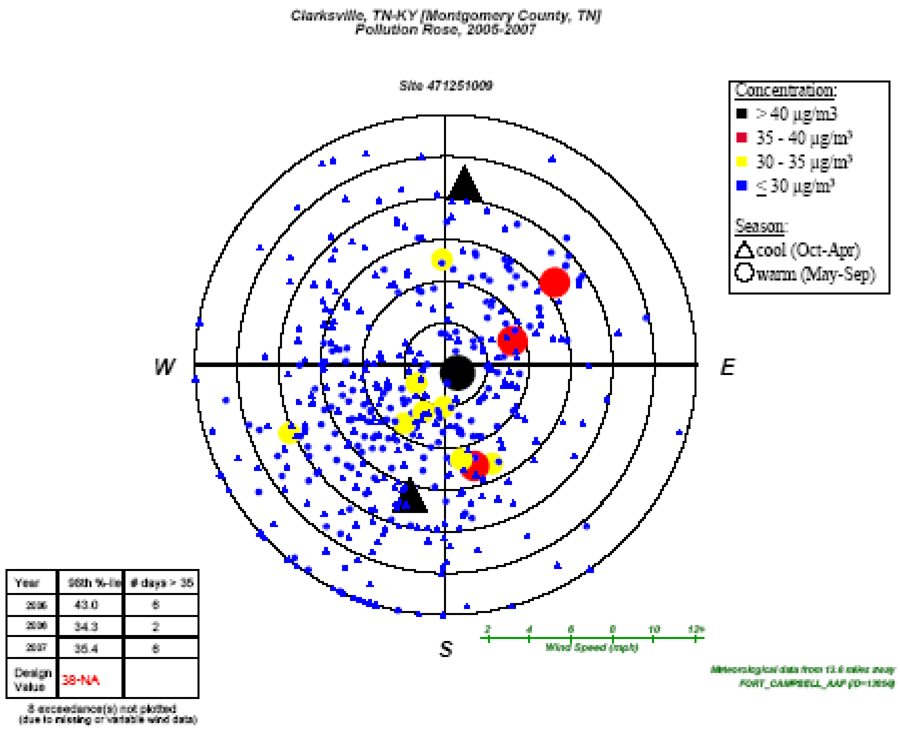
No Kentucky counties are candidates based on this factor.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on “high $PM_{2.5}$ days” for each of two seasons (an October-April “cold” season and a May-September “warm” season). These high days are defined as days where any FRM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a “pollution rose” to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. Pollution rose for the Clarksville area.



As shown in the pollution rose in Figure 2, on high PM2.5 days prevailing surface winds often come from the north or south. The pollution roses show that 24-hour $PM_{2.5}$ concentrations are influenced by emissions from any direction at various times, but these data also suggest that emissions from some directions relative to the violation are more likely to contribute to the violation than emissions from other directions, specifically from the direction of Muhlenberg County, Kentucky, and Humphreys County, Tennessee.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Based on this factor and the power plant emissions and CES, Muhlenberg County in Kentucky warrants inclusion in the Clarksville nonattainment area.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Clarksville area.

The Clarksville, TN-KY area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. Therefore, the absence of topographical and geographical barriers in this area supports our conclusion that emissions from Muhlenberg County can be contributing to violations in the area.

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

The Clarksville area is not an existing area under the 1997 $PM_{2.5}$ standards, but is a maintenance area (Montgomery County, Tennessee only) for the 1-hour and 8-hour ozone standards. Therefore, no Kentucky counties are candidates based on this factor.

Factor 9: Level of control of emission sources

This factor considers emission controls currently implemented for major sources in the Clarksville area.

The emission estimates on Table 1 (under Factor 1) include any control strategies implemented by the states in the Clarksville area before 2005 that may influence emissions of any component of $PM_{2.5}$ emissions (i.e., total carbon, SO_2, NOx, and crustal $PM_{2.5}$).

In considering county-level emissions, EPA used data from the 2005 National Emissions Inventory, the most updated version of the national inventory available at the beginning of the designations process in late 2007. However, EPA recognized that for certain counties, emissions may have changed since 2005. For example, certain power plants or large sources of emissions in or near this area may have installed emission controls or otherwise significantly reduced emissions since 2005. Some States provided updated information on emissions and emission controls in their comments to EPA. EPA considered such additional information in making final designation decisions.

With regard to nearby power plants, EPA considered information about whether a specific plant installed federally enforceable emission controls by December 2008 resulting in significant emissions reductions. A control requirement is considered to be federally-enforceable if it is required by a State regulation adopted in a State implementation plan, if it is included in a federally-enforceable Title V operating permit, or if it is required by a consent decree which also requires the controls to be included in federally enforceable permit upon termination of the consent decree. In making final decisions, EPA also considered whether a facility would continue to emit pollutants which contribute to PM2.5 exceedances even after emission controls are operational.

It should be noted that there are several electric generating units (EGU) within the area. Specifically, they reside in Muhlenberg, Humphreys, and Stewart Counties. The control levels on these power plants can be seen in the table below, and represent moderate to heavy control on emissions from these plants.

County	**Plant**	**Unit**	**Controls**	**Operating Date**	**2006 SO_2 (tons)**	**2006 NO_X (tons)**
Stewart, TN	Cumberland	2	Cold-side ESP + SCR + Wet Scrubber	All by 2004	9,538	18,704
Stewart, TN	Cumberland	1	Cold-side ESP + SCR + Wet Scrubber	All by 2003	8,814	15,656
Humphreys, TN	Johnsonville	10	Cold-side ESP	No SCR or scrubber	10,369	2,159
Humphreys, TN	Johnsonville	8	Cold-side ESP	No SCR or scrubber	9,947	2,085
Humphreys, TN	Johnsonville	7	Cold-side ESP	No SCR or scrubber	9,179	1,915
Humphreys, TN	Johnsonville	3	Cold-side ESP + Cyclone	No SCR or scrubber	9,175	1,901
Humphreys, TN	Johnsonville	2	Cold-side ESP + Cyclone	No SCR or scrubber	8,961	1,854
Humphreys, TN	Johnsonville	1	Cold-side ESP + Cyclone + SNCR	No SCR or scrubber	8,920	1,861
Humphreys, TN	Johnsonville	6	Cold-side ESP + Cyclone	No SCR or scrubber	8,749	1,817
Humphreys, TN	Johnsonville	9	Cold-side ESP	No SCR or scrubber	7,986	1,670
Humphreys, TN	Johnsonville	4	Cold-side ESP + Cyclone	No SCR or scrubber	7,909	1,592
Humphreys, TN	Johnsonville	5	Cold-side ESP + Cyclone	No SCR or scrubber	5,597	1,293

Muhlenberg, KY	Paradise	3	Cold-side ESP + SCR + Wet Scrubber	All by 2006	52,974	16,837
Muhlenberg, KY	Paradise	2	SCR + Wet Scrubber, OFA	All by 2000	15,805	13,040
Muhlenberg, KY	Paradise	1	SCR + Wet Scrubber, OFA	All by 2001	15,146	13,145
Muhlenberg, KY	Green River	all		No SCR or scrubber	14,000	1,500

Legend	
ESP	Electrostatic Precipitator
OFA	Over Fired Air
SCR	Selective Catalytic Reduction

Based on emission control levels as well as other factors (1, 6) and CES values, EPA has concluded that Muhlenberg County, KY should be included in the Clarksville 24-hour $PM_{2.5}$ nonattainment designation as there are still significant power plant emissions that contribute to the violating monitor even with the controls installed to date.

Conclusion

EPA concludes that the appropriate nonattainment boundary for the Clarksville area includes part of Muhlenberg County, Kentucky based on all of the above factors and analytic tools. Specifically, the TVA Paradise and Green River power plants in Muhlenberg County have emissions that impact the violating monitor in Montgomery County, and contribute to the violating monitor due to meteorology and level of control of emission sources. However, based on a review of the other factors and other information provided by the State, EPA does not find that inclusion of the entire county is required.

Additional information regarding responses to specific State comments can be found in EPA's Response to State Comments document at http://www.epa.gov/pmdesignations/2006standards/tech.htm.

EPA Technical Analysis for Evansville

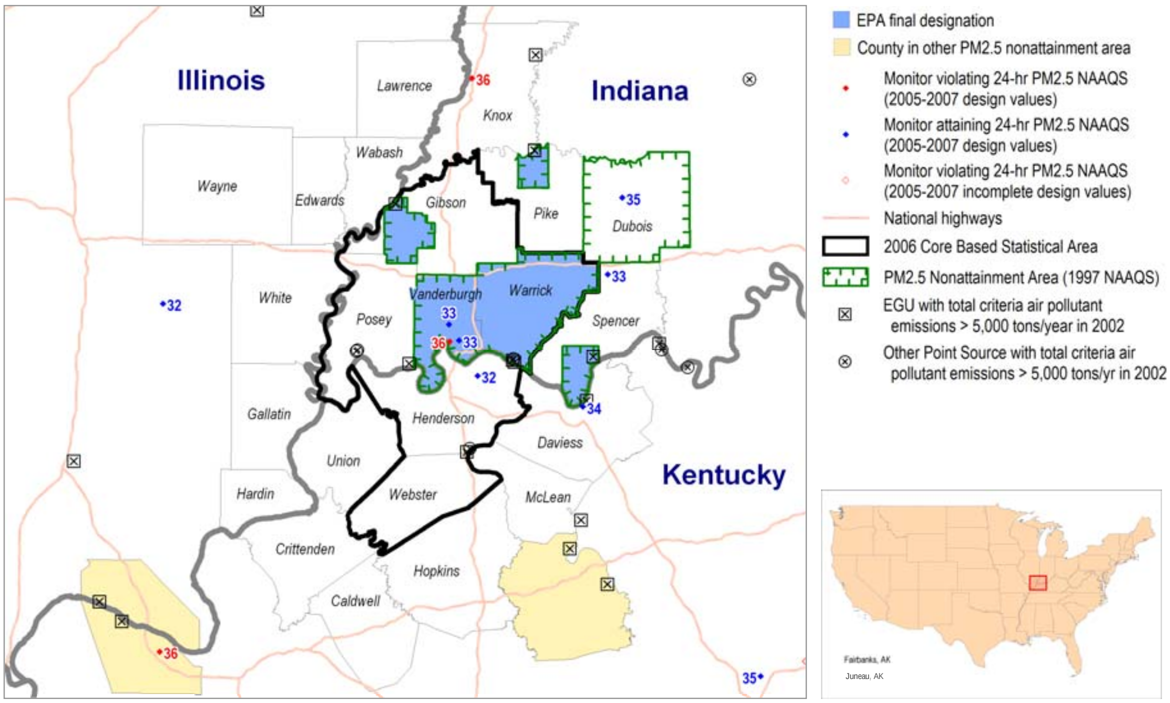
Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for the Evansville area identifies the counties with monitors that violate the 24-hour PM2.5 standard and evaluates nearby counties for contributions to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

We also used analytical tools and data such as pollution roses, fine particle composition monitoring data, back trajectory analyses, and the contributing emission score (CES) to evaluate these areas. (See additional discussion of the CES under factor 1 below.)

Figure 1 is a map of the counties in the nonattainment area and other relevant information such as the locations and design values of air quality monitors, and the metropolitan area boundary.

Figure 1. Evansville, IN-KY MSA



For this area, EPA previously established PM2.5 nonattainment boundaries for the 1997 $PM_{2.5}$ NAAQS that included 3 full and 3 partial counties, with all being located in Indiana.

In March of 2008, EPA also notified Kentucky that a monitor in the Evansville area was violating based on 2005-2007 data. Kentucky provided EPA with a recommendation for this area in June 2008 indicating that no counties in Kentucky should be included in this nonattainment area.

In August 2008, EPA notified Kentucky of its intended designations, which included no Kentucky counties in the Evansville area. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the state in making final decisions on the designations.

Based on EPA's technical analysis described below, EPA has designated no Kentucky counties as nonattainment for the 24-hour $PM_{2.5}$ air-quality standard as part of the

Evansville nonattainment area, based upon currently available information. See the table below.

Evansville, IN-KY	State-Recommended Nonattainment Counties	EPA-Final Designated Nonattainment Counties
Kentucky	None	None

The following is a technical analysis for the EPA Region 4 (Kentucky) portion of the Evansville area.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html.

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Evansville area. Counties that are part of the Evansville nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State Recom-mended Non-attain ment?	CES	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SO_2 (tpy)	NOx (tpy)	VOCs (tpy)	NH_3 (tpy)
Warrick, IN	No	**100**	**8,412**	**540**	**7,872**	**92,222**	**18,291**	**3,856**	**735**
Gibson, IN	No	**76**	**6,642**	**420**	**6,223**	**154,782**	**32,655**	**3,679**	**1,921**
Spencer, IN	No	**73**	**1,568**	**201**	**1,367**	**67,705**	**24,104**	**2,223**	**1,297**
Vanderburgh, IN	No	**61**	**1,558**	**308**	**1,250**	**2,029**	**7,048**	**8,405**	**469**
Pike, IN	No	**53**	**2,412**	**163**	**2,249**	**52,836**	**18,990**	**1,206**	**487**
Dubois, IN	No	**15**	**1,204**	**228**	**977**	**2,131**	**3,438**	**5,792**	**3,917**
Henderson, KY	No	33	1,202	267	936	8,612	5,525	3,068	670
Posey, IN	No	19	1,602	193	1,409	14,531	12,161	3,443	1,343
Daviess, KY	No	15	1,413	367	1,046	7,605	11,880	6,322	1,547
Webster, KY	No	8	1,068	167	901	16,478	12,138	803	1,813
Knox, IN	No	3	1,250	178	1,073	7,422	3,793	3,270	1,429

Note that the table may not include all counties considered in the 9-factor analysis, and that those counties not shown had no factors that indicated that they should be candidates for a nonattainment status.

Based on emission levels and CES values, no counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in $\mu g/m^3$) for air quality monitors in counties in the Evansville area based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35 $\mu g/m^3$ or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Evansville area are shown in Table 2.

Table 2. Air Quality Data

County	State Recommended Nonattainment?	24-hr PM2.5 Design Values, 2004-2006 ($\mu g/m^3$)	24-hr PM2.5 Design Values, 2005-2007 ($\mu g/m^3$)
Warrick, IN	No		
Gibson, IN	No		
Spencer, IN	No	**31**	**33**
Vanderburgh, IN	No	**34**	**36**
Pike, IN	No		
Dubois, IN	No	**34**	**35**

Henderson, KY	No	30	32
Posey, IN	No		
Daviess, KY	No		34
Webster, KY	No		
Knox, IN	No	36	36

No Kentucky counties show a violation of the 24-hour $PM_{2.5}$ standard. Therefore, no counties are included in the Evansville nonattainment area based on this factor. However, the absence of a violating monitor alone is not a sufficient reason to eliminate counties as candidates for nonattainment status. Each county has been evaluated based on the weight of evidence of the nine factors and other relevant information.

Under this factor, we also consider fine particle composition monitoring data. Air quality monitoring data on the composition of fine particle mass are available from the EPA Chemical Speciation Network and the IMPROVE monitoring network. Analysis of these data indicates that the days with the highest fine particle concentrations in the Evansville area occur about 94% in the warm season and 6% in the cool season. In the warm season, the average chemical composition of the highest days is 83% sulfate, 16% carbon, 1% crustal, and 0% nitrate. In the cool season, the average chemical composition of the highest days is 60% sulfate, 32% nitrate, 7% carbon, and 1% crustal. These data indicate that sources of SO2, direct PM2.5, and NOx emissions contribute to violations in the area.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with an FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the area being evaluated, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

Table 3. Population

County	State Recom-mended Non-attainment?	2005 Population	2005 Population Density (pop/sq mi)

Warrick, IN	No	**56,435**	**144**
Gibson, IN	No	**33,347**	**67**
Spencer, IN	No	**20,476**	**51**
Vanderburgh, IN	No	**172,774**	**734**
Pike, IN	No	**12,766**	**37**
Dubois, IN	No	**40,922**	**94**
Henderson, KY	No	45,563	98
Posey, IN	No	26,834	64
Daviess, KY	No	92,837	195
Webster, KY	No	14,134	42
Knox, IN	No	38,298	73
Warrick, IN	No	**56,435**	**144**
Gibson, IN	No	**33,347**	**67**

Although Daviess County, Kentucky has a relatively high population, it is not in the statistical area and, based on other factors, does not have very much interaction with Vanderburgh County, Indiana, or the rest of the statistical area. Therefore, based on this factor, no counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Evansville area, the percent of total commuters in each county who commute to other counties within the area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State Recom-mended Non-attain ment?	2005 VMT (millions of miles)	Number Commuting to any violating counties	Percent Commuting to any violating counties	Number Commuting into and within the statistical area	Percent Commuting into and within the statistical area
Vanderburgh	No	**1,452**	**75,290**	**90**	**81,640**	**98**
Warrick	No	**797**	**14,890**	**56**	**24,950**	**95**
Henderson	No	508	3,570	17	19,430	94
Gibson	No	**469**	**4,330**	**28**	**13,880**	**90**
Posey	No	553	5,600	44	12,520	98
Webster	No	141	290	5	4,560	76
Spencer	No	**430**	**3,020**	**31**	**2,200**	**22**
Daviess	No	782	660	2	1,740	4
Pike	No	**169**	**2,310**	**41**	**920**	**16**
Knox	No	448	15,250	86	490	3

Dubois	No	**539**	**19,030**	**93**	**450**	**2**

The listing of counties on Table 4 reflects a ranking based on the number of people commuting to other counties. The counties that are in the nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface.

Based on this factor, no counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation. Although Daviess has relatively high VMT, it has very low numbers traveling into violating counties or the MSA.

Note: The 2005 VMT data used for table 4 and 5 of the 9-factor analysis has been derived using methodology similar to that described in "Documentation for the final 2002 Mobile National Emissions Inventory, Version 3, September 2007, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: atftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002_mobile_nei_version_3_report_092807.pdf
The 2005 VMT data were taken from documentation which is still draft, but which should be released in 2008.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in the Evansville area, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Evansville area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

Location	Population (2005)	Population Density (2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Webster	14,134	42		141	36
Posey	26,834	64	(1)	553	22
Dubois	**40,922**	**94**	**3**	**539**	**21**
Spencer	**20,476**	**51**		**430**	**20**
Gibson	**33,347**	**67**	**2**	**469**	**19**
Knox	38,298	73	(2)	448	15
Warrick	**56,435**	**144**	**7**	**797**	**9**
Henderson	45,563	98	2	508	1
Daviess	92,837	195	1	782	(0)
Pike	**12,766**	**37**		**169**	**(0)**
Vanderburgh	**172,774**	**734**	**1**	**1,452**	**(7)**

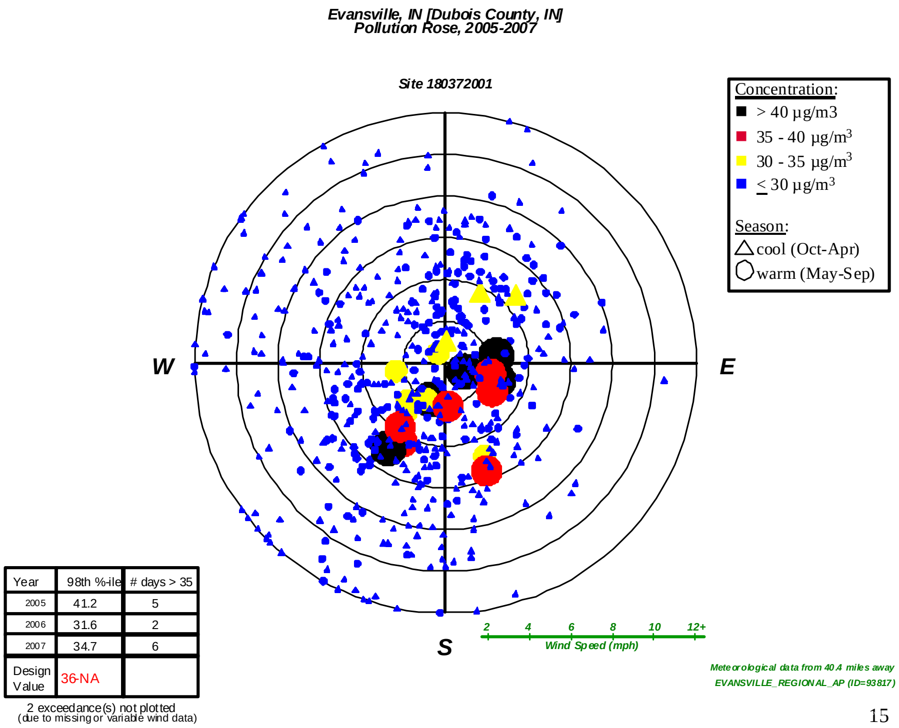
Although Webster County has the highest VMT % change in the area, its total VMT is relatively low. Based on this factor, no counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments and other meteorological monitoring sites in the area. Wind direction and wind speed data for 2005-2007 were analyzed, with an emphasis on "high $PM_{2.5}$ days" for each of two seasons (an October-April "cold" season and a May-September "warm" season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a "pollution rose" to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. Pollution rose the Evansville Area.



As shown in the pollution rose in Figure 2, on high PM2.5 days prevailing surface winds typically come from the southwest. The pollution roses show that 24-hour $PM_{2.5}$ concentrations are influenced by emissions from any direction at various times, but these data also suggest that emissions from the southwest relative to the violation are more likely to contribute to the violation than emissions from other directions.

Based on this factor, no counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis evaluates the physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Evansville area.

The area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. Therefore, this factor did not play a significant role in the decision-making process.

Factor 8: Jurisdictional boundaries (e.g., existing PM2.5 areas)

In evaluating the jurisdictional boundary factor, EPA gave special consideration to areas that were already designated nonattainment in 2005 for violating the 1997 fine particle standards. Analysis of chemical composition data in these areas indicates that the same components that make up most of the PM2.5 mass in the area on an annual average basis (such as sulfate and direct PM2.5 carbon in many eastern areas) also are key contributors to the PM2.5 mass on days exceeding the 24-hour PM2.5 standard. These data indicate that in many cities, the same source categories that contribute to violations of the annual standard also contribute to exceedances of the 24-hour standard.

Most areas that were originally designated nonattainment for the PM2.5 standards still have not attained the standards. Thus, EPA has generally concluded that counties that were designated as having emissions sources contributing to fine particle concentrations which continue to exceed the 1997 standards (all areas violated the annual standard, two also violated the previous 24-hour standard) also contribute to fine particle concentrations on the highest days. For this reason, EPA believes that for most existing nonattainment areas, the nonattainment area for the 2006 24-hour standard should be the same. Consideration also should be given to existing boundaries and organizations as they may facilitate air quality planning and the implementation of control measures to attain the standard. Areas already designated as nonattainment represent important boundaries for state air quality planning.

Daviess County was included in the Owensboro, Kentucky 1-hour ozone nonattainment area. Based on this factor, no counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 9: Level of control of emission sources

Under this factor, the existing level of control of emission sources is taken into consideration. The emissions data used by EPA in this technical analysis and provided in Table 1 (under factor 1) represent emissions levels taking into account any control strategies implemented in the Evansville area before 2005 on stationary, mobile, and area sources. Data are presented for PM2.5 components that are directly emitted (carbonaceous PM2.5 and crustal PM2.5) and for pollutants which react in the atmosphere to form fine particles (e.g. SO_2, NOx, VOC, and ammonia).

Based on this factor, no counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation as no counties had large emissions impacting the violating monitor.

Conclusion

EPA concludes that the appropriate nonattainment boundary for the Evansville area does not include any counties in Kentucky based on the above factors. Specifically, based on EPA's analysis of all factors and analytic tools EPA concludes that Daviess, Henderson, and Webster Counties do not contribute to the violating monitor in Vanderburgh County, Indiana.

Additional information regarding responses to specific State comments can be found in EPA's Response to Comments document at http://www.epa.gov/pmdesignations/2006standards/tech.htm.

EPA Technical Analysis for the Huntington-Ashland Area

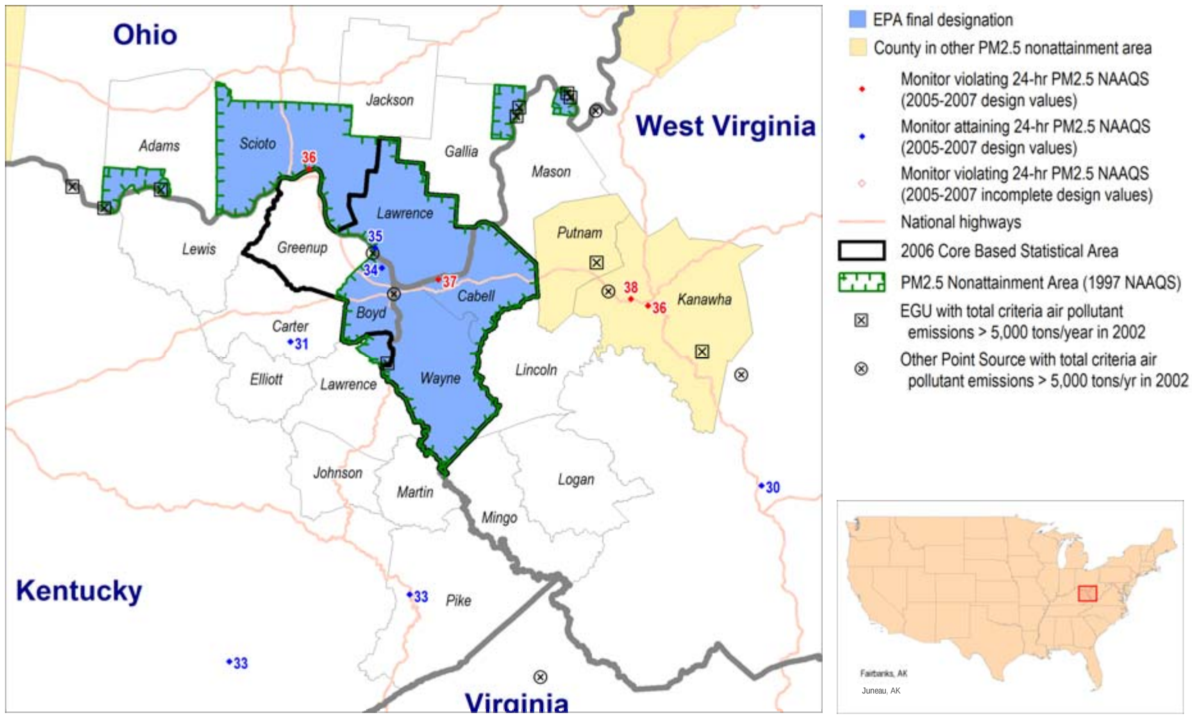
Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for Huntington-Ashland area identifies the counties with monitors that violate the 24-hour PM2.5 standard and evaluates nearby counties for contributions to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

We also used analytical tools and data such as pollution roses, fine particle composition monitoring data, back trajectory analyses, and the contributing emission score (CES) to evaluate these areas. (See additional discussion of the CES under factor 1 below.)

Figure 1 is a map of the counties in the nonattainment area and other relevant information such as the locations and design values of air quality monitors, and the metropolitan area boundary.

Figure 1. Huntington-Ashland, WV-KY-OH CBSA



For this area, EPA previously established PM2.5 nonattainment boundaries for the 1997 $PM_{2.5}$ NAAQS that included 9 full and partial counties, which included Boyd County and part of Lawrence County in Kentucky.

In December 2007, Kentucky recommended that no areas be designated as "nonattainment" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2004-2006. These data are from Federal Reference Method (FRM) monitors located in the State. In October 2008, Kentucky provided additional information to support their request for state-wide attainment. (Kentucky Division for Air Quality (KDAQ) letters dated December 7, 2007, June 25, 2008, and October 17, 2008)

At that time, the Huntington-Ashland area did not have any violating monitors and was not under consideration for nonattainment status for the 24-hour PM2.5 standard. Since that time, it was determined that monitors in Scioto County, Ohio and Cabell Counties, West Virginia violated the 24-hour PM2.5 standard for the 2005-2007 period.

In March of 2008, EPA also notified Kentucky that a monitor in the Huntington-Ashland area was violating based on 2005-2007 data. Kentucky submitted a second letter on June 25, 2008 to revise its recommendation yet still maintained that no Kentucky counties should be designated nonattainment for the standard.

In August 2008, EPA notified Kentucky of its intended designations. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the state in making final decisions on the designations. On October 17, 2008, the State submitted comments on EPA's intended designations. See State and Tribal Comment Summary and Response Document made a part of the docket for the 2006 PM2.5 designation rulemaking for our response to the State's comments.
Based on EPA's technical analysis described below, EPA has designated the same counties as previously designated for PM2.5 as nonattainment for the 24-hour $PM_{2.5}$ air-quality standard as part of the Huntington-Ashland nonattainment area, based upon currently available information. These counties are listed in the table below.

Huntington-Ashland	State-Recommended Nonattainment Counties	EPA-Final Designated Nonattainment Counties
Kentucky	None	Boyd Lawrence (partial)

The following is a technical analysis for the EPA Region 4 portion of the Huntington-Ashland area located in the state of Kentucky.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Huntington-Ashland area. Counties that are part of the Huntington-Ashland nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State	State Recom-mended Non-attain ment	CES	$PM_{2.5}$ Emissions total (tpy)	$PM_{2.5}$ Emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SO_2 (tpy)	NO_x (tpy)	VOCs (tpy)	NH_3 (tpy)
Cabell	WV	No	100	1,082	434	649	4,355	10,644	5,878	181
Gallia	OH	No	100	7,087	499	6,588	100,704	59,035	1,939	327
Lawrence	OH	No	78	1,078	672	406	573	3,769	4,847	316
Scioto	OH	No	58	775	416	359	555	4,981	4,111	1,349
Mason	WV	No	54	3,528	305	3,222	82,856	24,561	2,496	237
Adams	OH	No	46	5,970	494	5,476	126,316	33,822	1,918	837
Boyd	KY	No	44	1,729	412	1,317	10,501	10,123	5,762	477
Wayne	WV	No	33	657	446	210	1,041	7,619	2,577	70
Lawrence	KY	No	27	2,567	199	2,368	50,239	13,761	932	90
Greenup	KY	No	24	319	151	169	2,183	4,102	1,694	155

Note that the table may not include all counties considered in the 9-factor analysis, and that those counties not shown had no factors that indicated that they should be candidates for a nonattainment status.

Lawrence county has high emissions primarily due to the Big Sandy power plant. Boyd has a moderate level of emissions and relatively high CES score. The emissions of Greenup county are well below those of Lawrence and Boyd. Based on emission levels and CES values, Boyd, Lawrence, and potentially Greenup Counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in $\mu g/m^3$) for air quality monitors in counties in the Huntington-Ashland area based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's

98th percentile values are 35 μg/m^3 or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Huntington-Ashland area are shown in Table 2.

Table 2. Air Quality Data

County	State	State Recommended Nonattainment	24-hr PM2.5 Design Values, 2004-2006 (μg/m^3)	24-hr PM2.5 Design Values, 2005-2007 (μg/m^3)
Cabell	**WV**	No	**34**	**37**
Lawrence	**OH**	No	**34**	**35**
Scioto	**OH**	No	**33**	**36**
Boyd	**KY**	No	**32**	**34**

In Kentucky, no counties show a violation of the 24-hour $PM_{2.5}$ standard. The design value of the Boyd, KY monitor is just under the standard at 34 ug/m3. However, the absence of a violating monitor alone is not a sufficient reason to eliminate counties as candidates for nonattainment status. Each county has been evaluated based on the weight of evidence of the nine factors and other relevant information and require further evaluation.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with an FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the area being evaluated, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

Boyd, Lawrence, and Greenup Counties of Kentucky have moderately sized populations. Boyd County has the highest population of the Kentucky counties in the area and it is one of the most densely populated counties in the area. Lawrence county has low population but is primarily a concern due to emissions from the power plant there. Greenup county has a moderate level of emissions.

Table 3. Population

County	State	State Recommended Nonattainment	2005 Population	2005 Population Density (pop/sq mi)
Cabell	WV	No	93,988	327
Gallia	OH	No	31,241	68
Lawrence	OH	No	62,946	134
Scioto	OH	No	76,506	124
Adams	OH	No	28,454	49
Boyd	KY	No	49,359	305
Wayne	WV	No	41,959	82
Lawrence	KY	No	16,162	39
Greenup	KY	No	37,206	105

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Huntington-Ashland area, the percent of total commuters in each county who commute to other counties within the Huntington-Ashland area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State	State Recom-mended Non-attainment	2005 VMT (millions of miles)	Number Commuting to any violating county	Percent Commuting to any violating county	Number Commuting into and within the statistical area	Percent Commuting into and within the statistical area
Cabell	**WV**	No	**1,230**	**34,670**	**86**	**35,460**	**88**
Lawrence	**OH**	No	**650**	**7,970**	**35**	**21,160**	**92**
Boyd	**KY**	No	**574**	**1,380**	**7**	**17,580**	**93**
Wayne	**WV**	No	**438**	**7,170**	**46**	**14,040**	**90**
Greenup	KY	No	371	1,770	13	11,130	83
Scioto	**OH**	No	**591**	**22,040**	**78**	**1,330**	**5**
Lawrence	**KY**	No	**159**	**250**	**5**	**920**	**19**
Gallia	**OH**	No	**247**	**300**	**3**	**330**	**3**
Adams	**OH**	No	**283**	**130**	**1**	**20**	**0**

The listing of counties on Table 4 reflects a ranking based on the number of people commuting to other counties. The counties that are in the nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface.

In Region 4, Boyd, Lawrence and Greenup have relatively low VMT and percent commuting into violating counties which does not support including them based on this factor. In Boyd County, 93 percent of commuters remain in the statistical area. Based on this factor, Boyd County requires further evaluation and is also a candidate based on factors 1 and 3.

Note: The 2005 VMT data used for table 4 and 5 of the 9-factor analysis has been derived using methodology similar to that described in “Documentation for the final 2002 Mobile National Emissions Inventory, Version 3, September 2007, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002_mobile_nei_version_3_report_092807.pdf
The 2005 VMT data were taken from documentation which is still draft, but which should be released in 2008.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in the Huntington-Ashland area, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Huntington-Ashland area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

County	State	Population (2005)	Population Density (2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Wayne	**WV**	**41,959**	82	**-2**	438	**47**
Cabell	**WV**	**93,988**	327	**-3**	1230	**41**
Greenup	KY	37,206	105	**1**	371	23
Boyd	**KY**	**49,359**	305	**-1**	574	**16**
Lawrence	**KY**	**16,162**	39	**4**	159	**11**
Lawrence	**OH**	**62,946**	134	**1**	650	**9**
Adams	**OH**	**28,454**	49	**4**	283	**7**
Gallia	**OH**	**31,241**	68	**1**	247	**0**
Scioto	**OH**	**76,506**	124	**-3**	591	**-3**

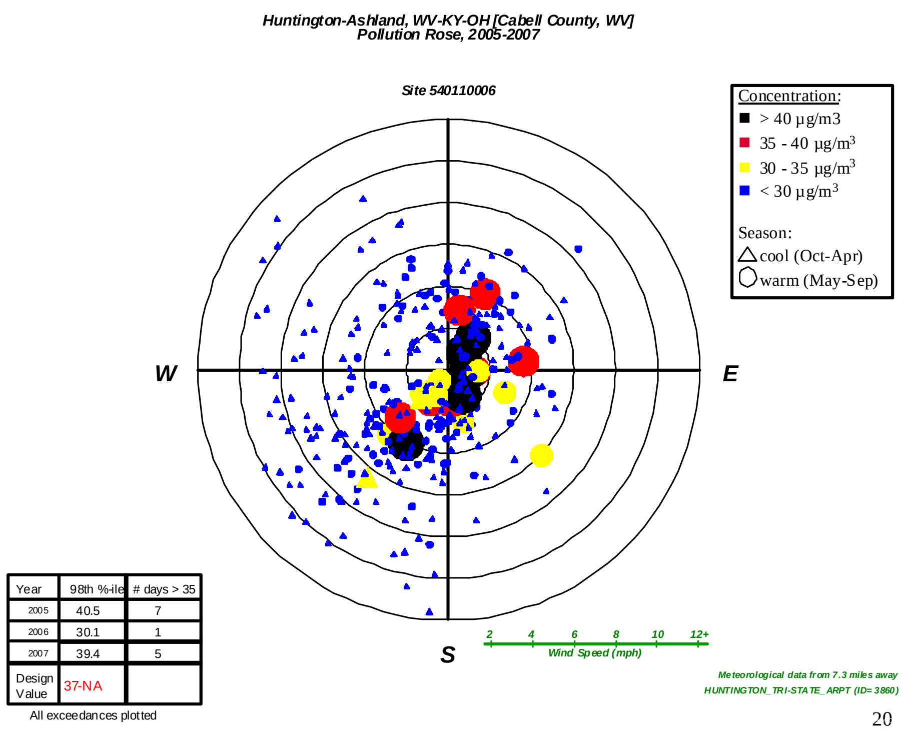
In general, there was little change in population from 2000-2005 in the Huntington-Ashland area. Boyd County had a 1 percent decrease; Greenup had a 1 percent increase, and Lawrence, KY, a 4 percent increase. Vehicle miles traveled increased between 11-23% for the three Kentucky counties during the 1996-2005 period. Overall, growth-related information was not a major consideration in EPA’s intended designation.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on “high $PM_{2.5}$ days” for each of two seasons (an October-April “cold” season and a May-September “warm” season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a “pollution rose” to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. Pollution rose for the Huntington-Ashland Area.



As shown in the pollution rose in Figure 2, on high PM2.5 days prevailing surface winds often come from the northeast, east and southwest. The pollution rose shows that 24-hour $PM_{2.5}$ concentrations are influenced by emissions from any direction at various times, but these data also suggest that emissions from some directions relative to the violation are more likely to contribute to the violation than emissions from other directions.

Based on analysis of this factor, EPA concludes that Boyd and Lawrence Counties in Kentucky contribute to the violating monitor in Cabell County, West Virginia. Boyd County is also a candidate based on factors 1, 3, and 4; Lawrence (partial) County is also a candidate based on factor 1. Greenup County is not a candidate based on this factor because the pollution rose shows that wind does not come from the direction of Greenup on high $PM_{2.5}$ days.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Huntington-Ashland area.

Boyd County sits at the northeastern corner of Kentucky and is situated along the Ohio River and the Big Sandy River.

Greenup County sits on the Ohio River in the Appalachian foothills.

Lawrence County lies on the Kentucky-West Virginia border and the eastern border is formed by the Big Sandy River.

The Kentucky portion of the Huntington-Ashland area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. Therefore, the absence of topographical and geographical barriers in this area supports our conclusion that emissions from Boyd, Greenup. And Lawrence can be contributing to violations in the area.

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

In evaluating the jurisdictional boundary factor, EPA gave special consideration to areas that were already designated nonattainment in 2005 for violating the 1997 fine particle standards. Analysis of chemical composition data in this area indicates that the same components that make up most of the PM2.5 mass in the area on an annual average basis (sulfate and direct PM2.5 carbon) also are key contributors to the PM2.5 mass on days exceeding the 24-hour PM2.5 standard. These data indicate that in Huntington-Ashland, the same source categories that contribute to violations of the annual standard also contribute to exceedances of the 24-hour standard.

Huntington-Ashland was originally designated nonattainment for the annual PM2.5 standard and still has not attained the standards. The 2005-7 design value for the area is 16.6 ug/m3. Thus, EPA has generally concluded that counties that were designated as having emissions sources contributing to fine particle concentrations which continue to exceed the 1997 standards also contribute to fine particle concentrations on the highest days. For this reason, EPA believes that for most existing nonattainment areas, the nonattainment area for the 2006 24-hour standard should be the same. Consideration also should be given to existing boundaries and organizations as they may facilitate air quality planning and the implementation of control measures to attain the standard. Areas already designated as nonattainment represent important boundaries for state air quality planning.

The 1997 annual standard PM2.5 boundary consisted of the Kentucky Counties of Boyd and Lawrence (partial), the Ohio Counties of Adams (partial), Gallia (partial), Lawrence, and Scioto, and the West Virginia Counties of Cabell, Wayne, and Mason (partial).

Factor 9: Level of control of emission sources

Under this factor, the existing level of control of emission sources is taken into consideration. The emissions data used by EPA in this technical analysis and provided in Table 1 (under Factor 1) represent emissions levels taking into account any control strategies implemented in the [area] area before 2005 on stationary, mobile, and area sources. Data are presented for PM2.5 components that are directly emitted (carbonaceous PM2.5 and crustal PM2.5) and for pollutants which react in the atmosphere to form fine particles (e.g. SO_2, NO_X, VOC, and ammonia).

In considering county-level emissions, EPA used data from the 2005 National Emissions Inventory, the most updated version of the national inventory available at the beginning of the designations process in late 2007. However, EPA recognized that for certain counties, emissions may have changed since 2005. For example, certain power plants or large sources of emissions in or near this area may have installed emission controls or otherwise significantly reduced emissions since 2005. Some States provided updated information on emissions and emission controls in their comments to EPA. EPA considered such additional information in making final designation decisions.

With regard to nearby power plants, EPA considered information about whether a specific plant installed federally enforceable emission controls by December 2008 resulting in significant emissions reductions. A control requirement is considered to be federally-enforceable if it is required by a State regulation adopted in a State implementation plan, if it is included in a federally-enforceable Title V operating permit,

or if it is required by a consent decree which also requires the controls to be included in federally enforceable permit upon termination of the consent decree. In making final decisions, EPA also considered whether a facility would continue to emit pollutants which contribute to PM2.5 exceedances even after emission controls are operational.

The Big Sandy Plant in Lawrence County is partially controlled, with additional controls required by consent decree in the future. The plant has selective catalytic reduction (SCR) on unit BSU2 (as of 2003), but no scrubber or SCR for BSU1. The emission estimates on Table 1 (under Factor 1) include any control strategies implemented by the state in the Huntington-Ashland area before 2005 that may influence emissions of any component of $PM_{2.5}$ emissions (i.e., total carbon, SO_2, NOx, and crustal $PM_{2.5}$). Although, a 2007 consent decree requires a scrubber on BSU2 by December 2015, as further explained in the State and Tribal Comment Summary and Response Document, EPA determined violations of the 2006 24-hour fine particulate NAAQS based solely on the most recent three complete years of certified monitoring data not on projected emissions reductions that may occur after area designations are finalized.

Based on emission control levels as well as other factors (1, 6) and CES values, part of Lawrence County in Kentucky warrants inclusion in the Huntington-Ashland 24-hour $PM_{2.5}$ nonattainment designation. Even with emission controls installed at the Big Sandy Plant in Lawrence County, it still emits a substantial level of emissions and contributes to fine particle concentrations at the nearby violating monitor.

Conclusion

EPA concludes that the appropriate nonattainment boundary for the Huntington-Ashland area includes Boyd and Lawrence (partial) Counties in Kentucky based on the above factors. Specifically, both counties have substantial levels of emissions, and meteorological data indicate that emissions from both counties contribute to PM2.5 concentrations at the violating monitors on the high days. The principal source in the partial county area of Lawrence County is the Big Sandy power plant. Both counties were found to contribute to a violation of the annual PM2.5 standard, which the area has not attained, and for this reason it is also appropriate to include these counties in the nonattainment area. Additionally, Boyd County has a high degree of population density, urbanization, and commuting.

Additional information regarding responses to specific State comments can be found in EPA's Response to Comments document at
http://www.epa.gov/pmdesignations/2006standards/tech.htm.

EPA Technical Analysis for Louisville

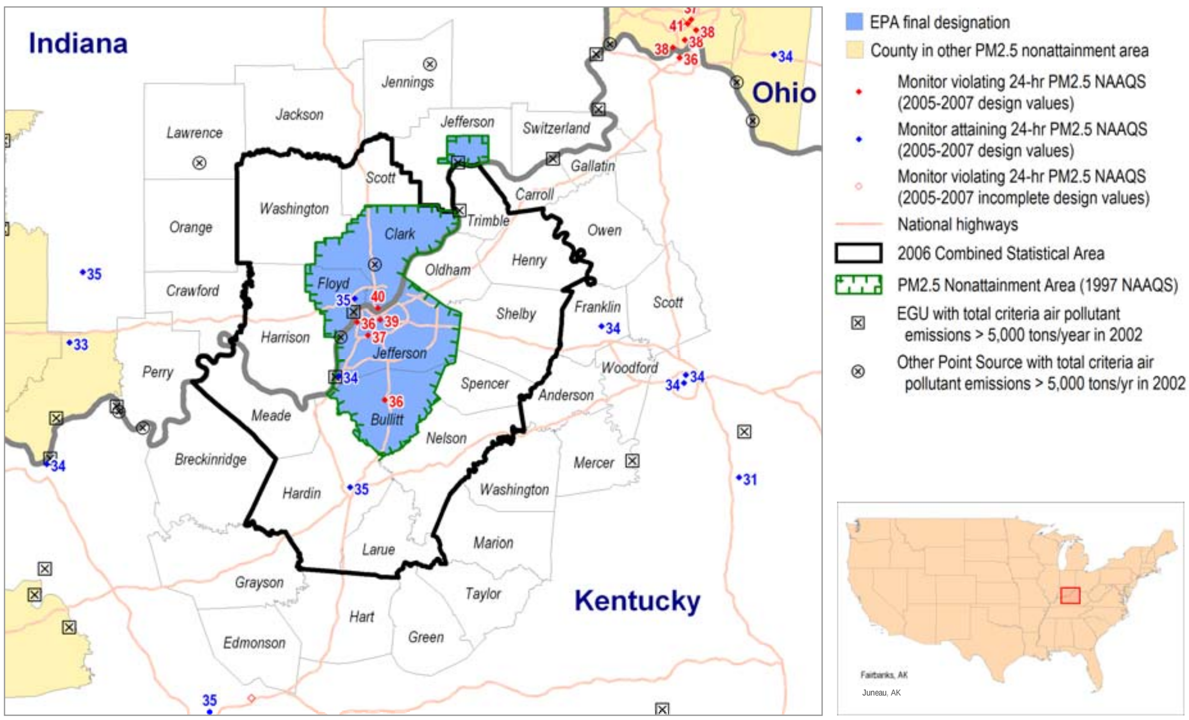
Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for the Louisville identifies the counties with monitors that violate the 24-hour PM2.5 standard and evaluates nearby counties for contributions to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

We also used analytical tools and data such as pollution roses, fine particle composition monitoring data, back trajectory analyses, and the contributing emission score (CES) to evaluate these areas. (See additional discussion of the CES under factor 1 below.)

Figure 1 is a map of the counties in the nonattainment area and other relevant information such as the locations and design values of air quality monitors, and the metropolitan area boundary.

Figure 1. Louisville, KY-IN MSA



For this area, EPA previously established PM2.5 nonattainment boundaries for the 1997 $PM_{2.5}$ NAAQS that included 4 full and 1 partial counties, with 2 (full) being located in Kentucky.

In December 2007, Kentucky recommended that no areas be designated as "nonattainment" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2004-2006. These data are from Federal Reference Method (FRM) and Federal Equivalent Method (FEM) monitors located in the state. In October 2008, Kentucky provided additional information to support their request for state-wide attainment. (Kentucky Division for Air Quality (KDAQ) letters dated December 7, 2007, June 25, 2008, and October 17, 2008)

In August 2008, EPA notified Kentucky of its intended designations. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the state in making final decisions on the designations.

Based on EPA's technical analysis described below, as proposed EPA has designated the same counties as previously designated for PM2.5 for the 1997 standard as nonattainment for the 2006 24-hour $PM_{2.5}$ air-quality standard as part of the Louisville nonattainment area, based upon currently available information. These counties are listed in the table below.

Louisville	State-Recommended Nonattainment Counties	EPA-Final Designated Nonattainment Counties
Kentucky	None	Bullitt Jefferson

The following is a technical analysis for the EPA Region 4 (Kentucky) portion of the Louisville area.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at
http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Louisville. Counties that are part of the Louisville nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State Recom-mended Non-attain ment	CES	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SO_2 (tpy)	NOx (tpy)	VOCs (tpy)	NH_3 (tpy)
Jefferson, KY	No	**100**	**5,941**	**2,726**	**3,215**	**53,066**	**58,643**	**38,095**	**1,628**
Floyd, IN	No	**33**	**3,206**	**285**	**2,920**	**57,498**	**8,169**	**3,462**	**258**
Clark, IN	Yes	**16**	**1,398**	**338**	**1,060**	**4,043**	**5,749**	**6,049**	**800**
Bullitt, KY	No	**6**	**659**	**283**	**376**	**857**	**3,140**	**5,816**	**182**
Oldham, KY	No	6	579	220	359	504	3,306	1,821	254
Jefferson, IN	No	**3**	**1,265**	**168**	**1,097**	**75,319**	**25,214**	**2,272**	**341**
Hardin, KY	No	3	896	358	538	1,207	4,714	4,384	1,163
Franklin, KY	No	1	352	140	212	532	2,147	3,329	179

Note that the table may not include all counties considered in the 9-factor analysis, and that those counties not shown had no factors that indicated that they should be candidates for a nonattainment status.

Based on emissions levels and CES values, Jefferson County in Kentucky is the clearest candidate for a 24-hour $PM_{2.5}$ nonattainment designation. The other Kentucky counties shown here individually have relatively low levels of PM2.5-related emissions.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in µg/m^3) for air quality monitors in counties in the Louisville area based on data for the 2004-2006 and 2005-2007 periods. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35 µg/m^3 or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Louisville area are shown in Table 2.

Table 2. Air Quality Data

County	State Recommended Nonattainment	24-hr PM2.5 Design Values, 2004-2006 (µg/m^3)	24-hr PM2.5 Design Values, 2005-2007 (µg/m^3)
Jefferson, KY	No	36	37
Floyd, IN	No	32	35
Clark, IN	Yes	37	40
Bullitt, KY	No	34	36

Hardin, KY	No	32	35
Franklin, KY	No	31	34

Jefferson and Bullitt Counties show a violation of the 24-hour $PM_{2.5}$ standard based on 2005-2007 data. A monitor in Clark county, Indiana is also violating. Therefore, these counties are included in the Louisville nonattainment area. The remaining counties are evaluated as candidates for their possible contribution to a nearby violating area based on the weight of evidence of the nine factors and other relevant information. Hardin and Franklin Counties have design values that approach but do not exceed the standard.

Under this factor, we also consider fine particle composition monitoring data. Air quality monitoring data on the composition of fine particle mass are available from the EPA Chemical Speciation Network and the IMPROVE monitoring network. Analysis of these data indicates that the days with the highest fine particle concentrations in the Louisville area occur about 82% in the warm season and 18% in the cool season. In the warm season, the average chemical composition of the highest days is 67% sulfate, 30% carbon, 3% crustal, and 0% nitrate. In the cool season, the average chemical composition of the highest days is 50% sulfate, 25% carbon, 23% nitrate, and 2% crustal. These data indicate that sources of SO2, direct PM2.5, and NOx emissions contribute to violations in the area.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with an FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the area being evaluated, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

Jefferson County has the highest population and population density in the area. Bullitt, Oldham, and Hardin Counties of Kentucky have moderately-sized populations, and population densities are relatively low compared to Jefferson County.

Table 3. Population

County	State Recommended	2005 Population	2005 Population Density (pop/sq mi)

	Nonattainment		
Jefferson, KY	No	699,051	1755
Floyd, IN	No	72,025	485
Clark, IN	Yes	101,625	270
Bullitt, KY	No	71,440	238
Oldham, KY	No	53,459	273
Hardin, KY	No	96,825	154

Based on this factor, Jefferson County clearly requires further evaluation.

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Louisville area, the percent of total commuters in each county who commute to other counties within the Louisville area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State Recommended Non-attainment	2005 VMT (millions of miles)	Number Commuting to any violating counties	Percent Commuting to any violating counties	Number Commuting into and within the statistical area	Percent Commuting into and within the statistical area
Jefferson, KY	**No**	**9,030**	**312,660**	**95**	**322,950**	**98**
Clark, IN	**Yes**	**1,218**	**41,100**	**85**	**47,410**	**98**
Hardin, KY	No	688	6,060	14	43,440	98
Floyd, IN	**No**	**768**	**18,380**	**52**	**34,590**	**99**
Bullitt, KY	**No**	**852**	**28,570**	**94**	**30,160**	**99**
Oldham, KY	No	526	13,050	61	21,020	98

The listing of counties on Table 4 reflects a ranking based on the number of people commuting to other counties. The counties that are in the nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface.

In Region 4, Jefferson and Bullitt Counties in Kentucky show a violation of the 24-hour $PM_{2.5}$ standard and also have the highest vehicle miles traveled of the Kentucky counties. Based on this factor, Jefferson and Bullitt Counties had traffic and commuting patterns that warrant consideration based on this and other factors. Hardin County also had area-wide commuting numbers greater than Bullitt County, however, the number communting specifically to the violating counties (Jefferson and Bullitt) and the absolute VMT are among the lowest in the area. This suggests this factor alone is not a strong basis for including Hardin County in the nonattainment area; in addition Hardin County is not a significant candidate for contribution based on any other of the 8 factors.

Note: The 2005 VMT data used for tables 4 and 5 of the technical analysis have been derived using methodology such as that described in "Documentation for the 2005 Mobile National Emissions Inventory, Version 2," December 2008, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: ftp://ftp.epa.gov/EmisInventory/2005_nei/mobile_sector/documentation/2005_mobile_nei_version_2_report.pdf.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in Louisville, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Louisville area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

Location	Population (2005)	Population Density (2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Oldham , KY	53,459	273	14	526	19
Jefferson , KY	**699,051**	**1755**	**1**	**9030**	**18**
Bullitt, KY	**71,440**	**238**	**16**	**852**	**13**
Clark , IN	**101,625**	**270**	**5**	**1218**	**10**
Floyd, IN	**72,025**	**485**	**2**	**768**	**3**
Hardin, KY	96,825	154	3	688	-39

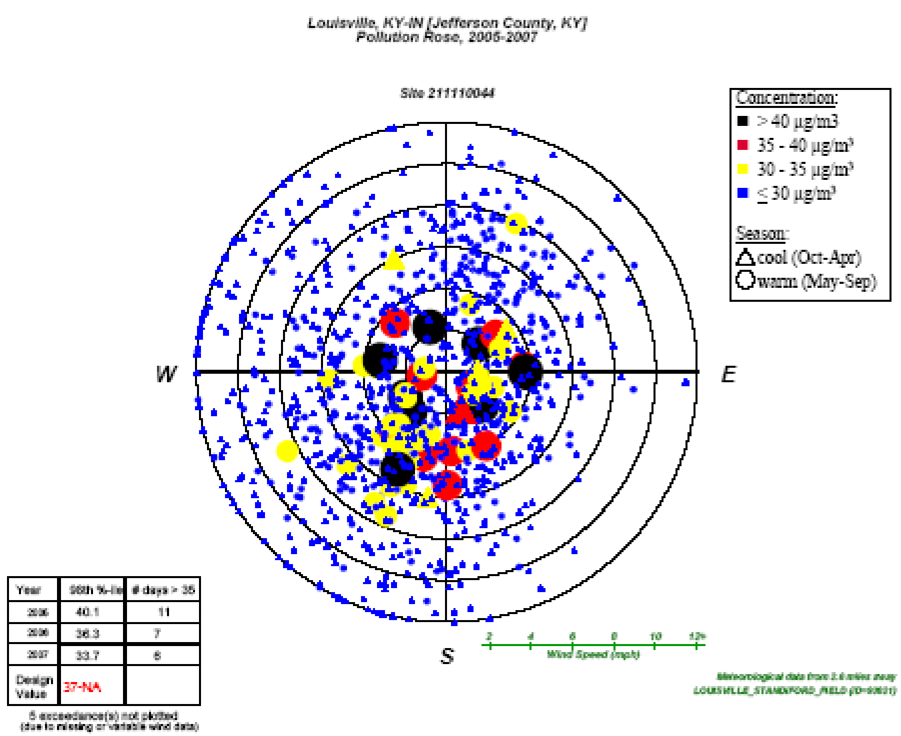
Bullitt and Oldham Counties had relatively high population growth between 2000 and 2005 compared to the other counties in the Louisville area. Oldham, Jefferson and Bullitt Counties had a sizable increase in VMT from 1996 and 2005; an increase greater than Clark, Floyd and Hardin Counties in the Louisville area. Jefferson and Bullitt Counties are nonattainment candidates based on this factor (and other factors). Oldham County is suggested for consideration under this factor, however, even with significant growth it still has the lowest population and VMT of the Kentucky counties shown here, and it is not a clear candidate based on any other factor.

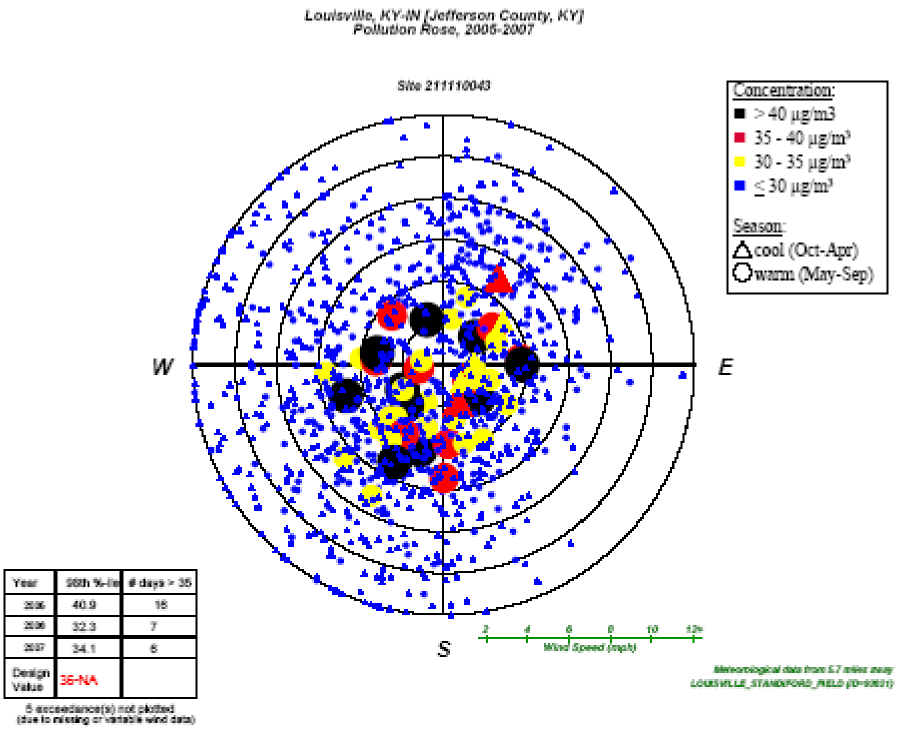
Factor 6: Meteorology (weather/transport patterns)

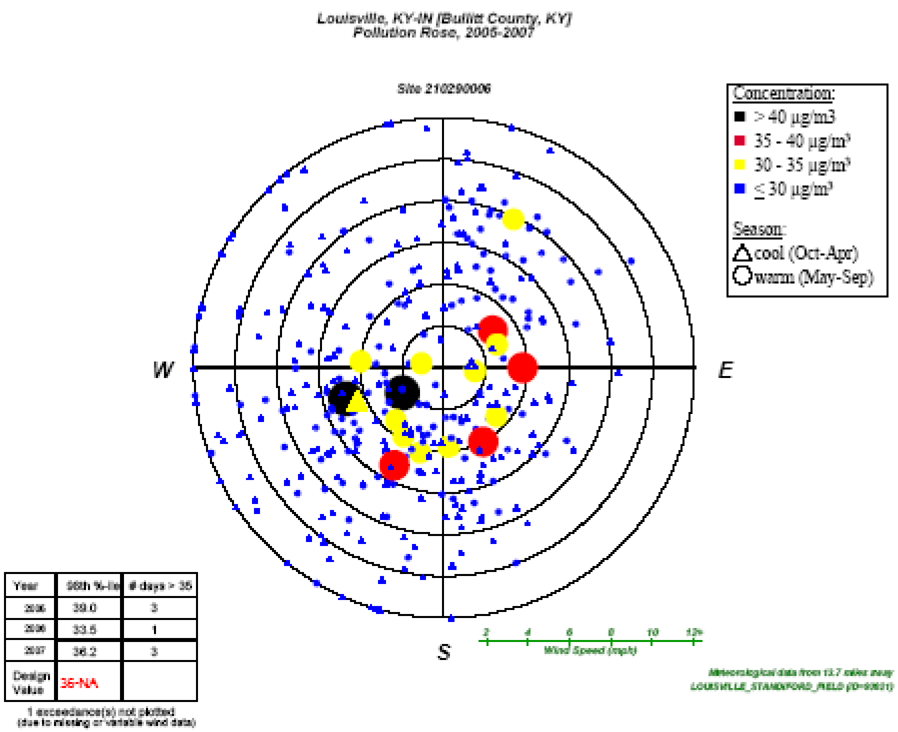
For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on “high $PM_{2.5}$ days” for each of two seasons (an October-April “cold” season and a May-September “warm” season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a “pollution rose” to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. Pollution roses for Bullitt and Jefferson Counties, KY







As shown in the pollution roses for Jefferson County, KY and Bullitt county, KY, on high PM2.5 days prevailing surface winds can come from any direction. The most frequent prevailing wind direction on the high PM2.5 days is from the south and south-

southwest, but a number of days also have north or eastern prevailing wind directions. The pollution roses indicate that contributions are possible from all directions.

However, based on analysis of this factor in conjunction with other factors, EPA concludes that Jefferson and Bullitt Counties in Kentucky are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Louisville area.

The Louisville area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. Therefore, this factor did not play a significant role in the decision-making process.

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

In evaluating the jurisdictional boundary factor, EPA gave special consideration to areas that were already designated nonattainment in 2005 for violating the 1997 fine particle standards. Analysis of chemical composition data in the Louisville area indicates that the same components that make up most of the PM2.5 mass in the area on an annual average basis (sulfate, direct PM2.5 carbon, and nitrate) also are key contributors to the PM2.5 mass on days exceeding the 24-hour PM2.5 standard. These data indicate that in Louisville, the same source categories that contribute to violations of the annual standard also contribute to exceedances of the 24-hour standard.

Louisville, with an annual PM2.5 design value of 16.6 ug/m3, still has not attained the annual standard. Thus, EPA has generally concluded that counties that were designated as having emissions sources contributing to fine particle concentrations which continue to exceed the 1997 standards (all areas violated the annual standard, two also violated the previous 24-hour standard) also contribute to fine particle concentrations on the highest days. For this reason, EPA believes that the existing nonattainment area would also be appropriate for the 2006 24-hour standard should be the same. Consideration also should be given to existing boundaries and organizations as they may facilitate air quality planning and the implementation of control measures to attain the standard. Areas already designated as nonattainment represent important boundaries for state air quality planning.

The existing PM2.5 nonattainment boundary consists of Jefferson and Bullitt Counties in Kentucky and Clark, Floyd, and Jefferson (partial) Counties in Indiana. Thus, under this factor it would be appropriate to consider including Jefferson and Bullitt Counties in Kentucky in the nonattainment area.

Factor 9: Level of control of emission sources

Under this factor, the existing level of control of emission sources is taken into consideration. The emissions data used by EPA in this technical analysis and provided in Table 1 (under Factor 1) represent emissions levels taking into account any control strategies implemented in the area before 2005 on stationary, mobile, and area sources. Data are presented for PM2.5 components that are directly emitted (carbonaceous PM2.5 and crustal PM2.5) and for pollutants which react in the atmosphere to form fine particles (e.g. SO_2, NOx, VOC, and ammonia).

In considering county-level emissions, EPA used data from the 2005 National Emissions Inventory, the most updated version of the national inventory available at the beginning of the designations process in late 2007. However, EPA recognized that for certain counties, emissions may have changed since 2005. For example, certain power plants or large sources of emissions in or near this area may have installed emission controls or otherwise significantly reduced emissions since 2005. Some States provided updated information on emissions and emission controls in their comments to EPA. EPA considered such additional information in making final designation decisions.

With regard to nearby power plants, EPA considered information about whether a specific plant installed federally enforceable emission controls by December 2008 resulting in significant emissions reductions. A control requirement is considered to be federally-enforceable if it is required by a State regulation adopted in a State implementation plan, if it is included in a federally-enforceable Title V operating permit, or if it is required by a consent decree which also requires the controls to be included in federally enforceable permit upon termination of the consent decree. In making final decisions, EPA also considered whether a facility would continue to emit pollutants which contribute to PM2.5 exceedances even after emission controls are operational. Jefferson County has two major power plants (Cane Run and Mill Creek). EPA did not receive additional information indicating a significant change in emissions or pollution controls from these sources since 2005. These sources continue to have relatively large emissions of PM2.5-related pollutants that contribute to the violating area.

Conclusion

Based on this evaluation, EPA has concluded that the counties in Kentucky with violations of the standard (Jefferson and Bullitt Counties), and nearby areas that contribute to the violation (Jefferson and Bullitt Counties) should be included in the nonattainment area. The results from evaluation of Factors 1, 2, 3, 4, 5, 6, 8, and 9 support this conclusion for Jefferson County, and Factors 2, 4, 5, 6, 8, and 9 for Bullitt County.

Additional information regarding responses to specific State comments can be found in EPA's Response to State Comments document at http://www.epa.gov/pmdesignations/2006standards/tech.htm.

EPA Technical Analysis for Louisville

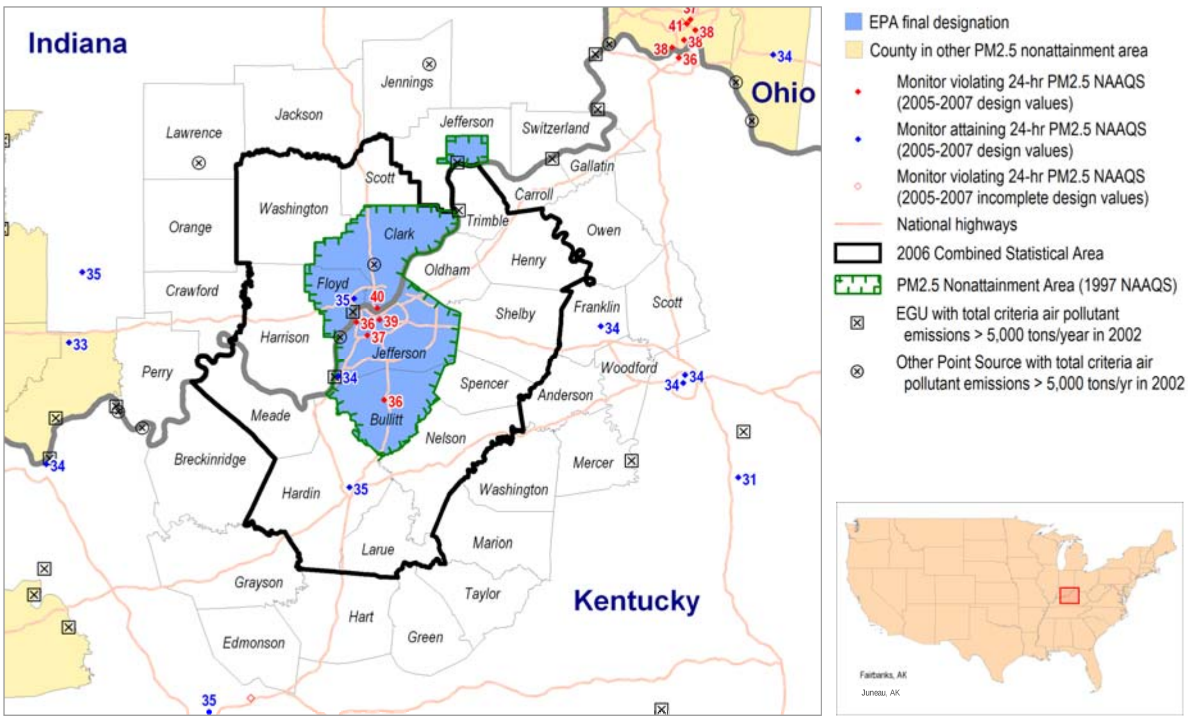
Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for the Louisville identifies the counties with monitors that violate the 24-hour PM2.5 standard and evaluates nearby counties for contributions to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

We also used analytical tools and data such as pollution roses, fine particle composition monitoring data, back trajectory analyses, and the contributing emission score (CES) to evaluate these areas. (See additional discussion of the CES under factor 1 below.)

Figure 1 is a map of the counties in the nonattainment area and other relevant information such as the locations and design values of air quality monitors, and the metropolitan area boundary.

Figure 1. Louisville, KY-IN MSA



For this area, EPA previously established PM2.5 nonattainment boundaries for the 1997 $PM_{2.5}$ NAAQS that included 4 full and 1 partial counties, with 2 (full) being located in Kentucky.

In December 2007, Kentucky recommended that no areas be designated as "nonattainment" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2004-2006. These data are from Federal Reference Method (FRM) and Federal Equivalent Method (FEM) monitors located in the state. In October 2008, Kentucky provided additional information to support their request for state-wide attainment. (Kentucky Division for Air Quality (KDAQ) letters dated December 7, 2007, June 25, 2008, and October 17, 2008)

In August 2008, EPA notified Kentucky of its intended designations. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the state in making final decisions on the designations.

Based on EPA's technical analysis described below, as proposed EPA has designated the same counties as previously designated for PM2.5 for the 1997 standard as nonattainment for the 2006 24-hour $PM_{2.5}$ air-quality standard as part of the Louisville nonattainment area, based upon currently available information. These counties are listed in the table below.

Louisville	State-Recommended Nonattainment Counties	EPA-Final Designated Nonattainment Counties
Kentucky	None	Bullitt Jefferson

The following is a technical analysis for the EPA Region 4 (Kentucky) portion of the Louisville area.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other", primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at
http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Louisville. Counties that are part of the Louisville nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State Recom-mended Non-attain ment	CES	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SO_2 (tpy)	NOx (tpy)	VOCs (tpy)	NH_3 (tpy)
Jefferson, KY	No	**100**	**5,941**	**2,726**	**3,215**	**53,066**	**58,643**	**38,095**	**1,628**
Floyd, IN	No	**33**	**3,206**	**285**	**2,920**	**57,498**	**8,169**	**3,462**	**258**
Clark, IN	Yes	**16**	**1,398**	**338**	**1,060**	**4,043**	**5,749**	**6,049**	**800**
Bullitt, KY	No	**6**	**659**	**283**	**376**	**857**	**3,140**	**5,816**	**182**
Oldham, KY	No	6	579	220	359	504	3,306	1,821	254
Jefferson, IN	No	**3**	**1,265**	**168**	**1,097**	**75,319**	**25,214**	**2,272**	**341**
Hardin, KY	No	3	896	358	538	1,207	4,714	4,384	1,163
Franklin, KY	No	1	352	140	212	532	2,147	3,329	179

Note that the table may not include all counties considered in the 9-factor analysis, and that those counties not shown had no factors that indicated that they should be candidates for a nonattainment status.

Based on emissions levels and CES values, Jefferson County in Kentucky is the clearest candidate for a 24-hour $PM_{2.5}$ nonattainment designation. The other Kentucky counties shown here individually have relatively low levels of PM2.5-related emissions

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in $\mu g/m^3$) for air quality monitors in counties in the Louisville area based on data for the 2004-2006 and 2005-2007 periods. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98^{th} percentile values are 35 $\mu g/m^3$ or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Louisville area are shown in Table 2.

Table 2. Air Quality Data

County	State Recommended Nonattainment	24-hr PM2.5 Design Values, 2004-2006 ($\mu g/m^3$)	24-hr PM2.5 Design Values, 2005-2007 ($\mu g/m^3$)
Jefferson, KY	No	36	37
Floyd, IN	No	32	35
Clark, IN	Yes	37	40
Bullitt, KY	No	34	36

Hardin, KY	No	32	35
Franklin, KY	No	31	34

Jefferson and Bullitt Counties show a violation of the 24-hour $PM_{2.5}$ standard based on 2005-2007 data. Therefore, these counties are included in the Louisville nonattainment area. The remaining counties area evaluated as candidates for their possible contribution to a nearby violating area based on the weight of evidence of the nine factors and other relevant information. Hardin and Franklin Counties have design values that nearly approaching, but not exceeding, the standard. As shown in Figure 1, the design values peak in the center of the MSA and drop below the standard the farther you go away from the center. This suggests a convergence of sources located in and around the core are potentially contributing to the violations.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with an FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the area being evaluated, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

Jefferson County has the highest population and population density in the area. Bullitt, Oldham, and Hardin Counties of Kentucky have moderately-sized populations, and population densities are relatively low compared to Jefferson County.

Table 3. Population

County	State Recommended Nonattainment	2005 Population	2005 Population Density (pop/sq mi)
Jefferson, KY	No	699,051	1755
Floyd, IN	No	72,025	485
Clark, IN	Yes	101,625	270
Bullitt, KY	No	71,440	238
Oldham, KY	No	53,459	273
Hardin, KY	No	96,825	154

Based on this factor, Jefferson County clearly requires further evaluation.

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Louisville area, the percent of total commuters in each county who commute to other counties within the Louisville area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State Recommended Non-attainment	2005 VMT (millions of miles)	Number Commuting to any violating counties	Percent Commuting to any violating counties	Number Commuting into and within the statistical area	Percent Commuting into and within the statistical area
Jefferson, KY	**No**	**9,030**	**312,660**	**95**	**322,950**	**98**
Clark, In	**Yes**	**1,218**	**41,100**	**85**	**47,410**	**98**
Hardin, KY	No	688	6,060	14	43,440	98
Floyd, IN	**No**	**768**	**18,380**	**52**	**34,590**	**99**
Bullitt, KY	**No**	**852**	**28,570**	**94**	**30,160**	**99**
Oldham, KY	No	526	13,050	61	21,020	98

The listing of counties on Table 4 reflects a ranking based on the number of people commuting to other counties. The counties that are in the nonattainment area for the 1997 $PM_{2.5}$ NAAQS are shown in boldface.

In Region 4, Jefferson and Bullitt Counties in Kentucky show a violation of the 24-hour $PM_{2.5}$ standard and also have the highest vehicle miles traveled of the Kentucky counties. Based on this factor, Jefferson and Bullitt Counties had traffic and commuting patterns that warrant consideration based on this and other factors. Hardin County also had area-wide commuting numbers greater than Bullitt County, however, the number communting specifically to the violating counties (Jefferson and Bullitt) and the absolute VMT are among the lowest in the area. This suggests this factor alone is not a strong basis for including Hardin County in the nonattainment area; in addition Hardin County is not a significant candidate for contribution based on any other of the 8 factors.

Note: The 2005 VMT data used for tables 4 and 5 of the technical analysis have been derived using methodology such as that described in "Documentation for the 2005 Mobile National Emissions Inventory, Version 2," December 2008, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at:

ftp://ftp.epa.gov/EmisInventory/2005_nei/mobile_sector/documentation/2005_mobile_nei_version_2_report.pdf.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in Louisville, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Louisville area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

Location	Population (2005)	Population Density (2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Oldham , KY	53,459	273	14	526	19
Jefferson , KY	**699,051**	**1755**	**1**	**9030**	**18**
Bullitt, KY	**71,440**	**238**	**16**	**852**	**13**
Clark , IN	**101,625**	**270**	**5**	**1218**	**10**
Floyd, IN	**72,025**	**485**	**2**	**768**	**3**
Hardin, KY	96,825	154	3	688	-39

Bullitt and Oldham Counties had relatively high population growth between 2000 and 2005 compared to the other counties in the Louisville area. Oldham, Jefferson and Bullitt Counties had a sizable increase in VMT from 1996 and 2005; an increase greater than Clark, Floyd and Hardin Counties in the Louisville area. Jefferson and Bullitt Counties are nonattainment candidates based on this factor (and other factors). Oldham County is suggested for consideration under this factor, however, even with significant growth it still has the lowest population and VMT of the Kentucky counties shown here, and it is not a clear candidate based on any other factor.

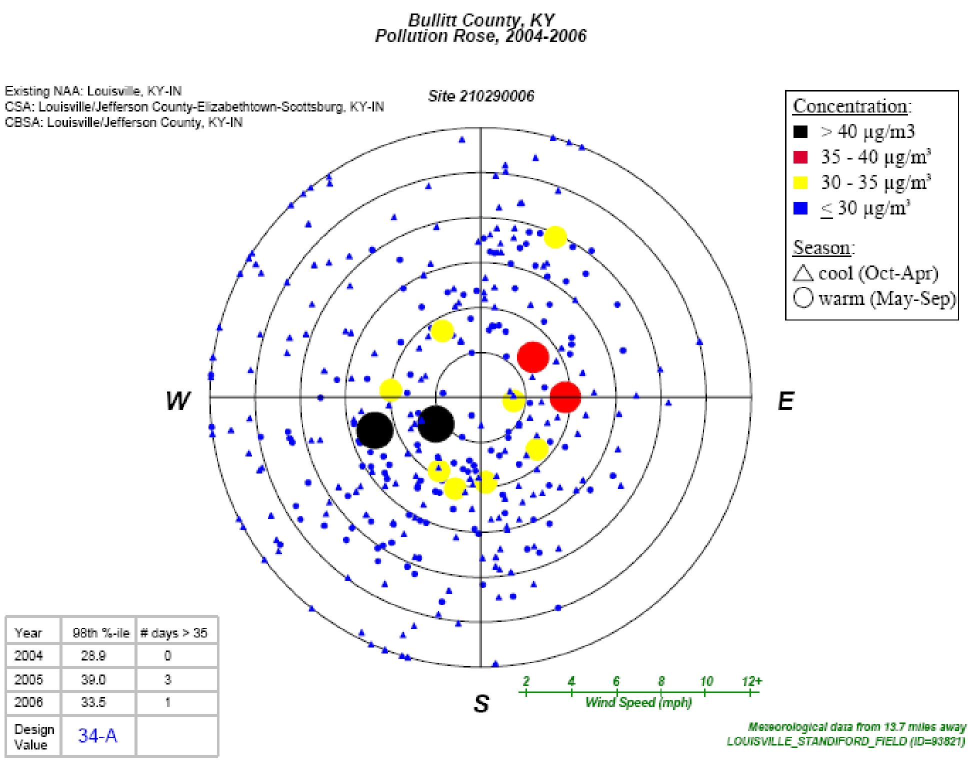
Factor 6: Meteorology (weather/transport patterns)

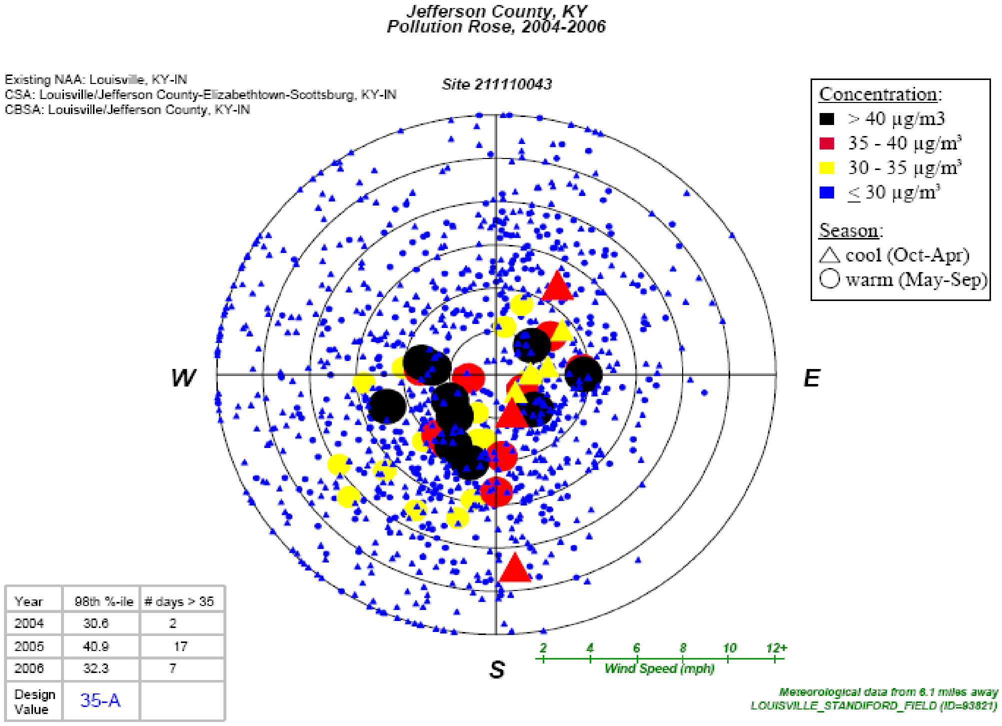
For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on “high $PM_{2.5}$ days” for each of two seasons (an October-April “cold” season and a May-September “warm” season). These high days are defined as days where any

FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

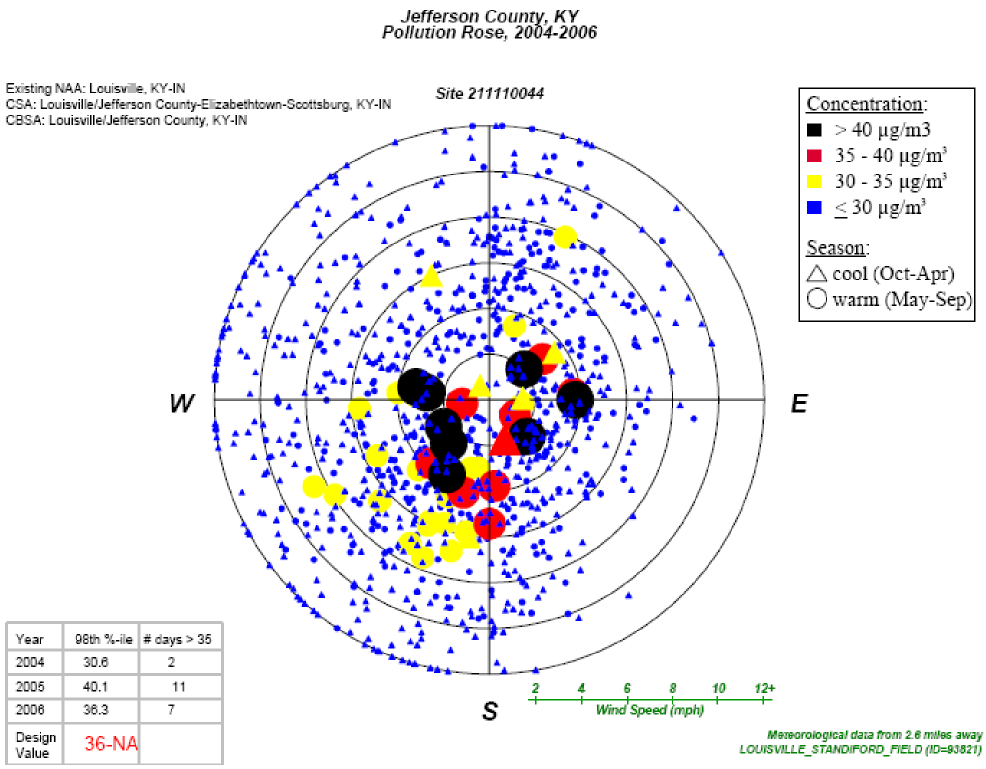
For each air quality monitoring site, EPA developed a "pollution rose" to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. Pollution roses for Bullitt and Jefferson Counties, KY



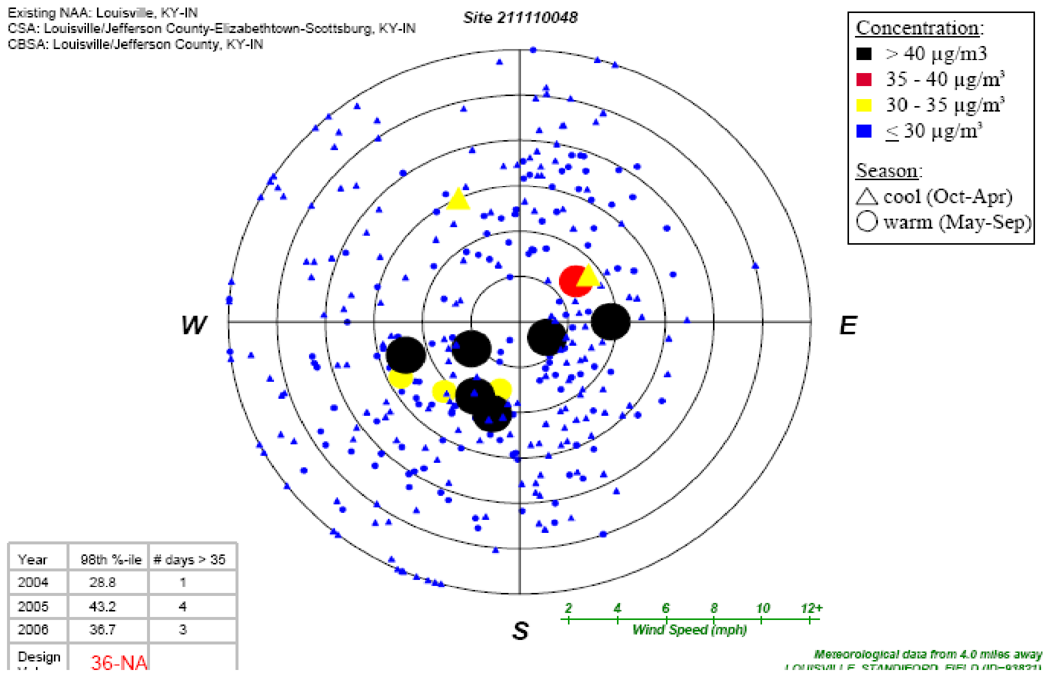


Year	98th %-ile	# days > 35
2004	30.6	2
2005	40.9	17
2006	32.3	7
Design Value	35-A	



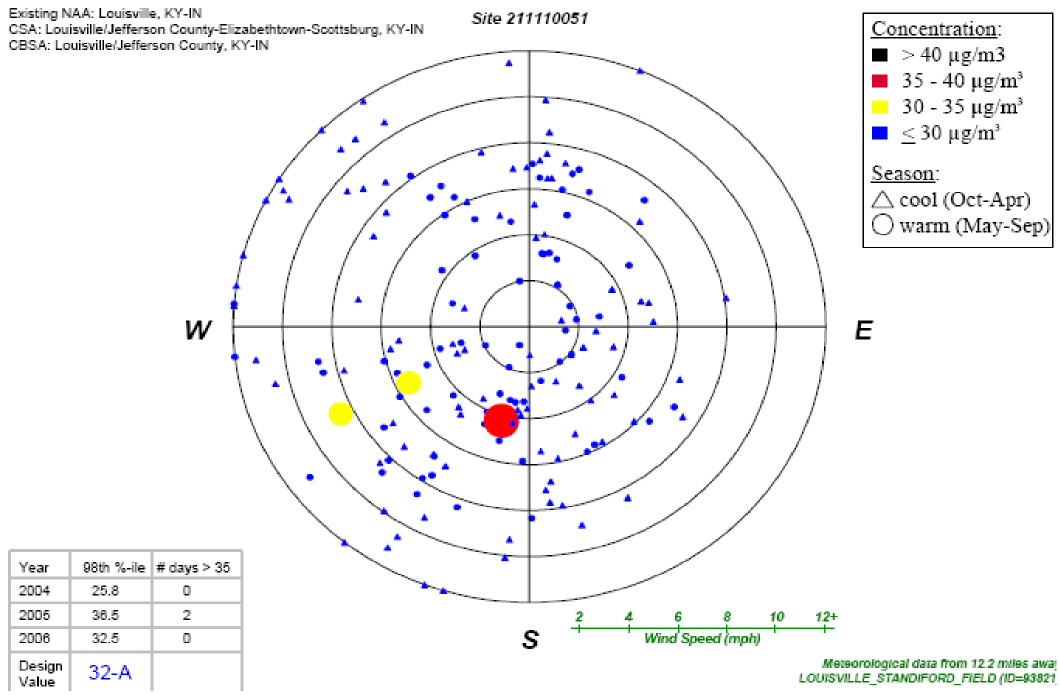
Year	98th %-ile	# days > 35
2004	30.6	2
2005	40.1	11
2006	36.3	7
Design Value	36-NA	

Jefferson County, KY
Pollution Rose, 2004-2006



Year	98th %-ile	# days > 35
2004	28.8	1
2005	43.2	4
2006	36.7	3
Design	36-NA	

Jefferson County, KY
Pollution Rose, 2004-2006



Year	98th %-ile	# days > 35
2004	25.8	0
2005	36.5	2
2006	32.5	0
Design Value	32-A	

As shown in the pollution roses for Jefferson County, KY in Figure 2, on high PM2.5 days prevailing surface winds come from several directions, but are most frequently concentrated from the south-southwest and west (in the direction of Bullitt and Harrison Counties). The pollution roses show that 24-hour $PM_{2.5}$ concentrations are less frequently influenced by emissions from a northwesterly direction (Clark and Jefferson County, IN). These data suggest that emissions from the south-southwest and west relative to the Jefferson County violations are more likely to contribute than emissions from other directions. The pollution rose for Bullitt County, KY show a less clear central tendency and do not point strongly to other KY counties identified as candidates for other factors (Hardin and Oldham Counties).

Based on analysis of this factor in conjunction with other factors, EPA concludes that Jefferson and Bullitt Counties are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Louisville area.

The Louisville area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. Therefore, this factor did not play a significant role in the decision-making process.

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

In evaluating the jurisdictional boundary factor, EPA gave special consideration to areas that were already designated nonattainment in 2005 for violating the 1997 fine particle standards. Analysis of chemical composition data in these areas indicates that the same components that make up most of the PM2.5 mass in the area on an annual average basis (such as sulfate and direct PM2.5 carbon in many eastern areas) also are key contributors to the PM2.5 mass on days exceeding the 24-hour PM2.5 standard. These data indicate that in many cities, the same source categories that contribute to violations of the annual standard also contribute to exceedances of the 24-hour standard.

Most areas that were originally designated nonattainment for the PM2.5 standards still have not attained the standards. Thus, EPA has generally concluded that counties that were designated as having emissions sources contributing to fine particle concentrations which continue to exceed the 1997 standards (all areas violated the annual standard, two also violated the previous 24-hour standard) also contribute to fine particle concentrations on the highest days. For this reason, EPA believes that for most existing nonattainment areas, the nonattainment area for the 2006 24-hour standard should be the same. Consideration also should be given to existing boundaries and organizations as they may facilitate air quality planning and the implementation of control measures to attain the standard. Areas already designated as nonattainment represent important boundaries for state air quality planning.

The existing PM2.5 nonattainment boundary consists of Jefferson and Bullitt Counties in Kentucky and Clark, Floyd, and Jefferson (partial) Counties in Indiana. Thus, under this factor it would be appropriate to consider including Jefferson and Bullitt Counties in Kentucky in the nonattainment area.

Factor 9: Level of control of emission sources

Under this factor, the existing level of control of emission sources is taken into consideration. The emissions data used by EPA in this technical analysis and provided in Table 1 (under Factor 1) represent emissions levels taking into account any control strategies implemented in the [area] area before 2005 on stationary, mobile, and area sources. Data are presented for PM2.5 components that are directly emitted (carbonaceous PM2.5 and crustal PM2.5) and for pollutants which react in the atmosphere to form fine particles (e.g. SO_2, NOx, VOC, and ammonia).

In considering county-level emissions, EPA used data from the 2005 National Emissions Inventory, the most updated version of the national inventory available at the beginning of the designations process in late 2007. However, EPA recognized that for certain counties, emissions may have changed since 2005. For example, certain power plants or large sources of emissions in or near this area may have installed emission controls or otherwise significantly reduced emissions since 2005. Some States provided updated information on emissions and emission controls in their comments to EPA. EPA considered such additional information in making final designation decisions.

With regard to nearby power plants, EPA considered information about whether a specific plant installed federally enforceable emission controls by December 2008 resulting in significant emissions reductions. A control requirement is considered to be federally-enforceable if it is required by a State regulation adopted in a State implementation plan, if it is included in a federally-enforceable Title V operating permit, or if it is required by a consent decree which also requires the controls to be included in federally enforceable permit upon termination of the consent decree. In making final decisions, EPA also considered whether a facility would continue to emit pollutants which contribute to PM2.5 exceedances even after emission controls are operational. Jefferson County has two major power plants (Cane Run and Mill Creek). EPA did not receive additional information indicating a significant change in emissions or pollution controls from these sources since 2005. These sources continue to have relatively large emissions of PM2.5-related pollutants that contribute to the violating area.

Conclusion

Based on this evaluation, EPA has concluded that the counties in Kentucky with violations of the standard (Jefferson and Bullitt Counties), and nearby areas that contribute to the violation (Jefferson and Bullitt Counties) should be included in the nonattainment area. The results from evaluation of Factors 1, 2, 3, 4, 5, 6, 8, and 9 support this conclusion for Jefferson County, and Factors 2, 4, 5, 6, 8, and 9 for Bullitt County.

Additional information regarding responses to specific State comments can be found in EPA's Response to State Comments document at http://www.epa.gov/pmdesignations/2006standards/tech.htm.

$PM_{2.5}$ Exceptional Events Technical Support Document

U.S. Environmental Protection Agency Region 4

Louisville, KY-IN Metropolitan Statistical Area

2004 - 2007

Introduction

This document provides U.S Environmental Protection Agency (EPA) Region 4 rationale for concurrence or non-concurrence with an exceptional event flag on the 24-hr average $PM_{2.5}$ concentration recorded at various Air Quality System (AQS) sites within the Louisville Metro Air Pollution Control District (LMAPCD) Ambient Air Monitoring Network. The exceptional event flags that EPA Region 4 has concurred with will be excluded from use in determinations of exceedances and National Ambient Air Quality Standards (NAAQS) violations.

According to 40 CFR 50.1(j):

> "Exceptional event means an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the Administrator in accordance with 40 CFR 50.14 to be an exceptional event. It does not include stagnation of air masses or meteorological inversions, a meteorological event involving high temperatures or lack of precipitation, or air pollution relating to source noncompliance."

§50.14(b)(2) also states:

> "EPA shall exclude data from use in determinations of exceedances and NAAQS violations where a State demonstrates to EPA's satisfaction that emissions from fireworks displays caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section. Such data will be treated in the same manner as exceptional events under this rule, provided a State demonstrates that such use of fireworks is significantly integral to traditional national, ethnic, or other cultural events including, but not limited to July Fourth celebrations which satisfy the requirements of this section."

Finally, §50.14(c)(3)(iii) states:

"The demonstration to justify data exclusion shall provide evidence that:

(A) The event satisfies the criteria set forth in 40 CFR 50.1(j);
(B) There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area;
(C) The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and
(D) There would have been no exceedance or violation but for the event.

Each $PM_{2.5}$ 24-hr average concentration requested for exclusion was first evaluated against these criteria using a two-step analysis. This analysis was designed to compare the requested value to historical values observed at the site and determine whether any exceedances could have been caused by the suspected event.

Step 1: Monthly Average Comparison

Using 24-hr $PM_{2.5}$ data from AQS for 2004-2007, a comparison three-year monthly average was calculated. The three-year monthly average concentration was calculated excluding data from the year in which the data in question was collected. For example, a requested value in May 2006 was compared to the average of all the samples collected at the site during May 2004, May 2005, and May 2007. If the three-year average was greater than the annual $PM_{2.5}$ NAAQS (15.0 $\mu g/m^3$) and the requested value was less than the 24-hr $PM_{2.5}$ NAAQS (35 $\mu g/m^3$), then EPA concurrence was generally not given to the requested value. This is because in EPA's judgment there is insufficient evidence that "there would have been no exceedance or violation but for the event" as required by §50.14(c)(3)(iii)(D) because the normally expected concentration at the site (the three-year monthly mean concentration) is in excess of the NAAQS.

Step 2: Monthly 84th Percentile Comparison

Using 24-hr $PM_{2.5}$ data from AQS for 2004-2007, a comparison three-year upper 84th percentile was calculated for the month in which the requested value was collected. The three-year monthly 84th percentile was calculated excluding data from the year in which the data in question was collected. For example, a requested value in May 2006 was compared to the upper 84th percentile calculated from of all the samples collected at the site during May 2004, May 2005, and May 2007. The calculated three-year monthly upper 84th percentile was considered to represent the range of normally expected high values at that site due to normal local and background sources If the requested value was below the calculated three-year monthly upper 84th percentile, EPA concurrence was generally not given to the requested value. This is because in EPA's judgment there is insufficient evidence to demonstrate that the NAAQS exceedance was caused by the suspected event as required by §50.14(c)(3)(iii)(D) and not by normal local and background sources at the site.

If a requested value did not meet the requirements described in one or more of the above steps and the State did not submit compelling evidence to demonstrate that the event satisfied the exceptional event criteria, then EPA concurrence was not given to the exceptional event flag on the requested value. The values that did meet all of the conditions described above were then evaluated against the requirements of §50.14(c)(3)(iii).

Summary of maps and graphs used

A variety of maps and graphs were used in this document. Unless otherwise noted, these products were obtained from the DATAFED Data Views Catalog, which can be accessed at http://datafedwiki.wustl.edu/index.php/Data_Views_Catalog. This includes maps using data from AQS, the National Aeronautics and Space Administration (NASA), and the Navy Aerosol Analysis and Prediction System (NAAPS.) Also, unless otherwise noted, all ambient air monitoring data used in this analysis was obtained from the EPA AQS database.

The following discussion will demonstrate that the 24-hr average $PM_{2.5}$ concentrations observed at various Louisville Metro Air Pollution Control District (LMAPCD) network monitoring sites on the following dates meet or fail to meet the criteria laid out in the Exceptional Events Rule, §50.14.

EXCEEDANCE EVENT: Independence Day Fire Work

Exceedance Date:	July 4, 2004
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from permitted Local firework displays

Table 1: site-specific information used in analysis (μg/m^3)

AQS ID	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	33.1	20.5	29.5	33.8	No[1]
21-111-0043-2	25.4	20.5	29.8	34.1	No[1,2]
21-111-0044	26.4	21.3	30.9	33.4	No[1,2]

Note [1]Three-year monthly average above 15μg/m^3 and observed concentration is below 35μg/m^3
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION:

Documentation submitted by the Louisville Metro Air Pollution Control District claims that smoke from permitted local firework displays caused NAAQS exceedances at the sites listed above. None of the requested values, however, passed the two-step analysis. Also, documentation submitted by LMAPCD did not clearly demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance "but for" the event. Due to these reasons, no further analyses of these events are necessary[1]. EPA concurrence was not given to these exceptional event flags.

[1] Sonomatech analysis Appendix 1

EXCEEDANCE EVENT: Independence Day Fire Work

Exceedance Date:	July 3 - 4, 2005
MSA:	Louisville -Jefferson Co. - Scottsburg
Event Description:	Smoke impact from permitted Local firework displays

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Table 2 Site-specific information used in analysis (μg/m³)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	7/3/2005	24.1	18.8	28.0	33.2	No[1,2]
21-111-0043-2	7/3/2005	23.7	18.8	27.8	33.0	No[1.2]
21-111-0044	7/3/2005	27.5	18.9	27.7	32.0	No[1,2]
21-111-0048	7/3/2005	24.9	19.9	29.0	36.8	No[1,2]
21-111-0051	7/3/2005	28.9	19.0	27.9	29.2	No[1]
21-111-0043-1	7/4/2005	29.5	18.8	28.0	33.2	No[1]
21-111-0043-2	7/4/2005	29.7	18.8	27.8	33.0	No[1]
21-111-0044	7/4/2005	31.7	18.9	27.7	32.0	No[1]

Note [1]Three-year monthly average above 15μg/m³ and observed concentration is below 35μg/m³
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

Documentation submitted by the Louisville Metro Air Pollution Control District claims that smoke from permitted local firework displays caused NAAQS exceedances at the site listed above. None of the requested values, however, passed the two-step analysis. Also, documentation submitted by LMAPCD did not clearly demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance or violation but for the event. Due to these reasons, no further analyses of these events are necessary[2]. EPA concurrence was not given to these exceptional event flags.

[2] Sonomatech analysis Appendix 1

EXCEEDANCE EVENT: Independence Day Fire Work

Exceedance Date:	July 3 - 4, 2006
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from permitted Local firework displays

Table 3 Site-specific information used in analysis ($\mu g/m^3$)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	7/3/2006	31.7	18.8	28.0	33.2	No[1]
21-111-0043-2	7/3/2006	32.6	18.8	27.8	33.0	No[1]
21-111-0044	7/3/2006	32.1	18.9	27.7	32.0	No[1]
21-111-0043-1	7/4/2006	29.6	18.8	28.0	33.2	No[1]
21-111-0043-2	7/4/2006	31.5	18.8	27.8	33.0	No[1]
21-111-0044	7/4/2006	31.7	18.9	27.7	32.0	No[1]
21-111-0048	7/4/2006	35.3	17.4	25.0	29.5	Yes
21-111-0051	7/4/2006	32.8	19.0	27.9	29.2	No[1]

Note [1]Three-year monthly average above $15\mu g/m^3$ and observed concentration is below $35\mu g/m^3$
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

Documentation submitted by the Louisville Metro Air Pollution Control District claims that smoke from permitted local firework displays caused NAAQS exceedances at the sites listed above. All but one of the requested values failed the two-step analysis and no further analyses of these events are necessary[3]. EPA concurrence was not given to these exceptional event flags.

The following analysis will be centered on the Barret site (21-111-0048) event which took place on July 4, 2006. The LMACPD Technical Demonstration provides graphical presentation of hourly data of the $PM_{2.5}$ continuous TEOM monitor, wind speed and wind direction as well as concentration levels three days prior and after the event. Permits for organized Independence Day Fire work displays were also provided.

Fine particulate matter speciation data are available for July 4, 2006, where measured concentrations of both Potassium and Strontium are significantly above background levels for the same time period in 2004, 2005, 2006 and 2007. The increased concentration of potassium is indicative that the measured $PM_{2.5}$ mass was impacted by the fire work displays. This along with the other evidence submitted satisfy the requirements of §50.14(c)(3)(iii)(A-D). Therefore, EPA concurs with LMAPCD request to flag July 4, 2006, at the Barret site as indicated in $PM_{2.5}$ in Table 3 above.

[3] Sonomatech analysis Appendix 1

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

A causal connection between the fireworks displays and the observed exceedance of the $PM_{2.5}$ NAAQS was graphically demonstrated with the hourly data from the $PM_{2.5}$ continuous TEOM monitors which show concentrations of $PM_{2.5}$ beginning to rise at 1900 hours (Figure 1). Large spikes in concentration were seen on 7/4/06 at hours 22-24. Smaller spikes were seen the previous night. The impact from the fireworks was limited to a few hours due to light/moderate winds throughout the night, a weak upper-level trough, and the lack of a surface inversion, all of which enhanced mixing. If the three highest hours (22-24) are replaced with the median or excluded, the 24-hour average decreases by about 38%[4].

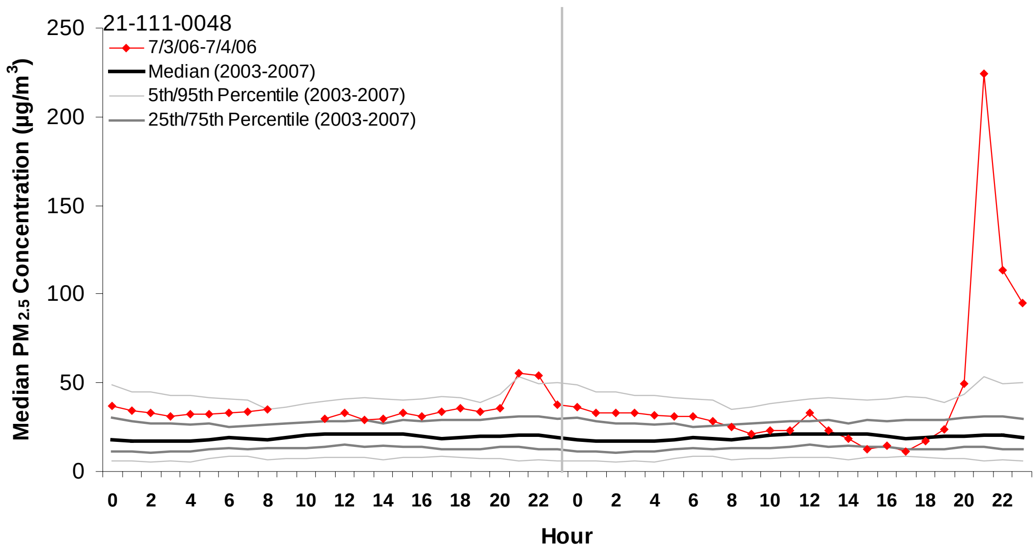


Figure 1: Barret TEOM hourly data SONOMATECH

According to Perry (1999) and Vecchi et al. (2008), strontium is widely used in fireworks to create red coloring, and is normally present in the atmosphere at very low levels. According to Vecchi et al. (2008), "Sr was recognized as the best fireworks tracer because its concentration was very high during the [fireworks] event and lower than, or comparable with, minimum detection limits during other time intervals, suggesting that it was mainly due to pyrotechnic displays." Potassium nitrate is used as an oxidizer and is a prominent component in fireworks.

[4] SONOMATECH

C. COMPARISON TO BACKGROUND LEVELS

Concentrations of both Potassium and Strontium are significantly above background levels for the same time period in 2004, 2005, 2006 and 2007 at the nearby Southwick site. The concentrations are 6 to 10 times higher than background levels for Strontium and 20 to 70 times higher for Potassium. The magnitudes of these concentrations are indicative that the measured $PM_{2.5}$ mass was impacted by the fire work displays (Figure 2 – 3).

Figure 2: Southwick 7/4/06 - Strontium

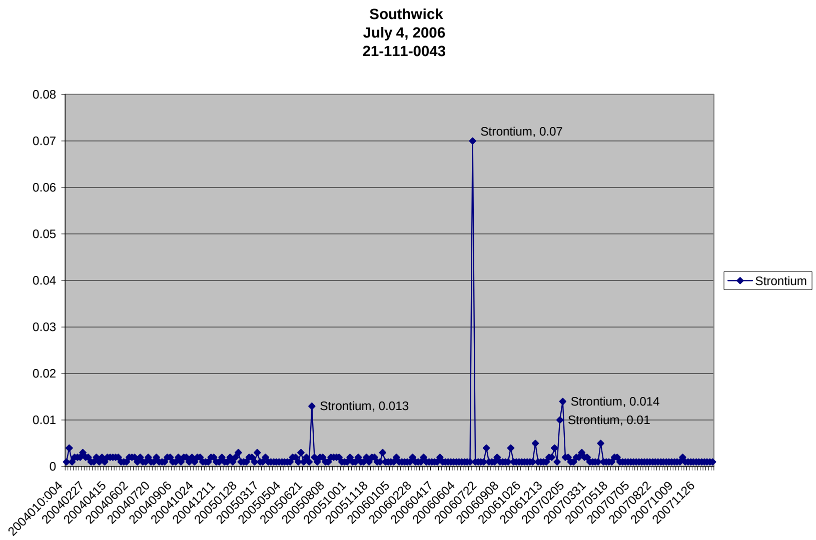
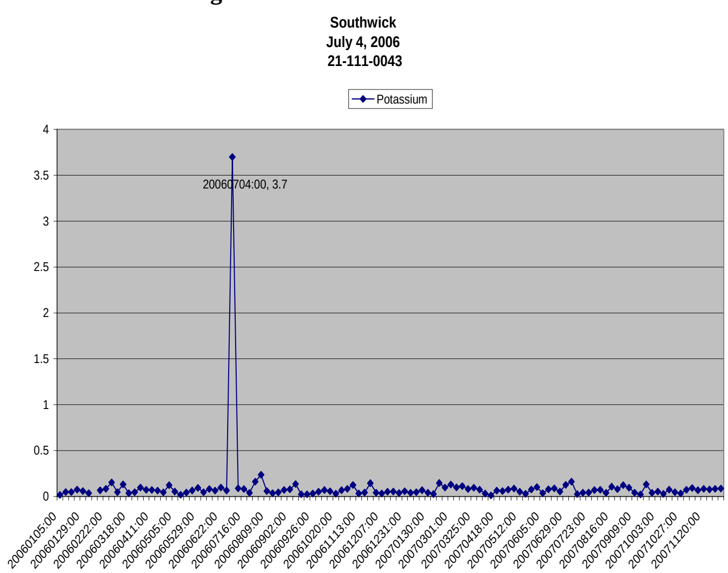


Figure 3: Southwick 7/4/06 - Potassium



D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

In order to demonstrate that there would have been no exceedance of the 24-hr $PM_{2.5}$ standard at the Barret site but for the fireworks displays, a $PM_{2.5}$ source apportionment analysis was conducted using $PM_{2.5}$ speciation data collected on July 4, 2006, at the Barret site, and as discussion using fireworks source apportionment data collected by Perry (1999).

First, $PM_{2.5}$ Speciation data for the Barret site was collected for June 22 – July 19, 2006 from EPA's Air Explorer website, which uses data from the EPA Air Quality System (AQS) database. Next, data collected by Perry (1999) on the percent variance in $PM_{2.5}$ mass explained by each of three source categories (fireworks, wind-blown soil, and other sources) for each of 18 $PM_{2.5}$ speciated parameters (Al, Ba, Br, Ca, Cu, Fe, K, Mg, Mn, Na, Pb, S, Si, Sr, Ti, V, Zn, and Soot) were identified. This data was based on $PM_{2.5}$ speciation data collected from July 1 – 7, 1990 across Western portion of Washington State.

Next, for each day that $PM_{2.5}$ speciation data was collected during June 22 – July 16, 2006, a $PM_{2.5}$ strontium ratio was calculated by dividing the measured $PM_{2.5}$ strontium mass on a given day by the measured $PM_{2.5}$ strontium mass at that site on July 4th. The purpose of this calculation was to quantify the relative impact of $PM_{2.5}$ from fireworks on different days. Next, a $PM_{2.5}$ mass apportionment was conducted for each measured speciation component for each day that speciation data was available. This was accomplished using the following equation:

$$M_{source} = \%V_{source} \times M_{measured} \quad (Eq.\ 1)$$

Where M_{source} is the mass of a specific $PM_{2.5}$ speciated component attributed to a source (i.e. fireworks, wind-blown soil, or other), $\%V_{source}$ is the percent variance that is explained by the source, obtained from Perry (1999), and Mmeasured is the measured $PM_{2.5}$ mass of the speciated component. This analysis was conducted for each of the 18 speciated components discussed in Perry (1999). Because no data was available for the $\%V_{source}$ values for sulfate mass, the $\%V_{source}$ values for elemental sulfur were used, assuming that sulfur mass and sulfate mass are directly proportional. Also, the $\%V_{source}$ values calculated by Perry (1999) for soot were used for both elemental and organic carbon. For all other speciated parameters for which no $\%V_{source}$ values were available, the mass was assumed to be entirely from "other sources."

One limitation of this analysis method is that the $\%V_{source}$ values for each of the three source categories do not add up to 100%. As a result, the entire $PM_{2.5}$ mass observed could not be directly accounted for (mean unaccounted mass fraction = 31.5%). To compensate for this problem, the percentage of the accounted mass was calculated for each of the three sources. The unaccounted mass (observed $PM_{2.5}$ mass – accounted mass) was then apportioned according to these percentages.

The final step in the source apportionment calculations was to account for day to day variability of source categories. Due to the fact that fireworks were only a documented source on July 4th, the $M_{fireworks}$ calculated for each day was multiplied by the $PM_{2.5}$ strontium ratio described above, in order to quantify the relative significance of fireworks as an emissions source on different days. This was considered the final $PM_{2.5}$ mass attributed to fireworks. A leftover mass was then calculated by subtracting the final mass attributed to fireworks from the fireworks. This leftover mass was then added to the “other sources” category. The resulting source apportionment analysis is shown in Figure 4. This figure demonstrates that this event satisfies the requirement of §50.14(c)(3)(iii)(D) that “there would have been no exceedance or violation but for the event.

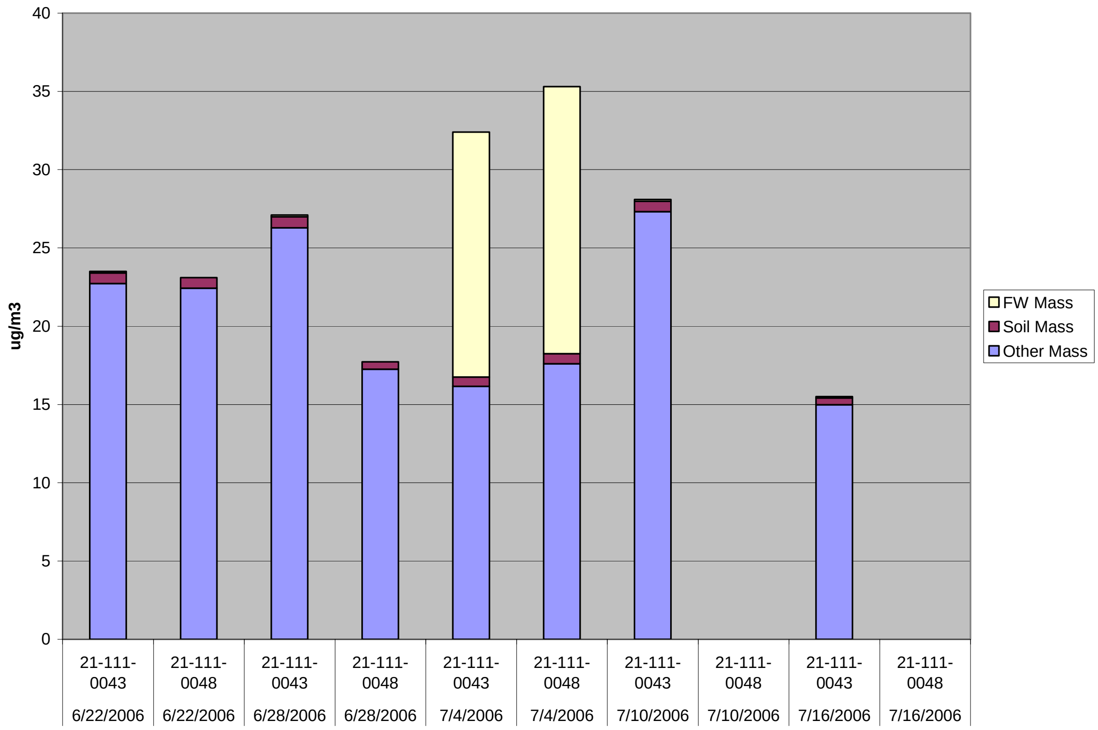


Figure 4 Southwick 7/4/06 “But For”

EXCEEDANCE EVENT: Fort Knox Range Fire

Exceedance Date:	November 11 – 12, 2005
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Tracer rounds started brush fire in unexplored munitions area

Table 4: Site-specific information used in analysis ($\mu g/m^3$)

AQS ID	Date	Observed Concentration[5]	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	11/11/2005	21.3	12.9	18.3	21.7	Yes
21-111-0043-2	11/11/2005	21.2	12.4	17.8	21.0	Yes
21-111-0044	11/11/2005	28.8	13.0	18.5	22.1	Yes
21-111-0043-1	11/12/2005	36.4	12.9	18.3	21.7	Yes
21-111-0043-2	11/12/2005	35.6	12.4	17.8	21.0	Yes
21-111-0044	11/12/2005	29.6	13.0	18.5	22.1	Yes
21-111-0048	11/12/2005	21.2	13.0	17.2	18.9	Yes

Note [1]Three-year monthly average above 15μg/m³ and observed concentration is below 35μg/m³
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

Documentation submitted by the Louisville Metro Air Pollution Control District (LMAPCD) claims that an accidental fire was created when tracer rounds ignited a brush fire and that the smoke from the Fort Knox range fire caused exceedances at the sites listed above. Although this was an anthropogenic event, the likelihood of a recurrence is sufficiently small to believe that it will not occur again. All of the requested values passed the two-step analysis. Those few values that were above the daily standard of 35μg/m³ were evaluated against the daily standard while those values below the daily standard were evaluated against the annual standard of 15μg/m³. Documentation submitted by LMAPCD was sufficient to make a determination of a clear causal relationship between the measured concentrations and the event, and that there would have been no exceedance or violation but for the event as required by of 40 CFR Part 50.14(c)(3)(iii). Therefore, EPA concurs with LMAPCD's request to flag on the dates in Table 4 above.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

The causal connection between the Fort Knox Military Reservation range fire and the exceedance or violation of the NAAQS values has been established by the documentation LMAPCD provided in their Technical Document. The demonstration provided the following: 95th percentile for the last four years at each of the sites, pollution roses, wind rose graphs, National Oceanic and Atmospheric Administration (NOAA) satellite fire detection and smoke maps, notification of Air Quality Index (AQI) alerts issued, TEOM continuous $PM_{2.5}$ strip chart and statistical analysis of daily $PM_{2.5}$ and speciation data.

[5] The concentrations which are less than 30μg/m³ were judged exceptional with regard to the annual standard level of 15μg/m³.

The Fort Knox Military Reservation is approximately 20 miles southwest of the Louisville. The Courier-Journal Newspaper article reported calls made to the fire stations in Elizabethtown and Louisville prompted by the haze visible in the area. Dispatcher Pat Riordan of the Louisville Fire & Rescue reported that "strong winds of 9 – 15 mph out of the south and low humidity carried smoke into the Louisville area[6]." The NOAA satellite fire detection map[7] demonstrates smoke plume passing over a portion of the Louisville area submitted provided enough evidence to pinpoint direct causation when taken into consideration together. Speciation data collected at the Barret and Southwick sites on November 12, 2005, show organic matter comprising a greater portion of the particulate mass measured on that day. The increased level of organic carbon is indicative that the measured particulate matter levels were impacted by smoke.

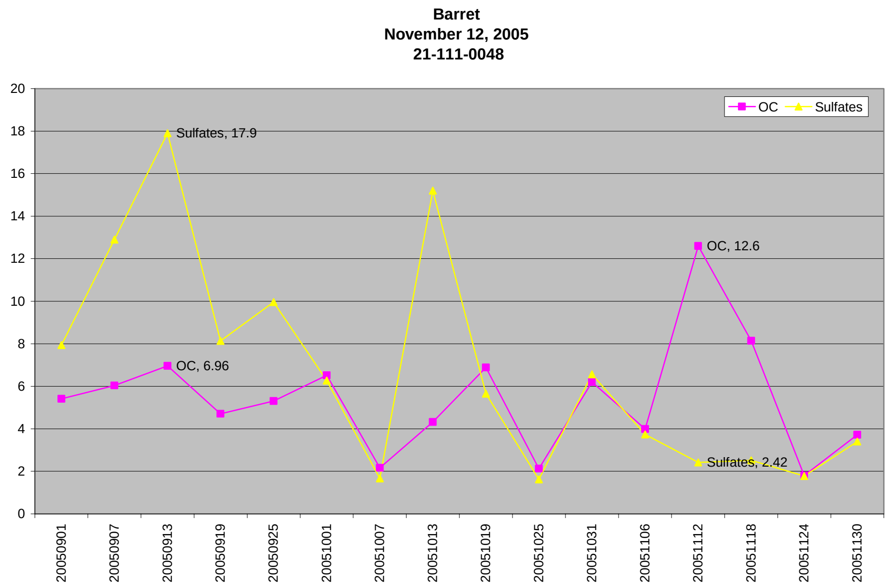


Figure 5: Barret Speciation 11/12/06

[6] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for November 11-12, 2005, (NOV 11-12, 2005) pg 7 of 11
[7] Nov 11-12, 2005, page 11 of 11

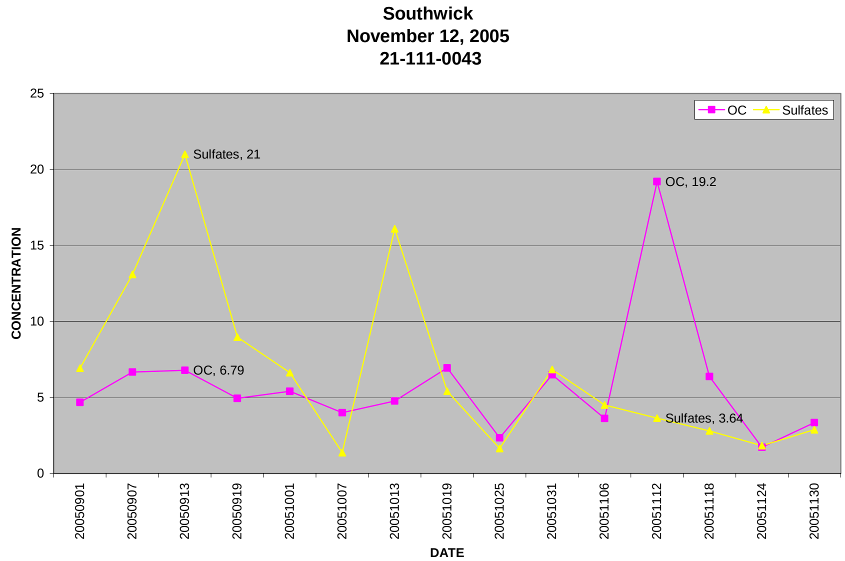


Figure 6: Southwick Speciation 11/12/06

Hourly concentrations on November 11, 2005 well above the 95th percentile concentrations were assumed to be due to smoke influence as a result of the Fort Knox Range fires and the high OC levels on the 12th (as shown in Figures 5 and 6). Contribution of smoke[8] to total $PM_{2.5}$, was calculated by replacing concentrations above the 95th percentile with the median concentration measured during the hours above the 95th percentile (as shown in Figures 7 and 8). The 24-hour average of the hourly measurements decreases by 30% (11/11) and 62% (11/12) at Southwick site and 54% (11/11) and 56% (11/12) at the Barret site. If the 24-hour filter measurements are decreased by the same percentages, the 11/12/05 concentration at 21-111-0043 is well below the 24-hour standard (17.5µg/m3).

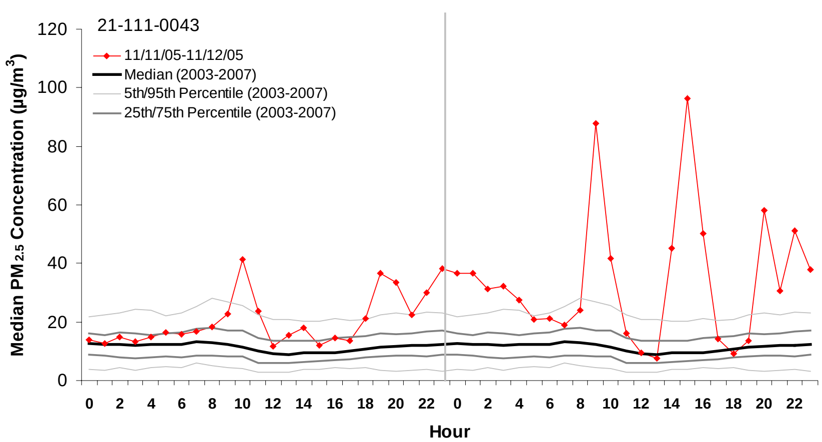


Figure 7: Southwick Hourly $PM_{2.5}$ Continuous Data 11/11/05-11/12/05

[8] Smoke contribution values and percentage decrease calculated by SONOMATECH

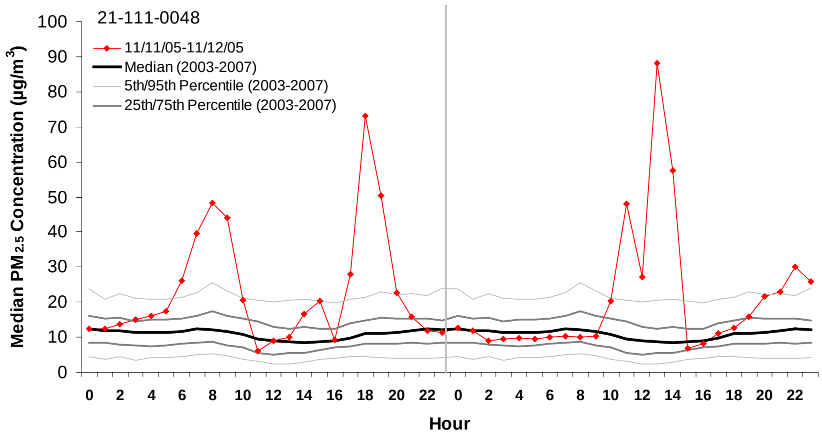


Figure 8: Barret Hourly $PM_{2.5}$ Continuous Data 11/11/05-11/12/05

C. COMPARISON TO BACKGROUND LEVELS

The 24-hr average $PM_{2.5}$ concentrations measured at the sites are above the monthly mean and calculated 95th percentile. The organic carbon measured at Southwick site is approximately 4 times higher than the three year monthly average for that site and 3 times higher for the Barret site as indicated in Figures 9 and 10. This indicates that the exceedances were more likely caused by the increased level of organic carbon measured that day (19.2µg/m^3 at Southwick and 12.6µg/m^3 at Barret) as opposed to the measured sulfate mass (3.6µg/m^3 at Southwick and 2.4µg/m^3 at Barret).

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

In order to quantify the impacts of the fire on observed PM2.5 concentrations, speciation data collected at the Southwick site on November 12, 2005 was used to approximate the organic mass increment of the observed $PM_{2.5}$ mass that was caused by the fire. To demonstrate that there would have been an exceedance or violation of the 24-hour NAAQ Standard the following graphs represents the estimated particulate matter "but for" speciated organic carbon and sulfate mass (Figure 8-9.) The portion of organic matter mass attributable to the fire is defined by the following equation: OMinc = 2(OCd – OC avg)[9], where OMinc is the organic mass increment; OCd and OCavg are the daily and typical (average) measured organic carbon.

The calculated OMinc for the data collected on Nov 12, 2005 at the Barret site (21-111-0048) was 16.8µg/m^3 and at the Southwick site (21-111-0043) was 29.8µg/m^3. Averaging the portion of organic matter mass attributable to the fire yields an OM_{inc} average of 23.3µg/m^3. This amount of OC and Figures 9 and 10 demonstrate that this event satisfies the requirement of §50.14(c)(3)(iii)(D) that there would have been no exceedance of the daily standard of 35µg/m^3 at Site 21-111-0043 on November 12 and of the annual standard of 15µg/m^3 at sites 21-111-0043, 0044 and 0048 on November 11 and 12 "but for" the event.

[9] "Species Contributions to PM2.5 Mass Concentrations (Turpin and Lim 2001)"

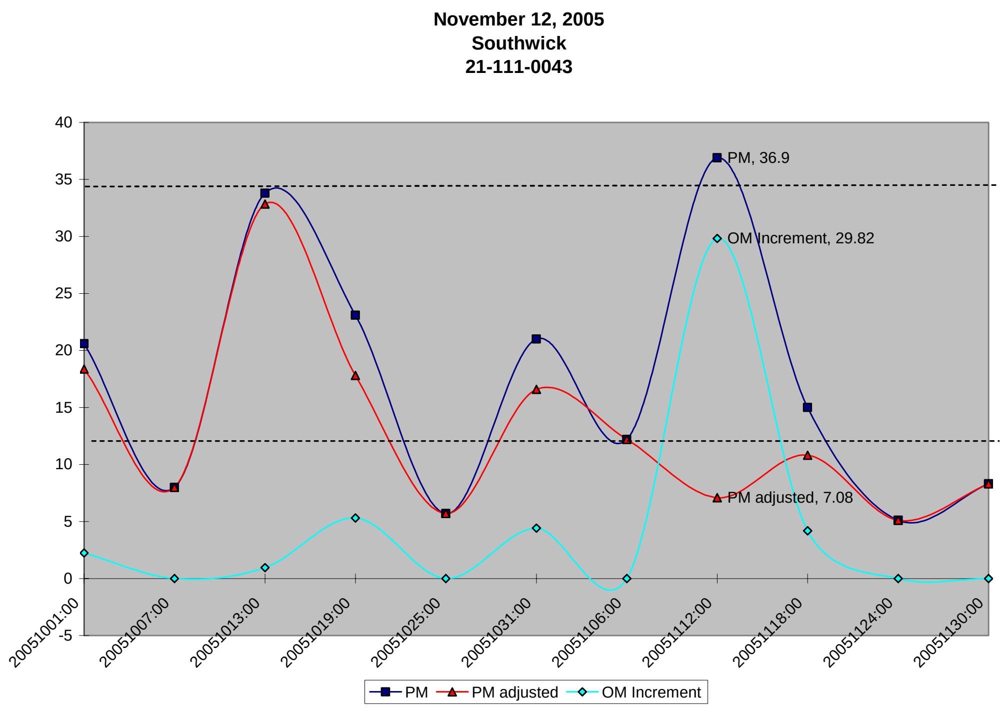


Figure 9 Barret "But For" November 12, 2005

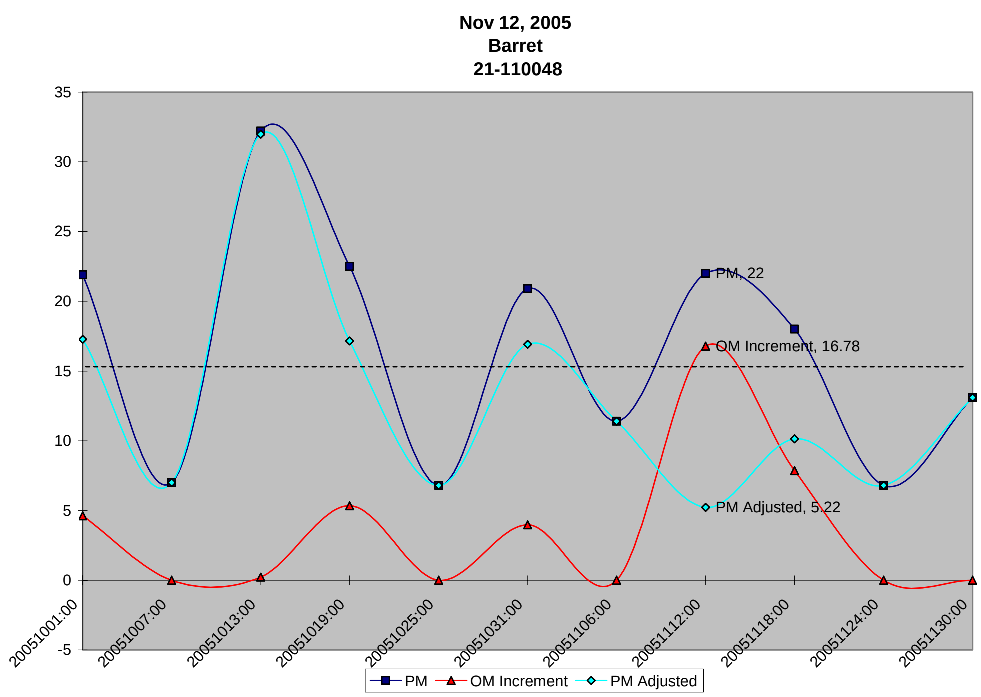


Figure 10 "But For" Southwick November 12, 2005

EXCEEDANCE EVENT: Kansas and Southeastern Wildfires

Exceedance Date:	July 21, 2004
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from Kansas and Southeastern Wildfires

Table 5 site-specific information used in analysis ($\mu g/m^3$)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	7/21/2004	35.1	21.3	30.9	33.4	No
21-111-0043-2	7/21/2004	35.7	20.5	29.5	33.8	No
21-111-0044	7/21/2004	34.2	20.5	29.8	34.1	No

Note [1]Three-year monthly average above 15$\mu g/m^3$ and observed concentration is below 35$\mu g/m^3$
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

Documentation submitted by the Louisville Metro Air Pollution Control District (LMAPCD) claims that smoke from the Kansas and Southeastern wildfires caused NAAQS exceedances at the site listed above. All of the requested values passed the two-step analysis. However, documentation submitted by LMAPCD did not clearly demonstrate a clear causal relationship between the measured concentration and the smoke impact from the event, and did not demonstrate that there would have been no exceedance “but for” the event. EPA concurrence was not given to these exceptional event flags.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

A causal connection between the Kansas and Southeastern wildfires and the observed exceedances of the $PM_{2.5}$ NAAQS was not demonstrated. The demonstration provided the following: TEOM continuous $PM_{2.5}$ strip chart, daily $PM_{2.5}$ measured values four days prior to and two days after the event, statistical analysis of historical $PM_{2.5}$ data and $PM_{2.5}$ speciation data, pollution roses, HYSPLIT backward trajectories, notification of Air Quality Index (AQI) alerts issued, and National Oceanic and Atmospheric Administration (NOAA) smoke maps. The NOAA satellite smoke maps show no smoke plume coverage over the Louisville, KY-IN MSA from the 20th through the 23rd of July 2004[10].

The supporting documentation provided in this Technical Document does not provide enough evidence to prove direct causation. A causal connection between the Kansas and Southeastern wildfires and the observed exceedance of the $PM_{2.5}$ NAAQS cannot be demonstrated as required in §50.14(c)(3)(iii)(C).

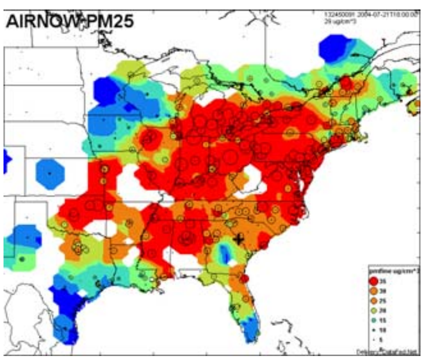
[10] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for July 21, 2004, (Jul 21, 2004) pg (9-10, 12-13)

C. COMPARISON TO BACKGROUND LEVELS

Figure 10 shows the elevated $PM_{2.5}$ concentration over entire Eastern U.S. was a regional event. The 24-hr average $PM_{2.5}$ concentrations measured at the sites are above the monthly mean and calculated 95th percentile. Also, the multi-year 98th percentile for 2004 including this event is considerably lower than the 98th percentile calculated for 2005. This evidence alone is insufficient to establish a causal relationship between the Kansas and Southeastern wildfires and the exceedance of the 24-hr NAAQS.

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

The requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met. The submittal does not adequately demonstrate that emissions from the wildfires impacted exceedances of the NAAQS in Louisville - Jefferson Co. – Scottsburg MSA due to transport of airborne particulate matter, as defined in Section 3 of the Exceptional Events Rule. Region 4 does not concur with the request to flag data on July 21, 2004.



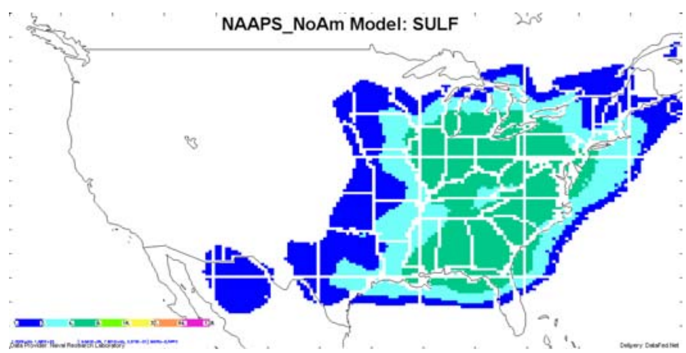


Figure 10: $PM_{2.5}$ concentrations Jul, 21, 2004 **Figure 11: Modeled SO_4 July 21, 2004**

Kansas and Northwestern Wildfires

Exceedance Date:	August 3 – 4, 2004
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from Kansas/Northwestern Wildfires

Table 6: site-specific information used in analysis (μg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	8/03/2004	42.8	22.1	28.8	40.0	No
21-111-0043-2	8/03/2004	43.0	21.7	29.4	37.7	No
21-111-0044	8/03/2004	41.0	21.9	30.9	39.5	No
21-111-0043-1	8/04/2004	43.7	22.1	28.8	40.0	No
21-111-0043-2	8/04/2004	45.8	21.7	29.4	37.7	No
21-111-0044	8/04/2004	43.5	21.9	30.9	39.5	No
21-111-0048	8/04/2004	42.7	21.7	29.2	39.2	No

Note [1]Three-year monthly average above 15μg/m^3 and observed concentration is below 35μg/m^3
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

Documentation submitted by the Louisville Metro Air Pollution Control District claims that smoke from Kansas and Northwestern Wildfires caused the NAAQS exceedances at the site listed above. All of the requested values passed the two-step analysis. However, documentation submitted by LMAPCD did not clearly demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance or violation but for the event. EPA concurrence was not given to these exceptional event flags.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

A causal connection between the Kansas and Northwestern wildfires and the observed exceedances of the $PM_{2.5}$ NAAQS can not be demonstrated. No speciation data was provided in the Technical Demonstration for the site or surrounding sites. The demonstration provided the following: TEOM continuous $PM_{2.5}$ strip charts, daily $PM_{2.5}$ measured values four days prior to and two days after the event, statistical analysis of historical $PM_{2.5}$ data and $PM_{2.5}$ speciation data, pollution roses, wind rose graph, HYSPLIT backward trajectory, notification of Air Quality Index (AQI) Alerts issued, National Oceanic and Atmospheric Administration (NOAA) smoke maps, and MODIS TERRA and MODIS AQUA satellite images.

The HYSPLIT backward trajectory when referenced with the NOAA smoke plume maps[11] are insufficient to make an inference with air mass depicted, the subject wildfires and the potential impact to the air quality in the Louisville- KY-IN, MSA.

[11] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for august 3-4, 2004, (Aug 3-4, 2004) pg (7-13)

The supporting documentation provided in this Technical Document does not provide enough evidence to prove direct causation as the speciation data and the maps below demonstrate that there was a high sulfate event across the region. A causal connection between the Kansas and Northwestern wildfires and the observed exceedance of the $PM_{2.5}$ NAAQS cannot be demonstrated as required in §50.14(c)(3)(iii)(C).

C. COMPARISON TO BACKGROUND LEVELS

The 24-hr average $PM_{2.5}$ concentration is above the 30-day mean, and the calculated 95th percentile. The seasonal average at the Barret site for sulfate and carbon is 6.7µg/m^3 and 4.7µg/m^3 and at the Southwick site 6.5µg/m^3 and 4.8µg/m^3, respectively.

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

Figure 12 shows the entire Eastern U.S. was experiencing a regionally elevated $PM_{2.5}$ event. However, a widespread sulfate event is evident across the majority of the Southeast U.S. including Louisville on August 3, 2004 (Figure 13). Organic carbon is shown to be above average concentrations only in Alabama and parts of Georgia and Mississippi (Figure 14.) The levels of organic carbon measured are at or below the seasonal[12] averages which suggests that the elevated $PM_{2.5}$ levels observed on August 3rd were not caused by transport of airborne particulate matter due to a wildfire event. The requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met.

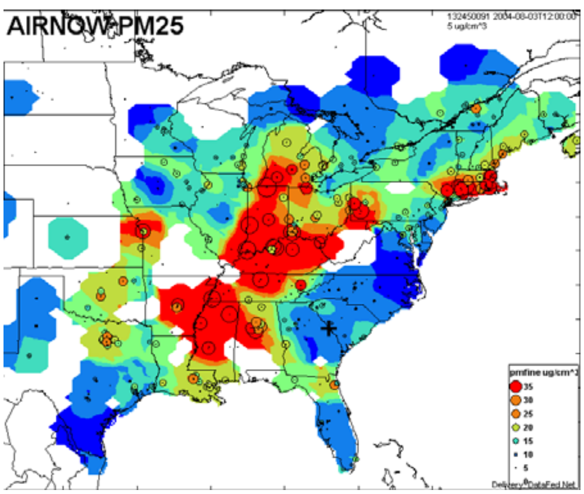
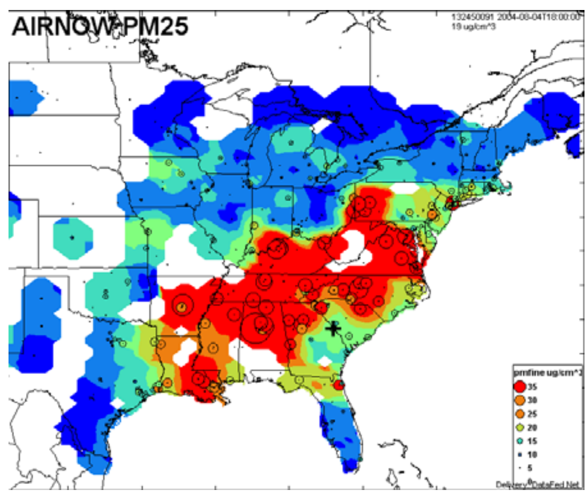


Figure 12: $PM_{2.5}$ concentrations Aug 3, 2004



$PM_{2.5}$ concentrations Aug 4, 2004

12 Seasonal average (Jun –Aug 2004 -2005 Barret) (Jun –Aug 2006 -2007 Southwick)

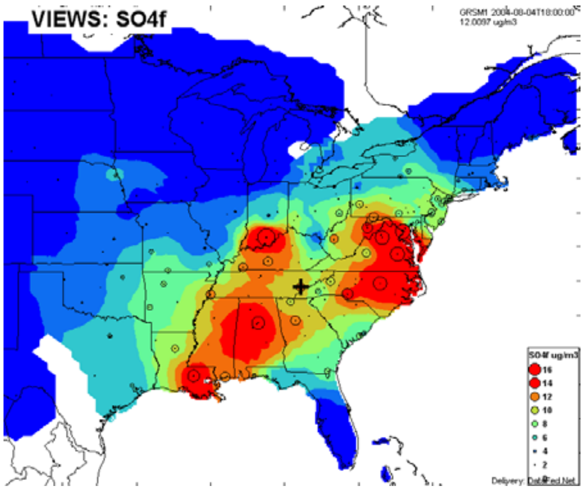


Figure 13: **SO4 Concentrations Aug 3, 2004**

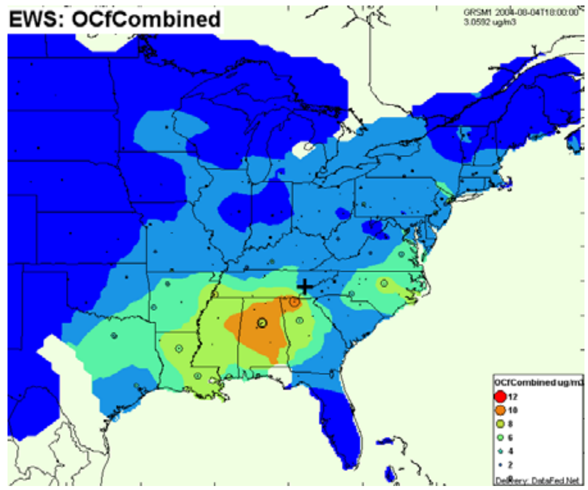


Figure 14: OC Concentrations Aug 3, 2004

Arkansas, Mississippi and Texas Wildfires

Exceedance Date:	September 8 – 13, 2005
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from Arkansas, Mississippi and Texas Wildfires

Table 7 : site-specific information used in analysis ($\mu g/m^3$)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	9/08/2005	43.5	17.0	27.4	31.1	No
21-111-0043-2	9/08/2005	42.3	16.0	26.7	30.4	No
21-111-0044	9/08/2005	41.1	16.4	26.9	30.6	No
21-111-0043-1	9/09/2005	48.8	17.0	27.4	31.1	No
21-111-0043-2	9/09/2005	47.4	16.0	26.7	30.4	No
21-111-0044	9/09/2005	44.5	16.4	26.9	30.6	No
21-111-0043-1	9/10/2005	45.9	17.0	27.4	31.1	No
21-111-0044	9/10/2005	43.2	16.4	26.9	30.6	No
21-111-0048	9/10/2005	46.4	16.3	25.5	31.2	No
21-111-0043-1	9/11/2005	47.8	17.0	27.4	31.1	No
21-111-0043-2	9/11/2005	47.1	16.0	26.7	30.4	No
21-111-0044	9/11/2005	48.9	16.4	26.9	30.6	No
21-111-0043-1	9/12/2005	40.1	17.0	27.4	31.1	No
21-111-0043-2	9/12/2005	38.2	16.0	26.7	30.4	No
21-111-0044	9/12/2005	37.4	16.4	26.9	30.6	No
21-111-0043-1	9/13/2005	42.9	17.0	27.4	31.1	No
21-111-0043-2	9/13/2005	42.7	16.0	26.7	30.4	No
21-111-0044	9/13/2005	40.1	16.4	26.9	30.6	No
21-111-0048	9/13/2005	41.6	16.3	25.5	31.2	No
21-111-0051	9/13/2005	39.1	14.8	23.6	26.5	No

Note [1]Three-year monthly average above $15\mu g/m^3$ and observed concentration is below $35\mu g/m^3$
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

The documentation submitted by the Louisville Metro Air Pollution Control District (LMAPCD) claims that smoke from Arkansas, Mississippi and Texas Wildfires caused NAAQS exceedances at the site listed above. All of the requested values passed the two-step analysis. However, documentation submitted by LMAPCD did not clearly demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance or violation but for the event. EPA concurrence was not given to these exceptional event flags.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

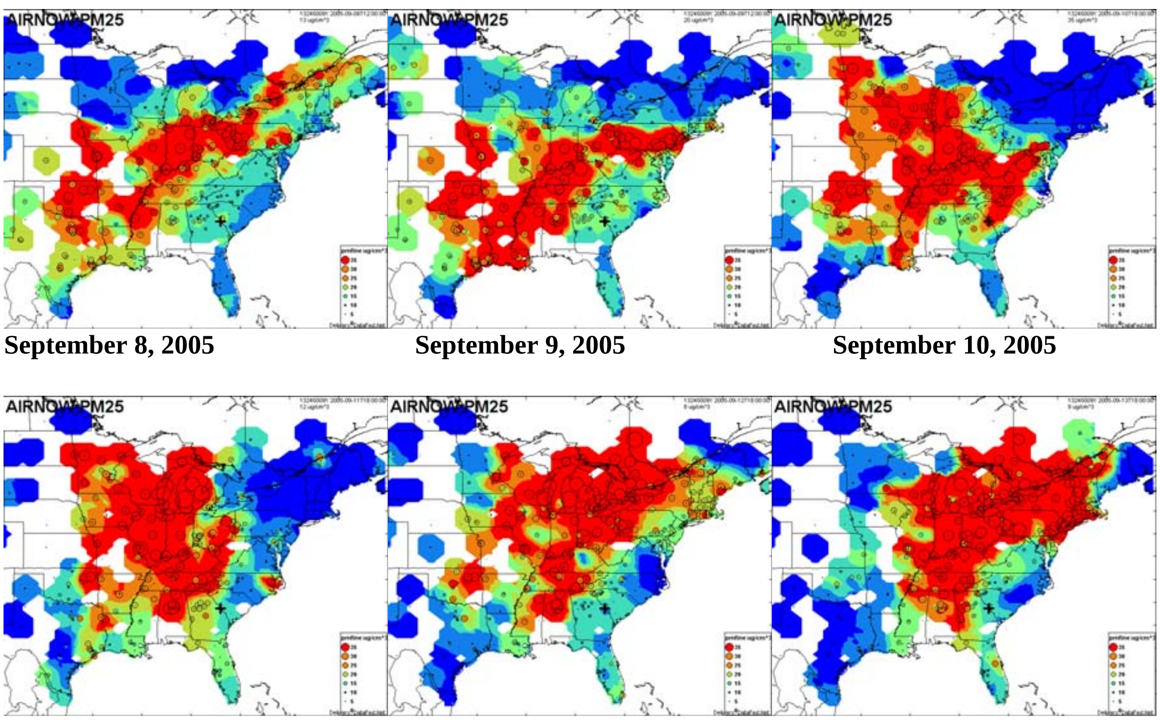
A causal connection between the Arkansas, Mississippi and Texas Wildfires and the observed exceedances of the $PM_{2.5}$ NAAQS was not demonstrated. The demonstration provided the following: TEOM continuous $PM_{2.5}$ strip charts, daily $PM_{2.5}$ measured values four days prior to and three days after the event, statistical analysis of historical $PM_{2.5}$ data and $PM_{2.5}$ speciation data, pollution roses, wind rose graphs, HYSPLIT backward trajectories, notification of Air

Quality Index (AQI) alerts issued, National Oceanic and Atmospheric Administration (NOAA) smoke maps, and MODIS TERRA and MODIS AQUA satellite images.

The HYSPLIT backward trajectory[13] from September 7th through September 10th does not indicate the air mass traveling from the Arkansas, Mississippi and Texas Wildfires. The NOAA smoke plume maps[14] provided is a composite of the dates listed above and therefore insufficient for making a determination. The speciation data did not support that the event was a smoke event as further documented in C and D below.

There is no indication as to causal relationship between the exceedances and the wildfires. The maps obtained from the www.datafed.net website show detectable organic carbon and sulfate levels for only September 10th and 13th. Figures 15 and 16 show a high regional $PM_{2.5}$ and sulfate concentrations overlapping the Louisville monitoring sites.

The supporting documentation provided in this Technical Document does not provide enough evidence to prove direct causation. A causal connection between the Arkansas, Mississippi and Texas Wildfires and the observed exceedance of the $PM_{2.5}$ NAAQS can not be demonstrated as required in §50.14(c)(3)(iii)©.



September 8, 2005 **September 9, 2005** **September 10, 2005**

September 11, 2005. **September 12, 2005** **September 13, 2005**

Figure 15 : $PM_{2.5}$ Concentrations

[13] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for September 8-13, 2005, (EMD Sep 8- 13, 2005) pg 17
[14] EMD Sep 8-13, 2005, pg 12-13

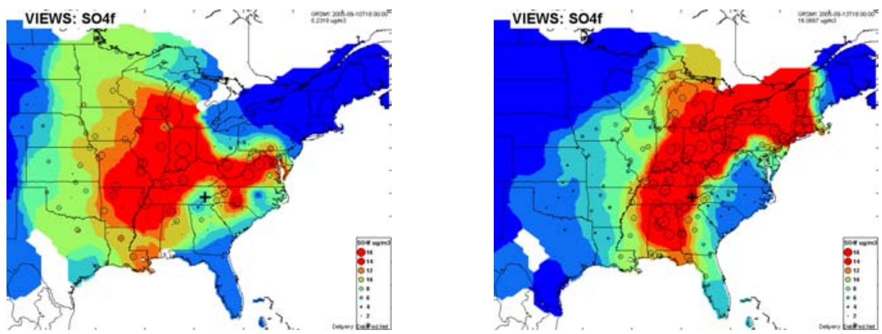


Figure 16: SO4 Concentrations Sep 10, 2005 **SO4 Concentrations Sep 13, 2005**

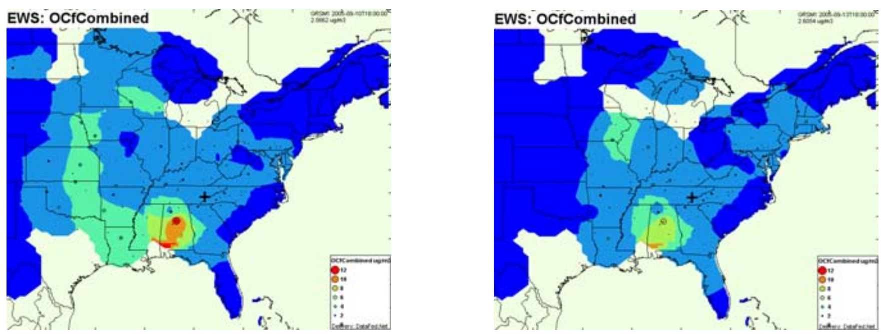
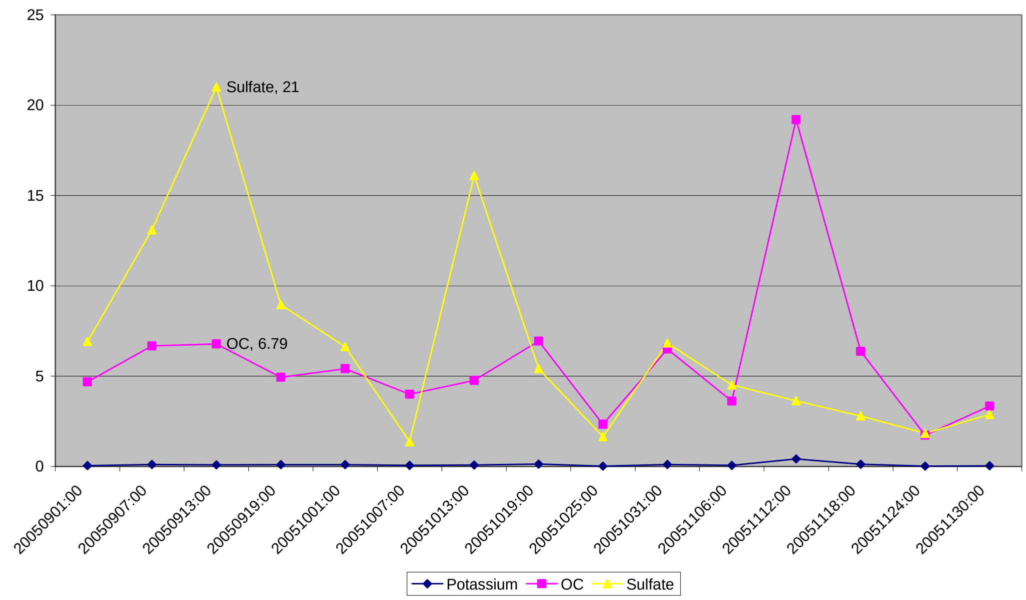


Figure: 17: OC Concentrations Sep 10, 2005 **OC Concentrations Sep 13, 2005**

C. COMPARISON TO BACKGROUND LEVELS

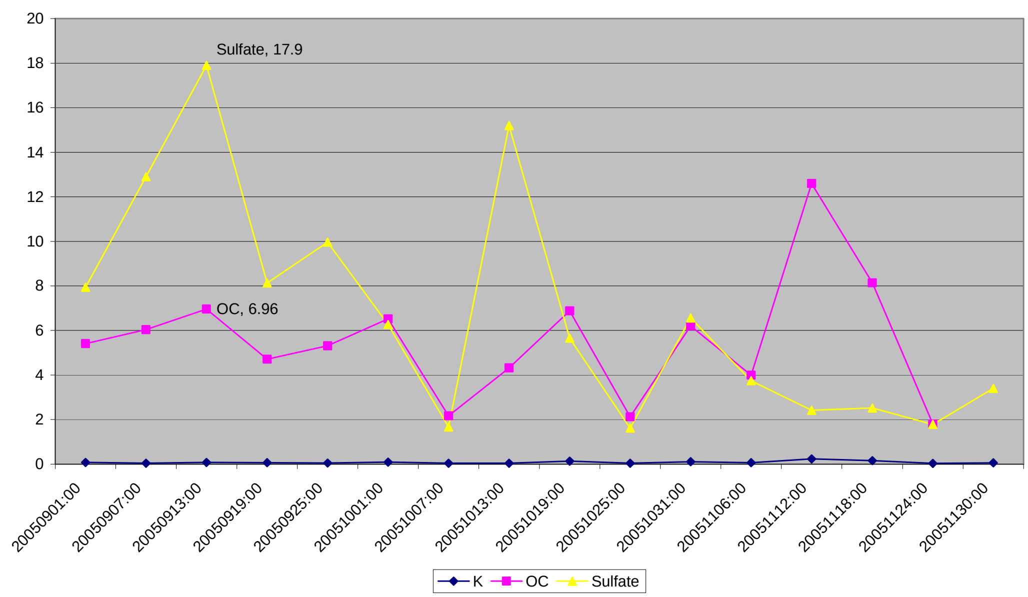
The 24-hr average $PM_{2.5}$ concentrations measured at the sites are above the monthly mean and calculated 95^{th} percentile. On September 13, 2005 Speciated fine particulate organic carbon matter and sulfate levels measured 6.96µg/m^3 and 17.9µg/m^3 and 6.79µg/m^3 and 21.0µg/m^3 at the Barret and Southwick sites, respectively (Figures 16 and 17). The sulfates are approximately 4 times higher than the seasonal average at both sites. The PM mass is clearly impacted by the elevated sulfate mass and conversely the organic carbon mass attributes little to the particulate matter mass measured on September 8^{th} – 13^{th}.

Sep 13, 2005
Southwick
21-111-0043



Southwick SO_4/OC concentration

Barret
Sep 13, 2005
21-111-0048



Barret SO_4/OC concentration

Figure: 18 September 13, 2005

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

To demonstrate that there would have been an exceedance or violation of the 24hour NAAQS the following graph represents the "estimated particulate matter "but for" speciated organic carbon and sulfate mass (Figure 19)." The portion of organic matter mass attributable to the fire is defined by the following equation: OMinc = 2(OCd – OC avg)[15], where OMinc is the organic mass increment; OCd and OCavg are the daily and typical (average) measured organic carbon. The sulfate mass increment is calculated using the following: SMinc = 1.7(Sd – Savg). Figure 19 also shows that the contribution to the particulate matter mass attributable to the smoke is approximately 4.6μg/m^3.

Therefore the requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met. The submittal for affected Louisville sites does not adequately demonstrate that emissions from the wildfires impacted exceedances of the National Ambient Air Quality Standard in Louisville - Jefferson Co. – Scottsburg MSA due to transport of airborne particulate matter, as defined in Section 3 of the Final Rule. Region 4 does not concur with the request to flag data on September 8-13, 2005.

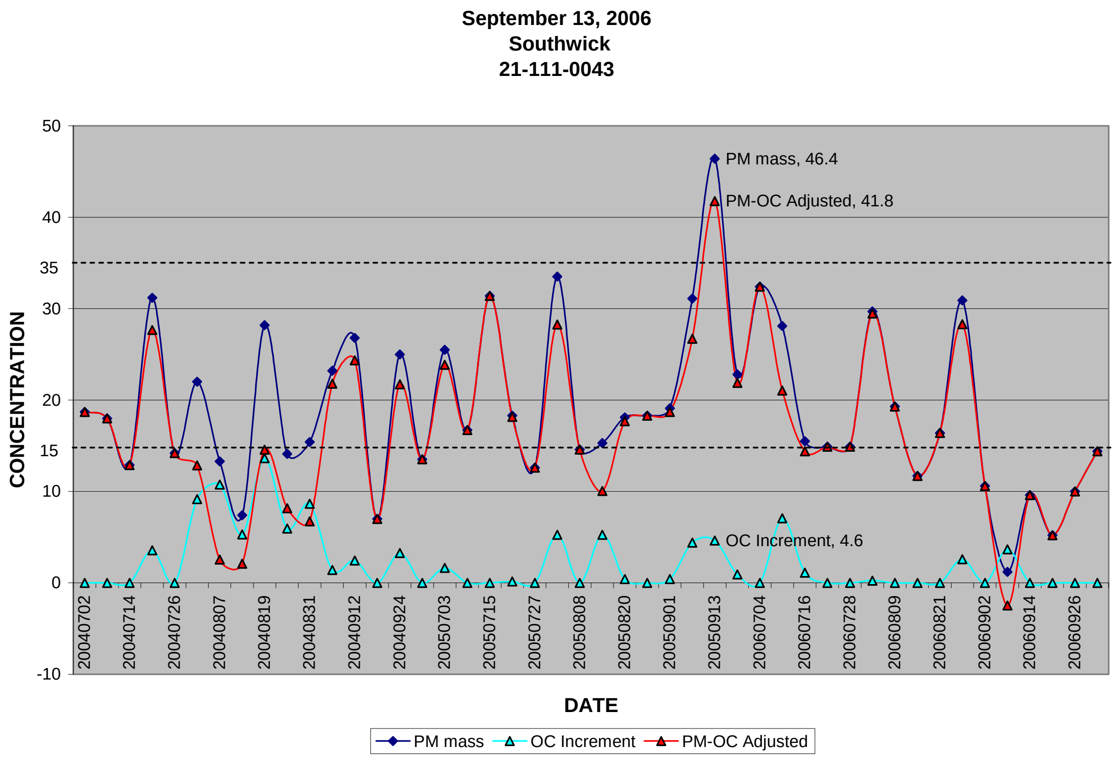


Figure 19: "But For" Southwick September 13, 2005

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[15] "Species Contributions to PM2.5 Mass Concentrations (Turpin and Lim 2001)"

Kansas and Surrounding States Wildfires

Exceedance Date:	July 18-20, 2006
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from Kansas Wildfires

Table 8: site-specific information used in analysis (μg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-2	7/18/2006	39.6	18.8	27.8	33.0	No
21-111-0044-1	7/18/2006	37.9	18.9	27.7	32.0	No
21-111-0048-1	7/18/2006	40.9	17.4	25.0	29.5	No
21-111-0043-1	7/19/2006	39.3	18.8	28.0	33.2	No
21-111-0043-2	7/19/2006	38.6	18.8	27.8	33.0	No
21-111-0044-1	7/19/2006	38.3	18.9	27.7	32.0	No
21-111-0048-1	7/19/2006	37.6	17.4	25.0	29.5	No
21-111-0043-1	7/20/2006	48.2	18.8	28.0	33.2	No
21-111-0043-2	7/20/2006	47.9	18.8	27.8	33.0	No
21-111-0044-1	7/20/2006	48.9	18.9	27.7	32.0	No

Note [1]Three-year monthly average above 15μg/m^3 and observed concentration is below 35μg/m^3
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

The documentation submitted by the Louisville Metro Air Pollution Control District (LMAPCD) claims that smoke from Kansas wildfires caused NAAQS exceedances at the site listed above. All of the requested values passed the two-step analysis. However, documentation submitted by LMAPCD did not clearly demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance or violation but for the event. EPA concurrence was not given to these exceptional event flags.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

A causal connection between the Kansas wildfires and the observed exceedances of the $PM_{2.5}$ NAAQS can not be demonstrated. The demonstration provided the following: TEOM continuous $PM_{2.5}$ strip chart, daily $PM_{2.5}$ measured values two days prior after the event, statistical analysis of historical $PM_{2.5}$ data and $PM_{2.5}$ speciation data, pollution roses, wind rose graph, HYSPLIT backward trajectory, notification of Air Quality Index (AQI) alerts issued, and National Oceanic and Atmospheric Administration (NOAA) smoke maps.

The HYSPLIT backward trajectory[16] for July 17 through July 21 does not indicate the air mass traveling from the Kansas wildfires. The wind rose graphs[17] indicate that the wind was from the WNW, NW, NNE, NE or 95% calm with the remaining 5% traveling at wind speeds less then 3 meters per second from of the WNW.

[16] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for July 18-20, 2006, (EMD Jul 18-20,2006) pg 17 of 18
[17] EMD Jul 18-20,2006, pg 8, 10, 12

There is no indication as to causal relationship between the exceedances and the wildfires. Figures 14 and 15 provide a view of high regional $PM_{2.5}$ and sulfate concentrations overlapping the Louisville monitoring sites. A causal connection between the Kansas wildfires and the observed exceedance of the $PM_{2.5}$ NAAQS can not be demonstrated as required in §50.14(c)(3)(iii)(C).

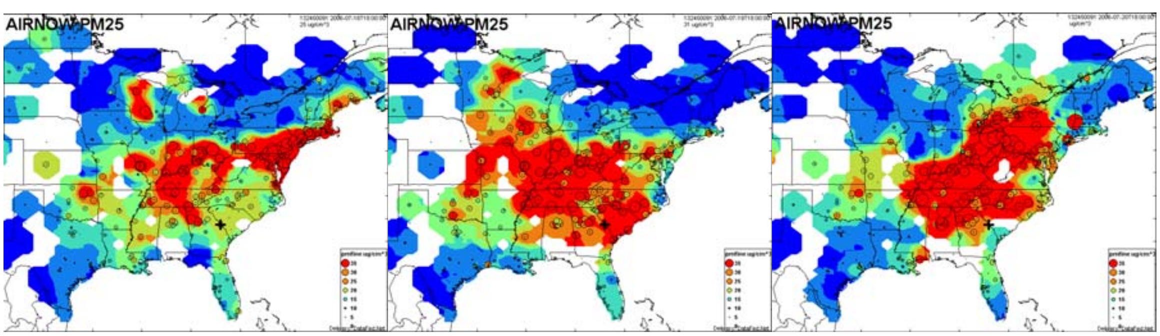
C. COMPARISON TO BACKGROUND LEVELS

The 24-hr average $PM_{2.5}$ concentration is above the 30-day mean, and the calculated 95th percentile. The seasonal[18] average at the Barret site for sulfate and carbon is 6.7µg/m^3 and 4.7µg/m^3 and at the Southwick site 6.5µg/m^3 and 4.8µg/m^3, respectively. The maps in Figure 21 show elevated concentrations of sulfate throughout the region while in Louisville organic carbons are shown to be at seasonal averages. This indicates that the exceedances were not caused by the level of organic carbon mass measured that day.

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

The increase in sulfate mass attributes to the particulate matter mass measured on July 18th – 20th while the organic carbon mass contribution was negligible. Maps in Figures 20 and 21 shows a high regional PM2.5 and sulfate concentrations overlapping the Louisville monitoring sites. The increased levels of sulfate negates the possibility that the there would have been no exccedance of the NAAQS "but for" this event.

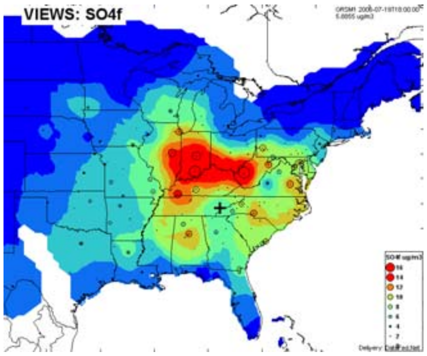
The requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met. The submittal for affected Louisville sites does not adequately demonstrate that emissions from the wildfires impacted exceedances of the NAAQS in Louisville - Jefferson Co. – Scottsburg MSA due to transport of airborne particulate matter, as defined in Section 3 of the Final Rule. Region 4 does not concur with the request to flag data on July 18-20, 2006.



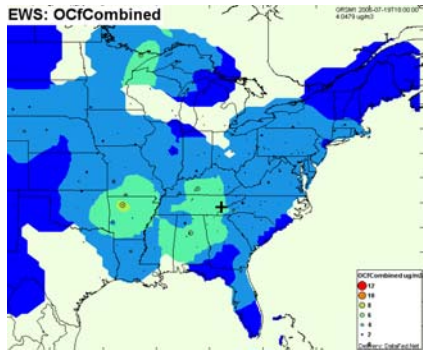
July 18, 2006 **July 19, 2006** **July 20, 2006**

Figure 20: PM2.5 Concentrations

[18] Seasonal average (Jun –Aug 2004 -2005 Barret) (Jun –Aug 2006 -2007 Southwick)



SO4 Concentrations July 19, 2006



OC Concentrations July 19, 2006

Figure: 21

Kentucky and Surrounding States Wildfires

Exceedance Date:	August 25-26, 2006
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from Kentucky and Surrounding States Wildfires

Table 9: site-specific information used in analysis (μg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	8/25/2006	38.0	20.2	27.3	42.6	No
21-111-0043-2	8/25/2006	38.0	20.0	27.3	39.4	No
21-111-0044-1	8/25/2006	38.2	20.0	27.2	40.9	No
21-111-0043-1	8/26/2006	37.3	20.2	27.3	42.6	No
21-111-0043-2	8/26/2006	37.7	20.0	27.3	39.4	No
21-111-0044-1	8/26/2006	38.4	20.0	27.2	40.9	No

Note [1]Three-year monthly average above 15μg/m^3 and observed concentration is below 35μg/m^3
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

Documentation submitted by the Louisville Metro Air Pollution Control District (LMAPCD) claims that smoke from Kentucky and surrounding states wildfires caused the NAAQS exceedances at the site listed above. All of the requested values passed the two-step analysis. However, documentation submitted by LMAPCD did not clearly demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance or violation but for the event. EPA concurrence was not given to these exceptional event flags.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

A causal connection between the Kentucky and surrounding states wildfires and the observed exceedances of the $PM_{2.5}$ NAAQS cannot be demonstrated. No speciation data was provided in technical demonstration for the site or surrounding sites. The demonstration provided the following: TEOM continuous $PM_{2.5}$ strip chart, daily $PM_{2.5}$ measured values four days prior to and three days after the event, statistical analysis of historical $PM_{2.5}$ data, pollution roses, wind rose graph, HYSPLIT back trajectory, notification of Air Quality Index (AQI) alerts issued, National Oceanic and Atmospheric Administration (NOAA) smoke maps.

The NOAA smoke plume maps[19] show no smoke plume over the Louisville, KY-IN MSA on either August 25th or 26th. The NOAA HYSPLIT model[20] does not provide conclusive evidence of an impact over the Louisville, KY-IN MSA on either August 25th or 26th. Wind rose graphs

[19] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for August 25-26, 2004, (Aug 25-26, 2004) pg (7-13)

[20] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for August 25-26, 2004, (Aug 25-26, 2004) pg (16)

show winds calm for over 95% and 70% on the 25th and 26th, respectively. Wind speeds over 3 meters per second on either day are insufficient to make an inference with air mass depicted, the subject wildfires and the potential impact to the air quality in the Louisville- KY-IN, MSA.

The supporting documentation provided in this Technical Document does not provide enough evidence to prove direct causation. A causal connection between the Kentucky wildfires and the observed exceedance of the $PM_{2.5}$ NAAQS was not demonstrated as required in §50.14(c)(3)(iii)(C).

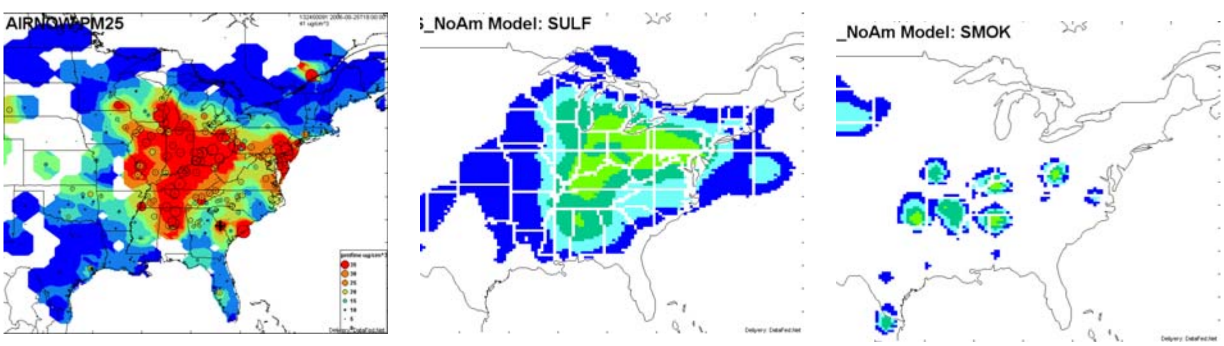
C. COMPARISON TO BACKGROUND LEVELS

The 24-hr average $PM_{2.5}$ concentration is above the 30-day mean, and the calculated 95th percentile. The seasonal[21] average at the Barret site for sulfate and carbon is 6.7µg/m^3 and 4.7µg/m^3 and at the Southwick site 6.5µg/m^3 and 4.8µg/m^3, respectively.

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

The increase in sulfate mass attributes to the particulate matter mass measured on August 25th – 26th while the organic carbon mass contribution was negligible. Maps in Figure 22 show a regional event of elevated $PM_{2.5}$ and sulfate concentrations overlapping over the Louisville monitoring sites. The increased levels of sulfate negates LMAPCD claim that the there would have been no exccedance of the NAAQS "but for" this event.

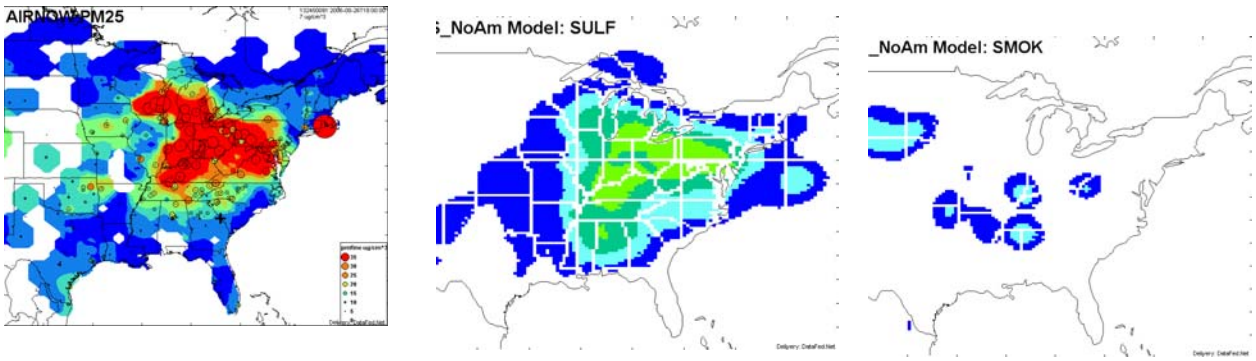
The requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met. The submittal for affected Louisville sites does not adequately demonstrate that emissions from the wildfires impacted exceedances of the NAAQS in Louisville - Jefferson Co. – Scottsburg MSA due to transport of airborne particulate matter, as defined in Section 3 of the Final Rule. Region 4 does not concur with the request to flag data on August 25-26, 2006.



PM2.5 Concentrations Aug 25, 2006 | Modeled SO_4 Aug 25, 2006 | Modeled Smoke Aug 25, 2006

Figure 22: PM2.5 Concentrations, Modeled SO_4, Modeled Smoke

[21] Seasonal average (Jun –Aug 2004-2005 Barret) (Jun –Aug 2006-2007 Southwick)



Daily Concentrations Aug 26, 2006 | Modeled SO_4 Aug 26 2006 | Modeled Smoke Aug -26 2006

Figure 23: PM2.5 Concentrations, Modeled SO_4, Modeled Smoke

Georgia Wild Fires

Exceedance Date:	June 2, 2007
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from Southeast Georgia and Northeast Florida wildfires

Table 10: site-specific information used in analysis (μg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-029-0006	6/2/2007	36.2	18.2	24.0	33.7	Yes
21-111-0043-1	6/2/2007	34.2	19.2	25.2	36.9	No[1]
21-111-0043-2	6/2/2007	33.8	18.7	25.6	35.1	No[1]
21-111-0044	6/2/2007	36.8	17.6	23.8	31.0	Yes
21-111-0048	6/2/2007	37.2	16.9	22.9	25.7	Yes
21-111-0051	6/2/2007	36.3	17.6	23.0	32.0	Yes

Note [1]Three-year monthly average above 15μg/m^3 and observed concentration is below 35μg/m^3

A. EVENT DESCRIPTION

The documentation submitted by the Louisville Metro Air Pollution Control District (LMAPCD) claims that smoke from Georgia wildfires caused the NAAQS exceedances at the site listed above. Two of the three requested values failed the two-step analysis. Region 4 has re-evaluated this event in response to comments received form the Commonwealth of Kentucky. Upon reevaluation of the new documentation submitted by LMAPCD along with maps obtained from the www.datafed.net website and the Sonoma, *Exceptional Event Analysis, Louisville, Kentucky* analysis (attached), the information was sufficient to make a determination of a clear causal relationship between the measured concentrations and the event, and that there would have been no exceedance but for the event as required by of §50.14(c)(3)(iii) for four of the six values. Therefore, EPA concurs with LMAPCD's request to flag four of the values in Table 10 above.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

Figure 24, "Source Impact Tool" shows a wind trajectory map and measured concentrations. The blue lines indicate air mass movement. The red lines indicate the direction of travel at the point of exit. The map indicates that the air mass traveled from South Georgia and North Florida and passed over the Louisville area on June 2, 2007. The Figure 25, AIRNOW $PM_{2.5}$ Concentration map shows that an elevated level of $PM_{2.5}$ ground level concentration was measured on June 2, 2007, which reflected the path of the air mass that passed through the South Georgia and North Florida wildfires. The NOAA Satellite Fire Detection Map[22] showing an absence of a smoke plume over the entire Commonwealth of Kentucky along with the isolated areas of moderate smoke concentrations seen in Figure 24 was likely due to cloud cover.

[22] EMD June 2, 2007 pg 20 of 26

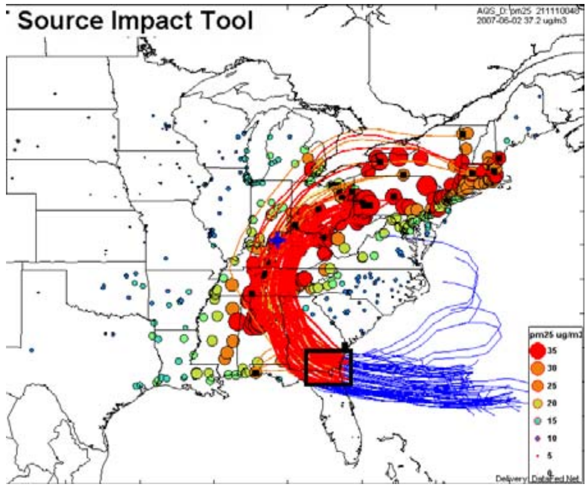


Figure 24: Air Mass Trajectory June 2, 2007

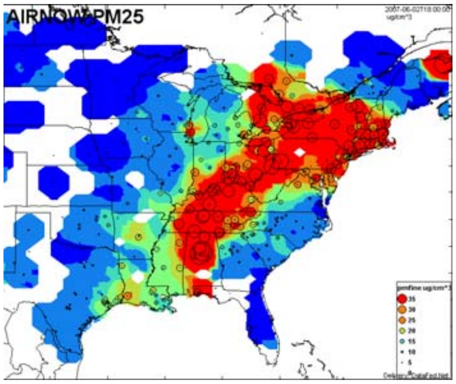
C. COMPARISON TO BACKGROUND LEVELS

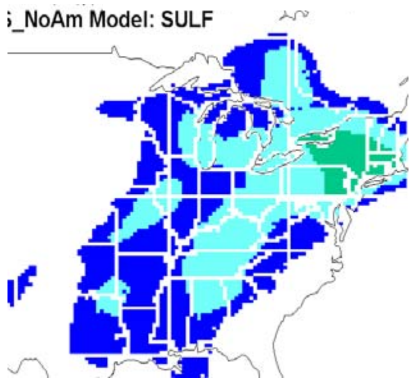
The 24-hr average $PM_{2.5}$ concentrations are above the 30-day mean and the calculated 84th percentile. Two of the flagged values were less than the 95th percentile and failed the two-step analysis. Therefore, these two were considered normally expected concentrations.

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

The low sulfate concentrations seen in Figure 26 indicate the exceedance was not a local or regional sulfate event. Moderate smoke concentrations seen in Figure 27 suggest that the high $PM_{2.5}$ concentrations measured in Louisville were likely impacted by the South Georgia and North Florida wildfires. Sonoma's, Exceptional Event Analysis, Louisville, Kentucky, on page 92[23], states that impacts are likely to have occurred from the Georgia/Florida fires throughout Kentucky on June 2, 2007 and nearby dates. The report also notes that "diurnal concentrations are much more varied on June 2, 2007, showing a buildup in concentrations over the morning – possibly due to a plume fire." Based on these facts and the trajectory analysis, the requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has been met. Region 4 concurs with the request to flag data as indicated in Table 10 above.

[23] Exceptional Event Analysis, Sonoma Technology Inc., September 30, 2008





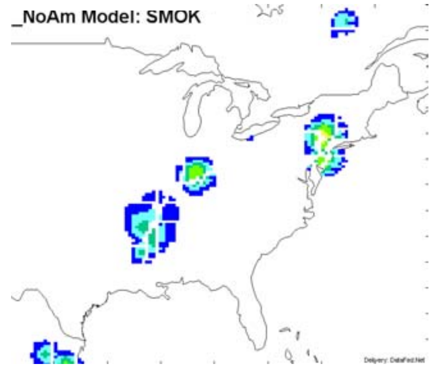


Figure 25: PM$_{2.5}$ Concentration **Figure 26: Modeled Sulfate** **Figure 27: Modeled Smoke**

June 2, 2007

Canada and Northwest Wildfires

Exceedance Date:	August 2-4, 2007
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from Canadian and Northwestern Wildfires

Table 11: site-specific information used in analysis ($\mu g/m^3$)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043-1	08/02/07	47.7	19.2	25.2	36.9	No
21-111-0043-2	08/02/07	47.2	18.7	25.6	35.1	No
21-111-0044	08/02/07	44.5	17.6	23.8	31.0	No
21-111-0043-1	08/03/07	40.4	19.2	25.2	36.9	No
21-111-0044	08/03/07	40.3	17.6	23.8	31.0	No
21-111-0043-1	08/04/07	43.0	18.7	25.6	35.1	No
21-111-0044	08/04/07	42.8	17.6	23.8	31.0	No
21-111-0048	08/04/07	42.9	16.9	22.9	25.7	No
21-111-0051	08/04/07	51.3	17.6	23.0	32.0	No

Note [1]Three-year monthly average above $15\mu g/m^3$ and observed concentration is below $35\mu g/m^3$
[2]Observed concentration is below 84 percentile

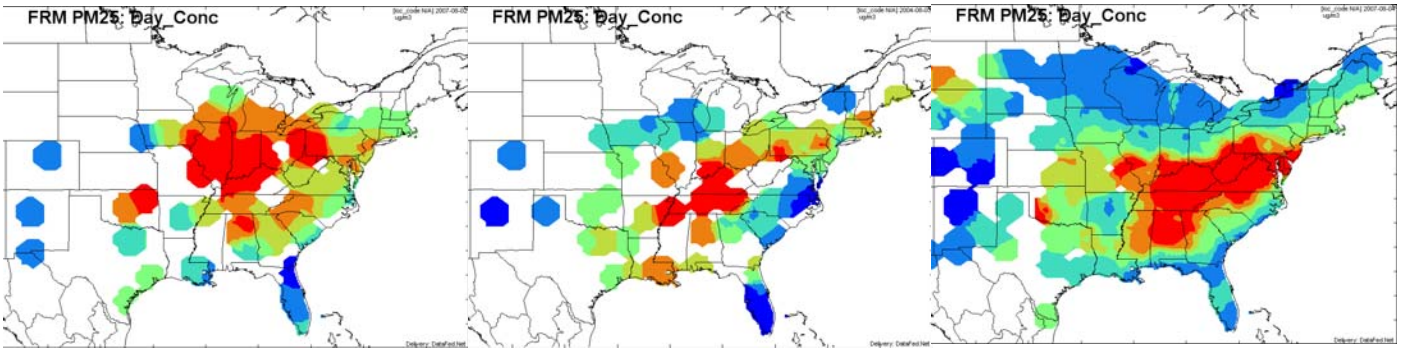
A. EVENT DESCRIPTION

Documentation submitted by the Louisville Metro Air Pollution Control District (LMAPCD) claims that smoke from Canada and Northwestern wildfires caused the NAAQS exceedances at the site listed above. All of the requested values passed the two-step analysis. However, documentation submitted by LMAPCD did not clearly demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance or violation but for the event. EPA concurrence was not given to these exceptional event flags.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

Figure 28, $PM_{2.5}$ Concentration maps show that an elevated level of $PM_{2.5}$ ground level concentration was measured on August 2nd, 3rd and 4th. However, the NOAA Satellite Fire Detection smoke maps[24] do not sufficiently establish a causal relationship (see Figure 29). On August 2nd and 3rd winds are over 87% calm and wind speeds are 3 meters per second. Wind speeds over 3 meters per second on any day are insufficient to make an inference with air mass referenced, the subject wildfires and the potential impact to the air quality in the Louisville- KY-IN, MSA. On August 4th winds are out of the W/WSW and over 70% calm with less than 25% winds over 6 meters per second[25]. A causal connection between the Canada and Northwestern wildfires and the observed exceedance of the $PM_{2.5}$ NAAQS was not demonstrated as required in §50.14(c)(3)(iii)(C).

[24] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for Aug 2-4, 2007, (EMD Aug 2-4, 2007) pg 18, 21, 22
[25] EMD Aug 2-4, 2007, pg 19, 21, 23



Aug 2, 2007 **Aug 3, 2007** **Aug 4, 2007**

Figure 28 $PM_{2.5}$ Concentration

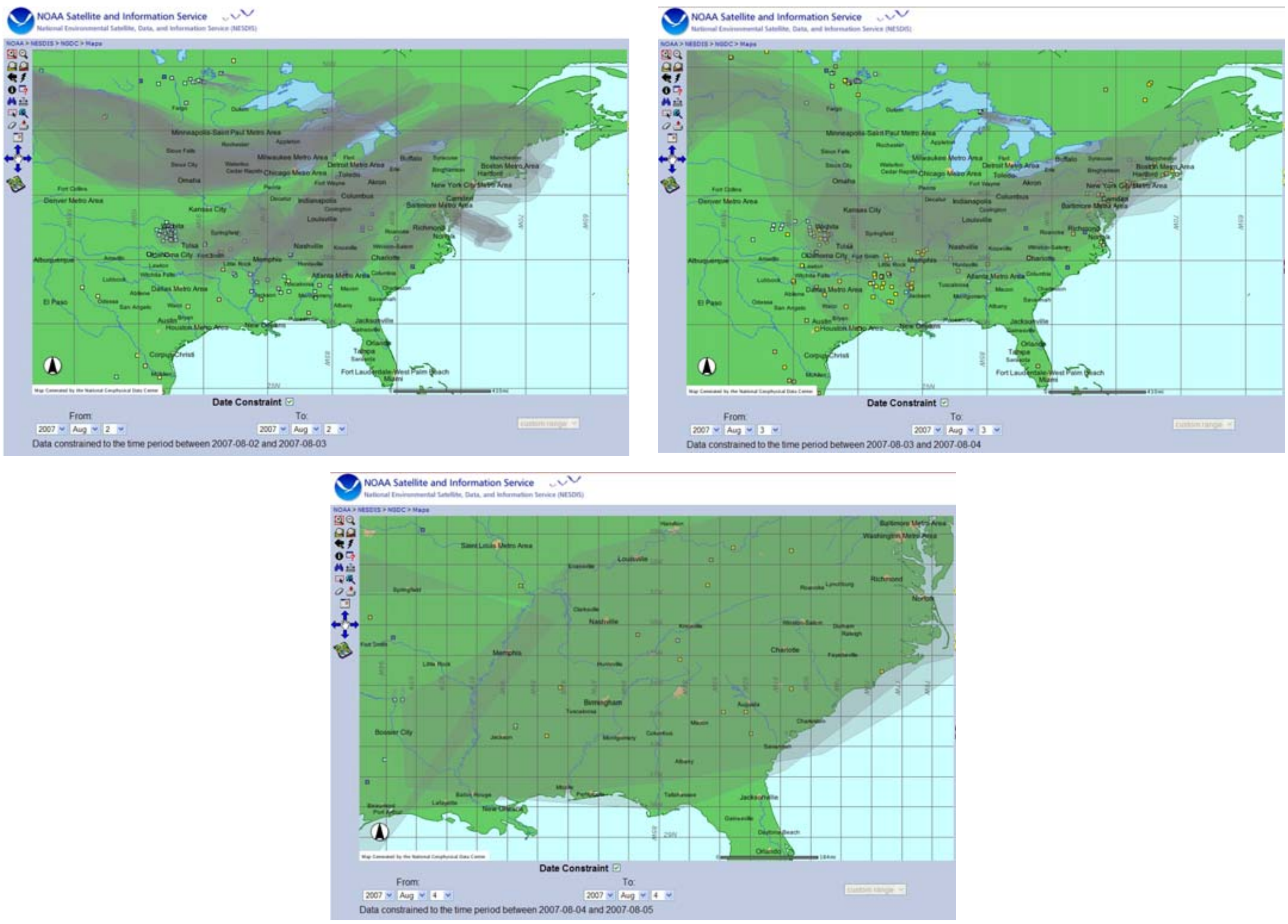


Figure 29: NOAA Smoke Maps, August 2, 3, 4, 2007

C. COMPARISON TO BACKGROUND LEVELS

The sulfate measured at the Southwick site was approximately 4 times higher than the seasonal[26] average and the organic carbon was only slightly higher then the seasonal averages. In LMAPCD's Technical Document, sulfates account for 50% and 51% of the particulate matter mass measured on July 29th and August 4th [27], respectively. Thereby indicating that exceedance was more likely caused by the increased level of sulfate mass measured that day as opposed to the organic carbon mass measured indicating that the fires did not cause the exceedance.

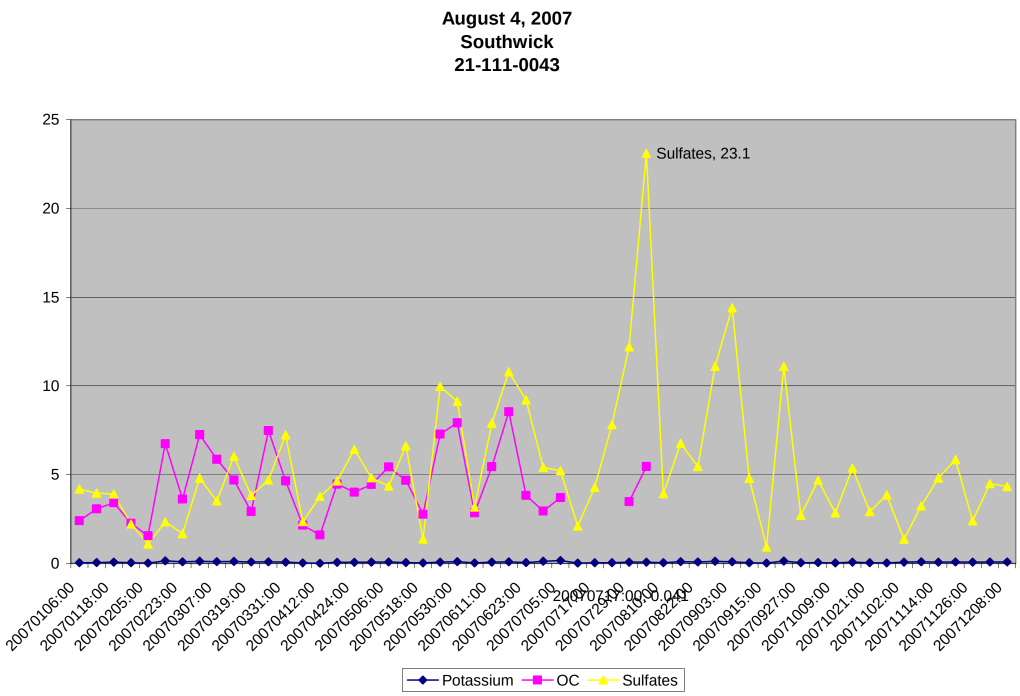


Figure 29 Southwick Speciation Aug 4, 2007

[26] Seasonal June – August 2005 -2006
[27] EMD Aug 2-4, 2007, pg 31 of 33.

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

To demonstrate that there would have been an exceedance or violation of the 24-hour NAAQS the following graph represents the "estimated particulate matter "but for" speciated organic carbon and sulfate mass (Figure 30)." The portion of organic matter mass attributable to the fire is defined by the following equation: OMinc = 2(OCd – OC avg)[28], where OMinc is the organic mass increment; OCd and OCavg are the daily and typical (average) measured organic carbon. The sulfate mass increment is calculated using the following: SMinc = 1.7(Sd – OC avg). The particulate matter mass has clearly been impacted by the increase in sulfates and conversely the organic matter attributes very little to the PM mass measured on August 4th.

The requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met. Speciated fine particulate matter data collected at the Southwick site on August 4, 2007 measured sulfate and organic carbon levels of 23.1µg/m^3 and 5.46µg/m^3, respectively (Figure 30). The increased levels of sulfate negates the possibility that there would have been no exceedance of the NAAQS "but for" this event.

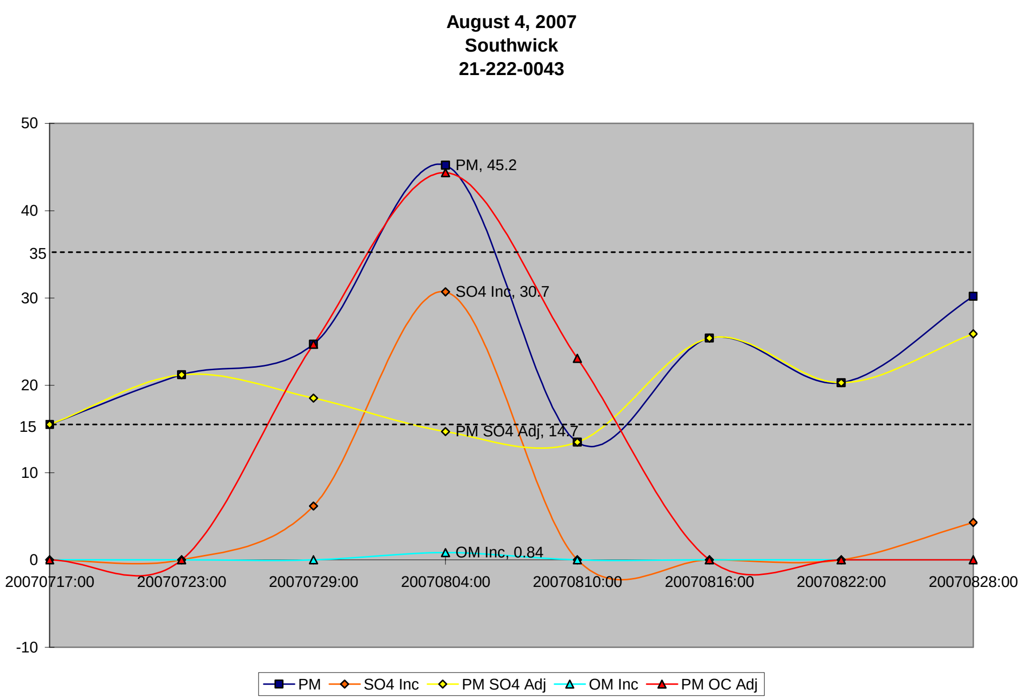


Figure 30 Southwick "But For" August 4, 2007

[28] "Species Contributions to PM2.5 Mass Concentrations (Turpin and Lim 2001)"

EXCEEDANCE EVENT: Idaho, Montana and Central U.S. Wildfires

Exceedance Date:	September 6, 2007
MSA:	Louisville - Jefferson Co. - Scottsburg
Event Description:	Smoke impact from Idaho, Montana and Central U.S. Wildfires

Table 12: site-specific information used in analysis (µg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-111-0043	09/06/07	41.4	19.0	27.8	43.0	No
21-111-0044	09/06/07	41.6	18.6	28.2	39.4	No
21-111-0048	09/06/07	40.4	18.3	29.5	36.0	No

Note [1]Three-year monthly average above 15µg/m^3 and observed concentration is below 35µg/m^3
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

Documentation submitted by the Louisville Metro Air Pollution Control District (LMAPCD) claims that smoke from the Idaho, Montana and Central U.S. wildfires caused the NAAQS exceedances at the sites listed above. All of the requested values passed the two-step analysis. However, supporting documentation provided in this Technical Document does not provide sufficient evidence to prove direct causation, nor does it meet the “but for” test. EPA concurrence was not given to these exceptional event flags.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

The Technical Demonstration attempts to establish a strong causal relationship between the measured values in Table 12 above and the smoke plumes generated by numerous wildfires in Idaho, Montana, Kansas, Oklahoma and Missouri. LMAPCD submitted NOAA fire detection maps, pollution roses, wind rose graphs, NOAA HYSPLIT trajectory models, $PM_{2.5}$ data at impacted sites five days prior to the event and two days post event along with statistical analyses of historical data for the month of September (2005-2007) as supporting documentation in the Technical Demonstration.

On September 6th, the NOAA Satellite smoke map[29] shows that no smoke plume covered the Louisville MSA. The HYSPLIT backward trajectory[30] when referenced with the NOAA smoke plume maps[31] are insufficient to make an inference with the air mass referenced, the subject wildfires and the potential impact to the air quality in the Louisville- KY-IN, MSA.

[29] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for September 6, 2007, (EMD Sep 6, 2007) pg 18 of 23

[30] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for September 6, 2007, (EMD Sep 6, 2007) pg 23 of 23

[31] LMAPCD Technical Demonstration Exclusion of $PM_{2.5}$ AQ Monitoring Data Influenced By Wildland Fires for August 3-4, 2004, (Aug 3-4, 2004) pg (7-13)

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The supporting documentation provided in this Technical Document does not provide sufficient evidence to prove direct causation. A causal connection between the Idaho, Montana and Central U.S. wildfires and the observed exceedance of the $PM_{2.5}$ NAAQS was not demonstrated as required in §50.14(c)(3)(iii)(C).

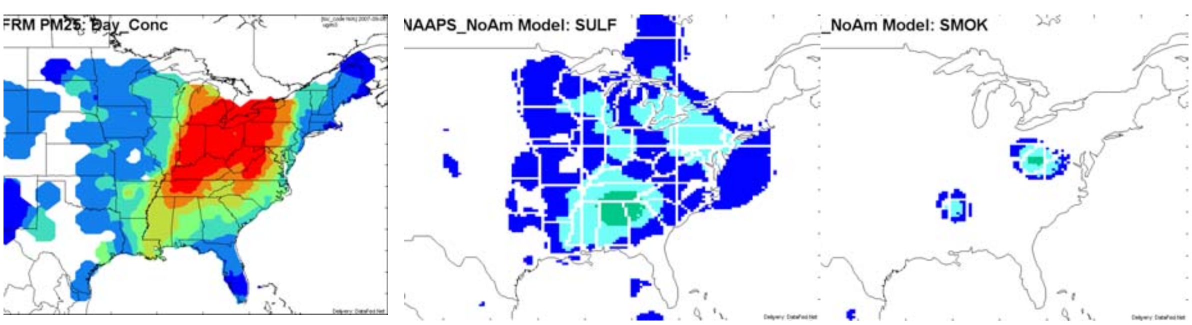
C. COMPARISON TO BACKGROUND LEVELS

In order to further assess the impacts of the Idaho, Montana, and Central U.S. wildfires on the Louisville area, the observed concentrations were compared to historical levels observed at each site. LMAPCD provided measured values five days prior and two days post event. Of these measured values nine are above the monthly average; five are above the 84 percentile value and one is above the 95 percentile value. On September 5th, where the NOAA smoke map[32] shows a dense plume covering most of the eastern seaboard, the two measured values are below the 95th percentile calculated for the given site. Values measured at both the Barret and Wyandotte site were greater that the 95th percentile. This evidence alone is insufficient to establish a causal relationship between the Idaho, Montana and Central U.S. wildfires and the exceedance of the 24-hr NAAQS.

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

In Figure 31, the $PM_{2.5}$ Concentration Map indicates a regional area of elevated $PM_{2.5}$ levels; the NAAPS Model Sulfur Concentration Map shows levels of sulfur below the seasonal average[33] of 7.55µg/m^3 and the NAAPS Model: Smoke concentration map indicates the absence of smoke over the Louisville area.

The supporting documentation provided in this Technical Document does not provide enough evidence to prove that there would have been no exceedance "but for" this event, as required in Section §50.14(c)(3)(iii)(B).



$PM_{2.5}$ Concentration **Modeled Sulfate Concentration** **Modeled Smoke Concentration**

Figure 31: September 6, 2007

[32] EMD Sep, 2007 pg 16
[33] July –September 2005 - 2007

References

Perry, K.D., 1999. Effects of outdoor pyrotechnic displays on the regional air quality of Western Washington State. *Journal of Air & Waste Management Association* Volume 49, Pages 146-155.

Turpin, B.J., Lim, H.J., 2001. Species Contributions to $PM_{2.5}$ Mass Concentrations: Revisiting common Assumptions for Estimating Organic Mass; *Aerosol Science and Technology*. Volume 35, Pages 602-610.

Exceptional Events Analysis Louisville, Kentucky

Prepared by:

Katie S. Wade
Sonoma Technology, Inc.
Petaluma, CA

Neil Frank
US Environmental Protection Agency
Research Triangle Park, NC

September 30, 2008

Sonoma Technology, Inc.
Air Quality Research and Innovative Solutions

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Overview

The following slides detail the analysis of several exceptional events (wildfires and fireworks) during the summers of 2004, 2005, 2006, and 2007 in Louisville, Kentucky.

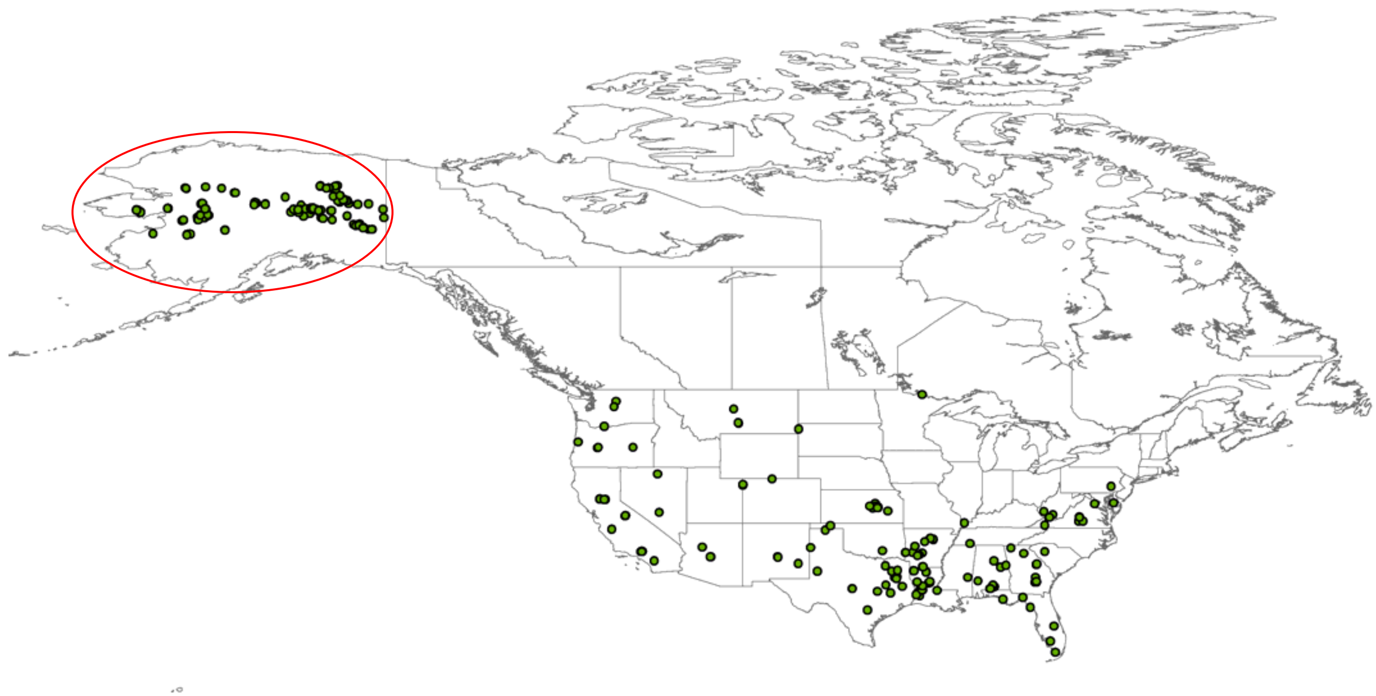
Publicly available data (from EPA's Air Quality System and AirNow Tech) and tools (from DataFed) were used in this analysis.

Exceptional Events Analysis Kentucky 7/21/04

two sites analyzed
(21-111-0043, 21-111-0044) for possible fire impact
from Canadian fires

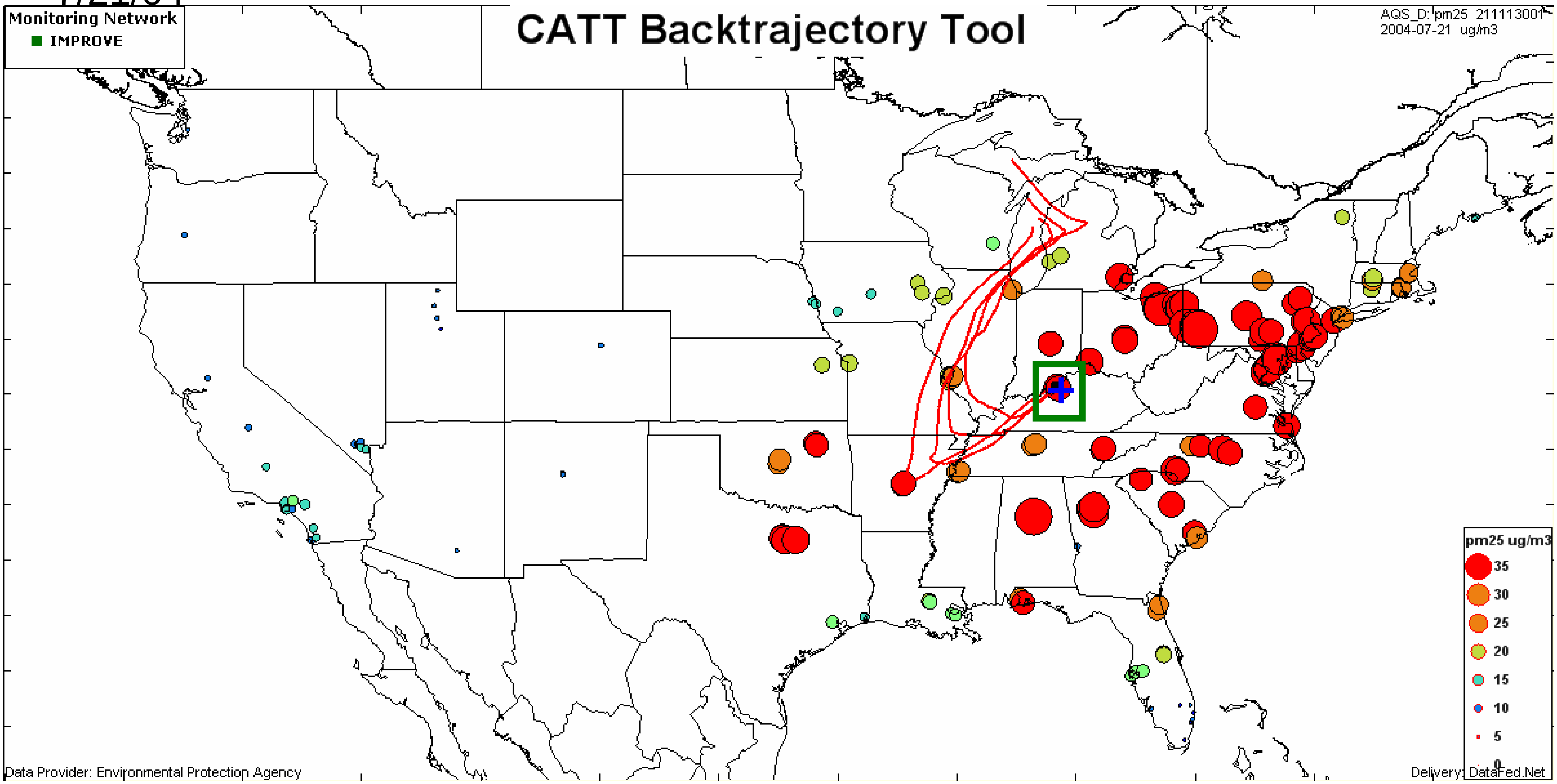
Concentrations Under Consideration

- 21-111-0043: 35.1 μg/m^3
- 21-111-0044: 34.2μg/m^3



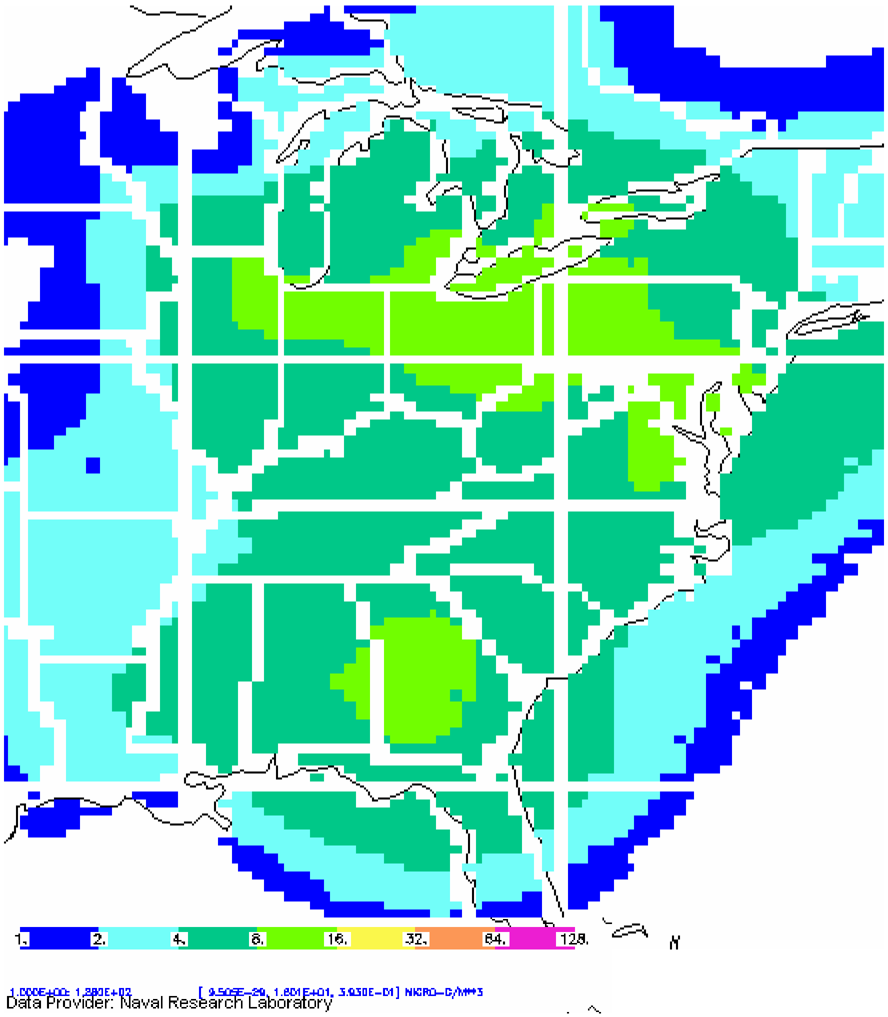
No fires were observed in Canada on 7/21/04; however a large fire was observed in Alaska.

7/21/04

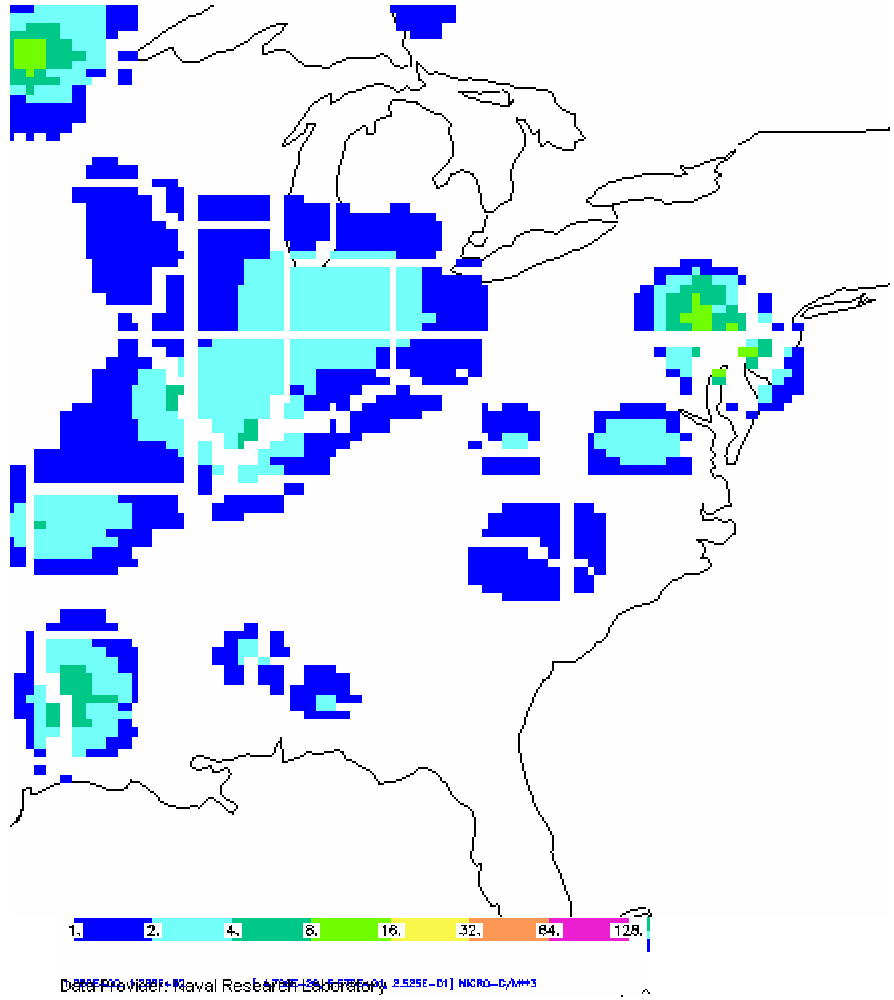


Back trajectories indicate stagnant conditions, with possible influence from the north (but not as far as Canada/Alaska). Also, $PM_{2.5}$ concentrations were high throughout the region, the Louisville area was not unique.

Modeled Sulfate

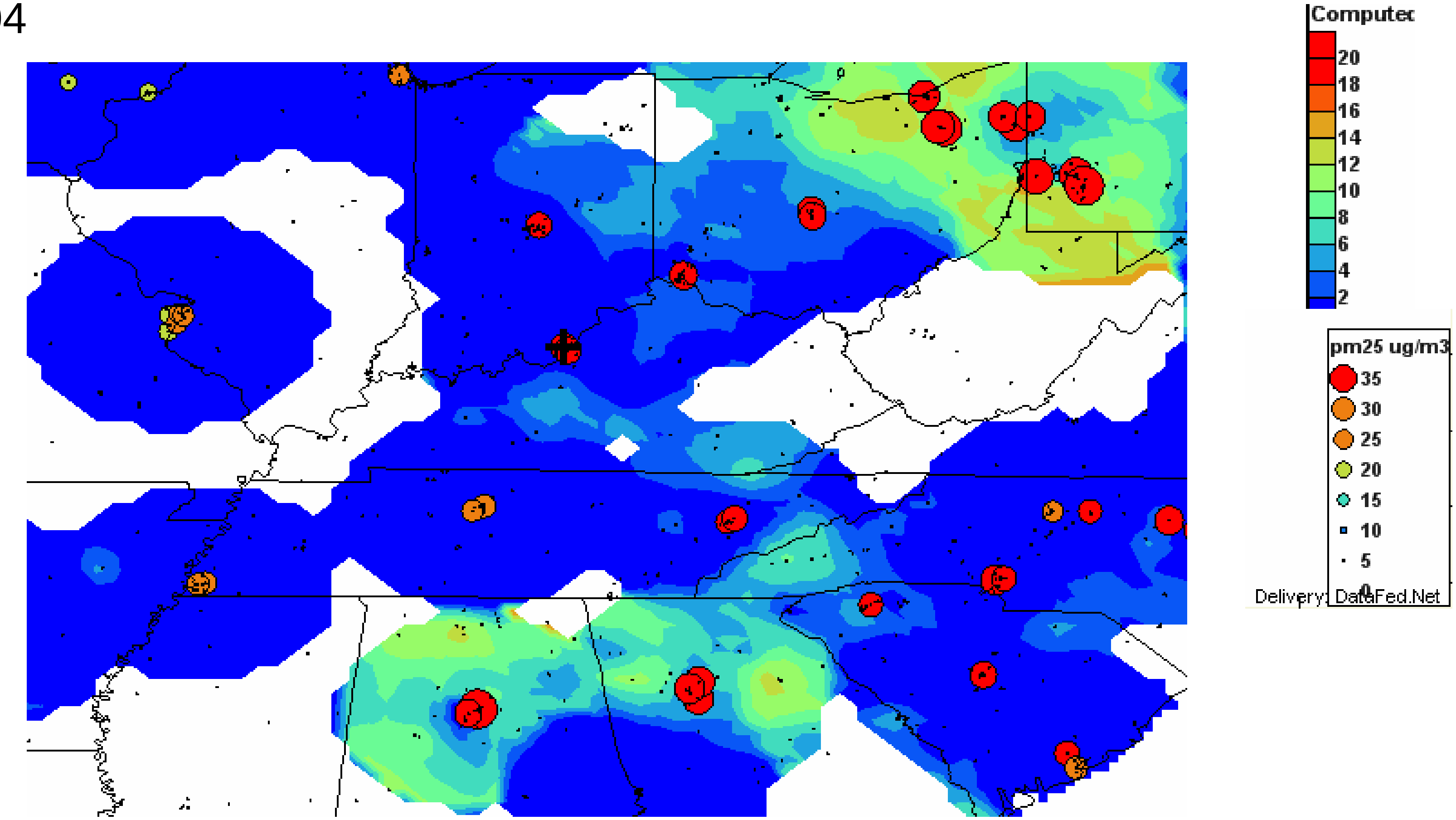


Modeled Smoke

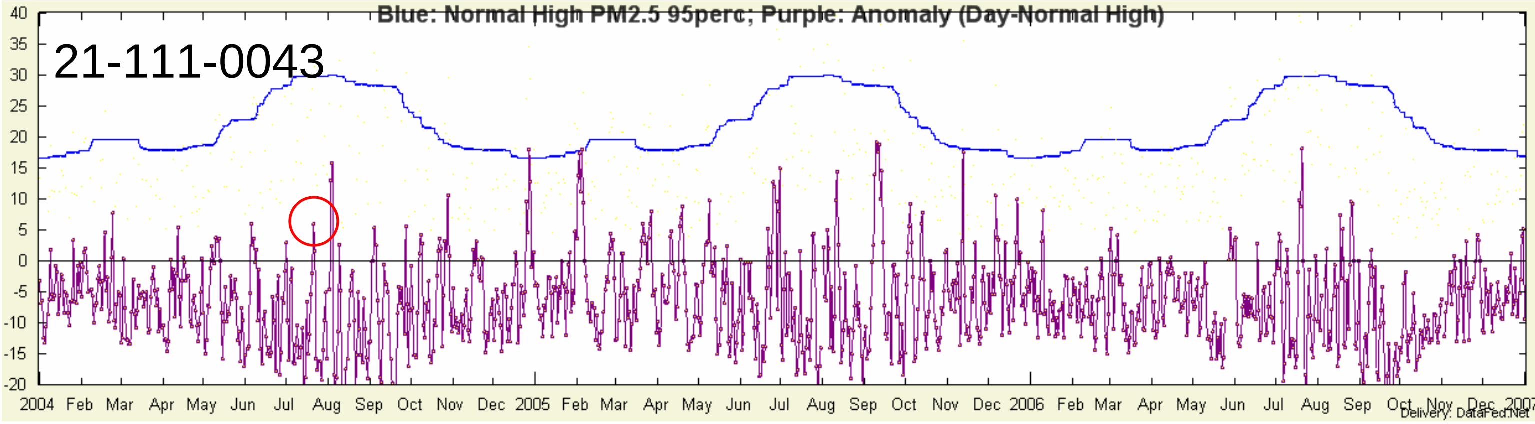


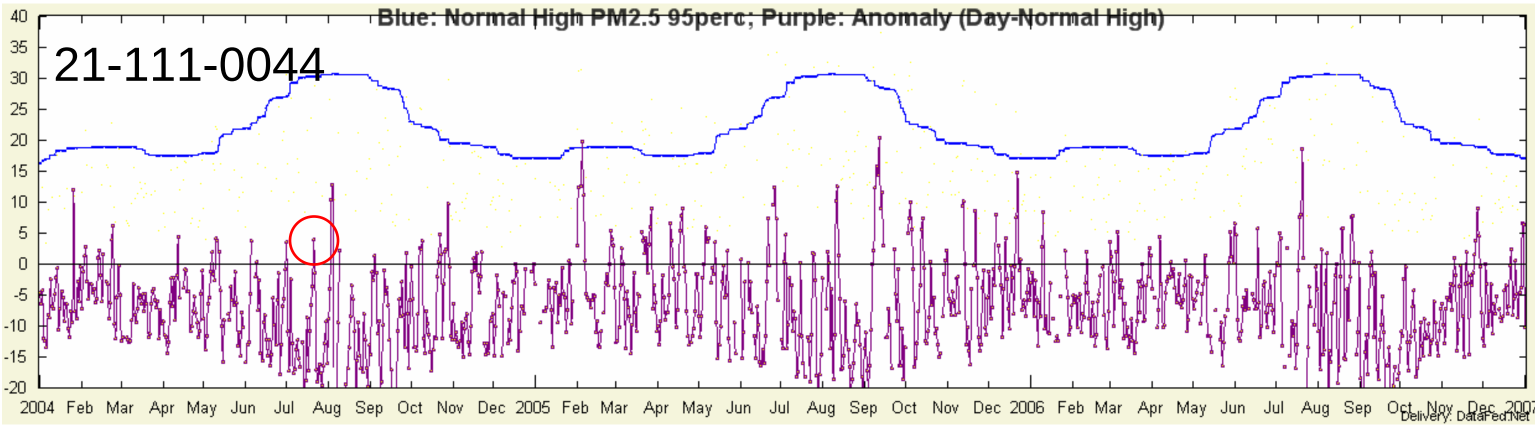
Model output indicated moderate/high sulfate concentrations and low smoke concentrations throughout the region on 7/21/04.

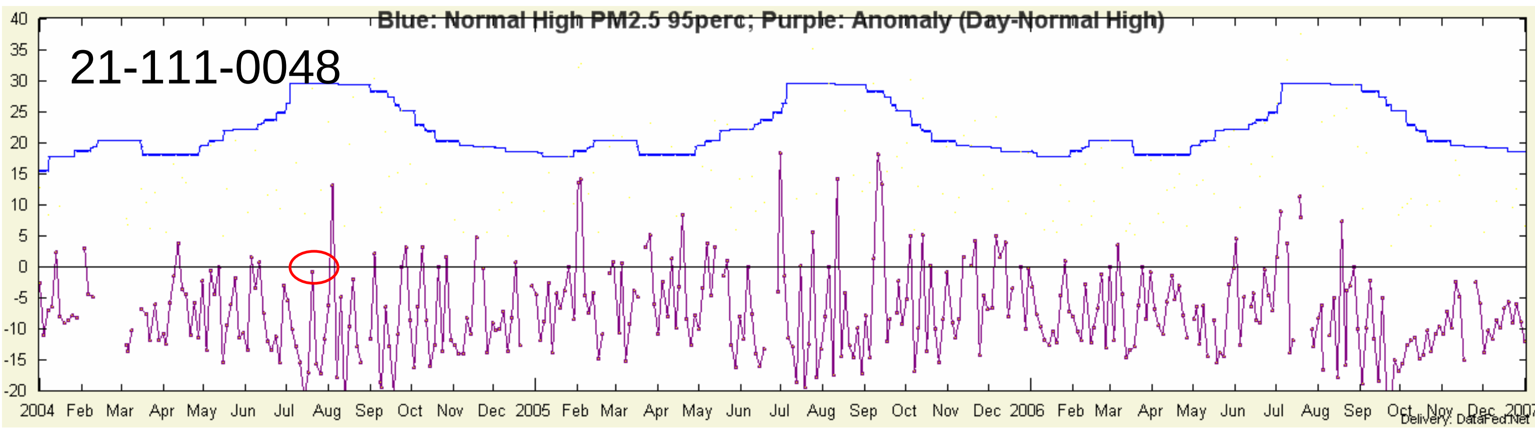
7/21/04



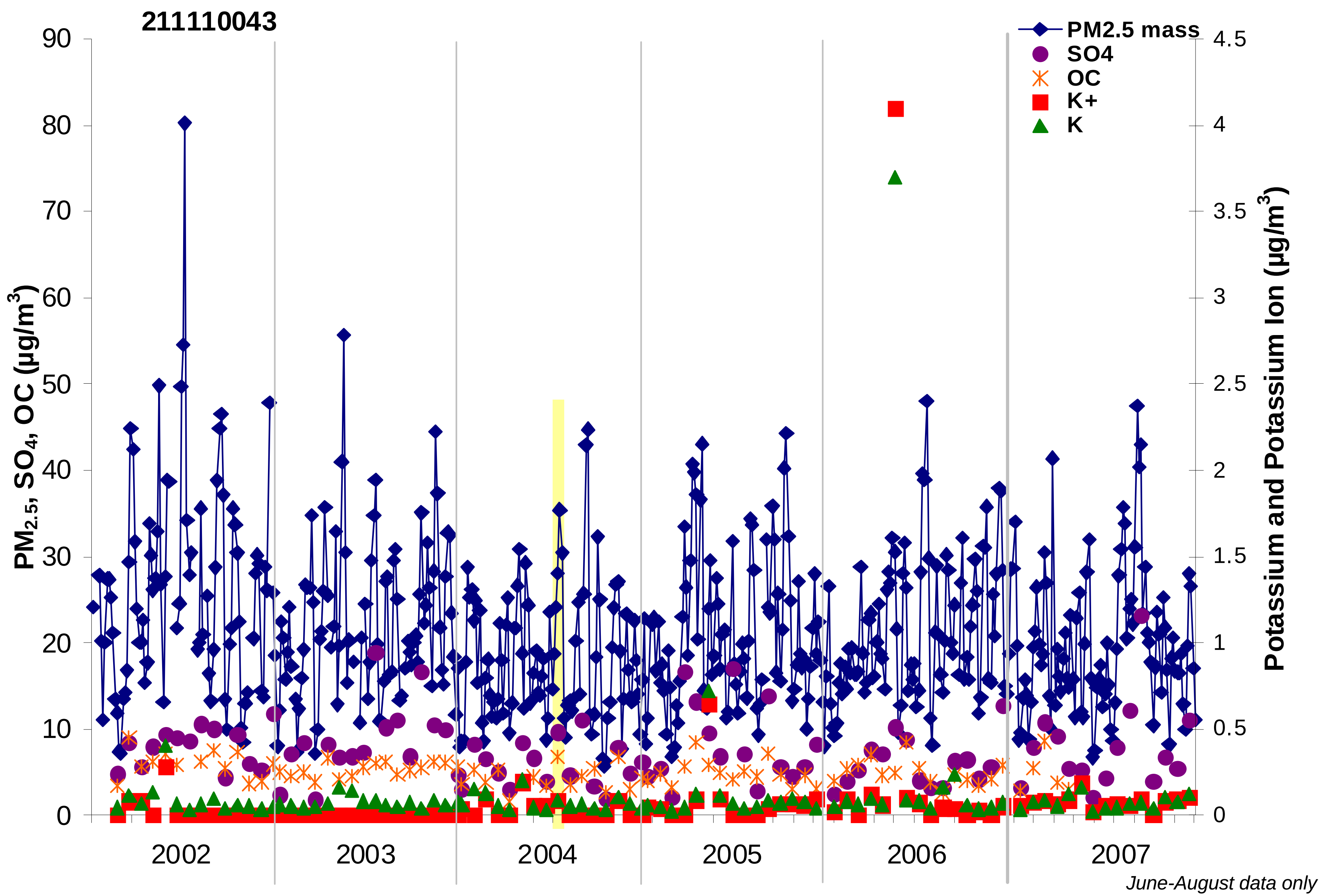
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 7/21/04, concentrations were very close to the historical values throughout Kentucky.



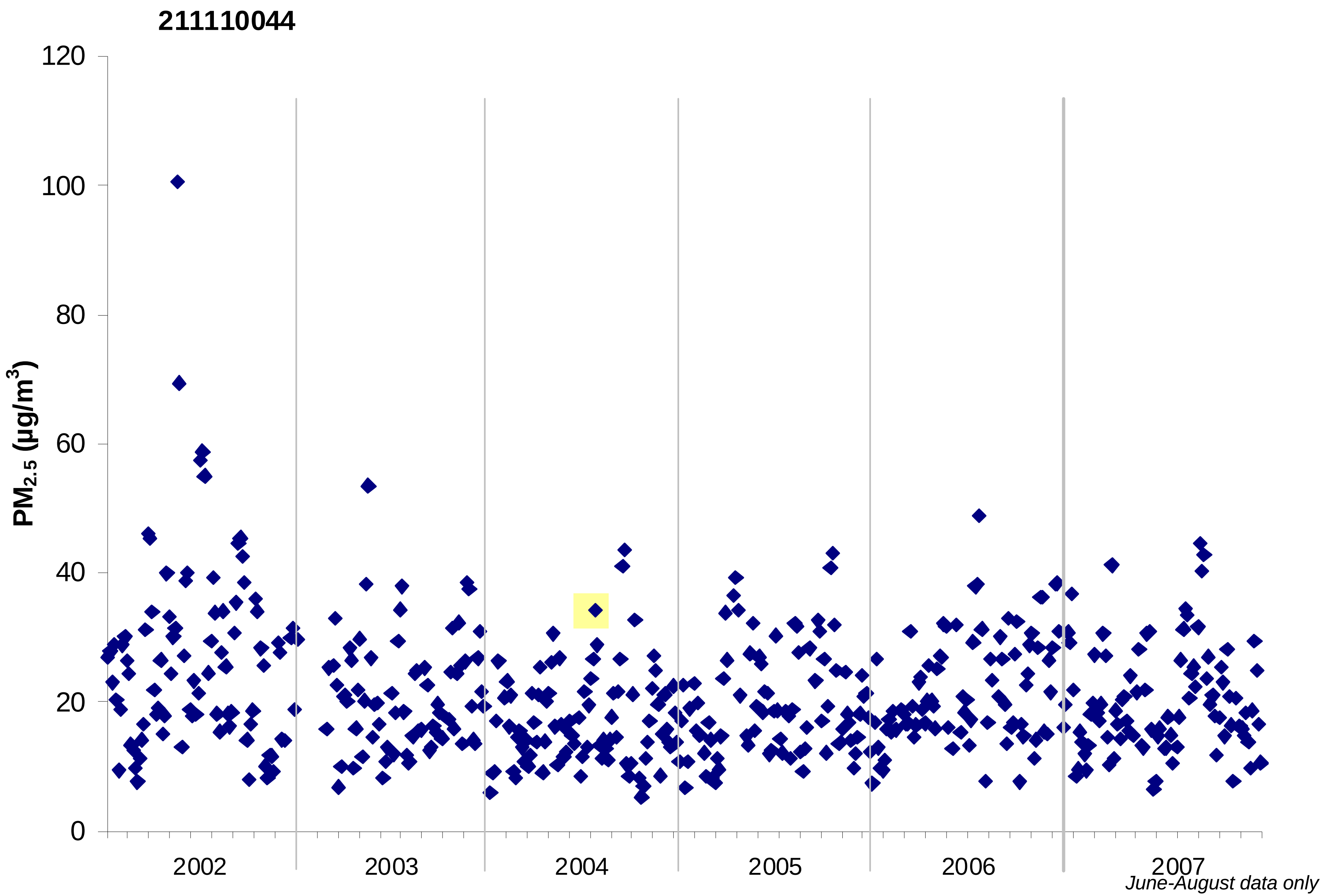




The purple lines show the difference between the given day and the historical 95th percentile concentration. On 7/21/04, concentrations were within 5 µg/m^3 of historical values.



At site 21-111-0043, $PM_{2.5}$, OC and potassium (indicators of fire impact) are within the normal range of values on 7/21/04 (highlighted in yellow). Sulfate is at the high end of the concentration range on 7/20/04.



At site 21-111-0044, $PM_{2.5}$ is high on 7/21/04, but not outside the historical range of concentrations.

Comparison to Historical Values

		Mean	Median	95th Percentile	7/21/2004
21-111-0043	2006	21.5	19.3	36.6	35.4
	2002-2007	21.3	19.5	38.9	
21-111-0044	2006	22.2	20.2	37.7	34.2
	2002-2007	21.2	18.9	38.5	

Summer data only (June-August) used in these statistics.

The concentrations on 7/21/04 are within the historical 95th percentiles of concentrations.

Summary

- Trajectory analysis does not support long-range transport of $PM_{2.5}$ from Canada/Alaska to Louisville.
- Concentrations were within the normal range of concentrations and likely not impacted by forest fires.

Exceptional Events Analysis
Kentucky
8/3/04-8/4/04

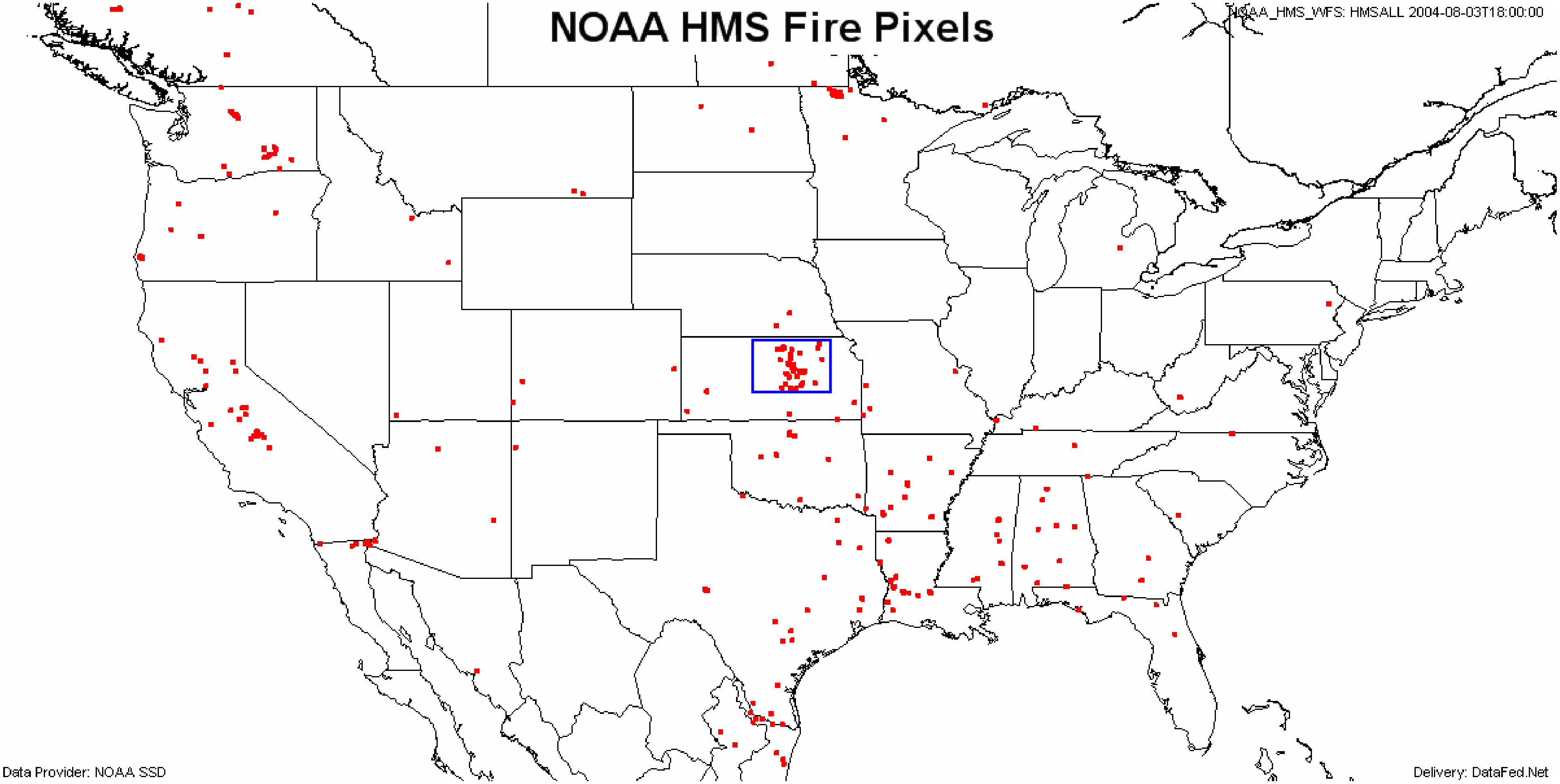
Three sites analyzed
(21-111-0043, 21-111-0044, 21-111-0048)
for possible fire impact
from Kansas fires

Concentrations Under Consideration

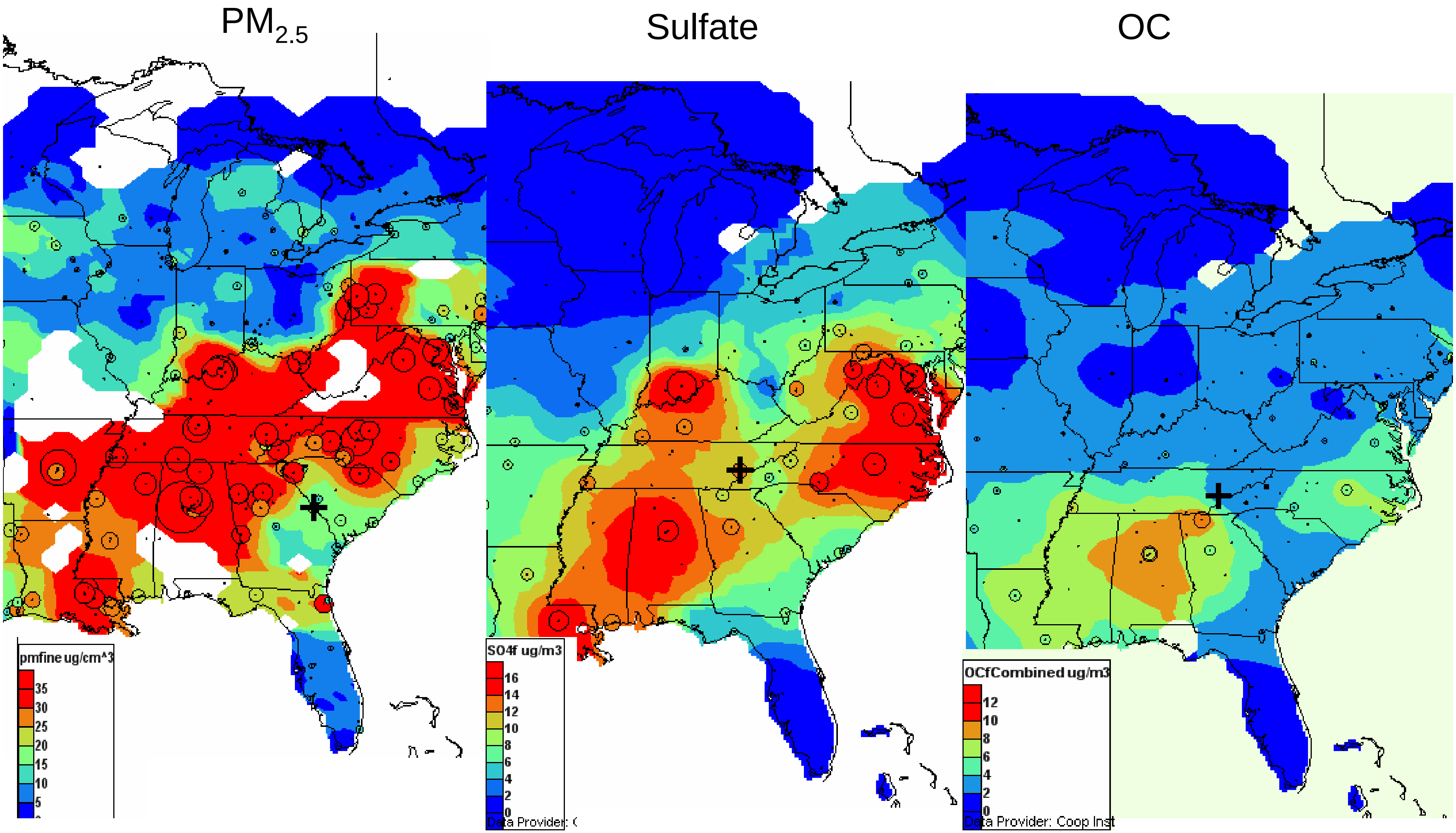
$PM_{2.5}$ concentrations in µg/m^3

Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret
August 3, 2004	42	43.8	41	
August 4, 2004	43.7	45.8	43.5	42.7

8/3/04



The fire believed to have impacted Louisville is a large (detected with multiple pixels) fire in central Kansas.

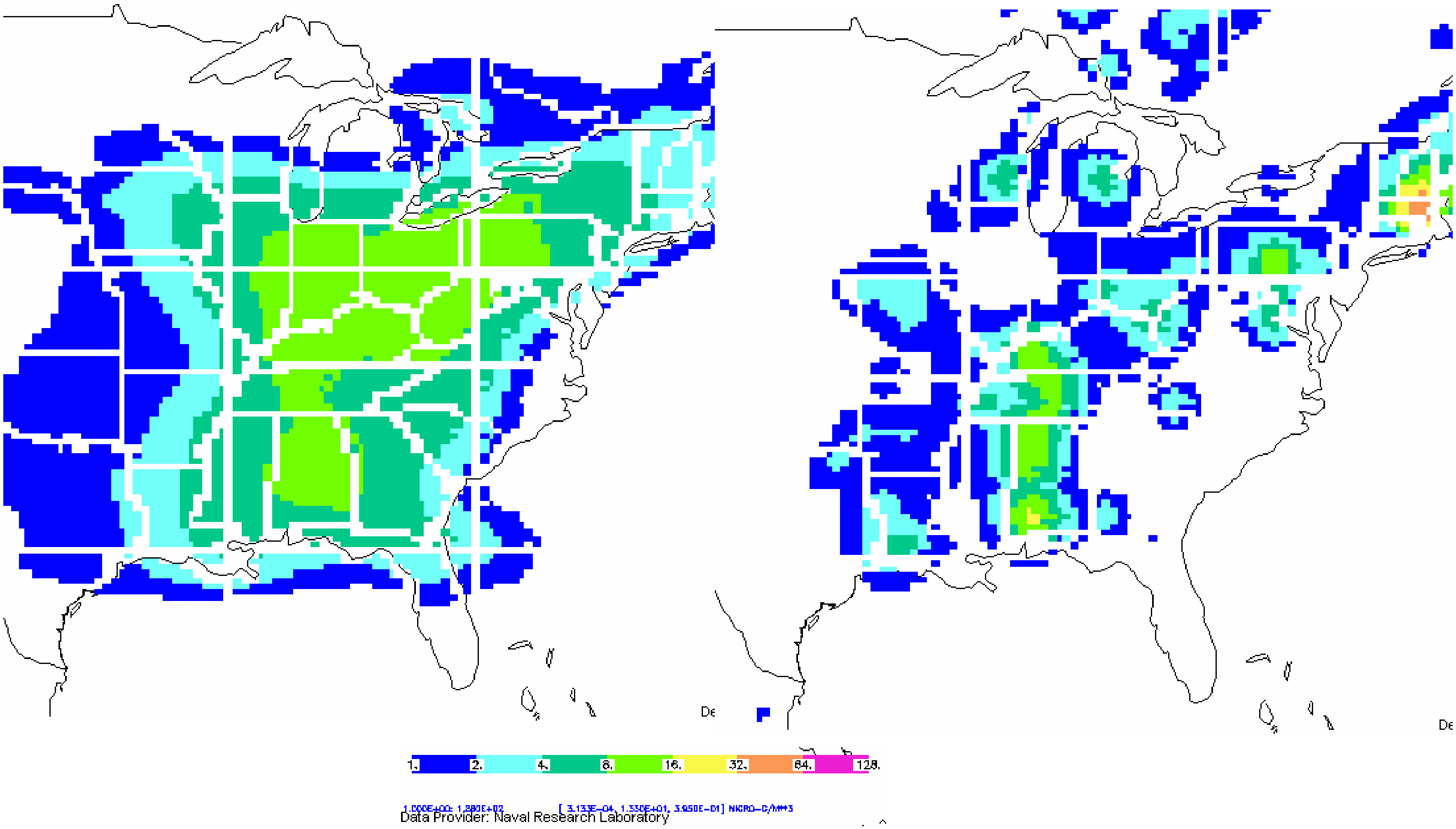


$PM_{2.5}$ and sulfate concentrations are high throughout the southeast, while OC concentrations are low/moderate.

8/3/04

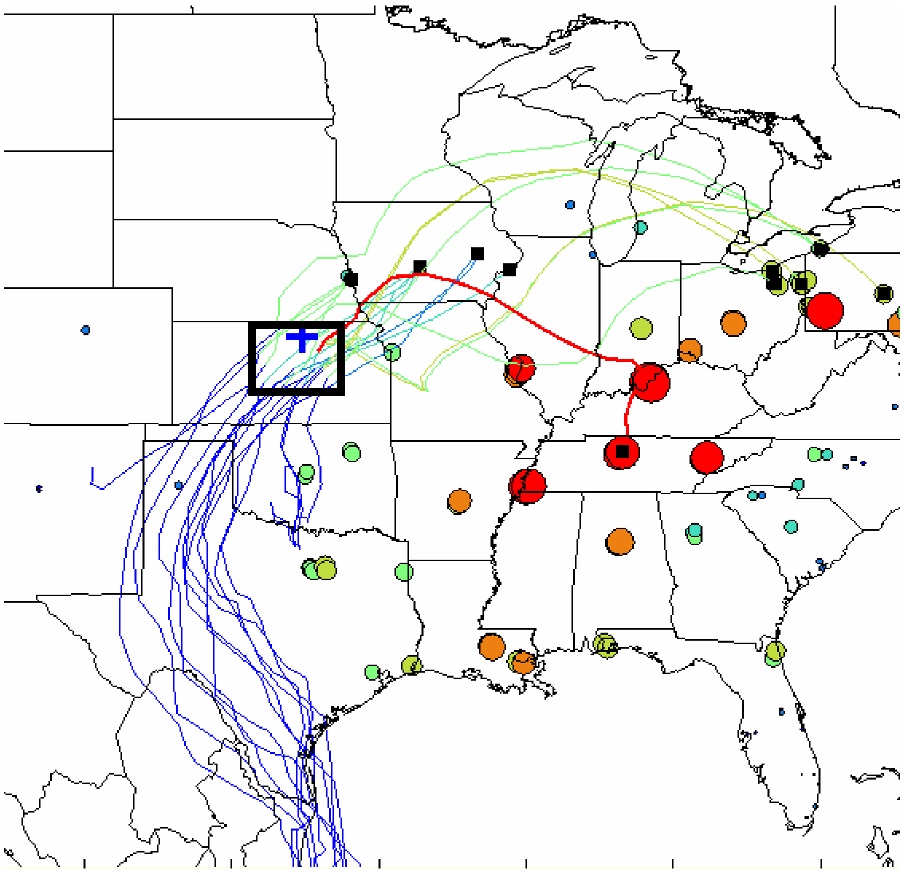
Modeled Sulfate

Modeled OC

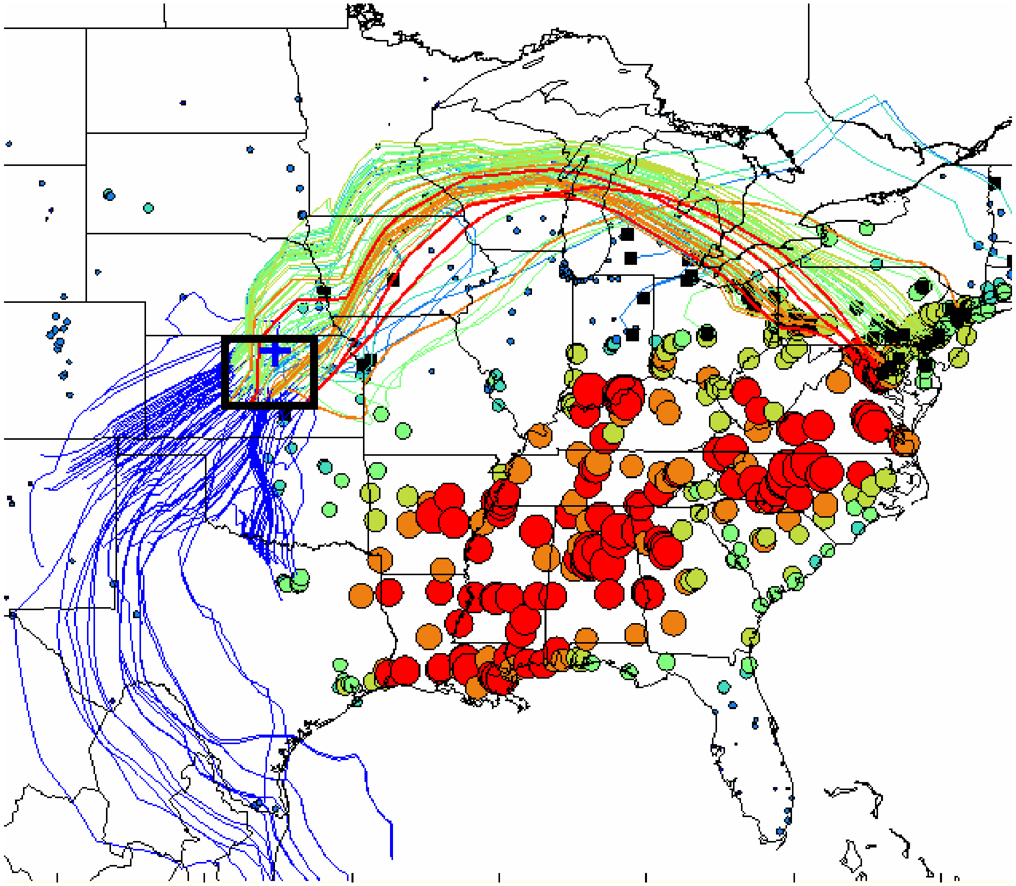


Modeled sulfate was moderate/high and modeled OC was moderate/low (lower on 8/4/04) on 8/3/04 and 8/4/04. (Only 8/3/04 shown here)

8/3/04

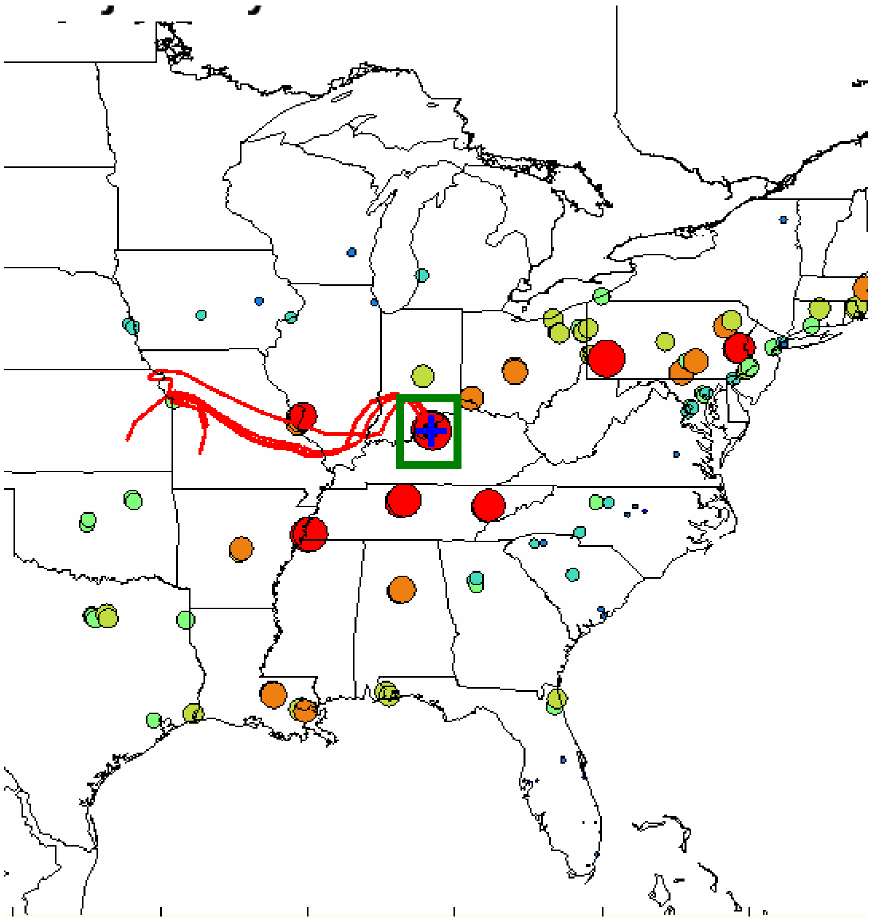


8/4/04

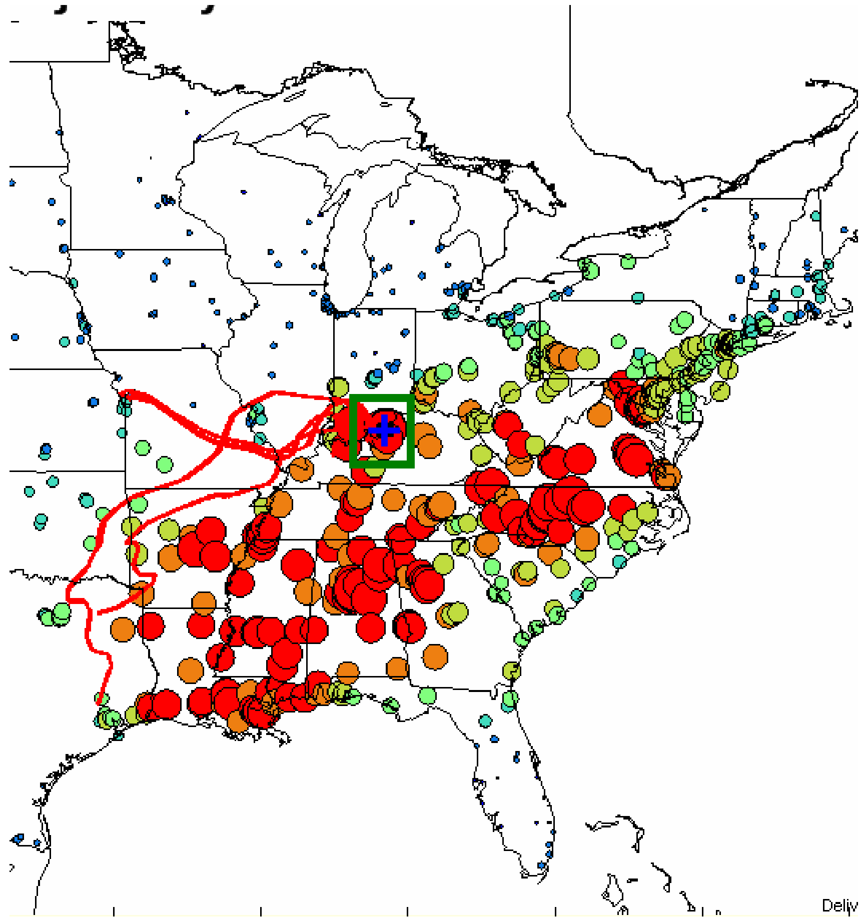


Source impact trajectories show the Louisville site had no impact from the fires in Kansas.

8/3/04

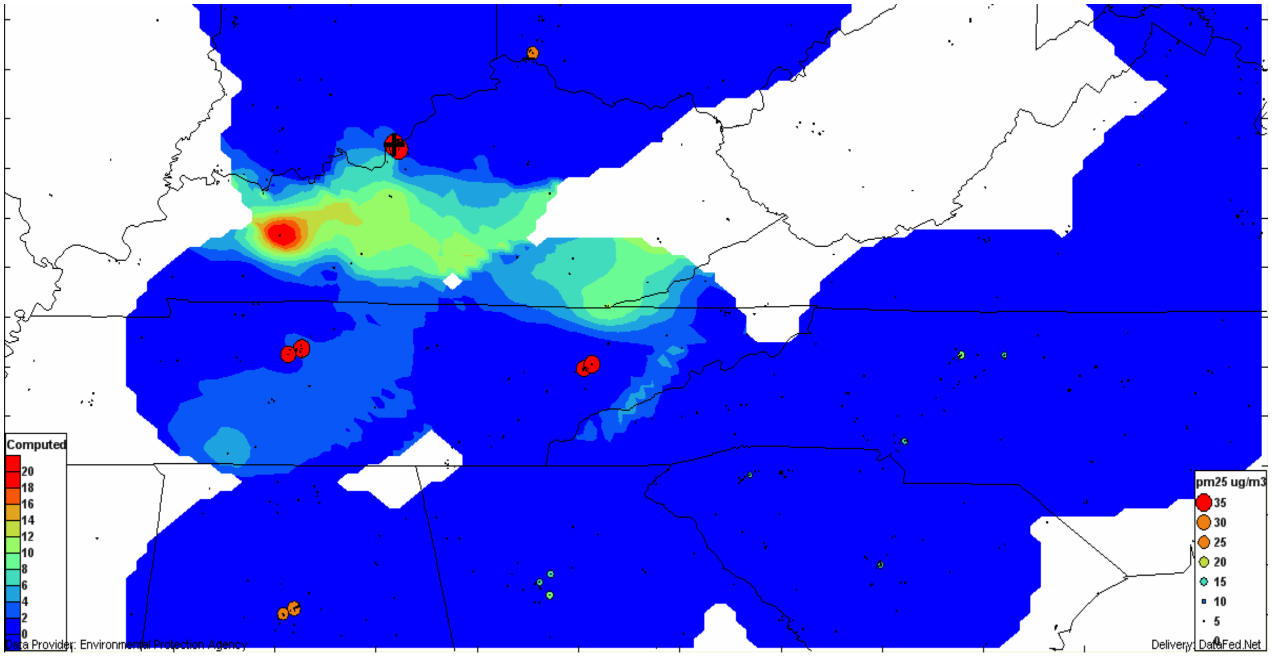


8/4/04

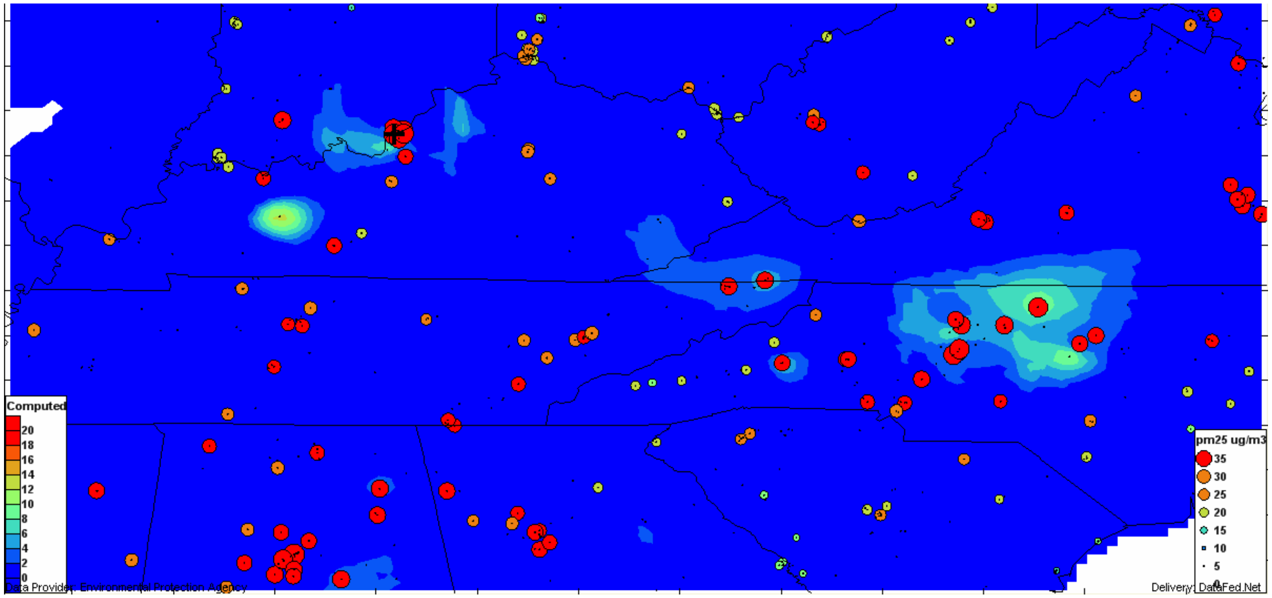


Back trajectories also show no impact from the Kansas fires. Winds appear slow moving (i.e., did not travel far in 72 hours), making them unlikely to transport much smoke from Kansas.

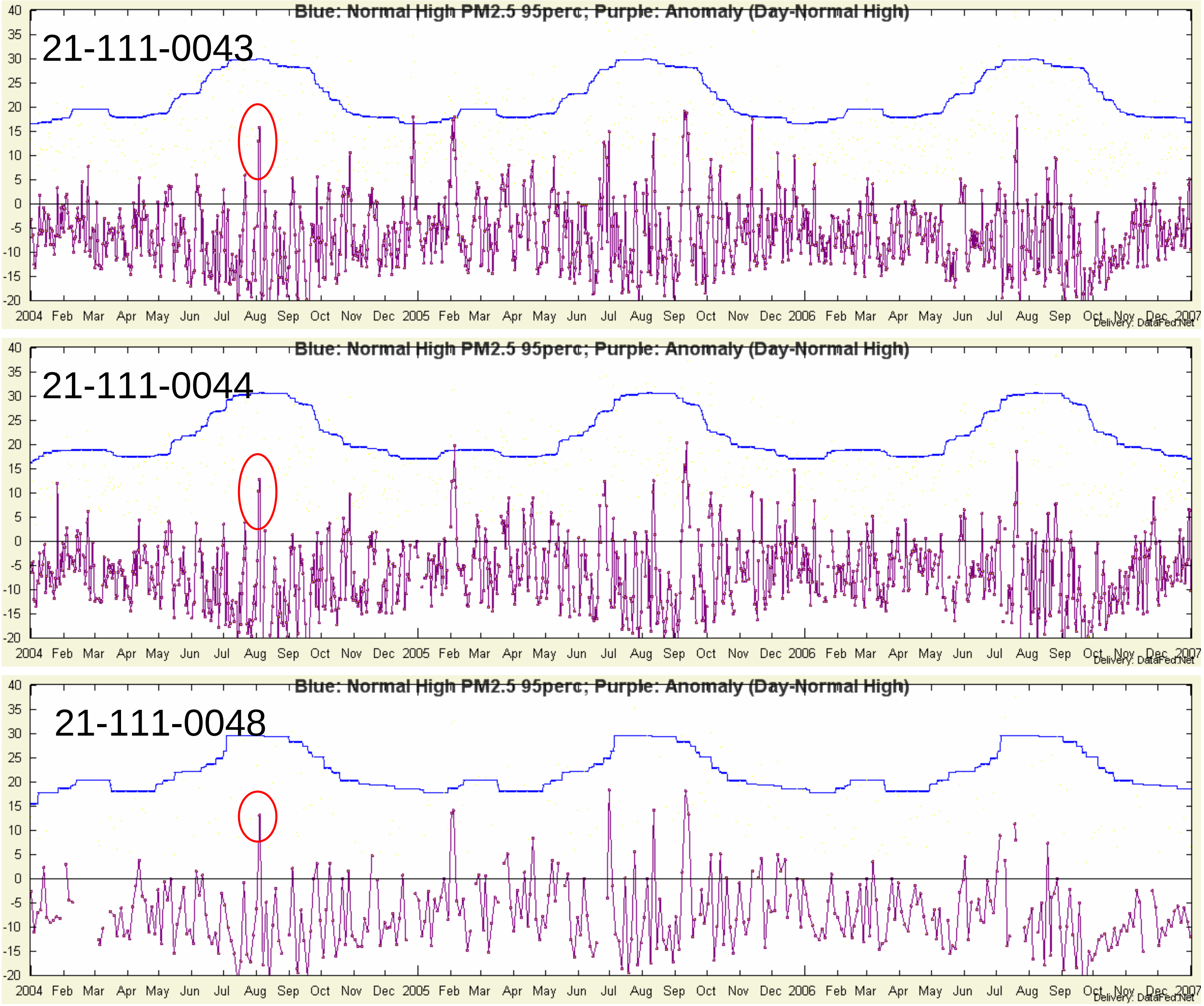
8/3/04



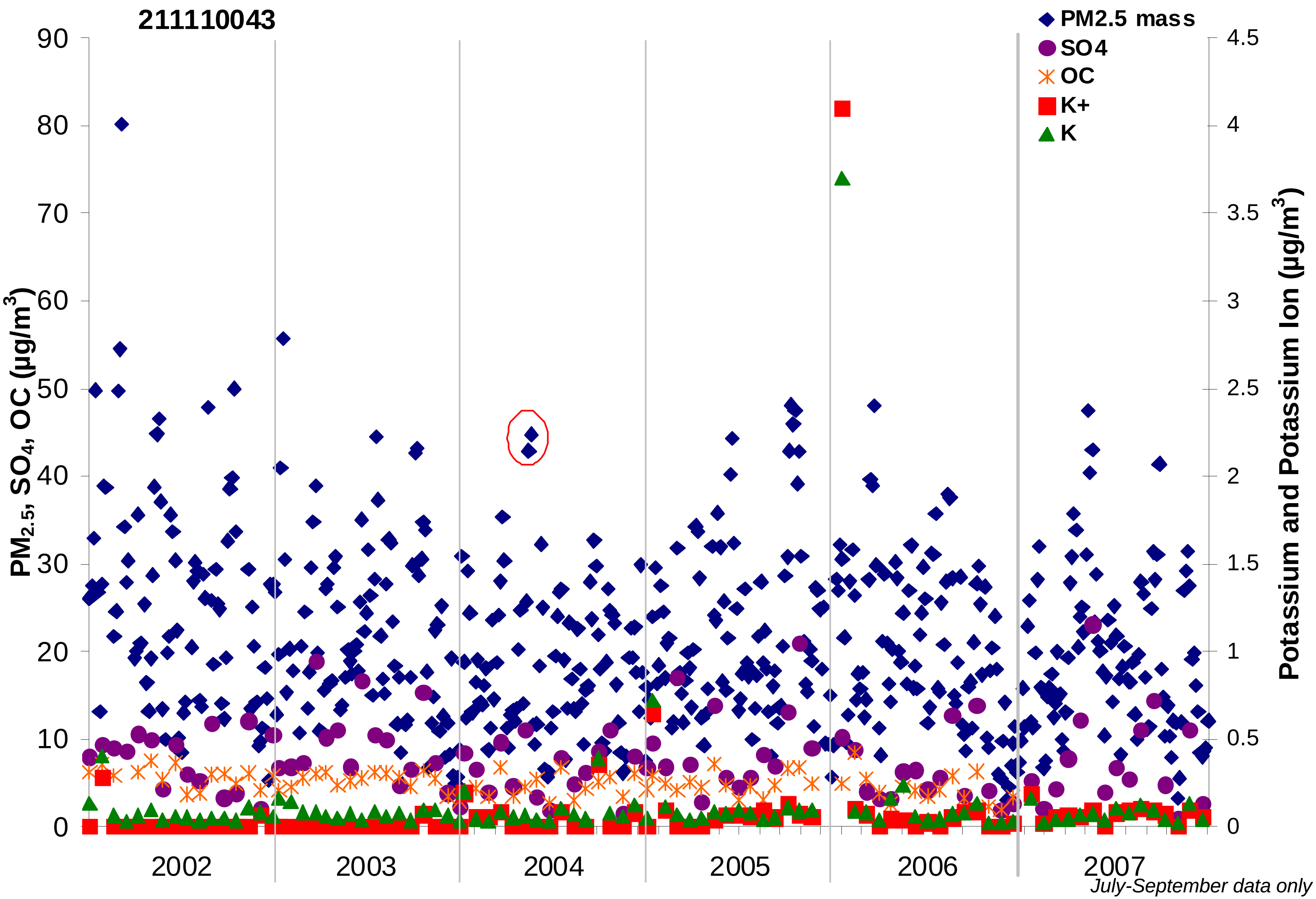
8/4/04



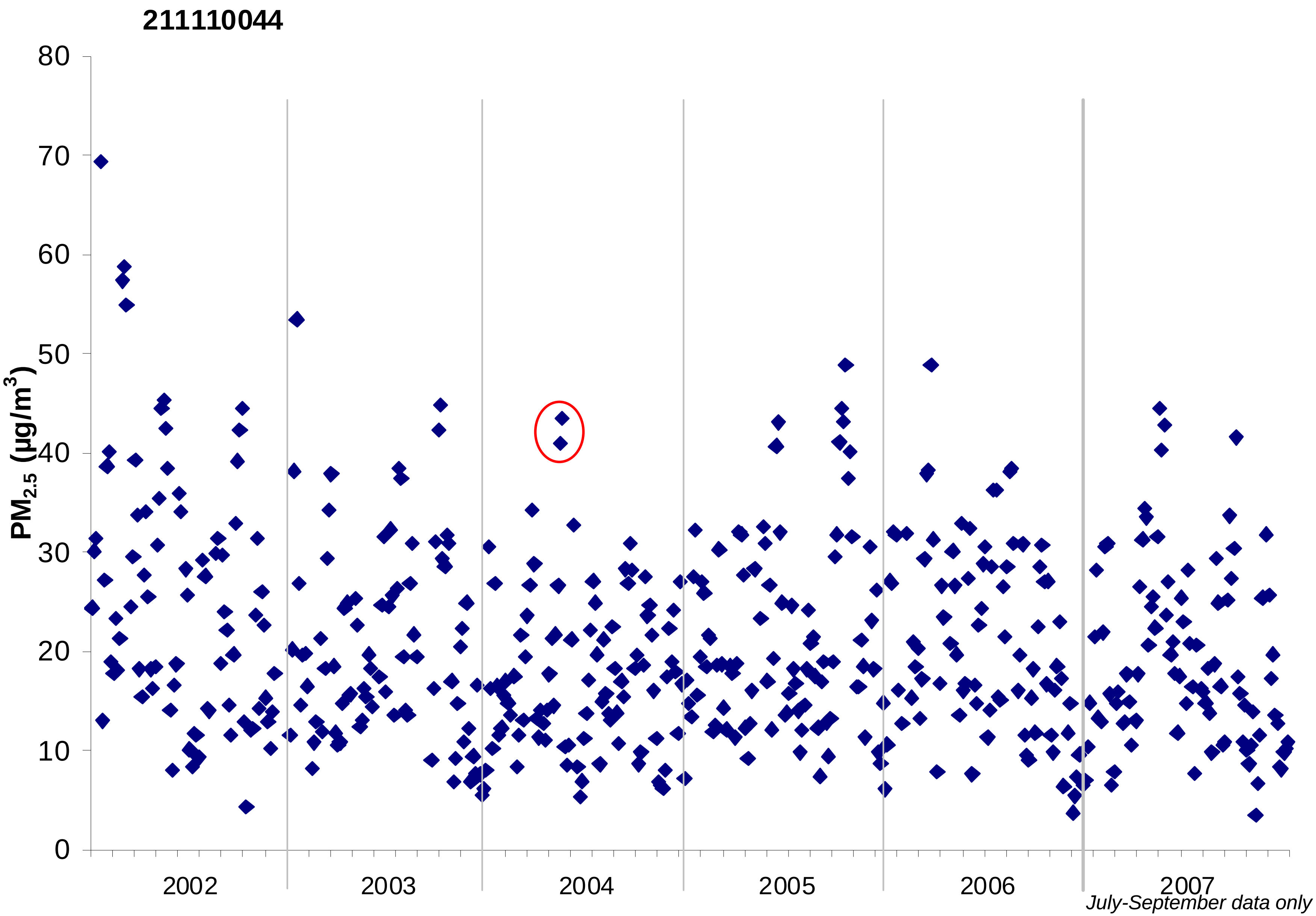
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 8/3/04 and 8/4/04, concentrations were very close to the historical values.



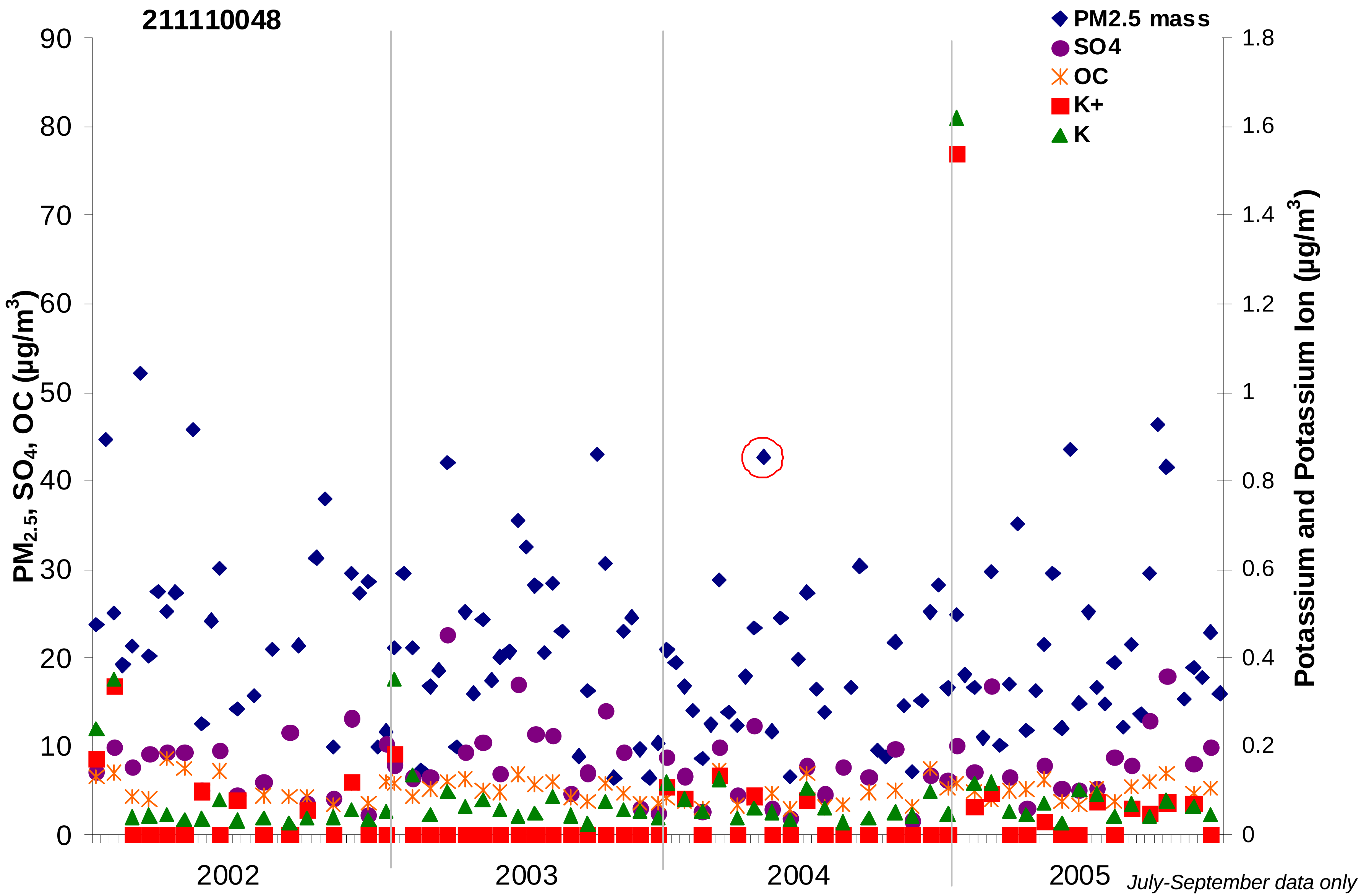
The purple lines show the difference between the given day and the historical 95th percentile concentration. On 8/3-8/4/04, concentrations were around 10-15 µg/m^3 higher than the historical values.



$PM_{2.5}$ concentrations are high, but within the range of historical concentrations. OC and potassium concentrations are not higher than normal, but sulfate is high on 8/1/04, which was the last reported sulfate measurement before the episode.



$PM_{2.5}$ concentrations are high, but within the range of historical concentrations. No speciated data are available for this site.



As at 21-111-0043, $PM_{2.5}$ concentrations are high, but within the range of historical concentrations. OC and potassium concentrations are not higher than normal, but sulfate is high on 8/1/04, which was the last reported sulfate measurement before the episode.

Summary

- Trajectory analysis does not indicate any impact from the area of the Kansas fires on 8/3/04 or 8/4/04.
- High sulfate concentrations indicate a regional sulfate episode throughout the southeast.
- Although $PM_{2.5}$ concentrations are high on 8/3/04 and 8/4/04, they are within the historical range of concentrations and were likely not impacted by forest fires.

Exceptional Events Analysis Kentucky 9/8/05-9/13/05

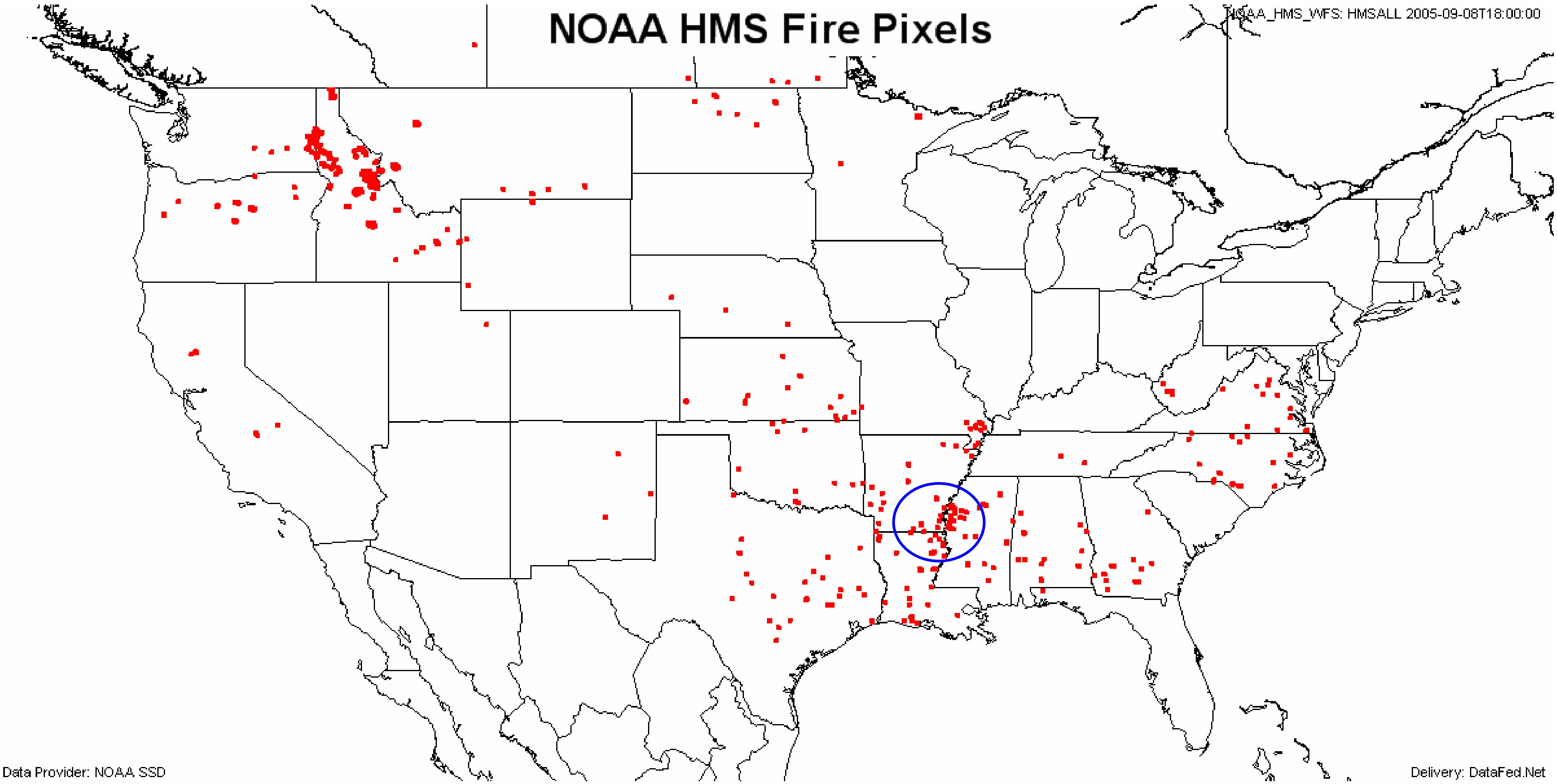
Four sites analyzed
(21-111-0043, 21-111-0044,
21-111-0048, 21-111-0051)
for possible fire impact from
Arkansas/Mississippi/Texas fires

Concentrations Under Consideration

$PM_{2.5}$ concentrations in µg/m^3

Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
September 8, 2005	43.5	42.2	41.1		
September 9, 2005	48.8	47.4	44.5		
September10, 2005	45.9		43.2	46.4	
September11, 2005	47.8	47.1	48.9		
September12, 2005	40.1	38.2	37.4		
September13, 2005	42.9	42.7	40.1	41.6	39.1

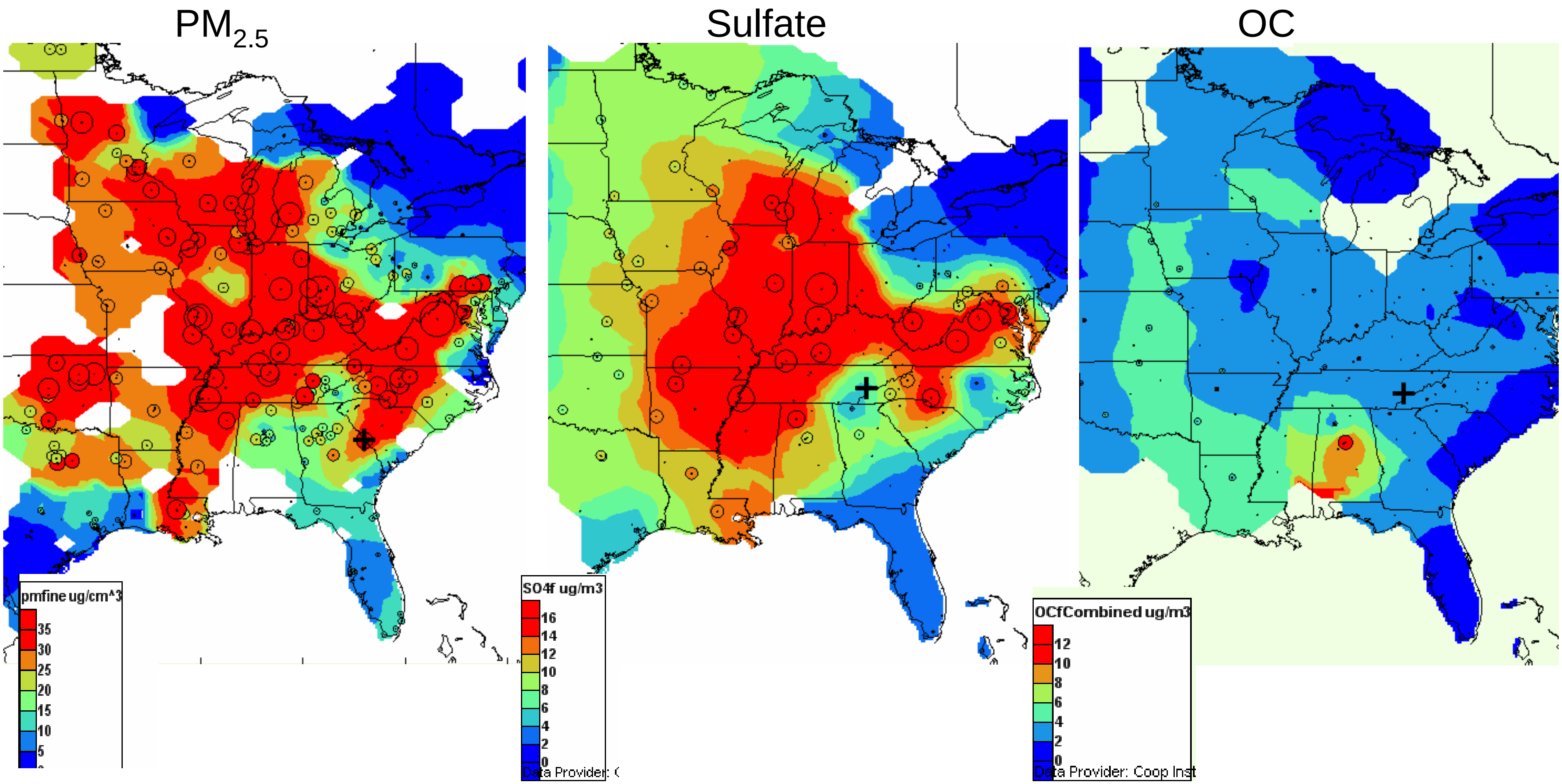
9/8/05



Fires in the Arkansas/Mississippi area are believed to be impacting the Louisville area for 9/8/05-9/13/05.

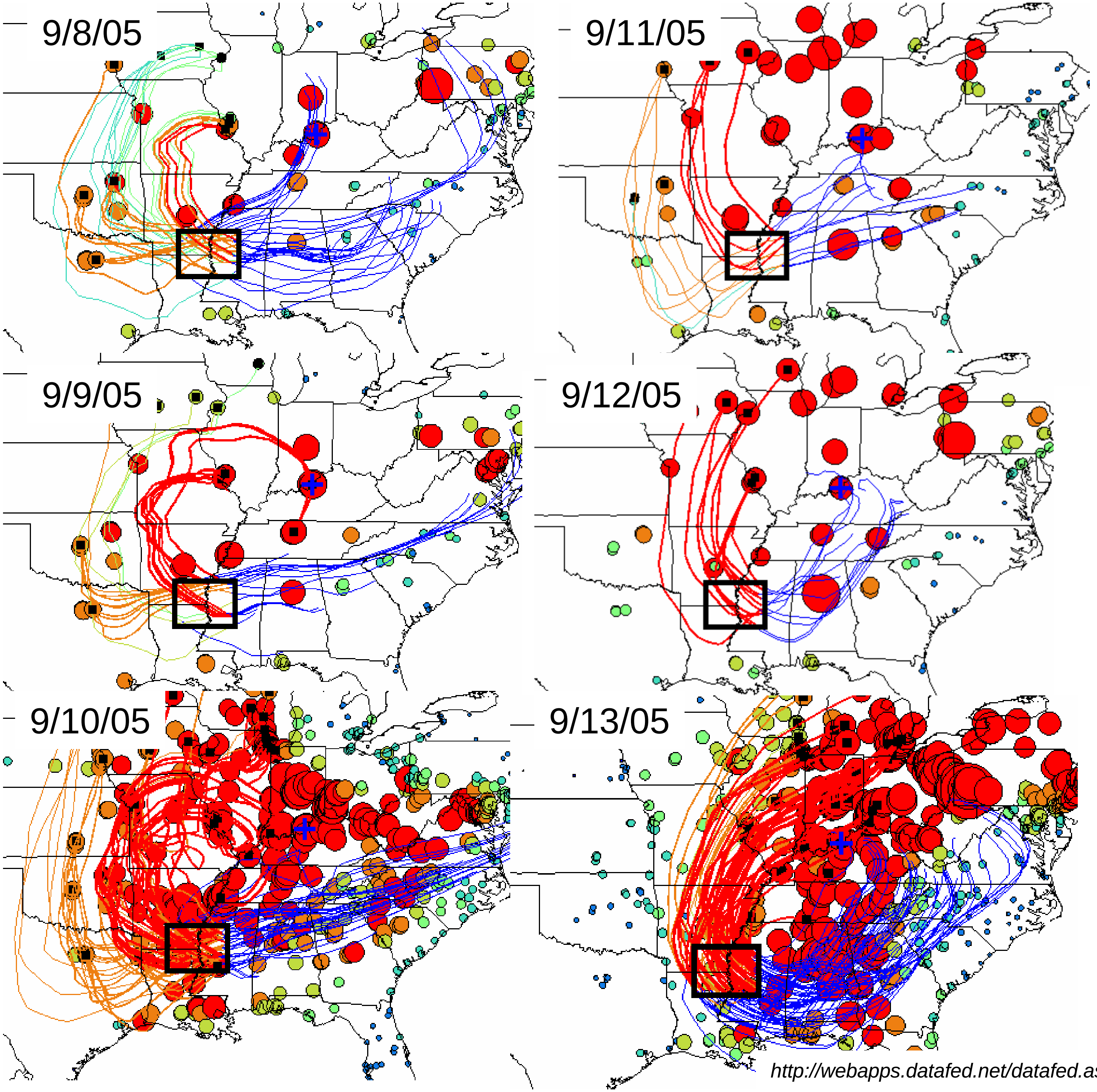
http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/NOAA_HMS_FirePix_map

9/10/05



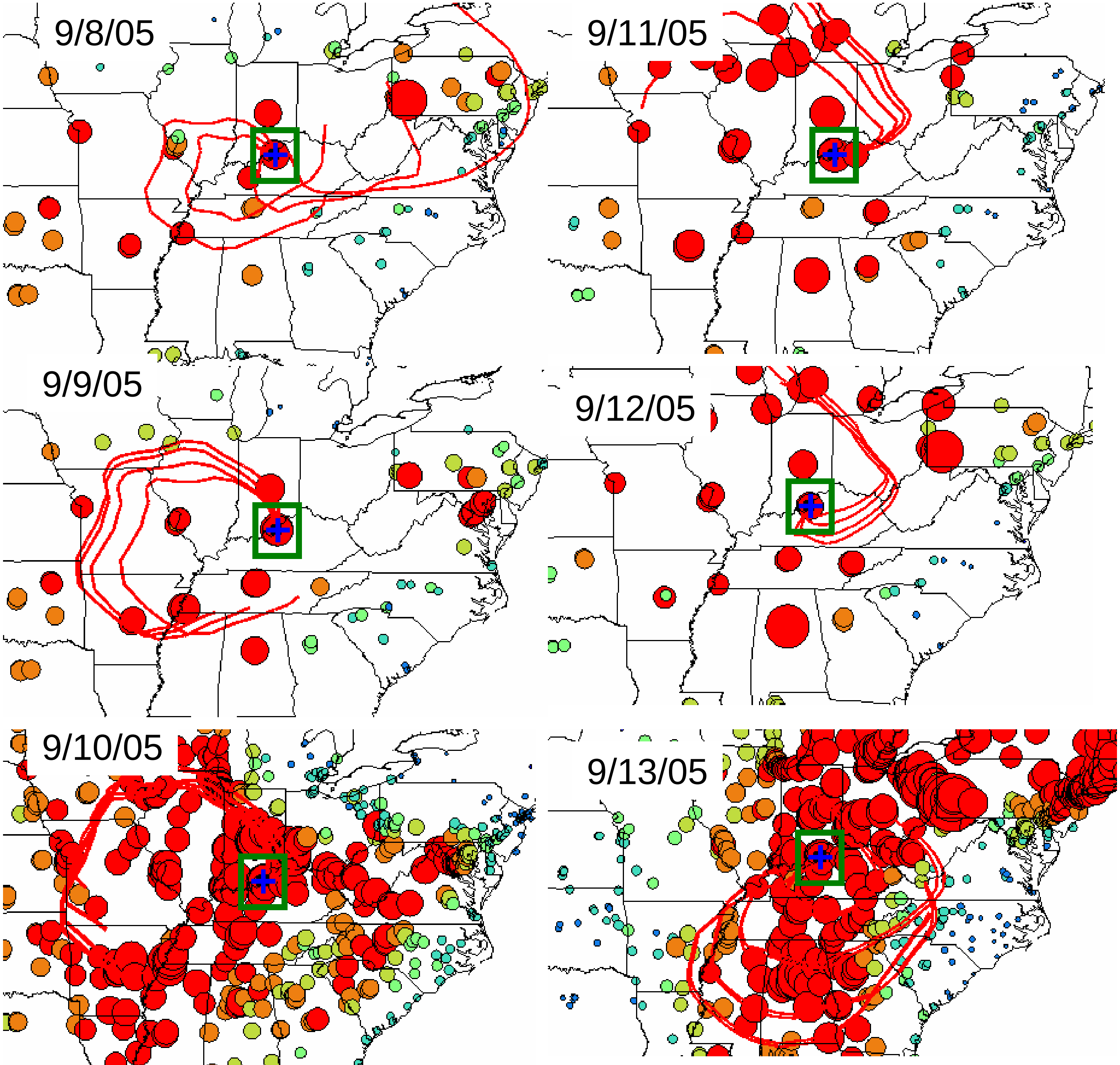
$PM_{2.5}$ and sulfate concentrations were high, and OC concentrations were low, throughout the region on 9/10/05, indicating a regional sulfate event. Data were not available for other study days.

http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/AIRNOW_PM25_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map



Source impact trajectories show that for most days, no trajectories from the fire location impacted the Louisville area. Although trajectories on 9/13/05 do pass through the fire area before impacting Louisville, this is caused by a surface high pressure centered over Kentucky that is conducive to a high regional sulfate event (likely caused by the transport of humid air into the region and limited dispersion).

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

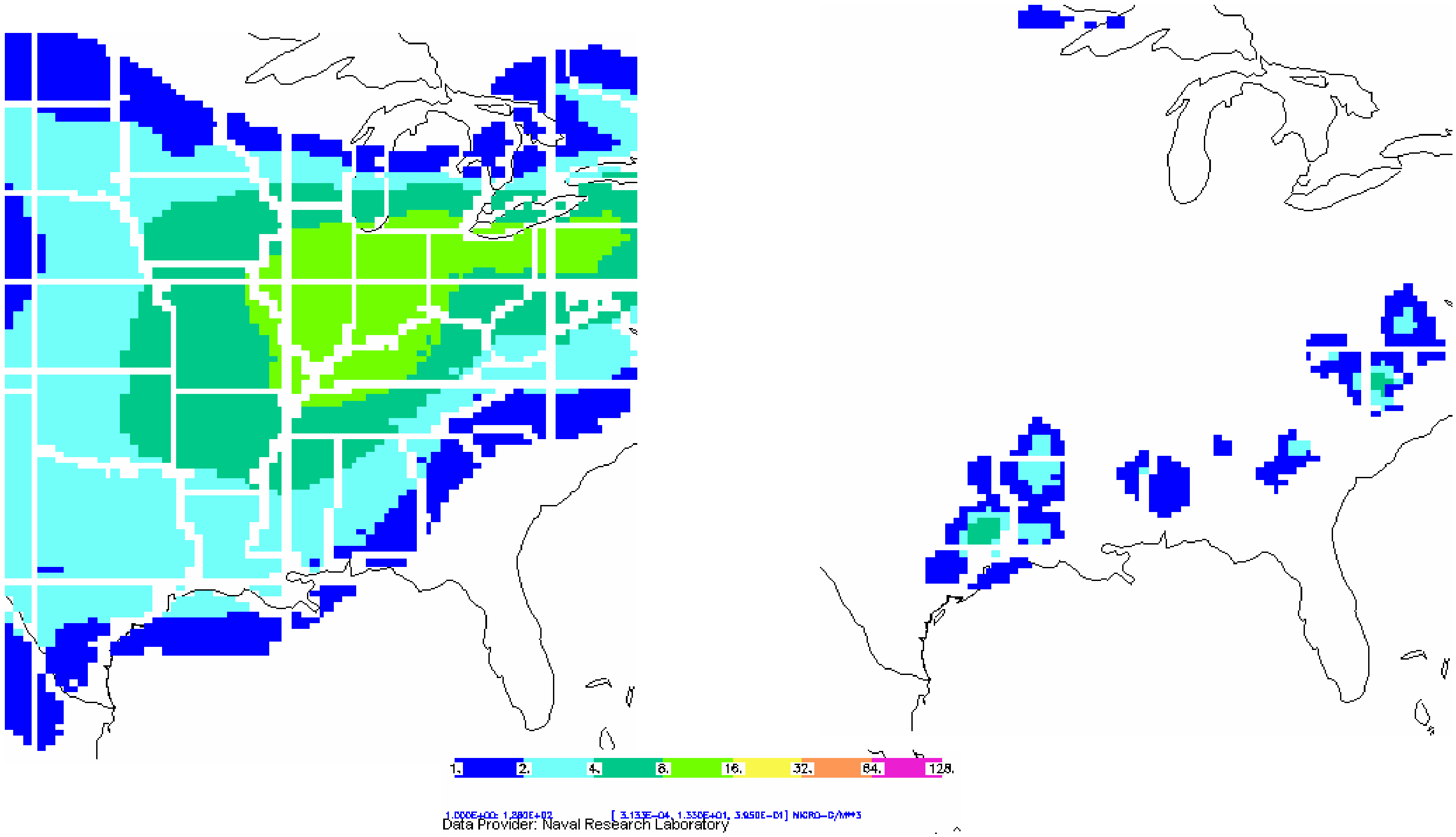


Back trajectories from the Louisville area do not show a distinct path from the fire area to the impacted sites and indicate light winds, which limit dispersion.

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

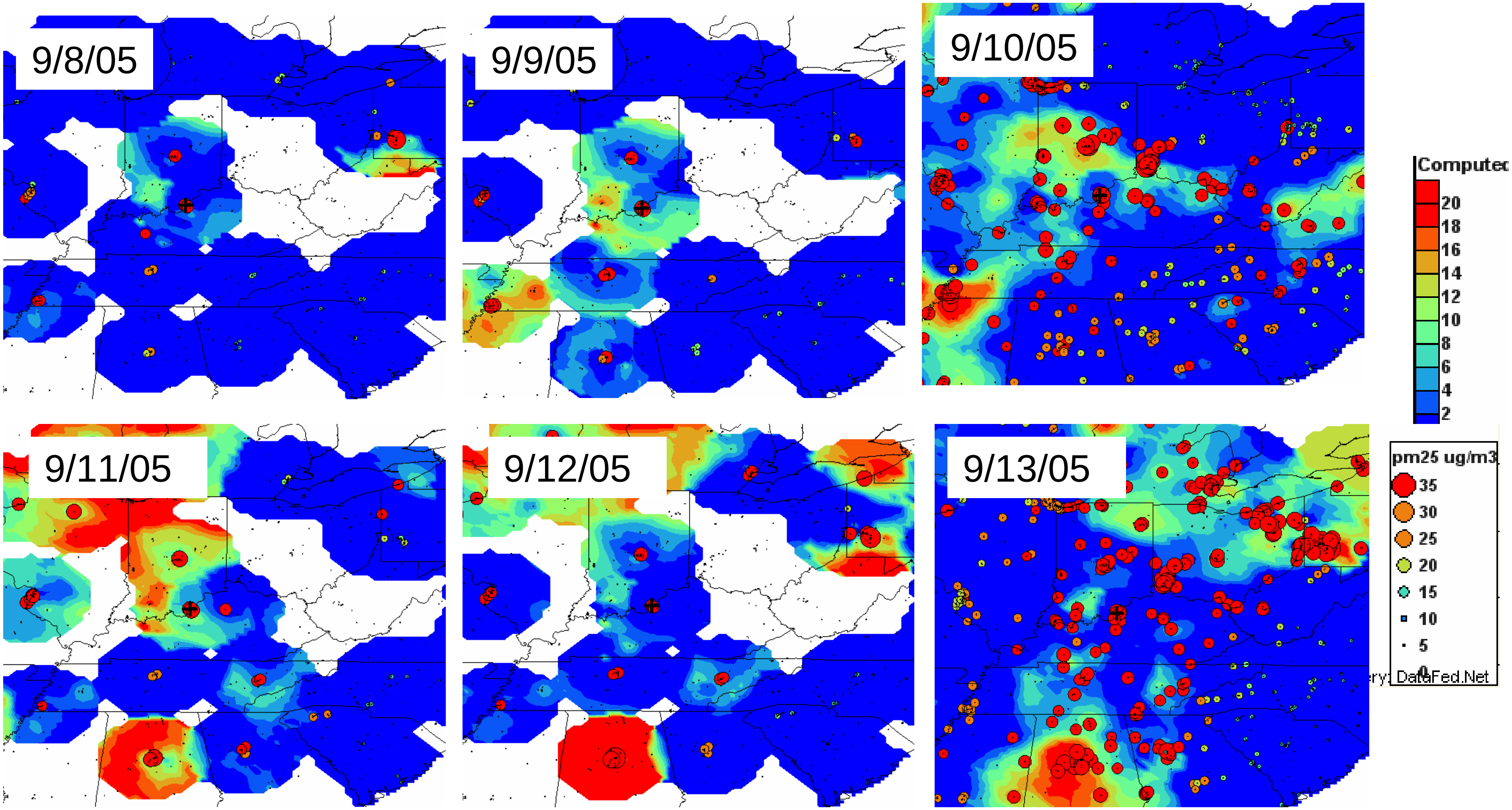
Modeled Sulfate

Modeled Smoke



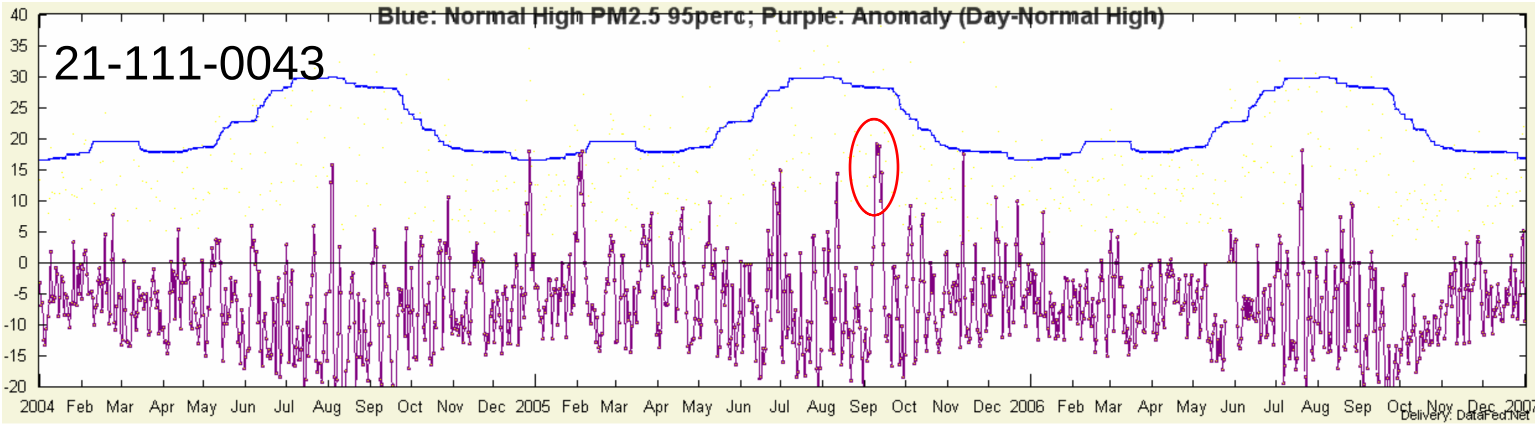
Modeled sulfate was moderate/high throughout the region and modeled smoke was low or zero throughout the region on all study days, again supporting a regional sulfate event. (9/8/05 shown)

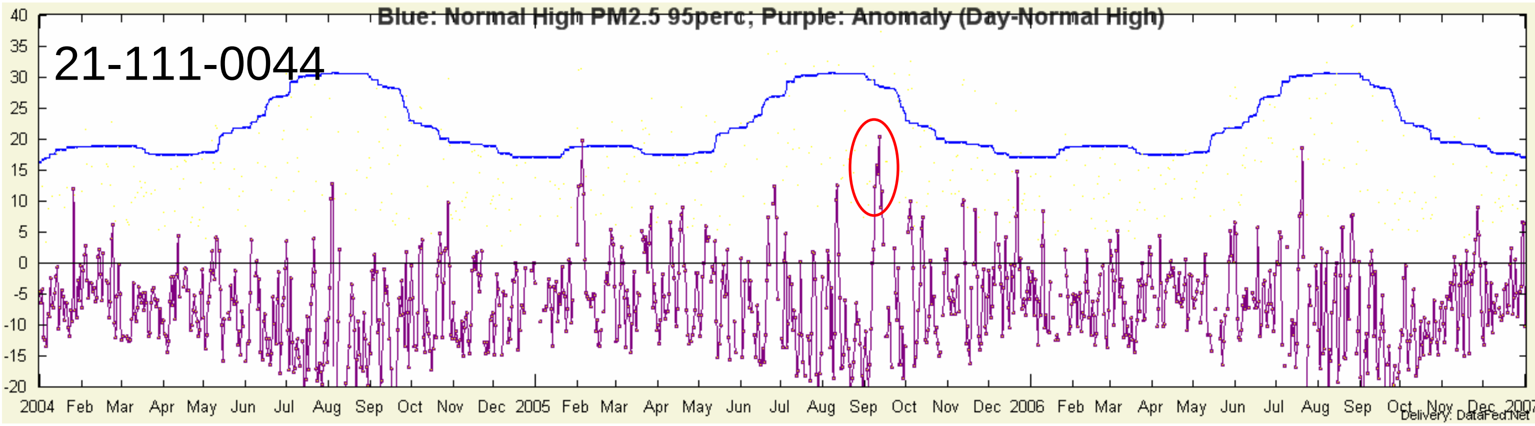
http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf

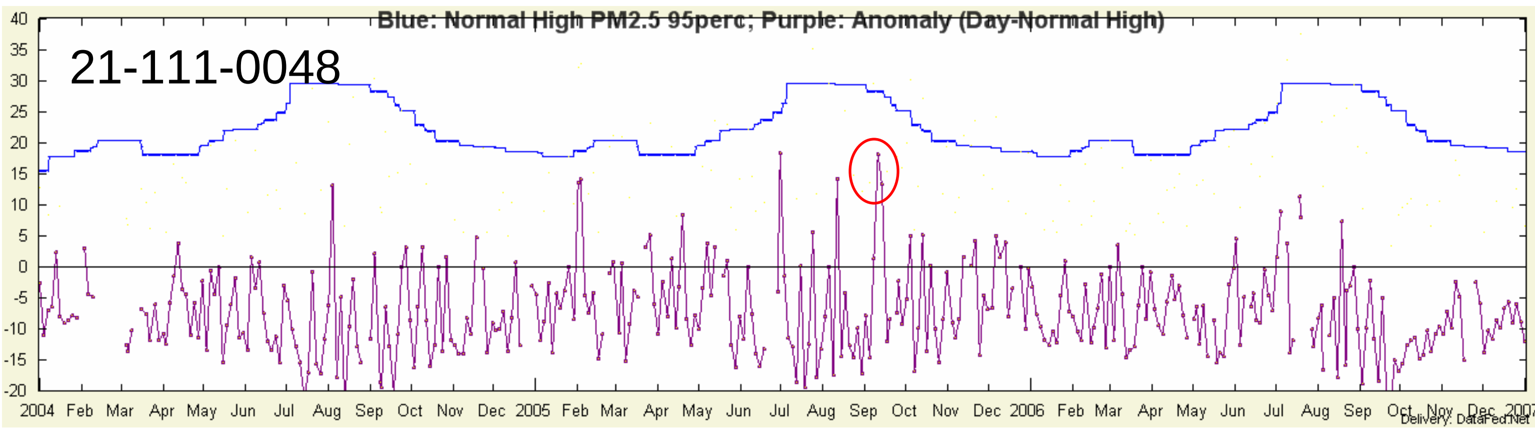


These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 9/8/05, 9/9/05, and 9/13/05, concentrations were very close to the historical values. On 9/10/05, 9/11/05, and 9/12/05, concentrations were around 10-15µg/m^3 higher than historical values.

http://webapps.datafed.net/datafed.aspx?page=NHF/Gadsen_05-22-07R

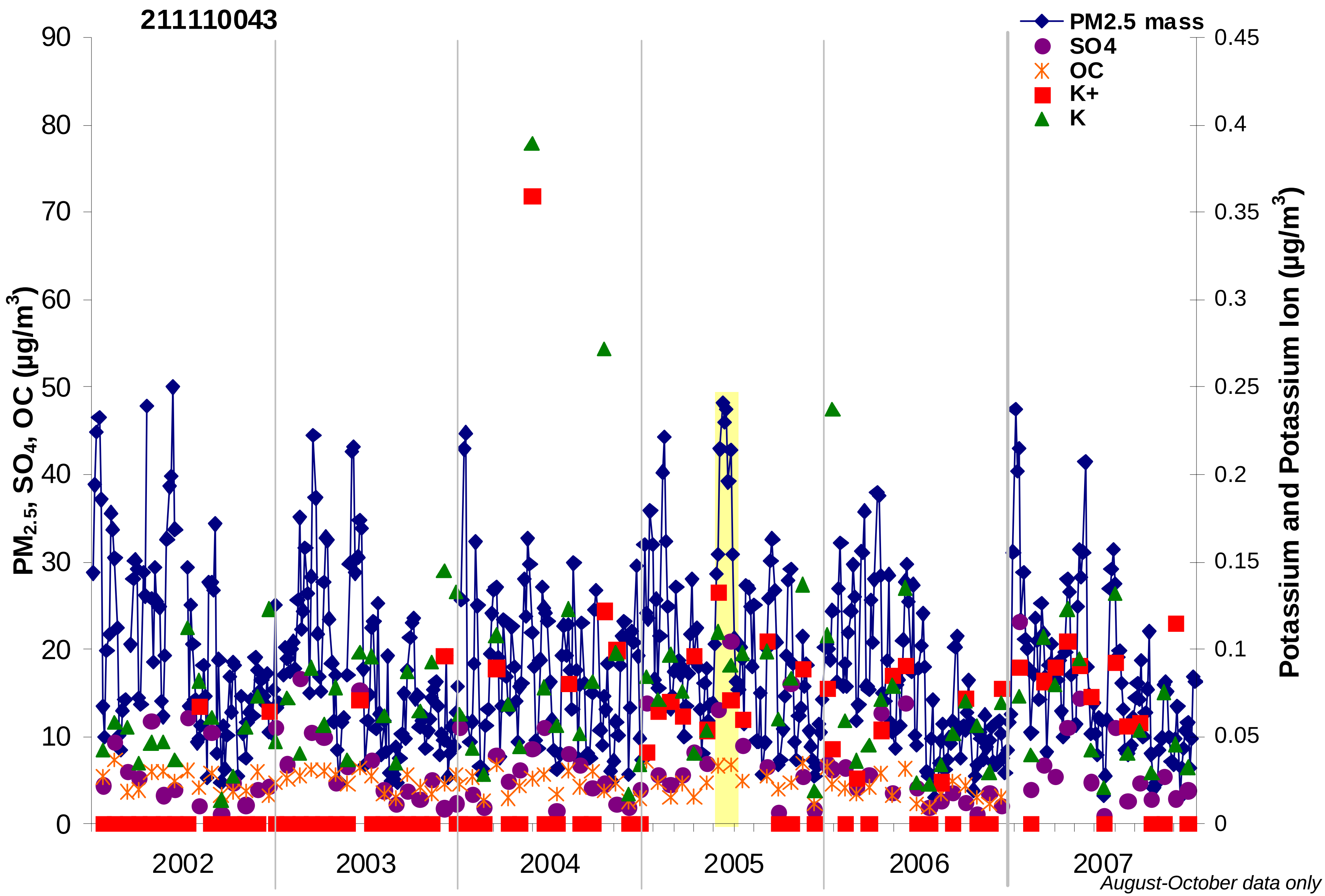






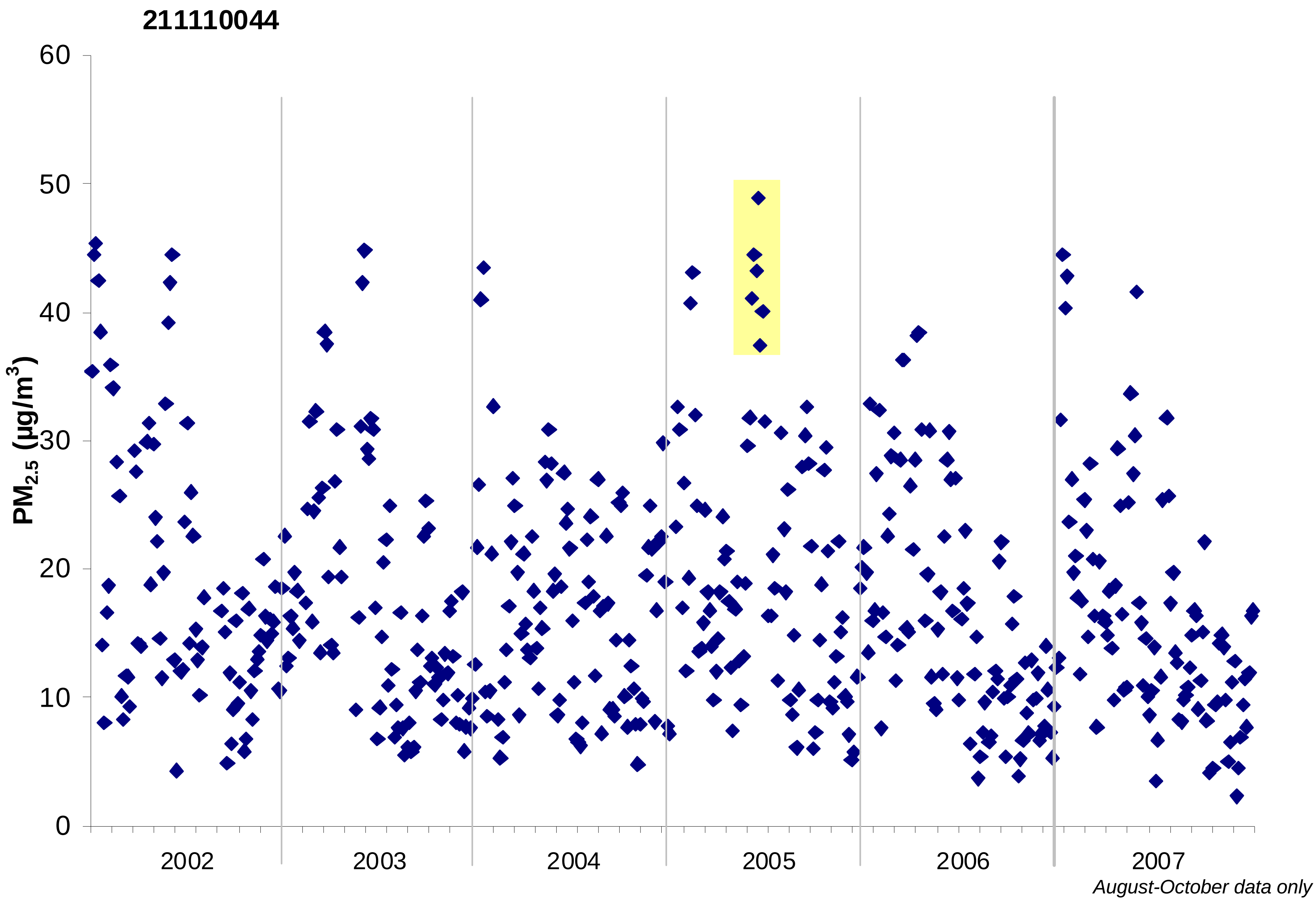
The purple lines show the difference between the given day and the historical 95th percentile concentration. On 9/10-9/12/05, concentrations were around 10 to 15 µg/m^3 higher than the historical values.

http://webapps.datafed.net/datafed.aspx?page=NHF/Gadsen_05-22-07R



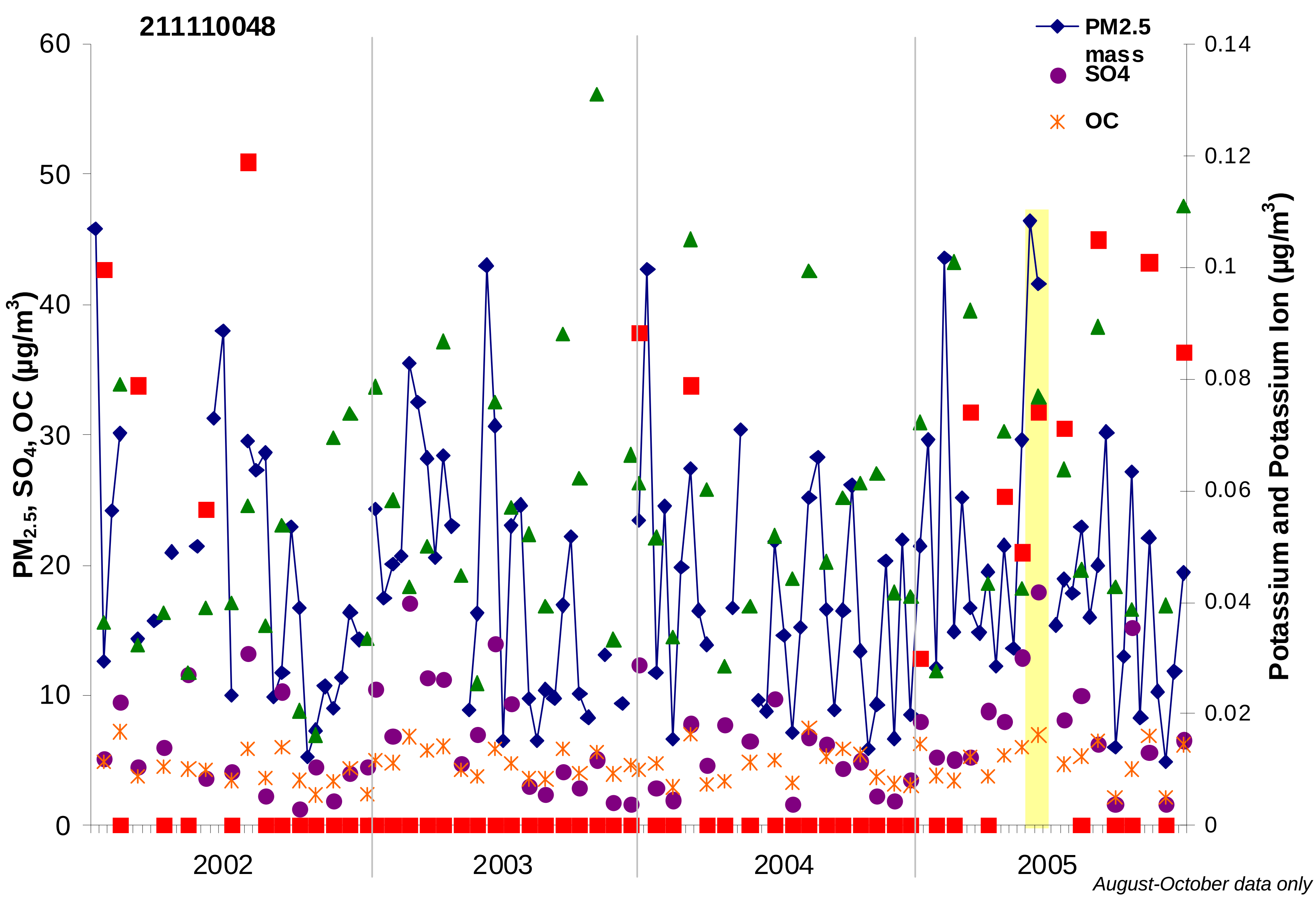
$PM_{2.5}$ concentrations were high on 9/8-9/13/05 (highlighted in yellow). OC concentrations were average and sulfate concentrations were very high (9/13/05).

Data from AQS



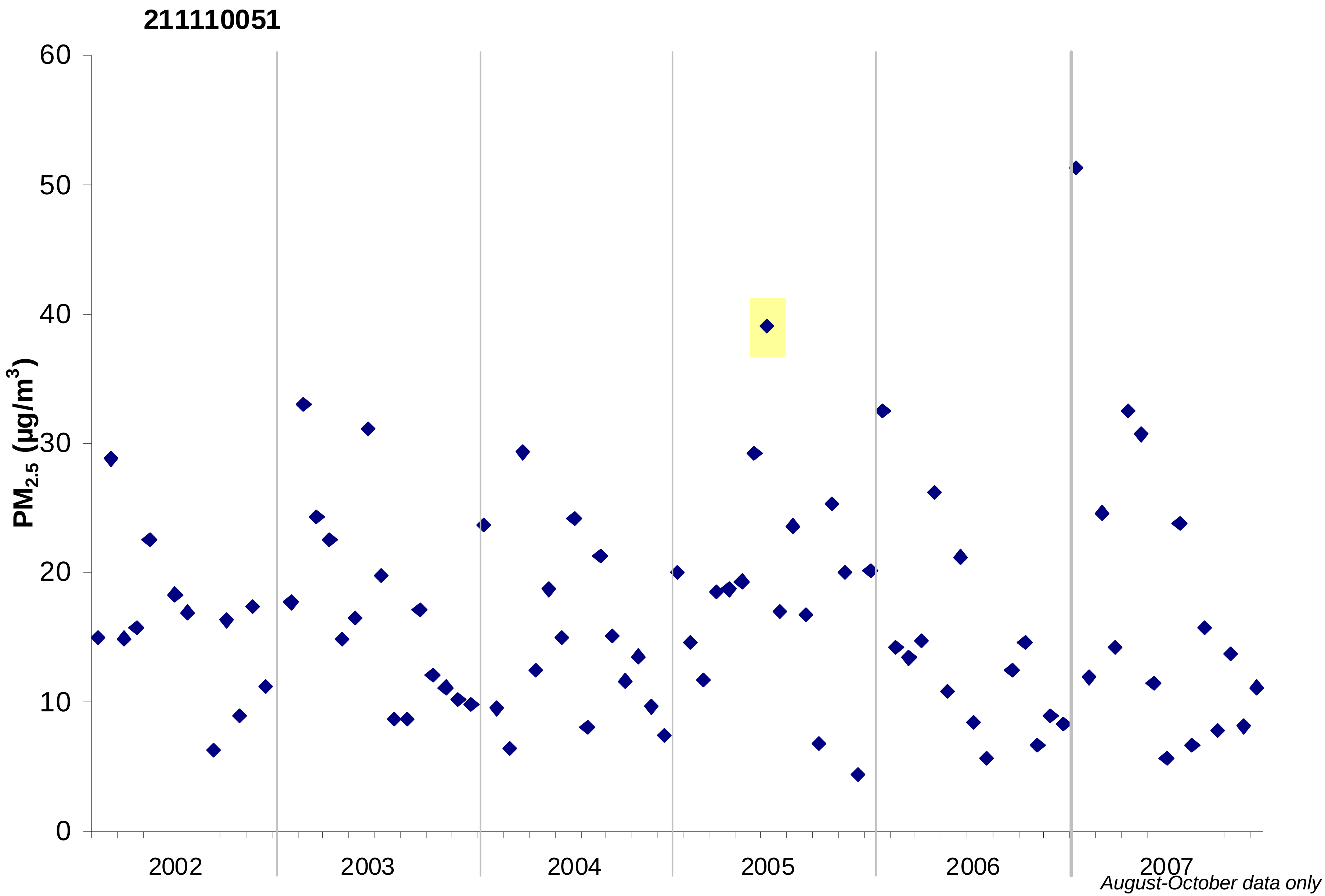
All study days have high $PM_{2.5}$ concentrations; all except for 9/11/05 are within the historical range of concentrations. Speciated data are not available for this site.

Data from AQS



$PM_{2.5}$ concentrations were high on 9/10/05 and 9/13/05 (highlighted in yellow). OC concentrations were average and sulfate concentrations were very high (9/13/05).

Data from AQS



$PM_{2.5}$ concentrations were very high on 9/13/05; speciated data are not available for this site.

Data from AQS

Summary

- Trajectories do not show a clear impact from the fire area on the Louisville area.
- Sulfate concentrations are very high throughout the region during 9/8-9/13/05, indicating a regional sulfate episode.
- Meteorological analysis shows a surface high centered over Kentucky that is likely causing the sulfate event (due to the transport of humid air into the region and limited dispersion).
- The high $PM_{2.5}$ concentrations in Louisville on 9/8-9/13/05 are likely not caused by impact from forest fires.

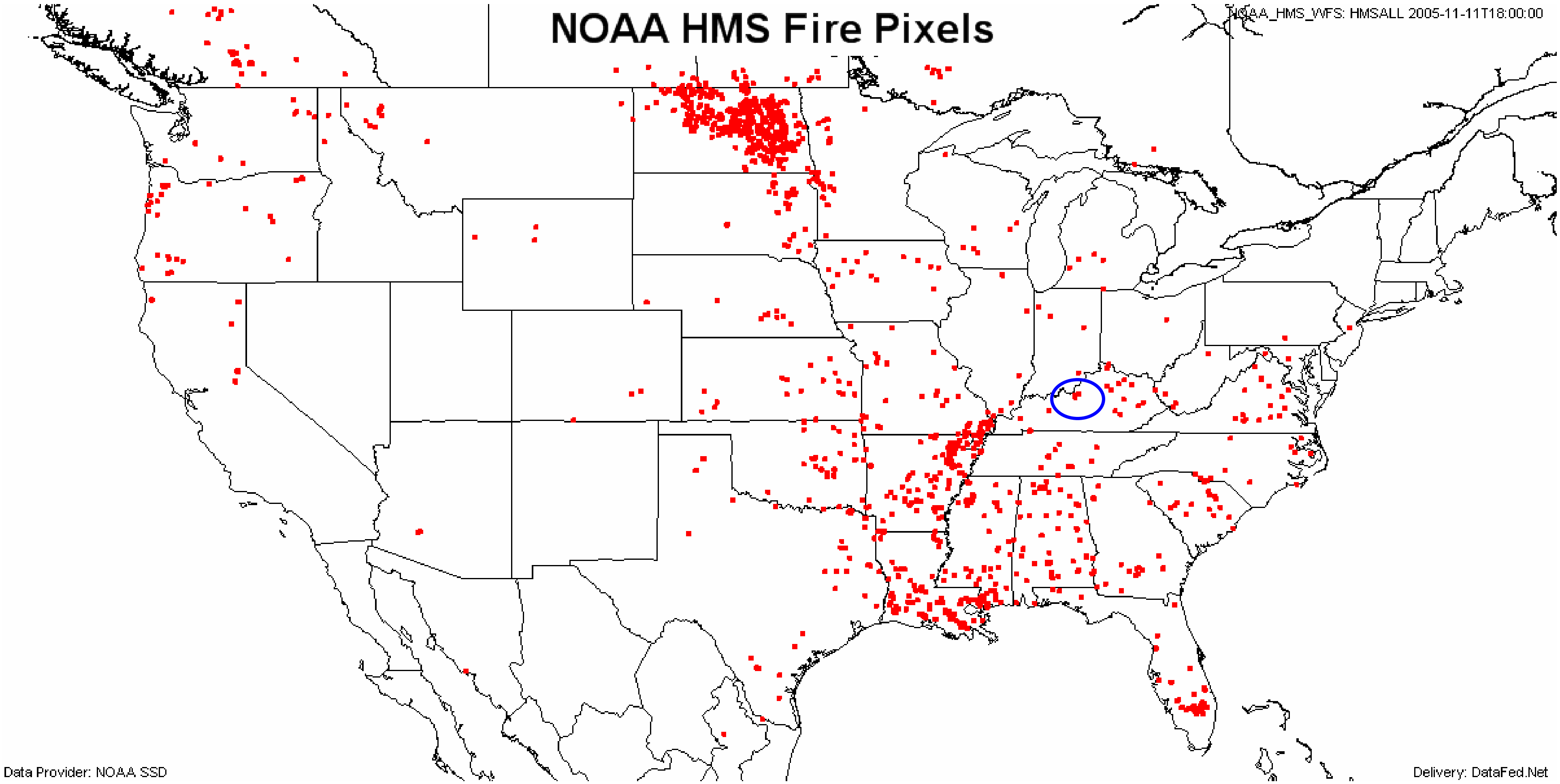
Exceptional Events Analysis
Kentucky
11/11/05-11/12/05

Three sites analyzed
(21-111-0043, 21-111-0044, 21-111-0048)
for possible fire impact
from Fort Knox fires

Days Under Consideration

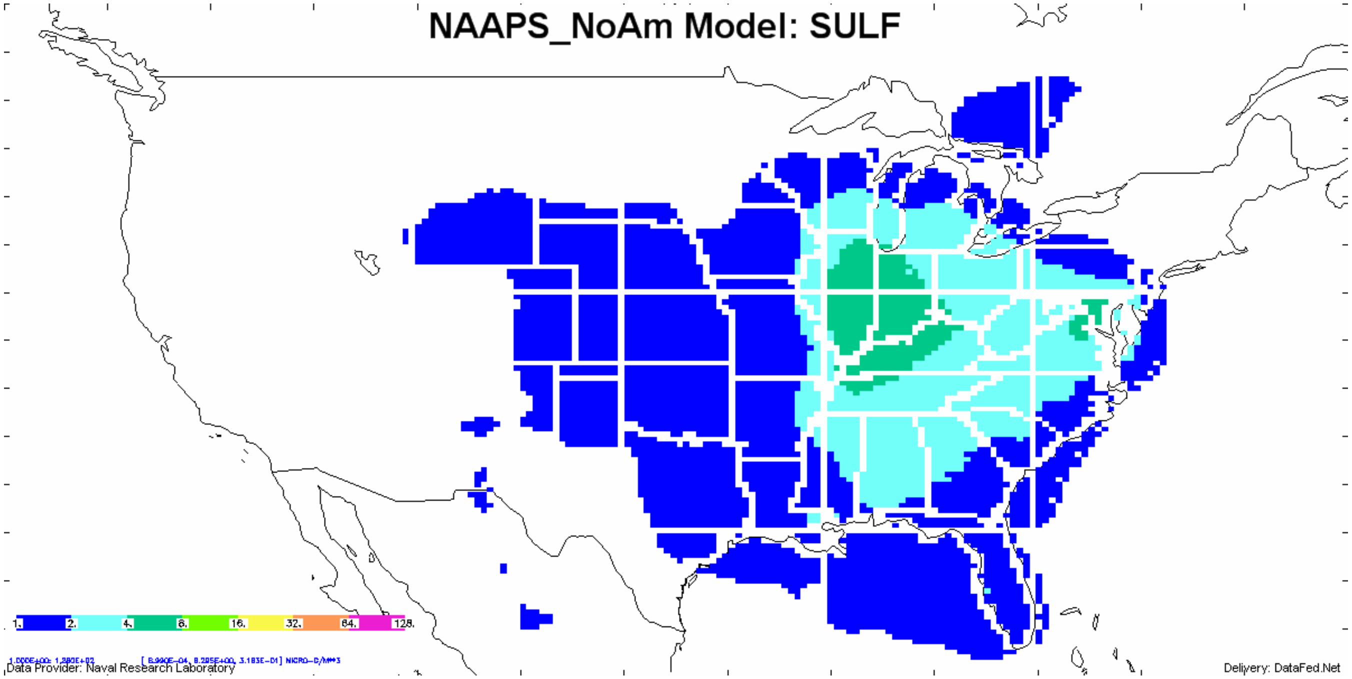
$PM_{2.5}$ in µg/m^3

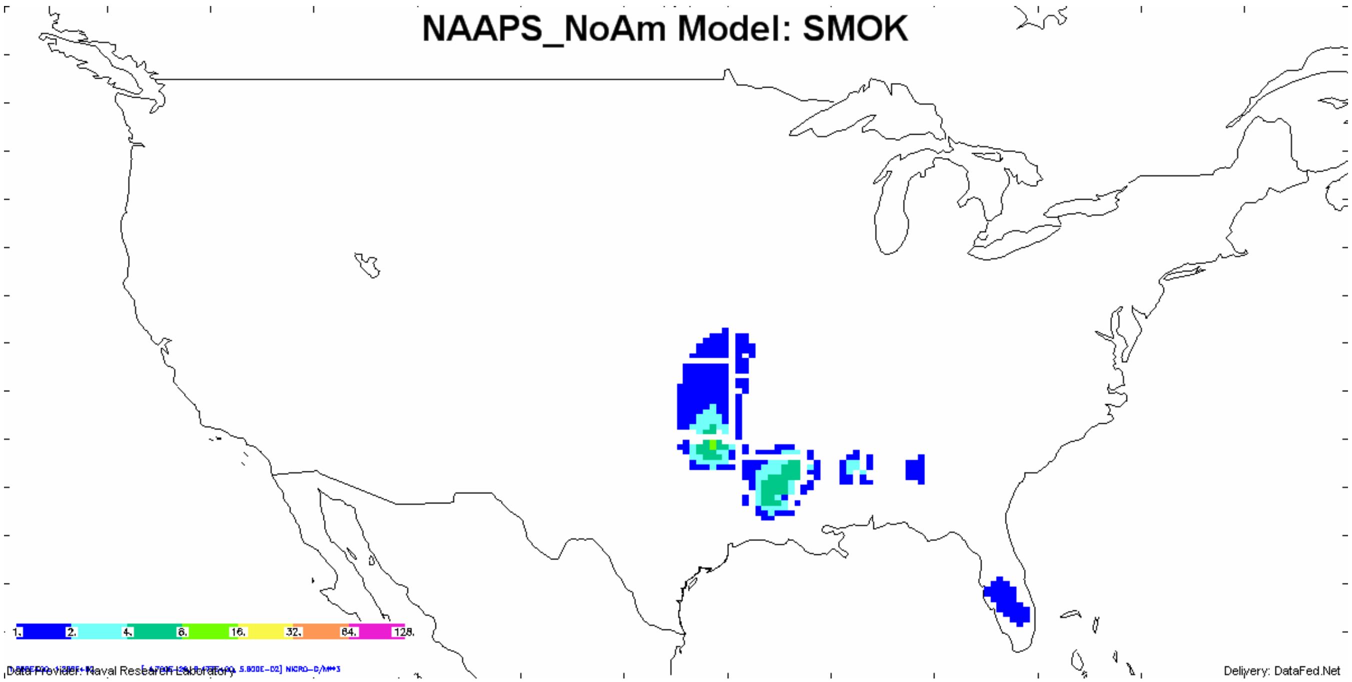
Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte	21-111-0048 Barret
November 11, 2005	21.3	28.8	Not Reported
November 12, 2005	36.0	29.6	21.2



Local fires are believed to be impacting concentrations at three sites on 11/11/05 and 11/12/05.

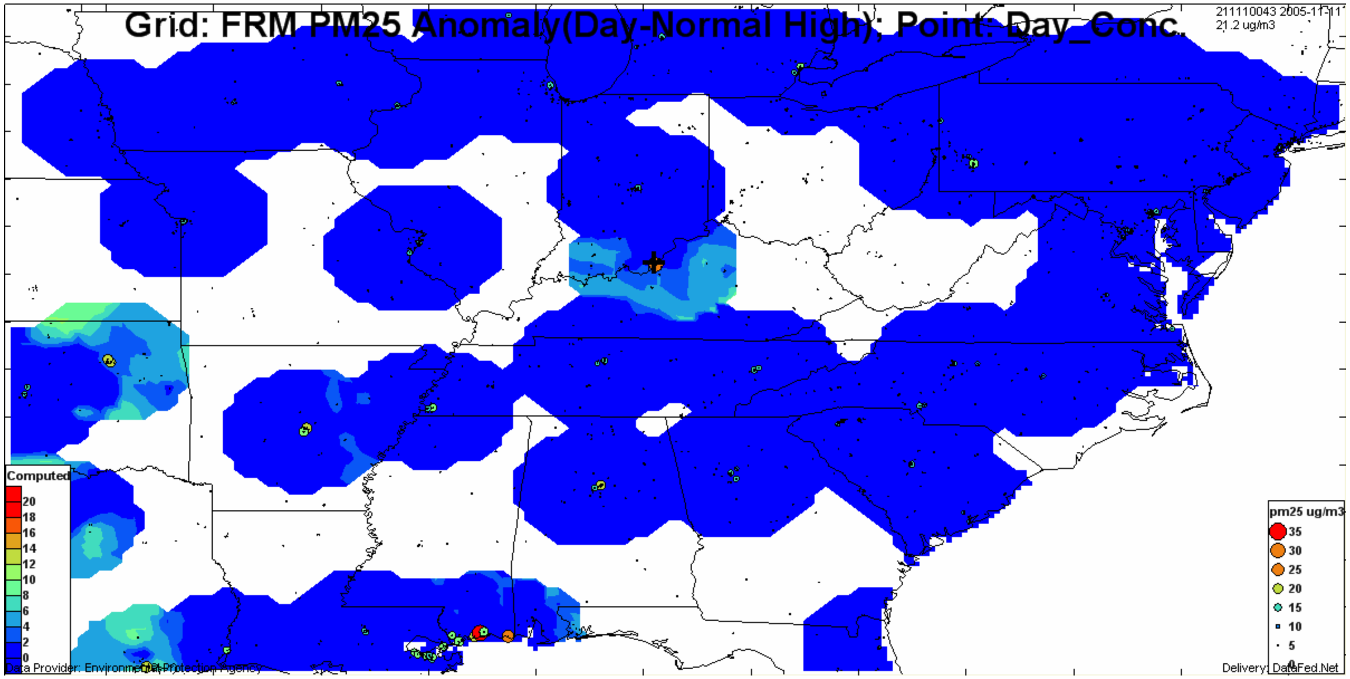
http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/NOAA_HMS_FirePix_map



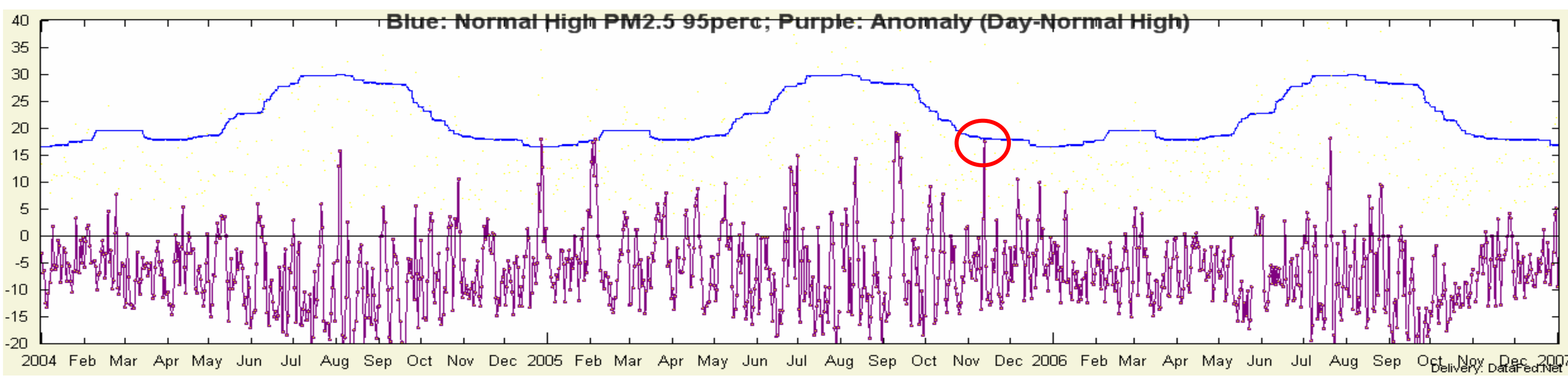


Modeled sulfate in Kentucky was low/moderate on 11/11/05. The absence of a contribution from smoke may be misleading as the fire under consideration is very small and believed to only have very local impacts.

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf

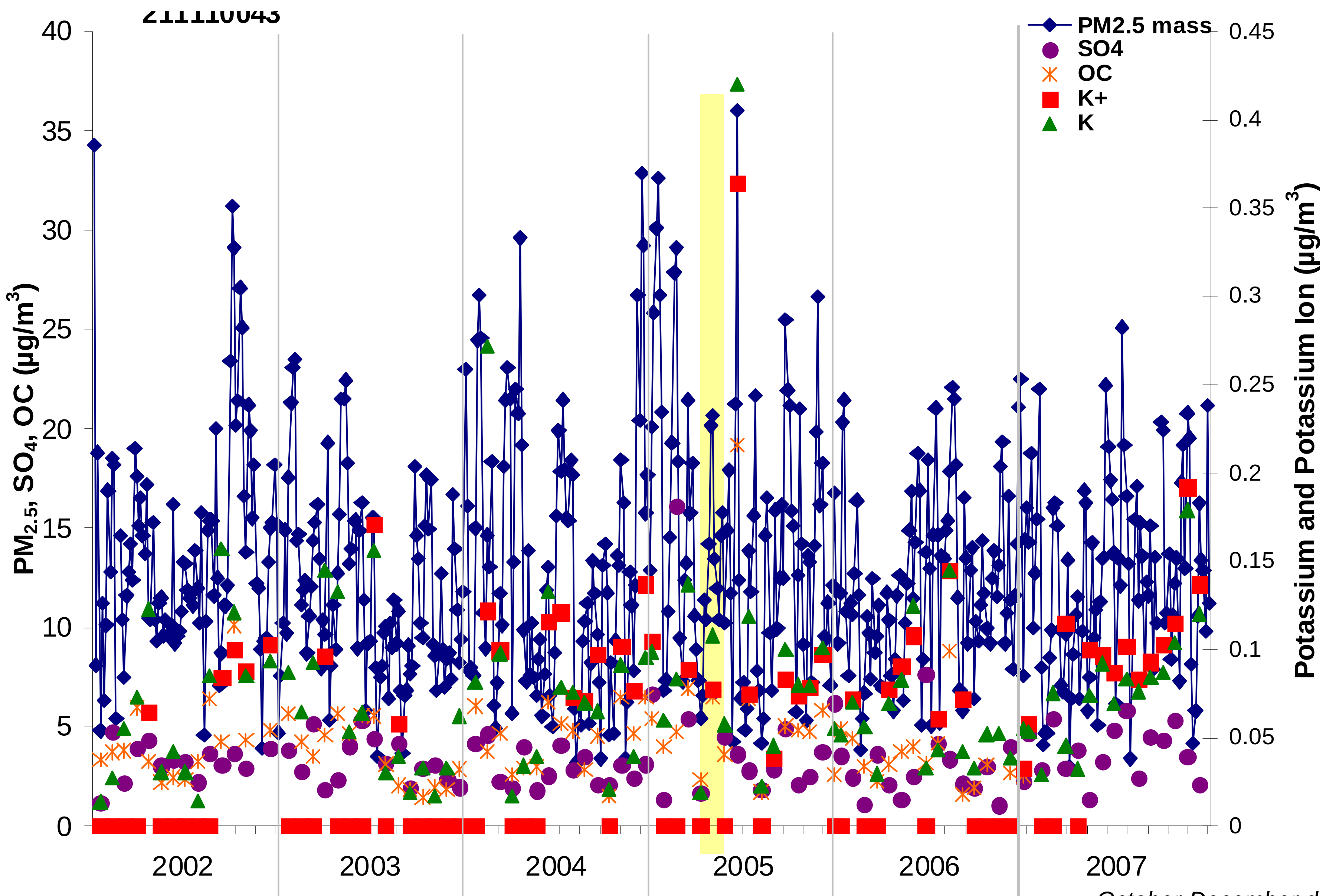


The map above shows the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (shaded background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 11/11/07, differences in excess of 5 µg/m^3 are seen throughout Kentucky.



The purple lines show the difference between the given day and the historical 95th percentile concentration at site 21-111-0043. On 11/11/07, concentrations were about 15µg/m^3 higher than normal. Other sites and days under consideration were similar.

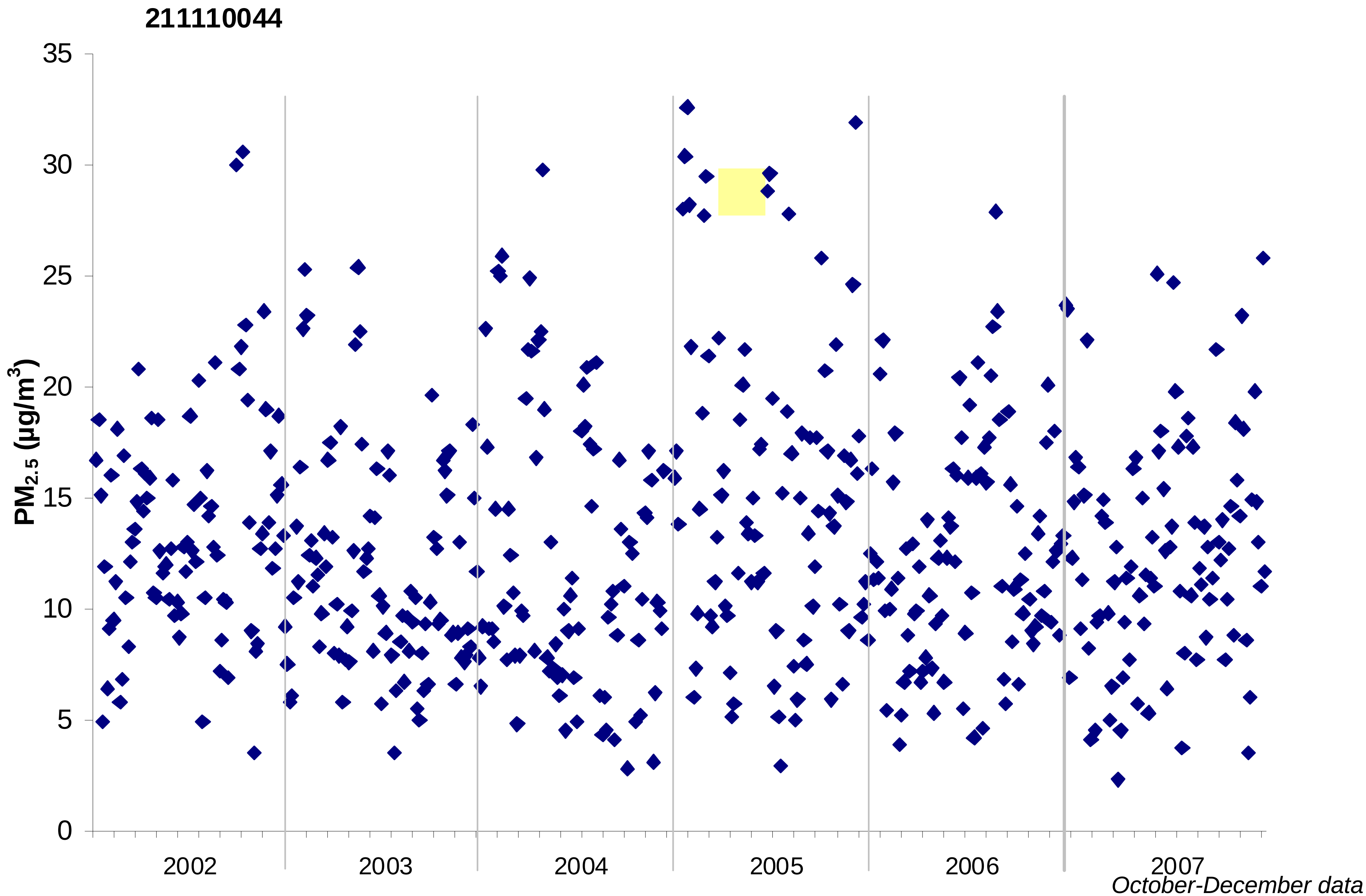
http://webapps.datafed.net/datafed.aspx?page=NHF/Gadsen_05-22-07R



October-December data

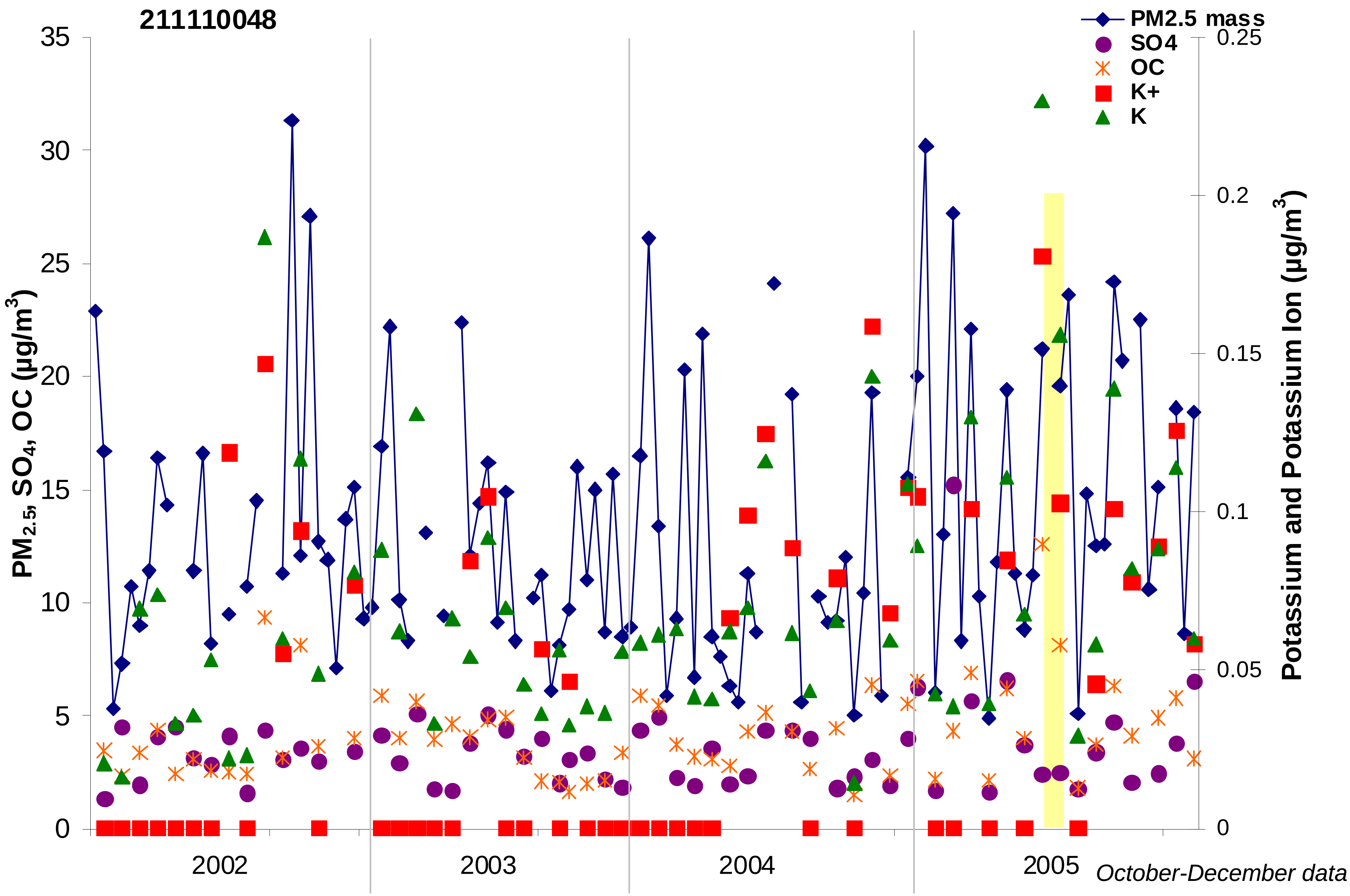
At 21-111-0043 $PM_{2.5}$ concentrations on 11/11/05 were within the historical range of concentrations. However, concentrations of PM2.5 and fire tracers (not measured on 11/11/05), were very high on 11/12/05. 11/11/05 and 11/12/05 are highlighted in yellow.

Data from AQS



$PM_{2.5}$ concentrations at 21-111-0044 were high but within with the historical range of concentrations on 11/11/05 and 11/12/05 (highlighted in yellow).

Data from AQS



Concentrations of PM2.5 and fire tracers at 21-111-0048 were high but within the historical range of concentrations on 11/12/05.

PM$_{2.5}$ in µg/m^3

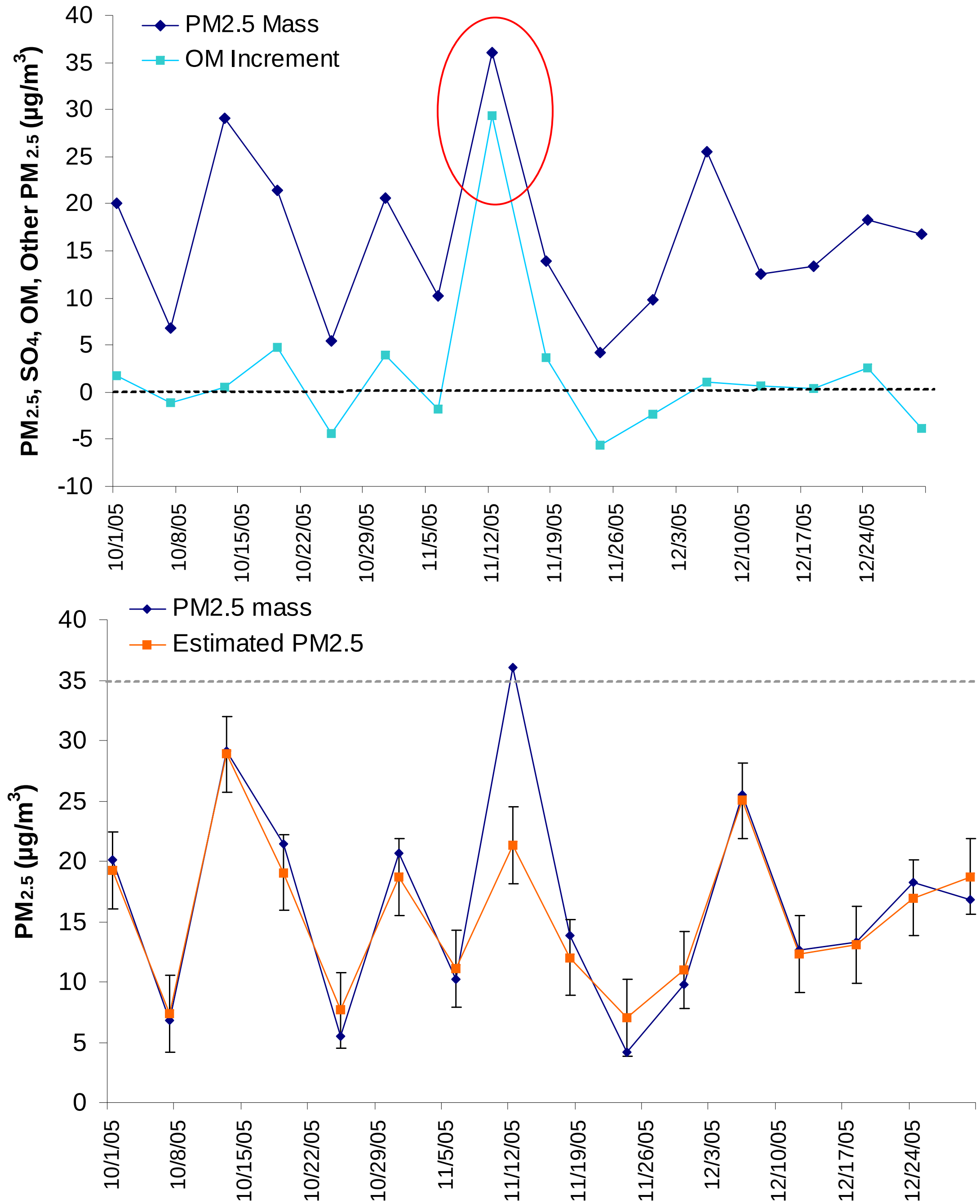
		Mean	Median	95th Percentile	11/11/05	11/12/05
21-111-0043	2005	14.2	13.3	27.2	21.3	36.0
	2002-2007	12.9	12.0	22.5		
21-111-0044	2005	15.2	14.4	29.3	28.8	29.6
	2002-2007	13.0	12.1	23.4		
21-111-0048	2005	15.6	14.8	26.0	Not Reported	21.2
	2002-2007	12.6	11.3	22.8		

October-December data

Concentrations on 11/11/05 were well above median concentrations but within the 95th percentile of concentrations for all cases except comparing site 21-111-0044 to 2002-2007 data (highlighted in green). 21-111-0043 was well above the 95th percentile of concentrations on 11/12/05 (highlighted in yellow), but the other sites were near or below the 95th percentiles.

Data from AQS

21-111-0043



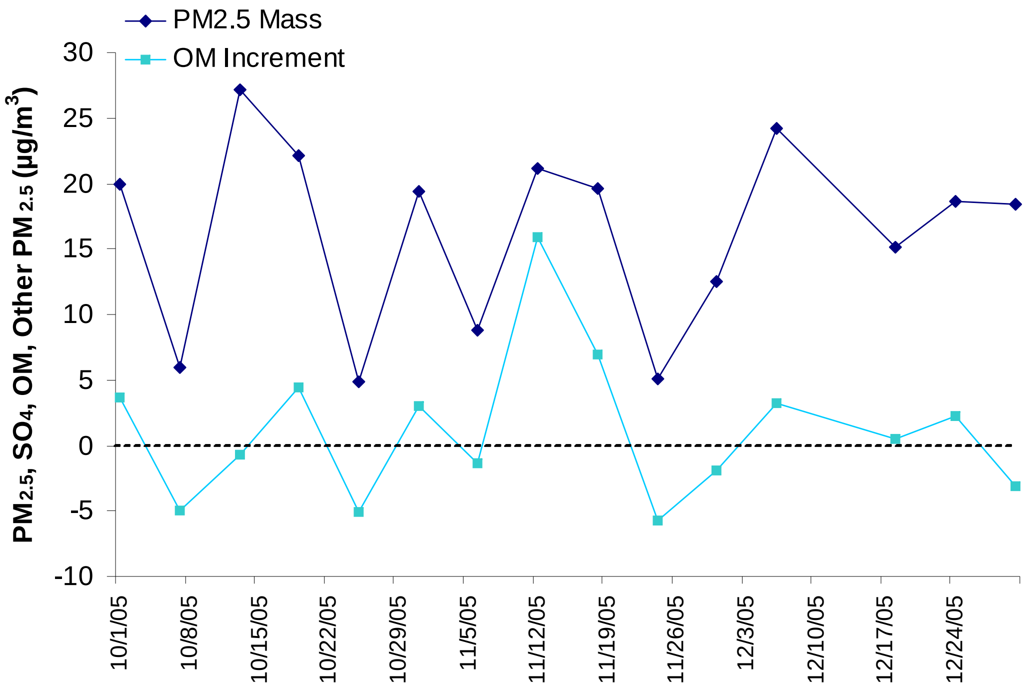
The OM Increment was calculated to represent fire-related mass:

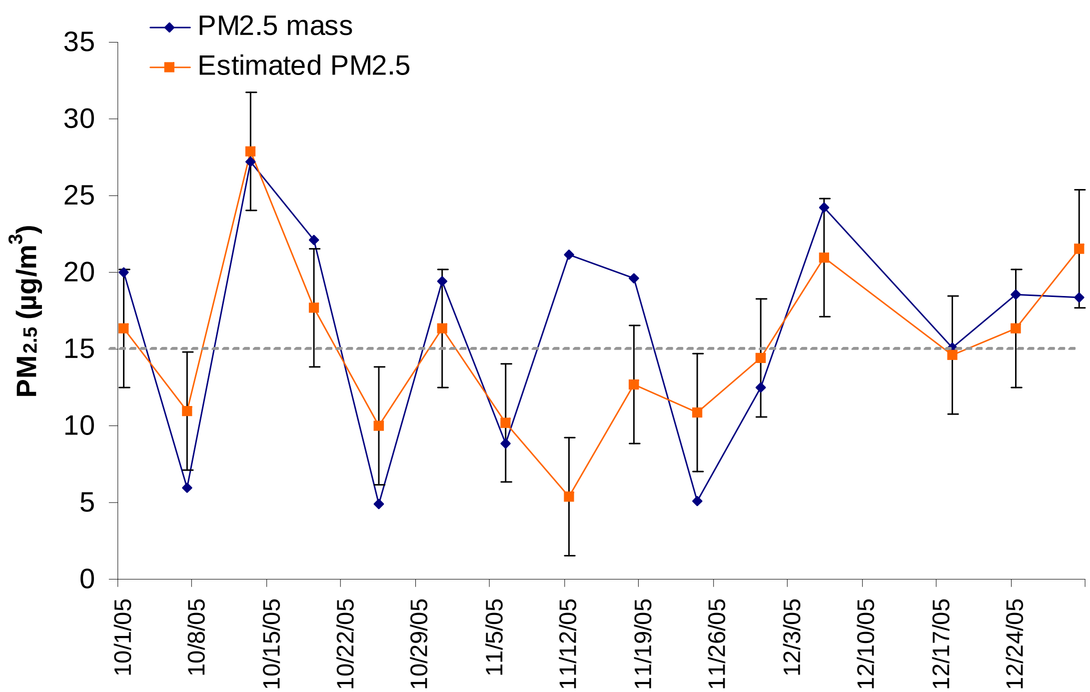
OM Increment = 2(OCd – OCavg), where OCd and OCavg are daily and typical (average over the quarter) measured OC. 2 was chosen as a reasonable multiplier of OM to estimate fire-related mass and is likely a conservative estimate.

Estimated PM2.5 is the measured PM2.5 – OM Increment. Error bars of +/- 2 standard deviations of the OC concentrations are used to include day-to-day variability in OC concentrations.

The large OM increment on 11/12/05 (red circle) is driving $PM_{2.5}$ concentrations on this day. Without the fire contribution, the $PM_{2.5}$ on 11/12/05 would be well below the 24-hour standard (35µg/m^3), but still above the annual standard (15µg/m^3).
OC measurements were not available for 11/11/05.

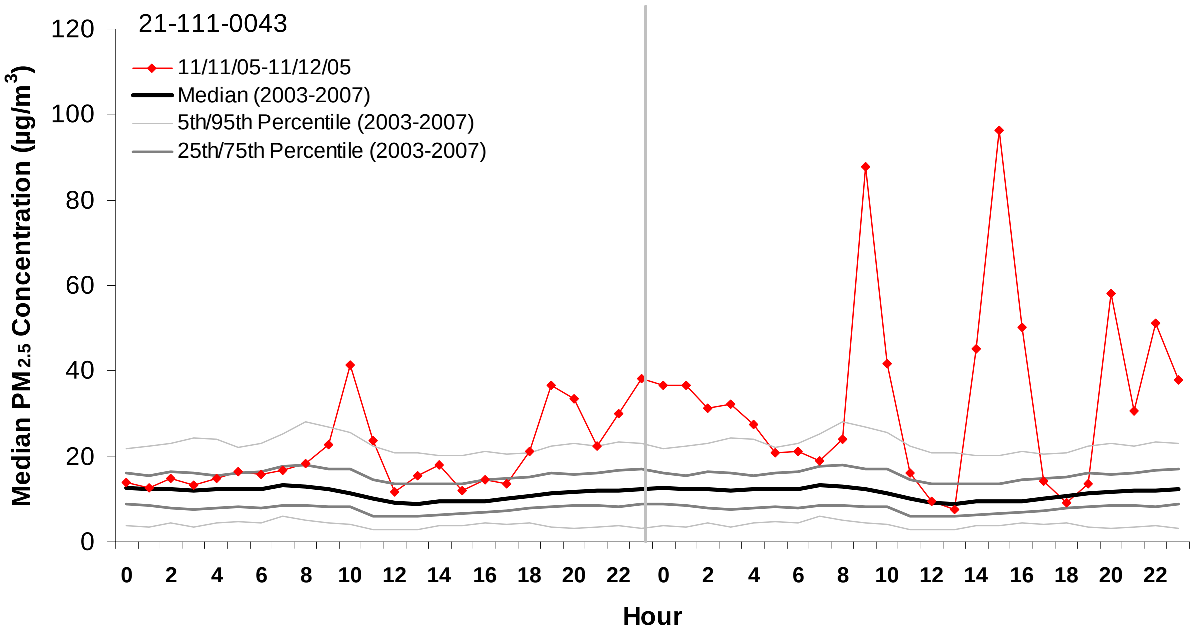
Data from AQS

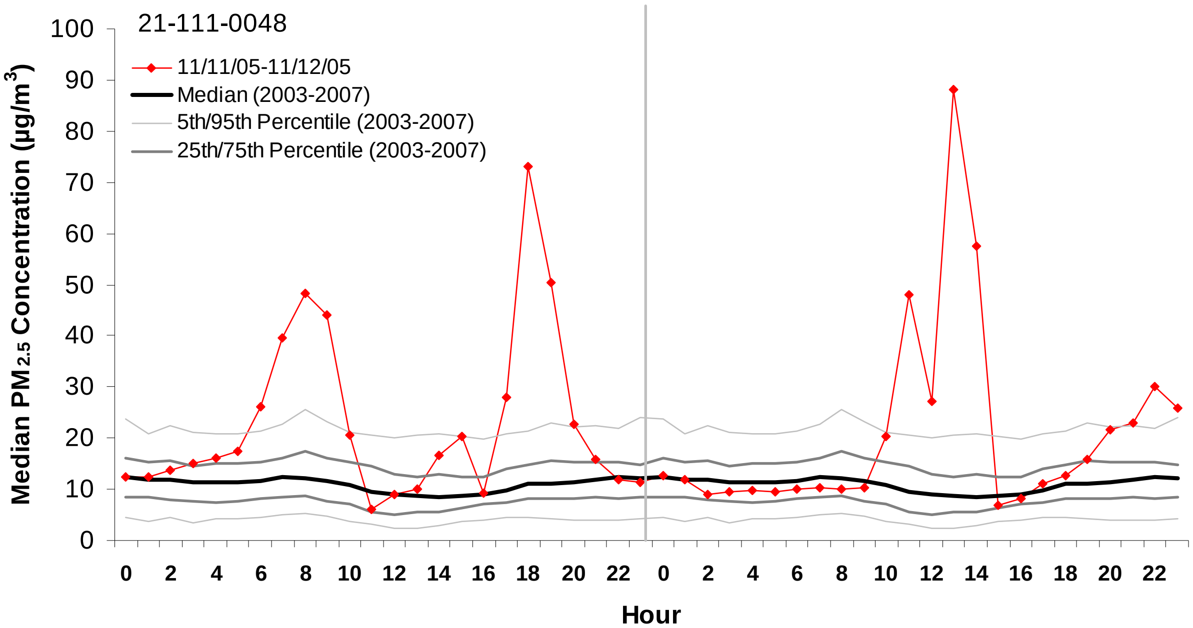




The large OM increment on 11/12/05 is likely driving $PM_{2.5}$ concentrations. Without the forest fire impact, the $PM_{2.5}$ would have been well below the annual standard (15µg/m^3). However, the quarterly and annual average for 2005 would likely remain above 15µg/m^3.
OC measurements were not available for 11/11/05.

Data from AQS





Hourly concentrations well above the 95th percentile of concentrations were assumed to be due to smoke influence. To calculate the contribution of smoke to total PM2.5, any concentrations above the 95th percentile were replaced by the median concentration for that hour. The 24-hour average of the hourly measurements then decreases by 30% (11/11) and 62% (11/12) at 21-111-0043 and 54% (11/11) and 56% (11/12) at 21-111-0048.
If the 24-hour filter measurements are decreased by the same percentages, the 11/12/05 concentration at 21-111-0043 is well below the 24-hour standard (17.5µg/m^3). However, the decreases had little impact on the quarterly and annual averages and would not affect the design value for either site.

Data from AQS

Summary

- High forest fire tracers and meteorological conditions favoring accumulation of pollution near the surface indicate impact from a local forest fire.
- $PM_{2.5}$ at 21-111-0043 on 11/12/05 would likely have been well below the 24-hour standard without the impact from the fire.
- Annual average values would likely not have changed significantly without the impact from the fire.

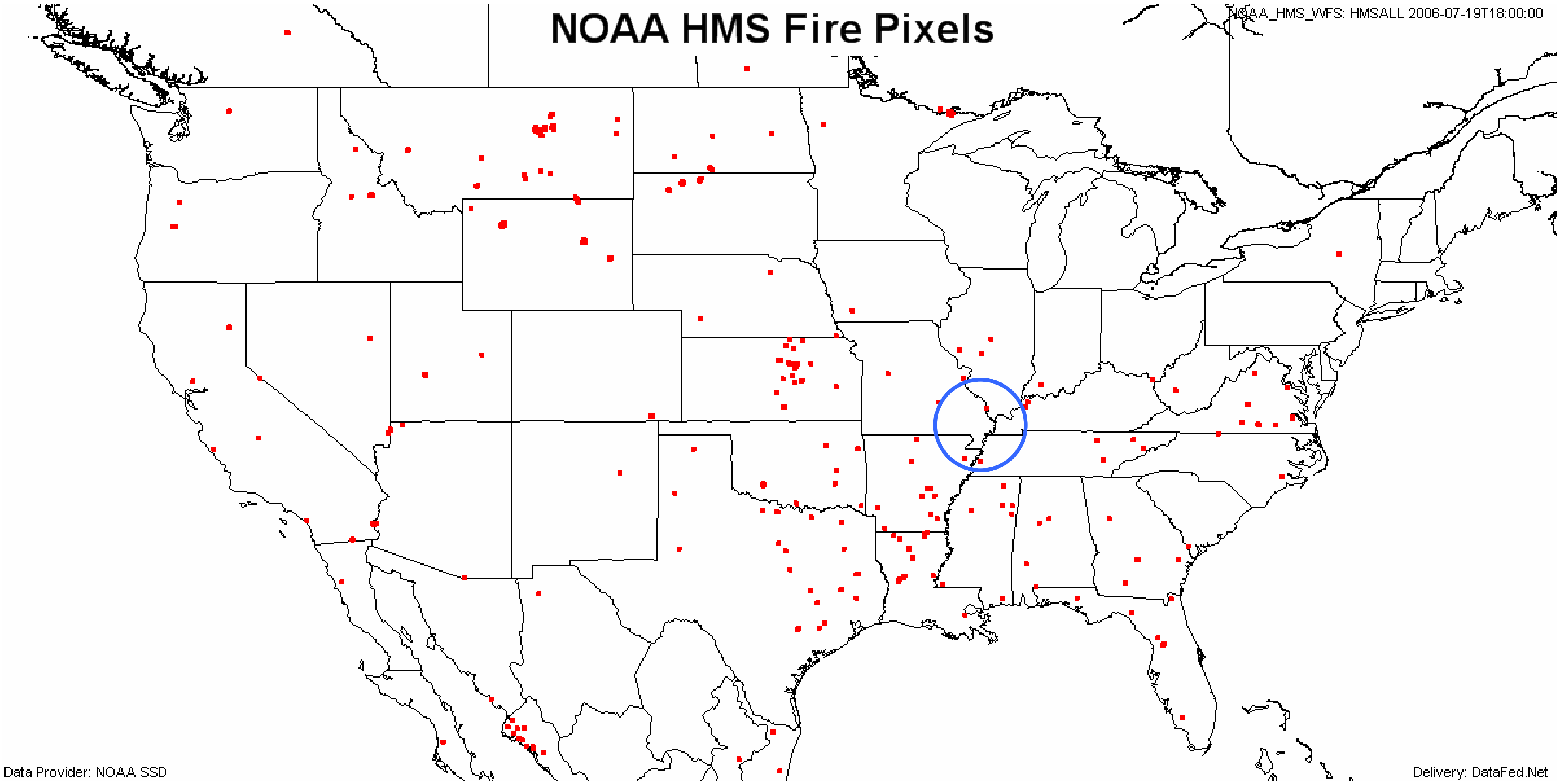
Exceptional Events Analysis
Kentucky
7/18/06 -7/20/06

Three sites analyzed
(21-111-0043, 21-111-0044, 21-111-0048)
for possible fire impact
from Arkansas/local fires

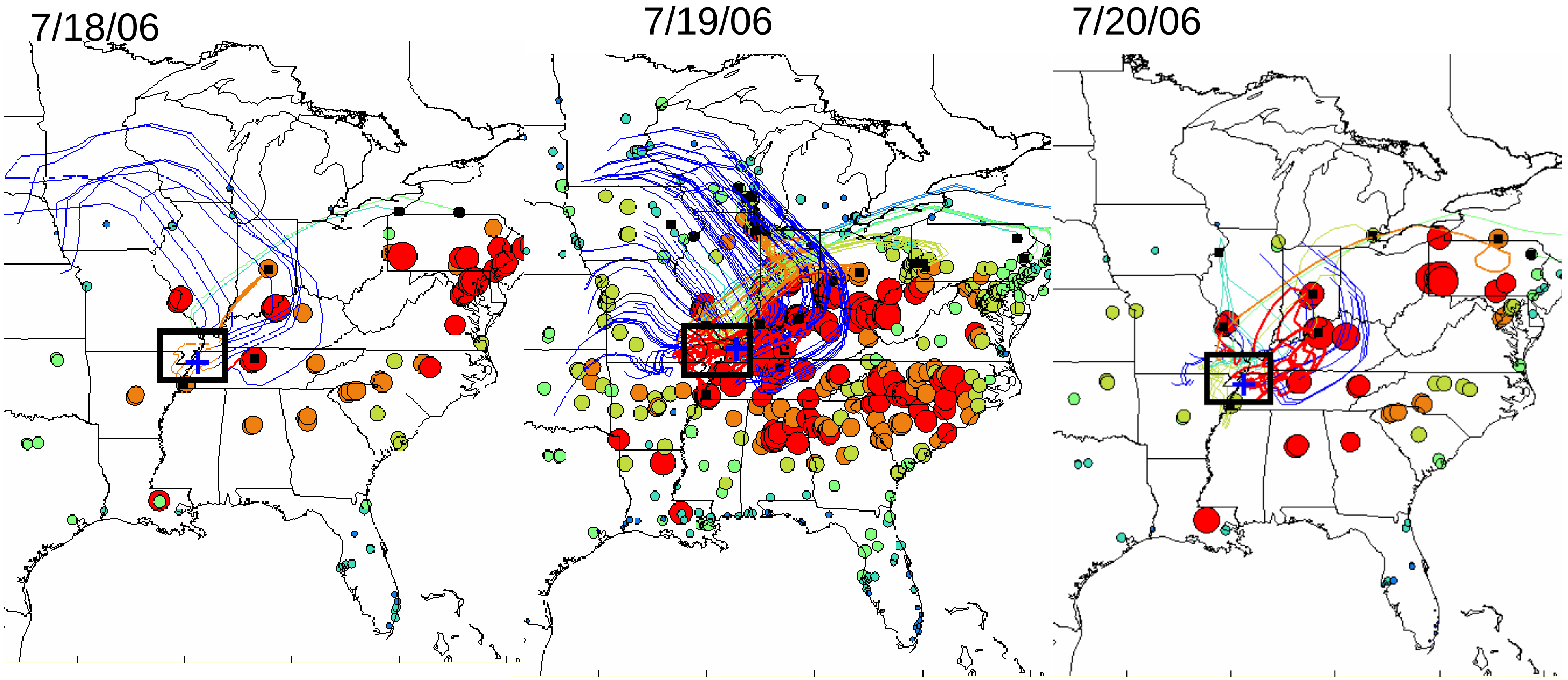
Concentrations Under Consideration

$PM_{2.5}$ concentrations in $\mu g/m^3$

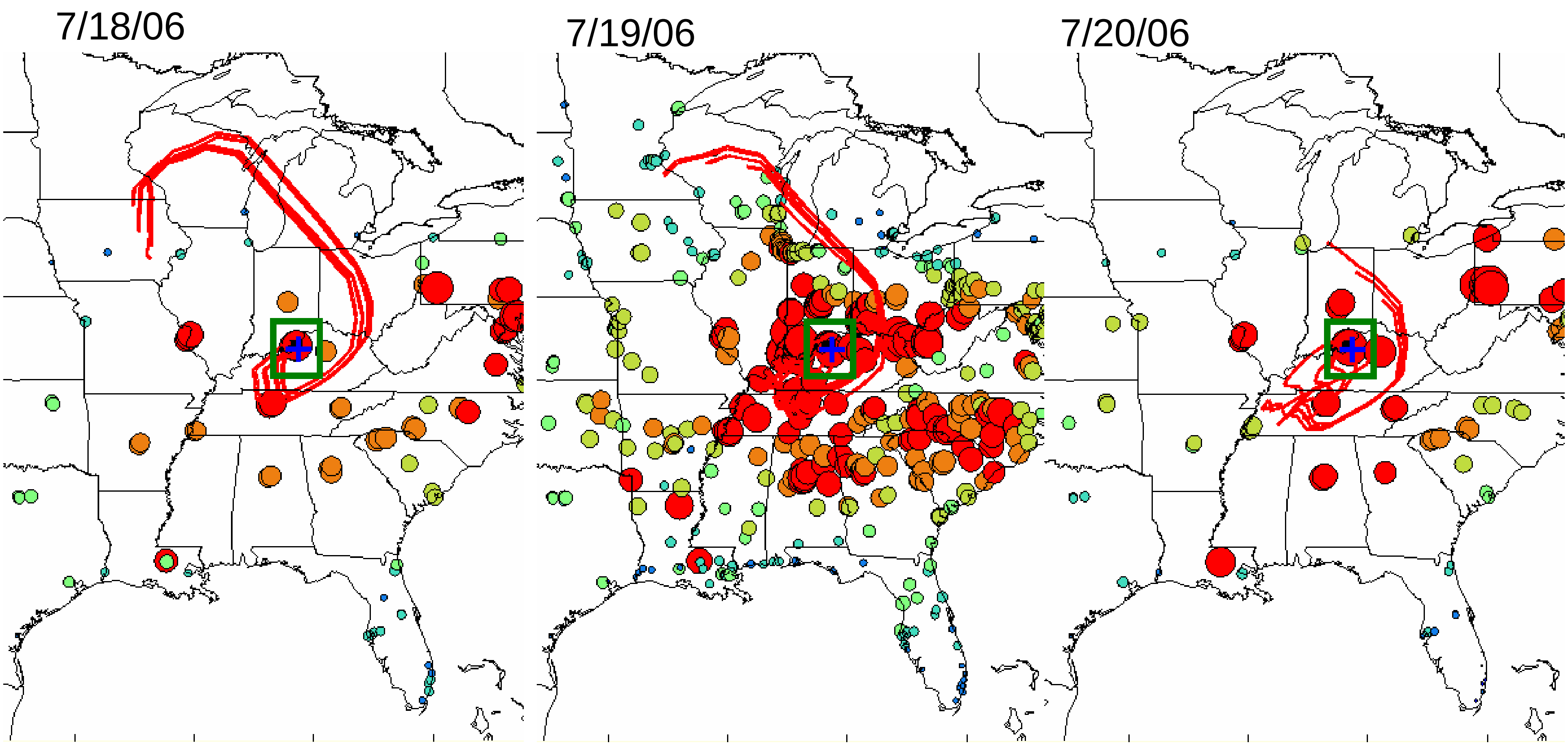
Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret
July 18, 2006		39.6	37.9	40.9
July 19, 2006	39.3	38.6	38.3	37.6
July 20, 2006	48.2	47.9	48.9	



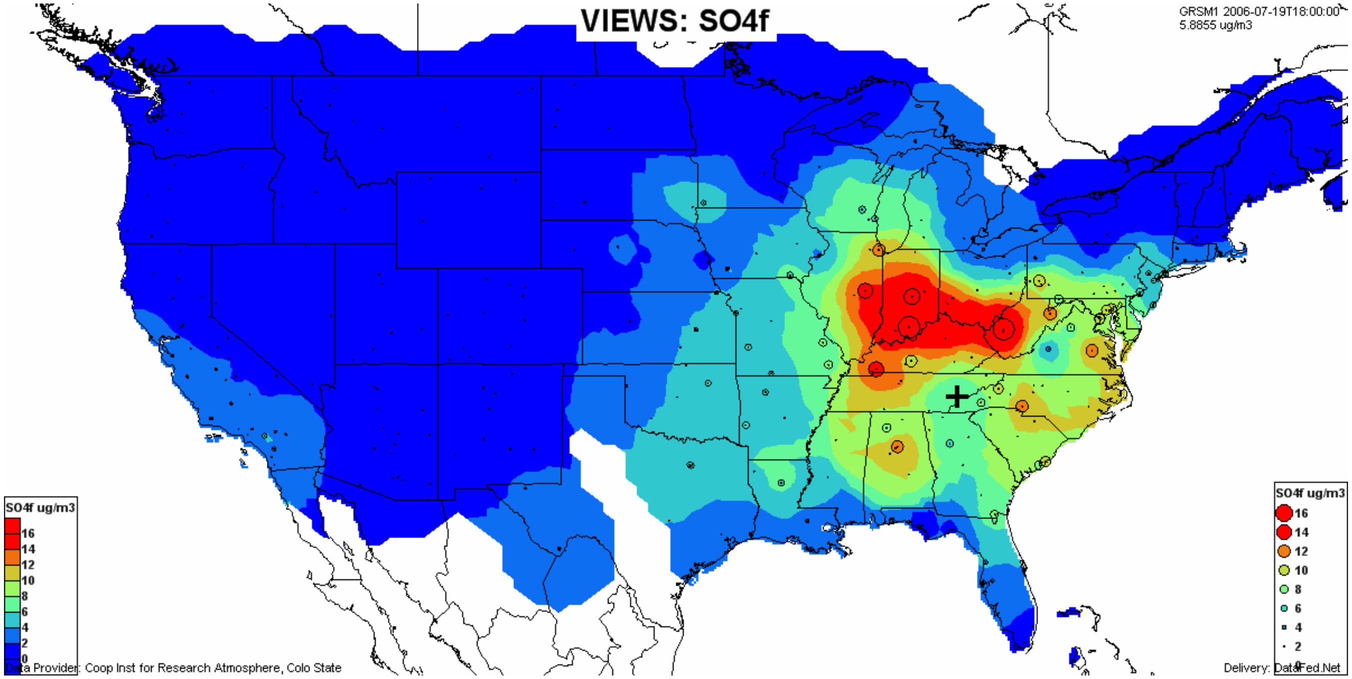
Some fires were observed in the area; however, the magnitude is unknown and none appears to be very large (none had multiple pixels). All three study days had similar fire detections.

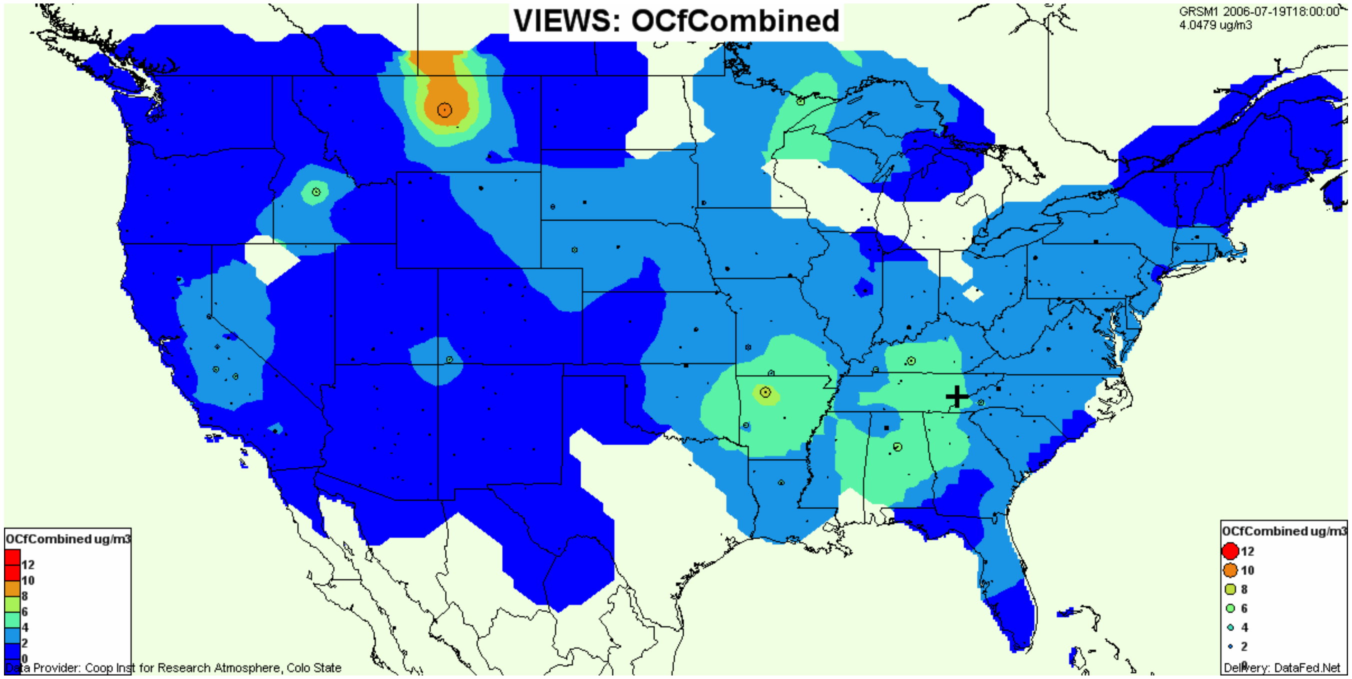


Source impact trajectories do not show a clear impact from the fire area on the sites.



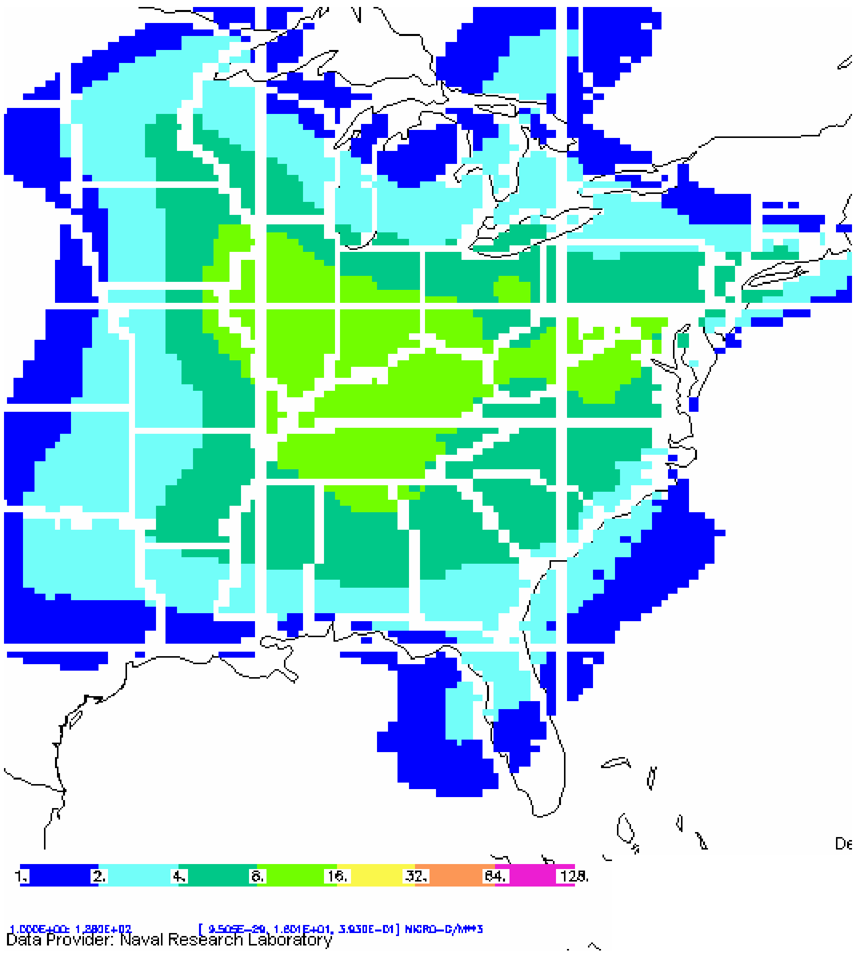
Back trajectories indicate stagnant conditions, particularly on 7/20/06, with some influence from the north early in the episode.



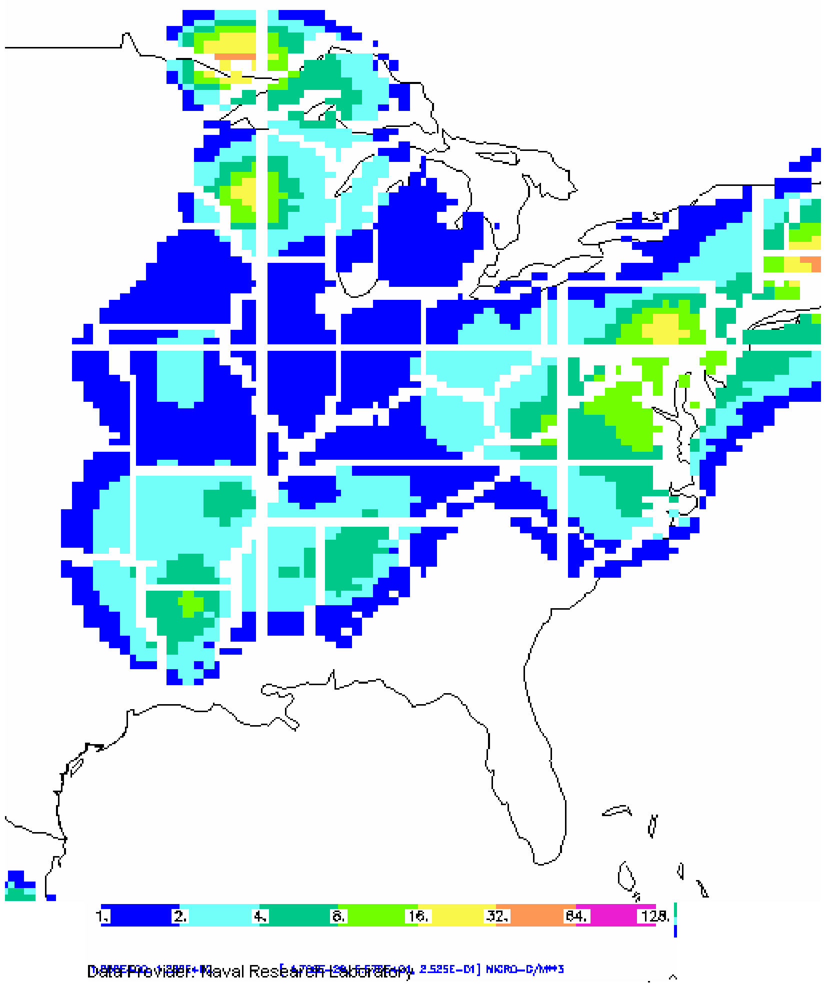


Regional sulfate concentrations were very high and regional OC was low/moderate on 7/19/06. (Data not available for other study days.)

Modeled Sulfate

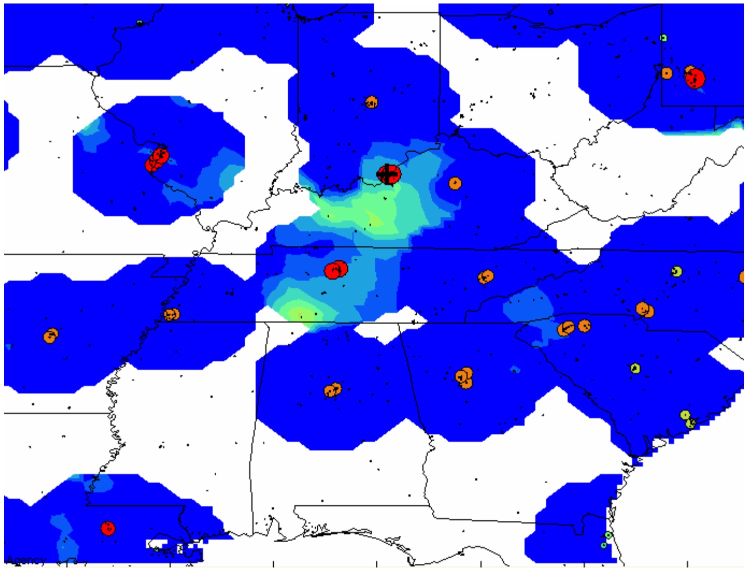


Modeled Smoke

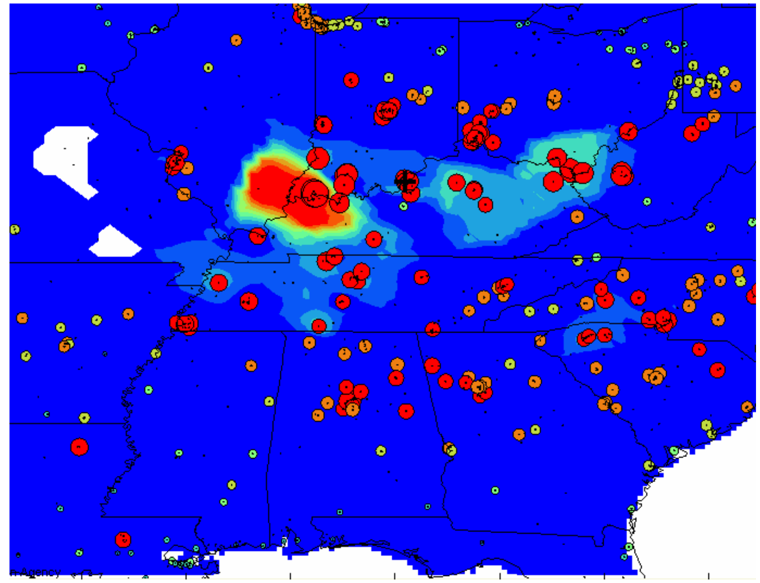


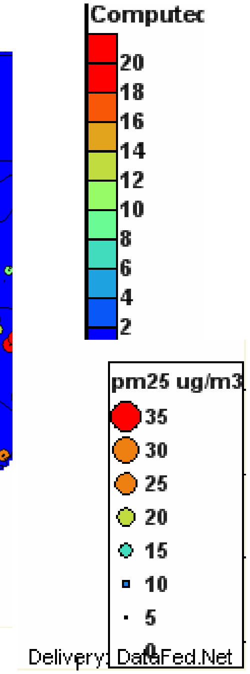
Model output indicated moderate/high sulfate concentrations and low/moderate smoke concentrations on all study days.

7/18/06

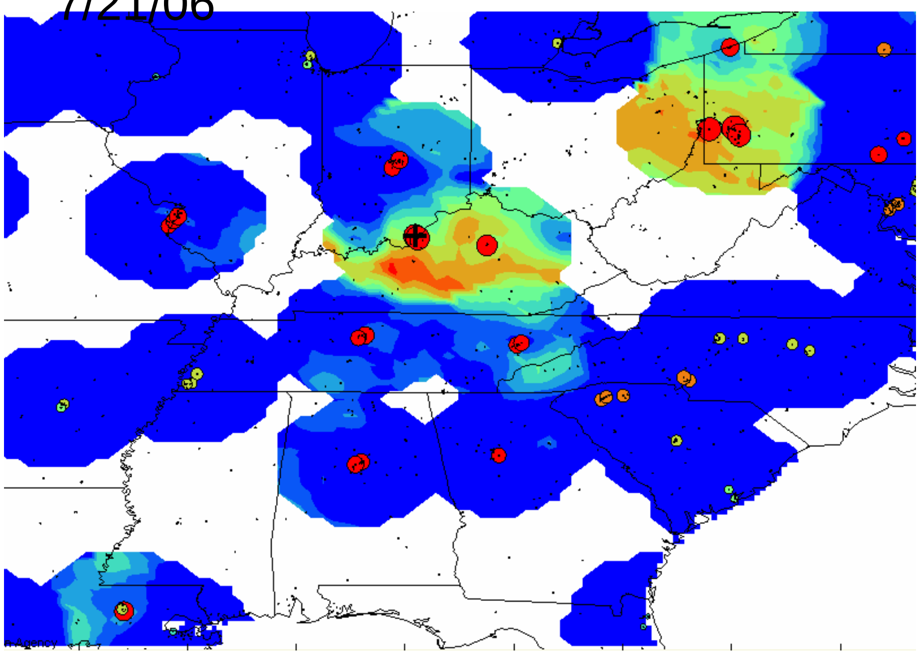


7/19/06

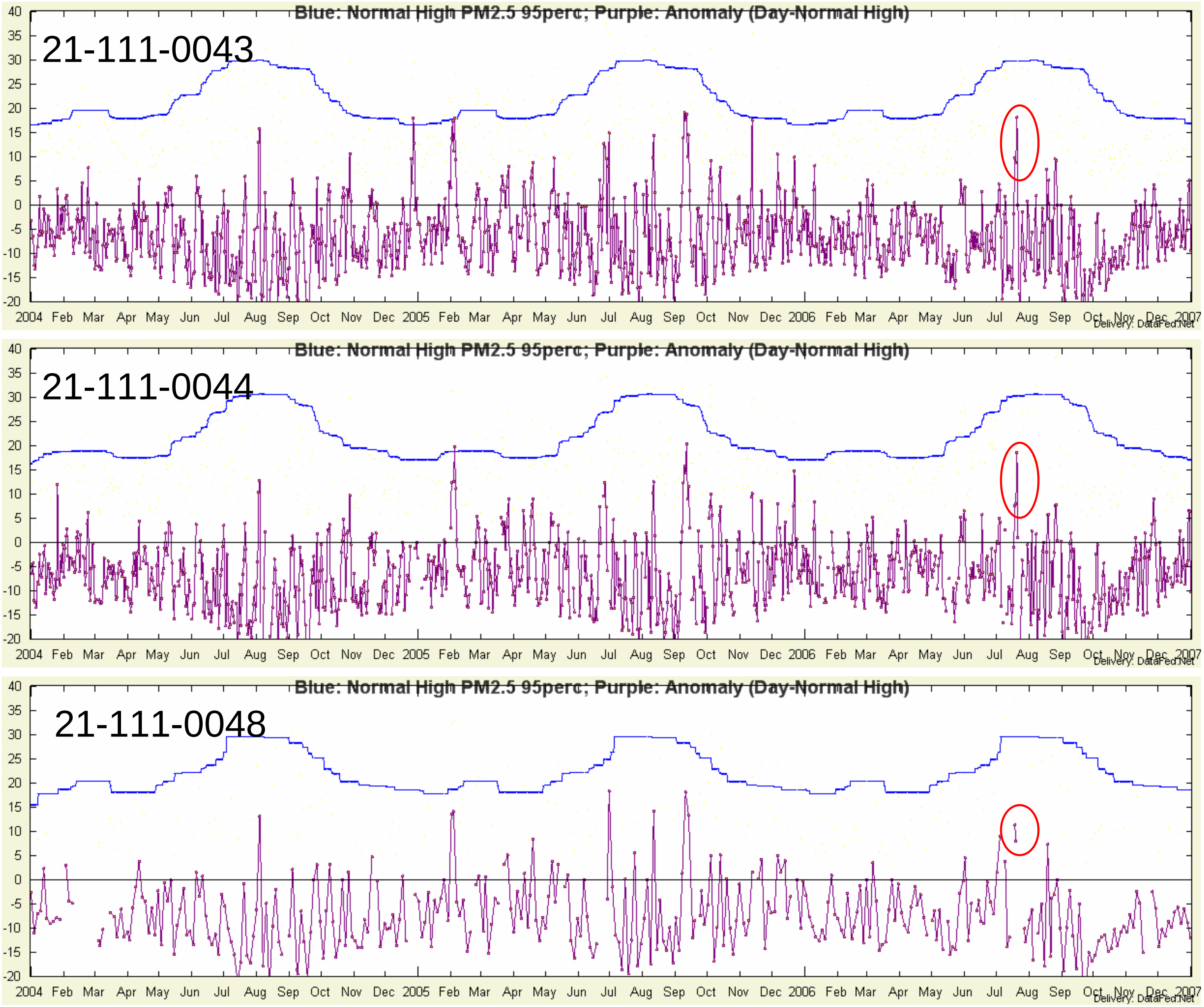




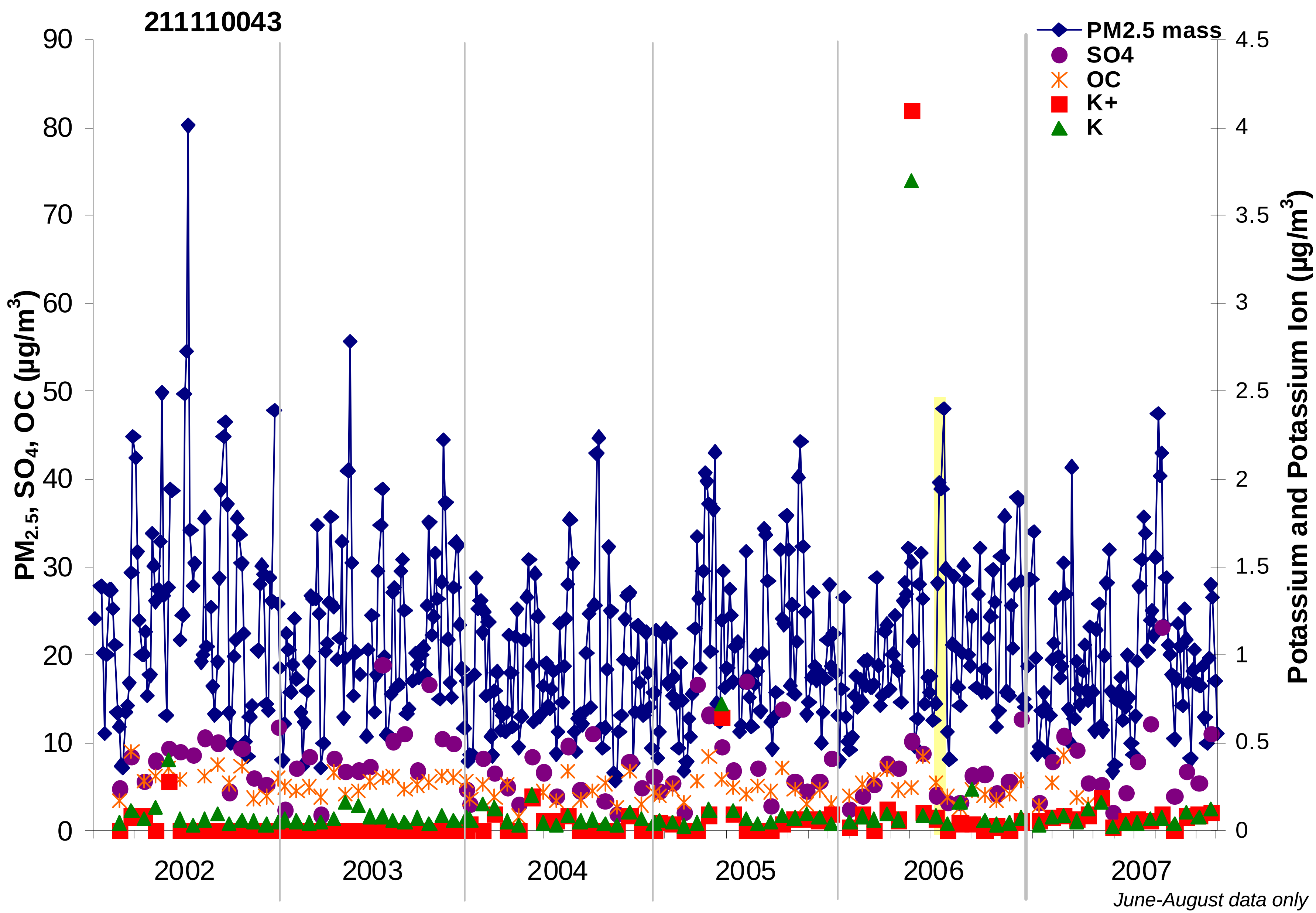
7/21/06



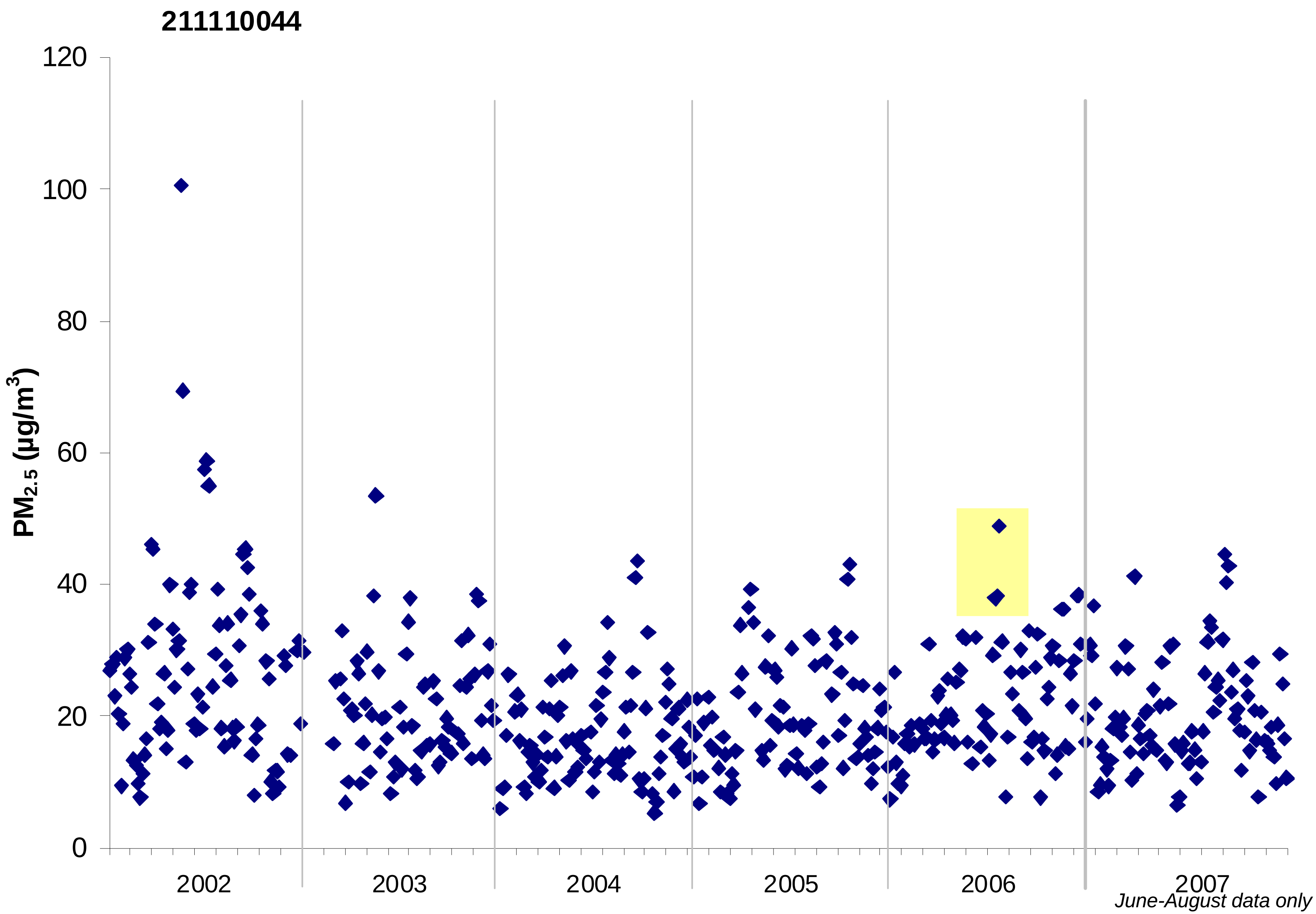
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 7/18/06 and 7/19/06, concentrations were very close to the historical values. On 7/21/06, concentrations were around 10 µg/m^3 higher than normal concentrations throughout Kentucky.



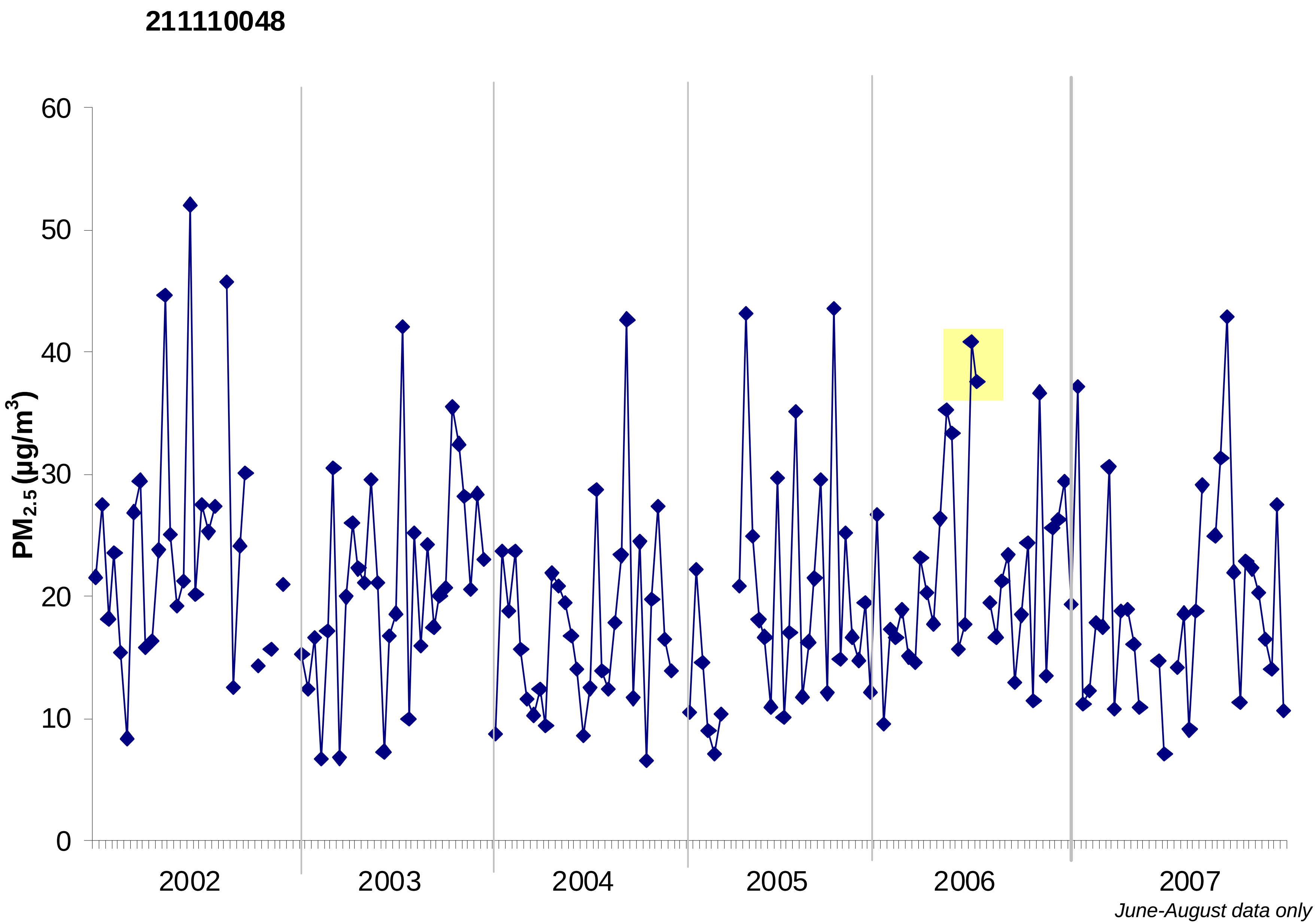
The purple lines show the difference between the given day and the historical 95th percentile concentration. On 7/18-7/20/06, concentrations were around 10-15 µg/m^3 higher than the historical values.



At site 21-111-0043, OC and potassium (indicators of fire impact) are within the normal range of values on 7/19/06 (highlighted in yellow). $PM_{2.5}$ is high on all study days, but not outside the historical range of concentrations.



At site 21-111-0044, $PM_{2.5}$ is high on the study days, but not outside the historical range of concentrations.



As at the other sites, $PM_{2.5}$ is high on the study days at site 21-111-0044, but not outside the historical range of concentrations.

Comparison to Historical Values

		Mean	Median	95th Percentile	7/18/2006	7/19/2006	7/20/2006
21-111-0043	2006	21.5	19.3	36.6	39.6	39.0	48.1
	2002-2007	21.3	19.5	38.9			
21-111-0044	2006	22.2	20.2	37.7	37.9	38.3	48.9
	2002-2007	21.2	18.9	38.5			
21-111-0048	2006	22.1	19.5	37.2	40.9	37.6	Not Reported
	2002-2007	20.6	19.0	38.6			

Summer data only (June-August) used in these statistics.

The concentrations on 7/18/06 and 7/19/06 are near the historical 95th percentiles of concentrations. Concentrations on 7/20/06 are 10 µg/m^3 higher than historical percentiles, but concentrations of $PM_{2.5}$ were high throughout the region.

Meteorological Conditions

Met conditions in the area were conducive to high PM (regardless of whether nearby fires were impacting the site):

- Persistent surface high pressure over the previous three days led to calm-to-light surface winds, limiting pollutant dispersion.
- Weak upper-level ridge of high pressure led to warm temperatures aloft, limiting vertical mixing.
- Persistent high dew point temperatures (frequently above 70°F) over the previous three days enhanced secondary particle production.

Summary

Although there could be some impact from forest fires in the Louisville area on 7/18/06-7/20/06, stagnant winds, temperature inversion, and high humidity all led to increased secondary PM formation. This supports the hypothesis that there was a regional sulfate episode on this day that was likely a more important contributor than forest fires to high $PM_{2.5}$ concentrations. Without any impact from fires, the $PM_{2.5}$ concentrations would still have been higher than normal.

Exceptional Events Analysis
Kentucky
8/25/06-8/26/06

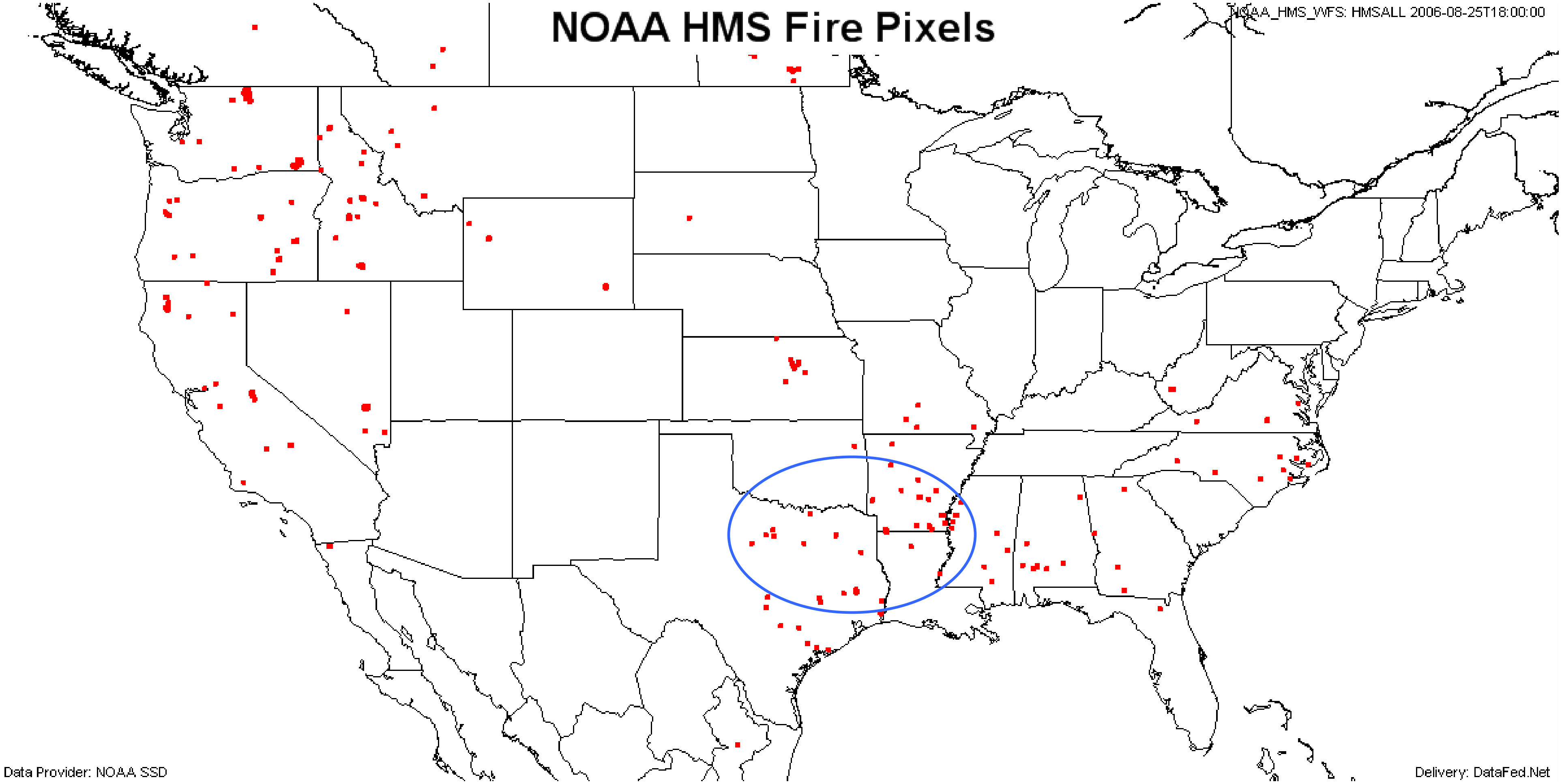
Two sites analyzed
(21-111-0043, 21-111-0044)
for possible fire impact
from Arkansas/Texas fires

Concentrations Under Consideration

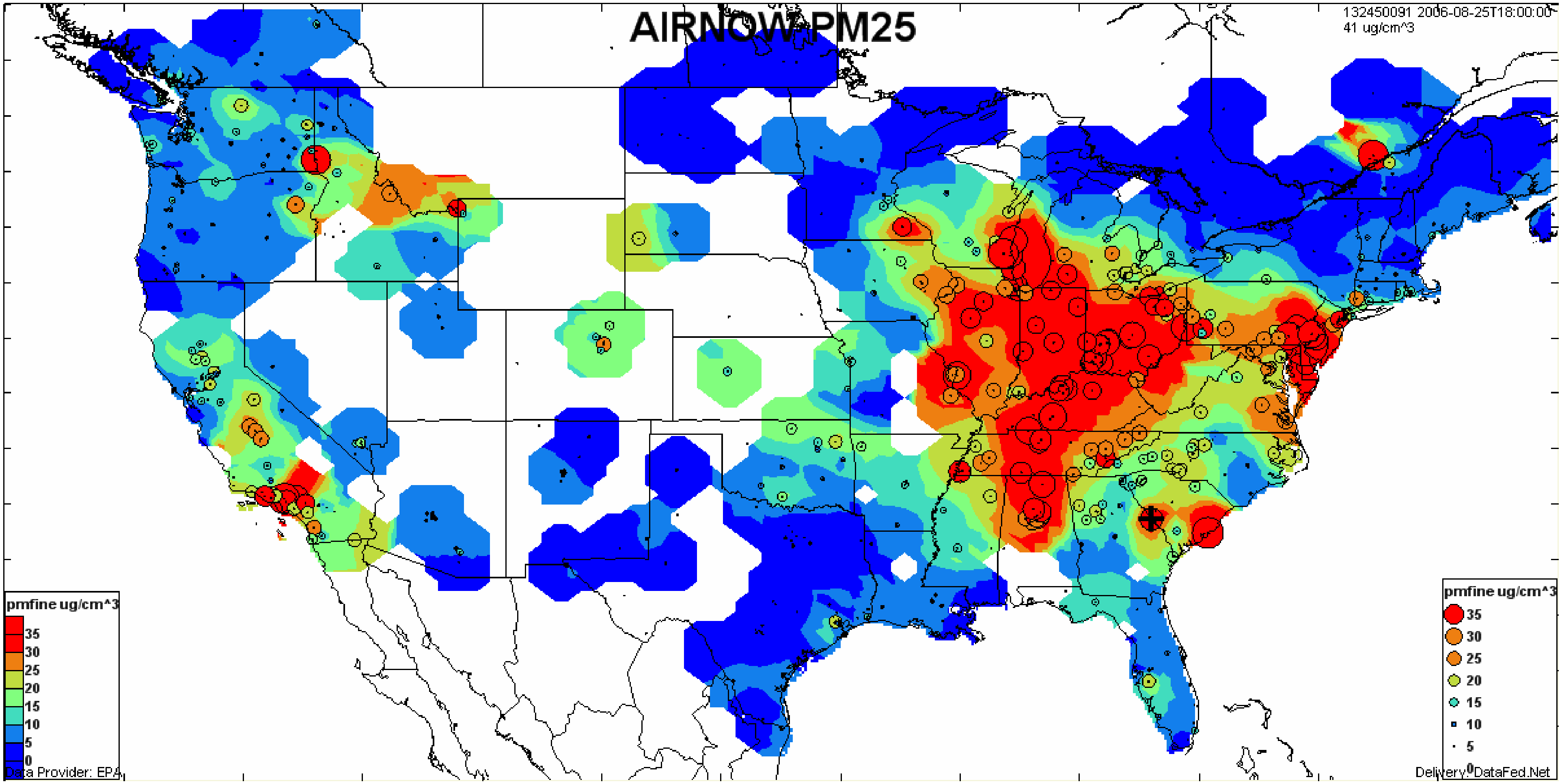
$PM_{2.5}$ concentrations in $\mu g/m^3$

Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte
August 25, 2006	38	38	38.2
August 26, 2006	37.3	37.7	38.4

8/25/06



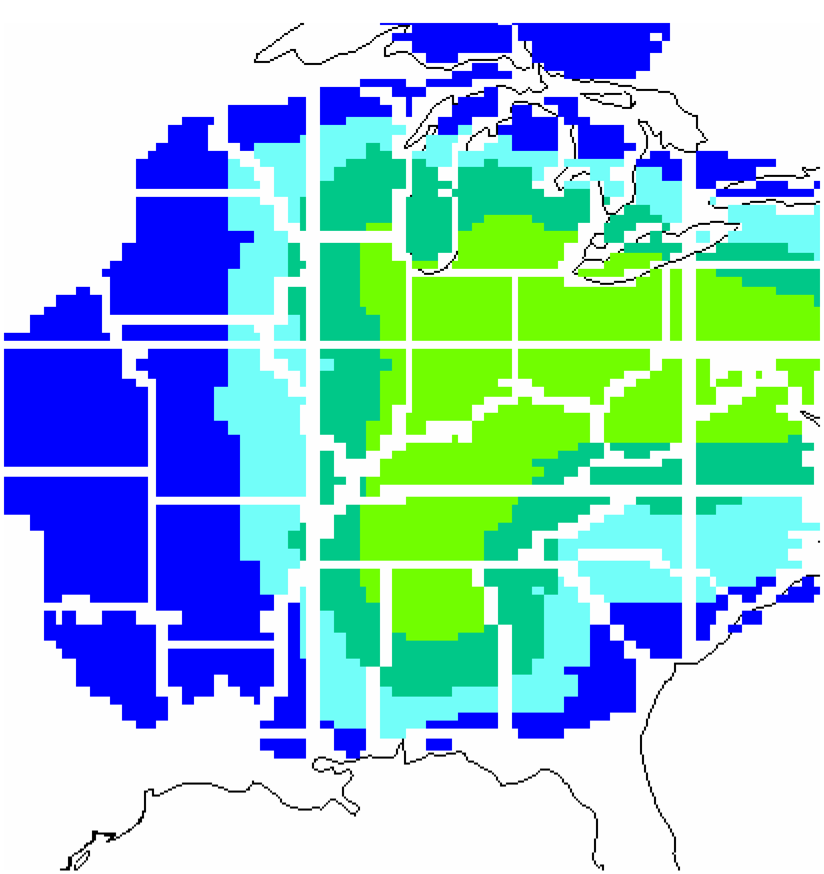
Several small fires throughout Arkansas and Texas are believed to have impacted $PM_{2.5}$ concentrations in Kentucky. Fewer fires were detected on 8/26/06.



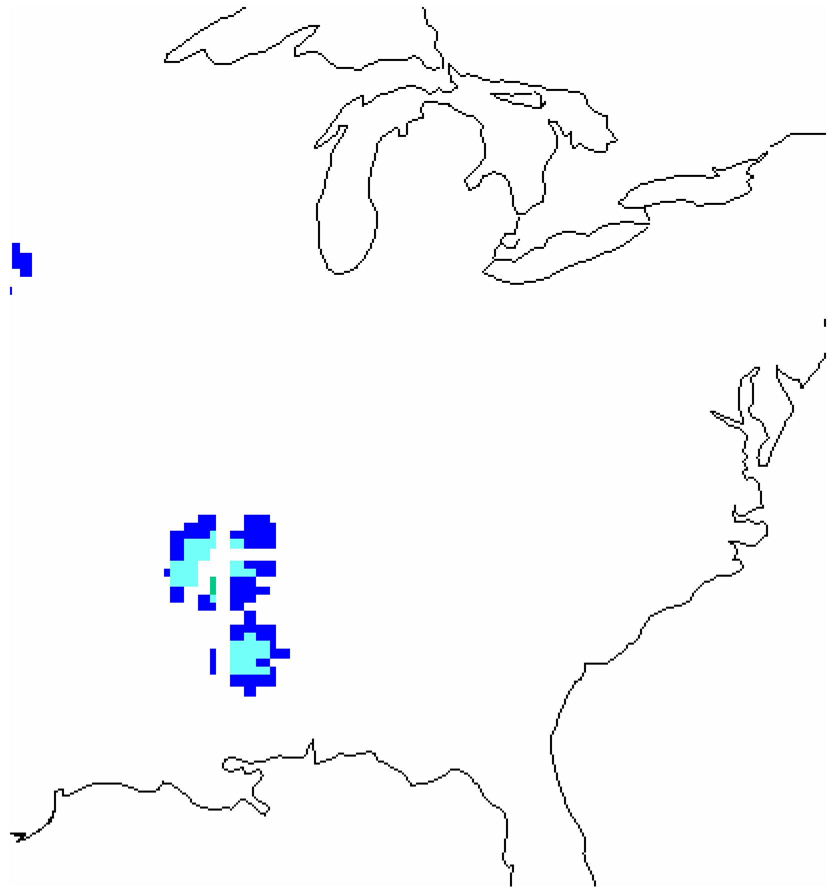
PM$_{2.5}$ concentrations are high throughout the region.

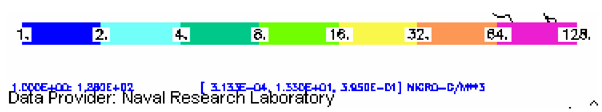
8/25/06

Modeled Sulfate



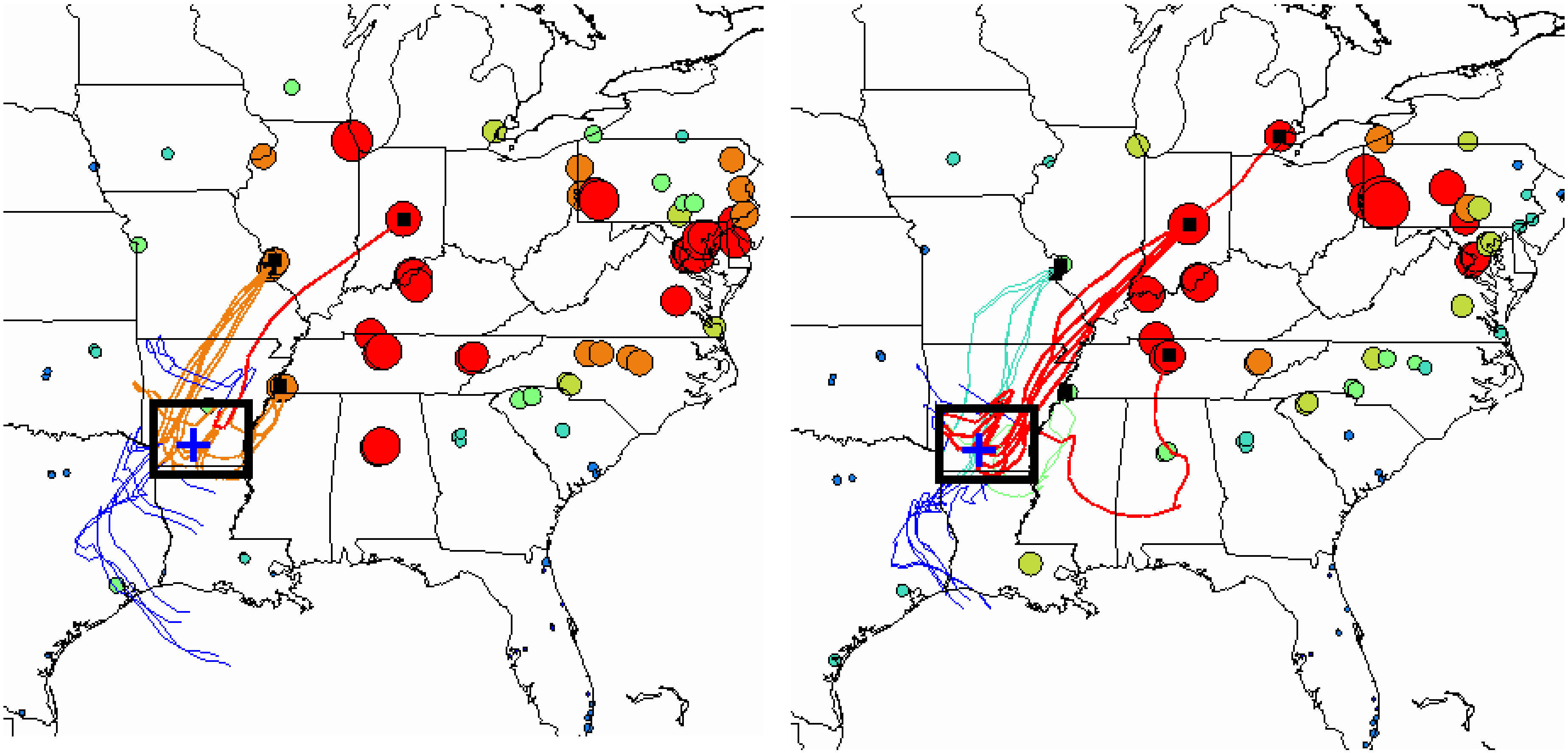
Modeled SMOKE





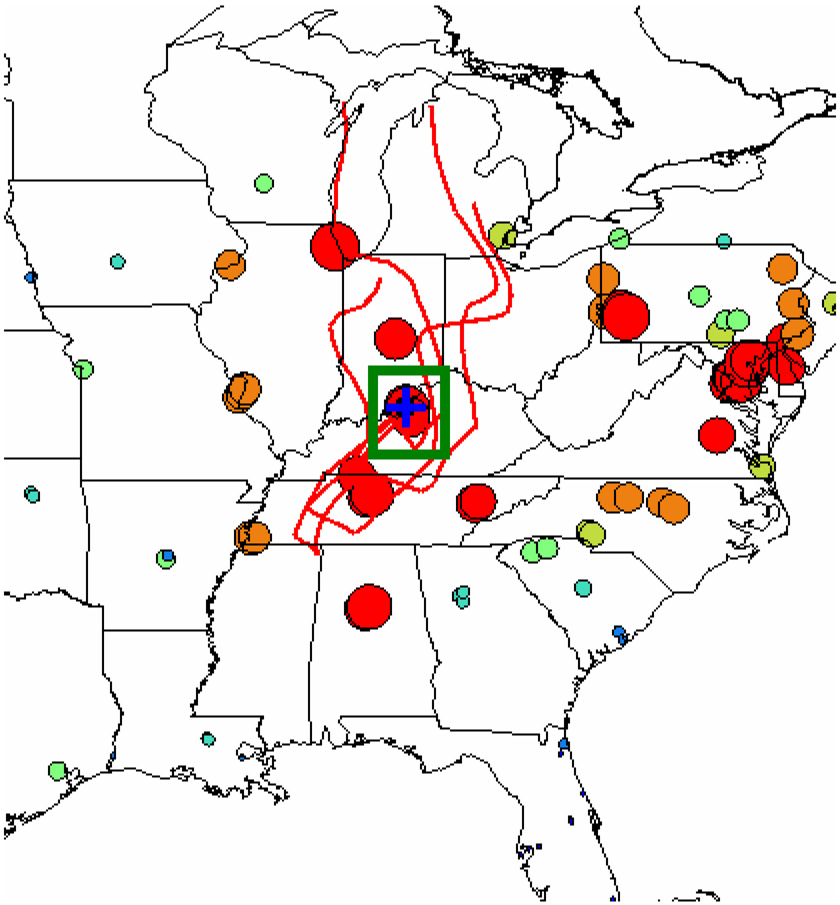
Modeled sulfate was moderate/high and modeled smoke was not present in Kentucky on 8/25/06. (Same results on 8/26/06.)

8/25/06 8/26/04

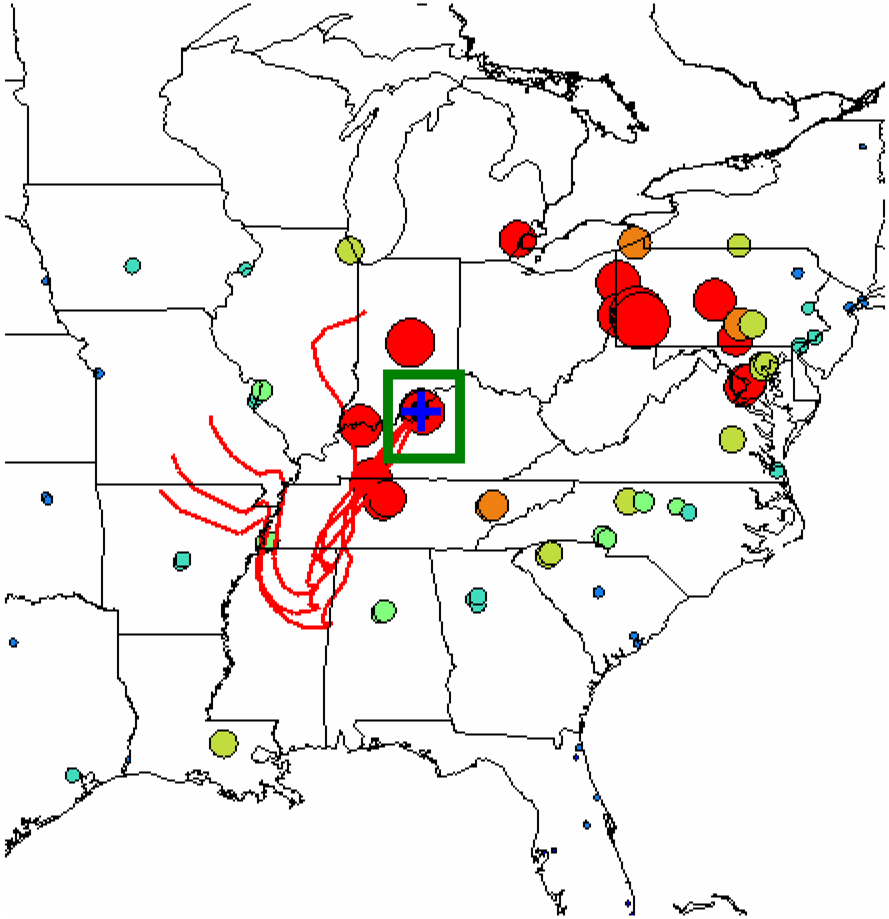


Source impact trajectories show that fires in the Arkansas area were unlikely to have impacted the Louisville area.

8/25/06

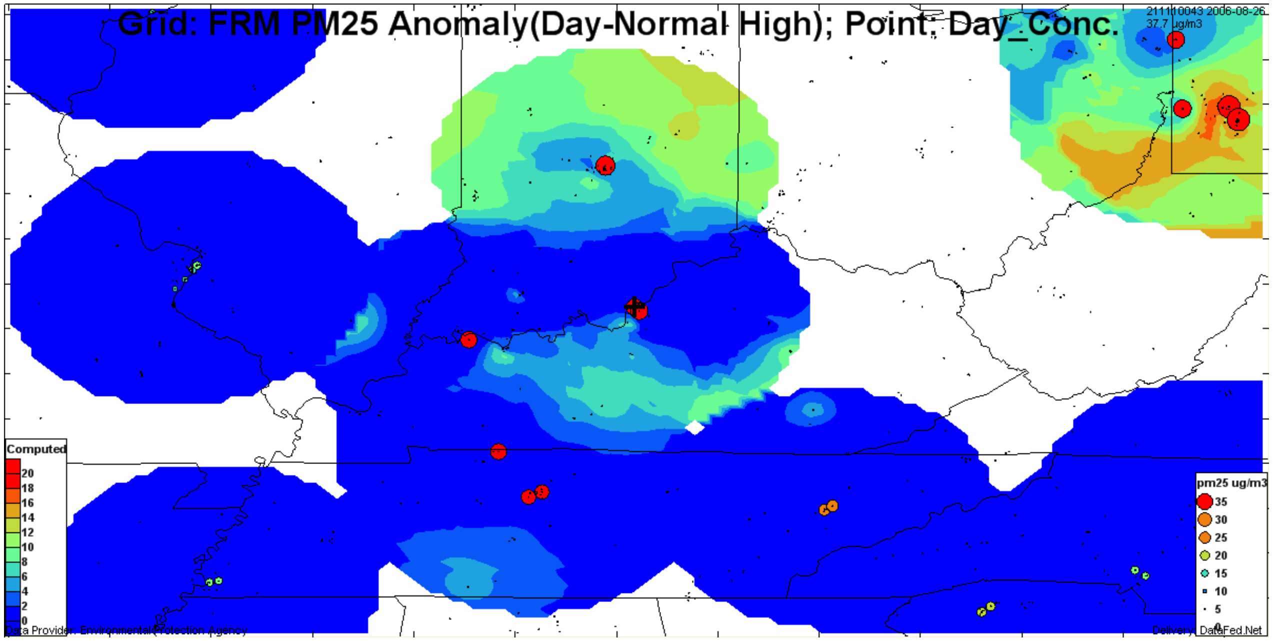


8/26/06

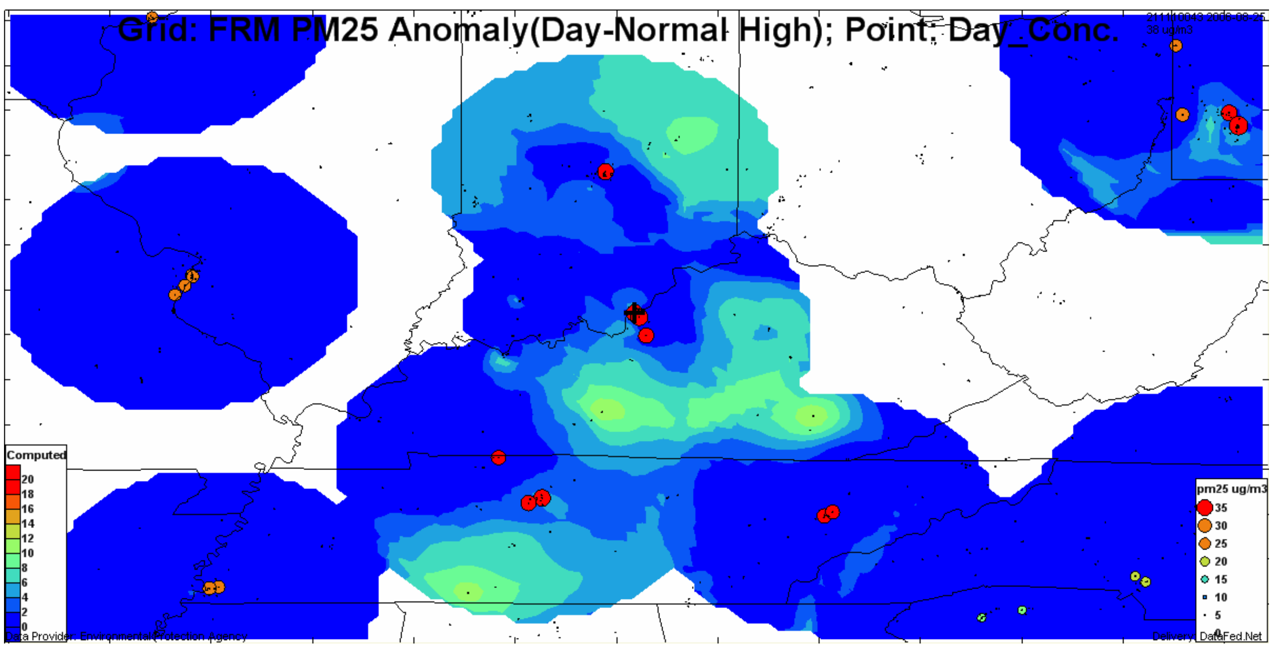


Back trajectories also show the Louisville site had no impact from the Arkansas/Texas area. Winds were light on these days, limiting transport.

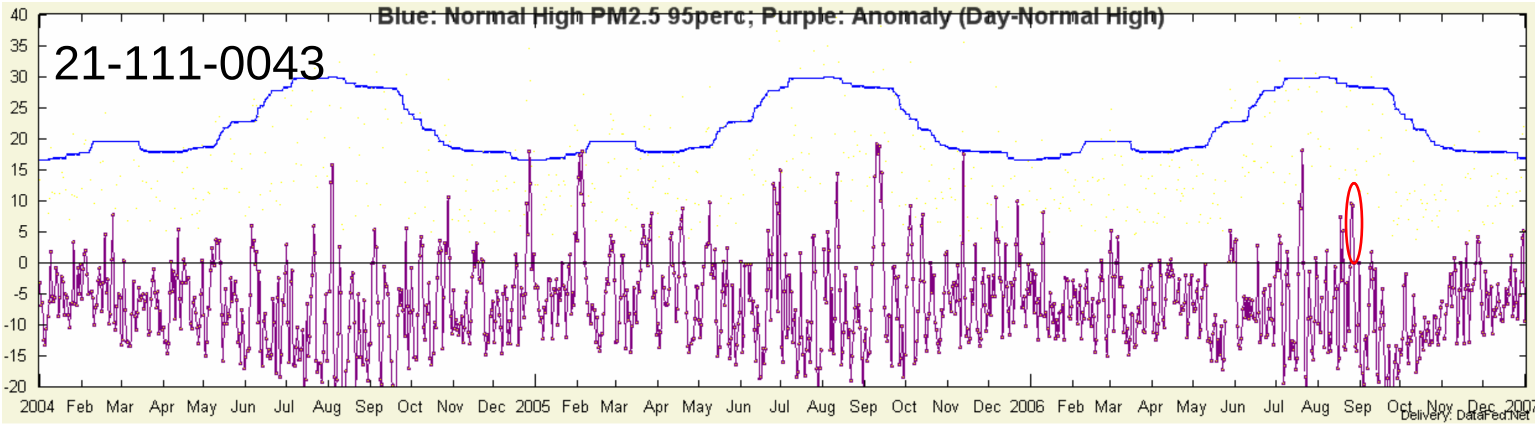
8/25/06

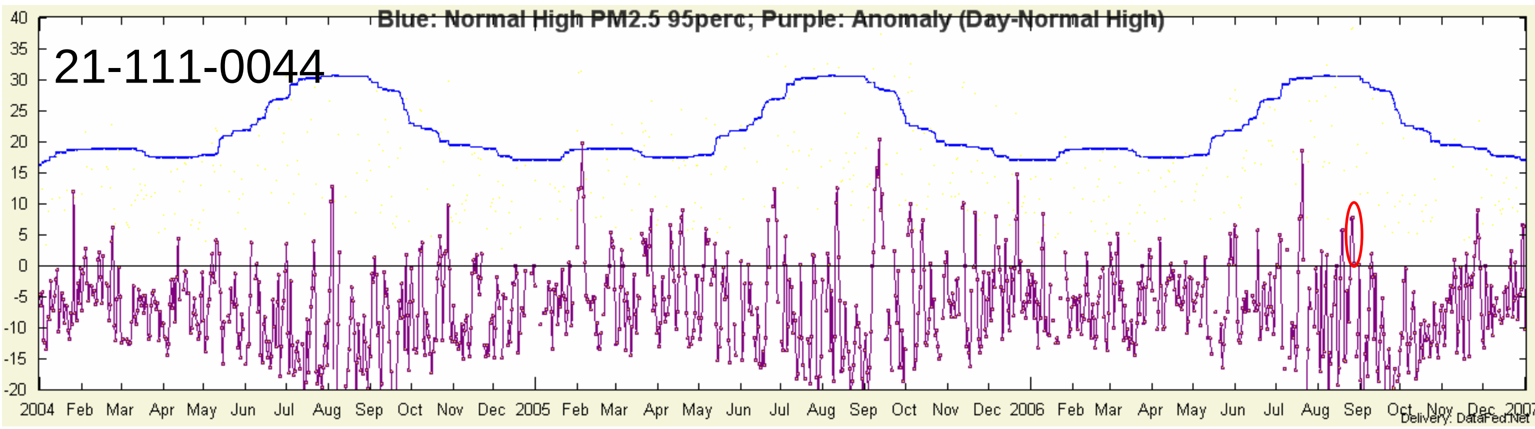


8/26/06

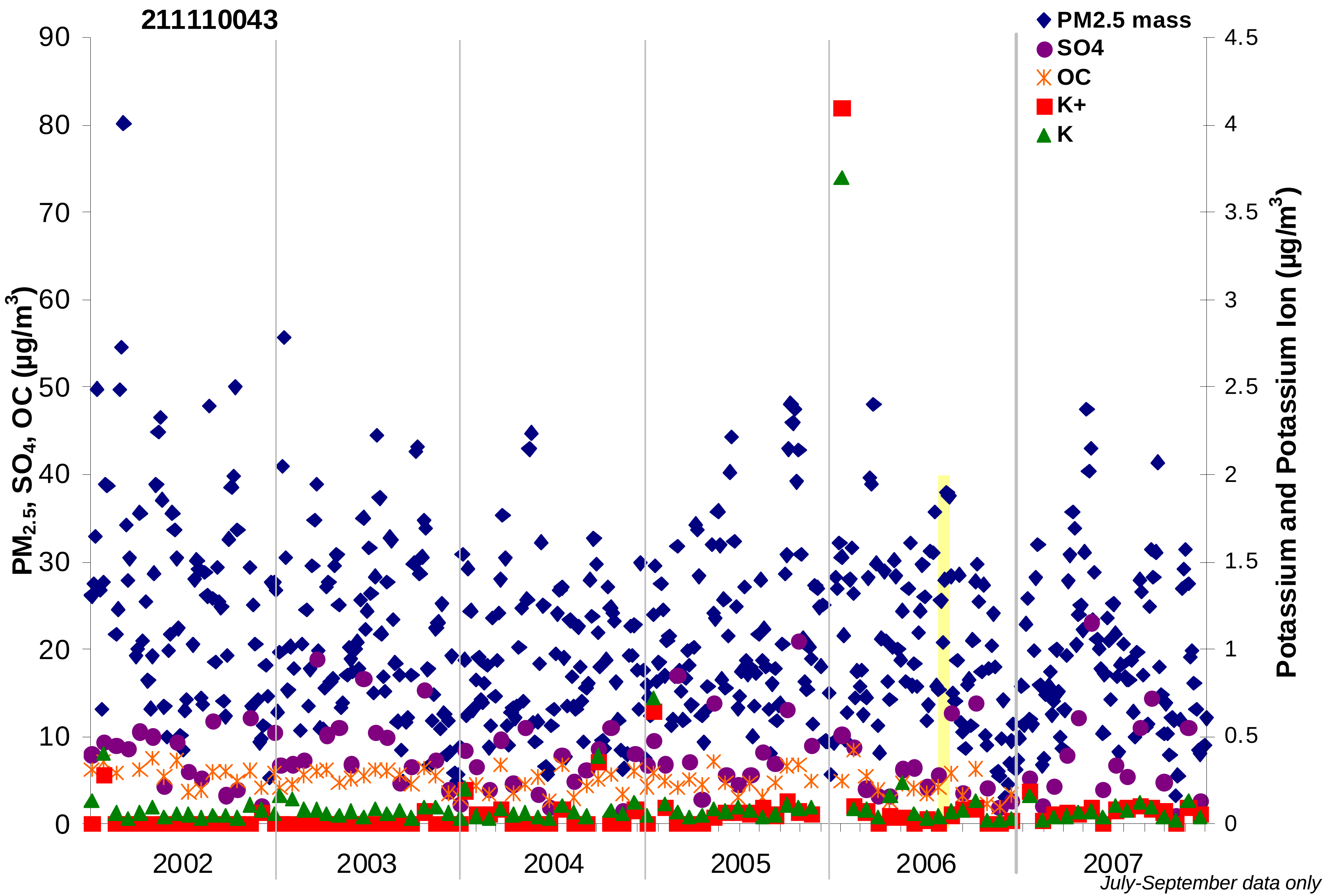


These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 8/25/06 and 8/26/06, concentrations were very close to the historical values.

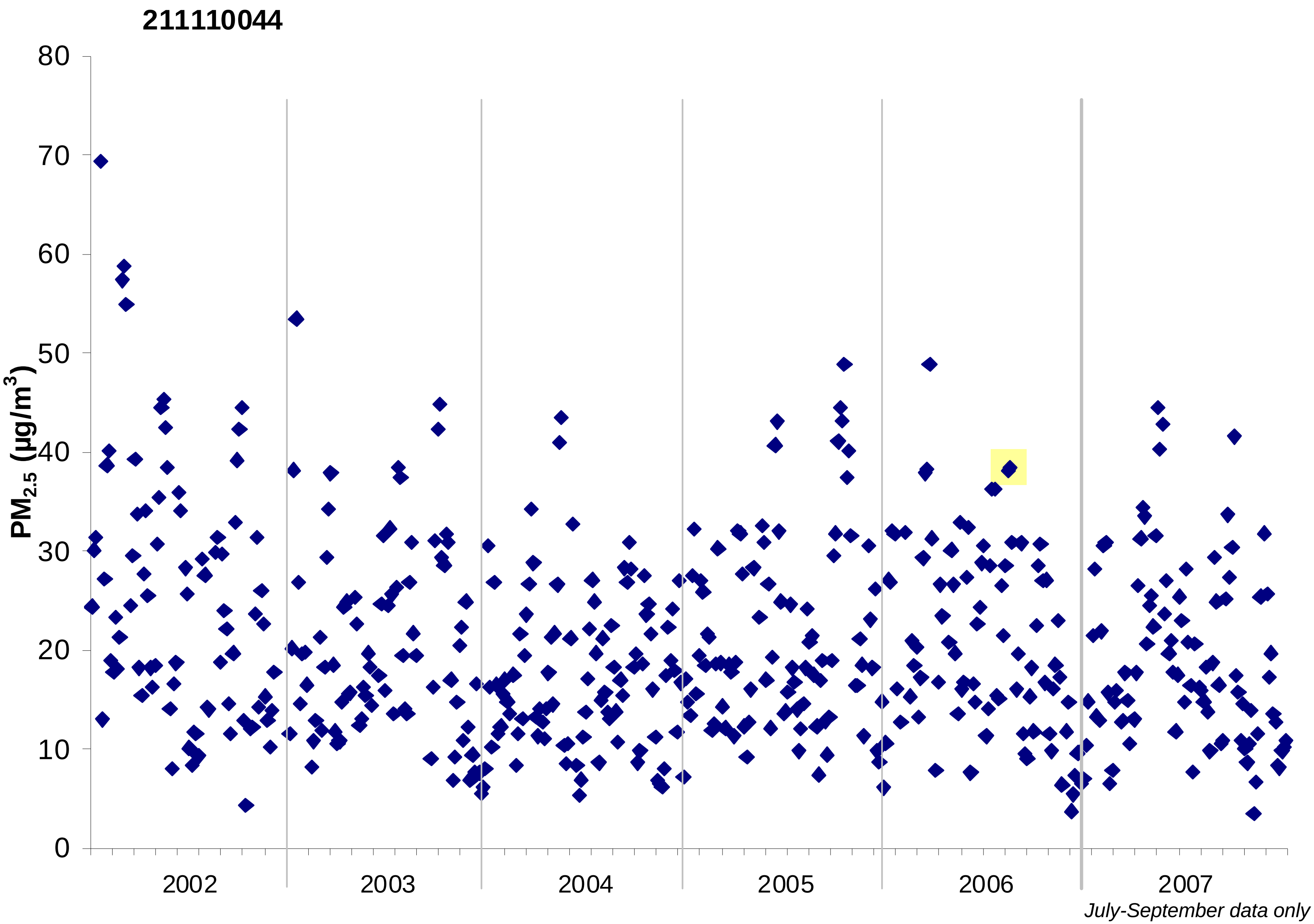




The purple lines show the difference between the given day and the historical 95th percentile concentration. On 8/25-8/26/06, concentrations were around 5 to 10 µg/m^3 higher than the historical values.



$PM_{2.5}$ concentrations were within the range of historical concentrations on 8/25-8/26/06 (highlighted in yellow). OC and potassium concentrations are not higher than normal, but sulfate is high on 8/26/04, which was the closest reported sulfate measurement to the episode



$PM_{2.5}$ concentrations are within the range of historical concentrations. No speciated data are available for this site.

Summary

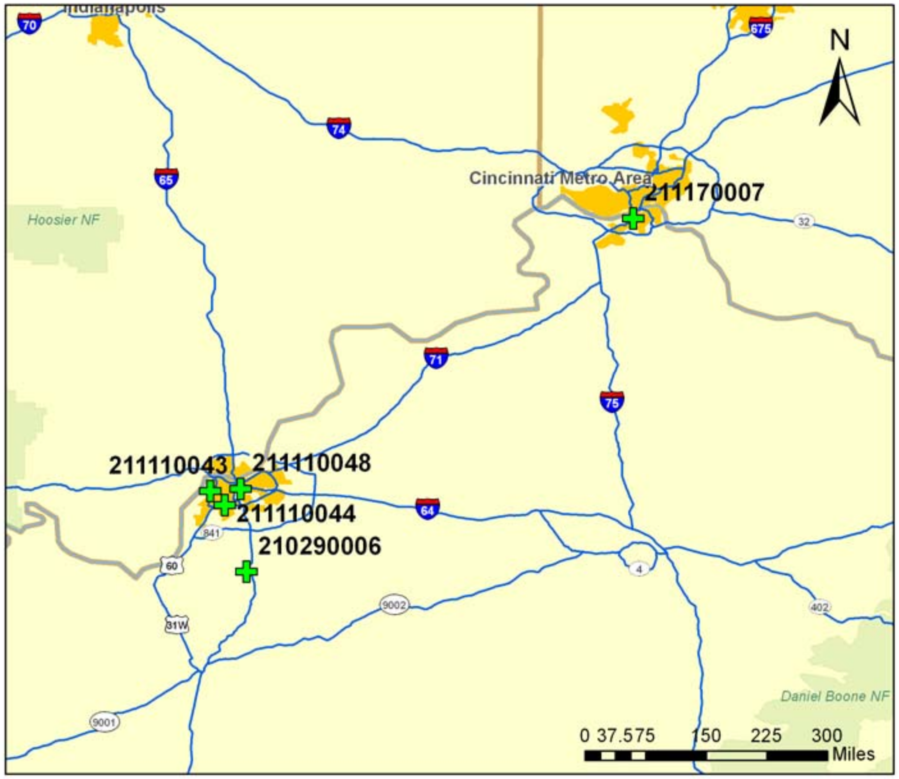
- Trajectory analysis does not indicate any impact from the area of the fires on 8/25/06 or 8/26/06.
- High modeled sulfate concentrations indicate a regional sulfate episode throughout the southeast.
- $PM_{2.5}$ concentrations are within the historical range of concentrations and were likely not impacted by forest fires.

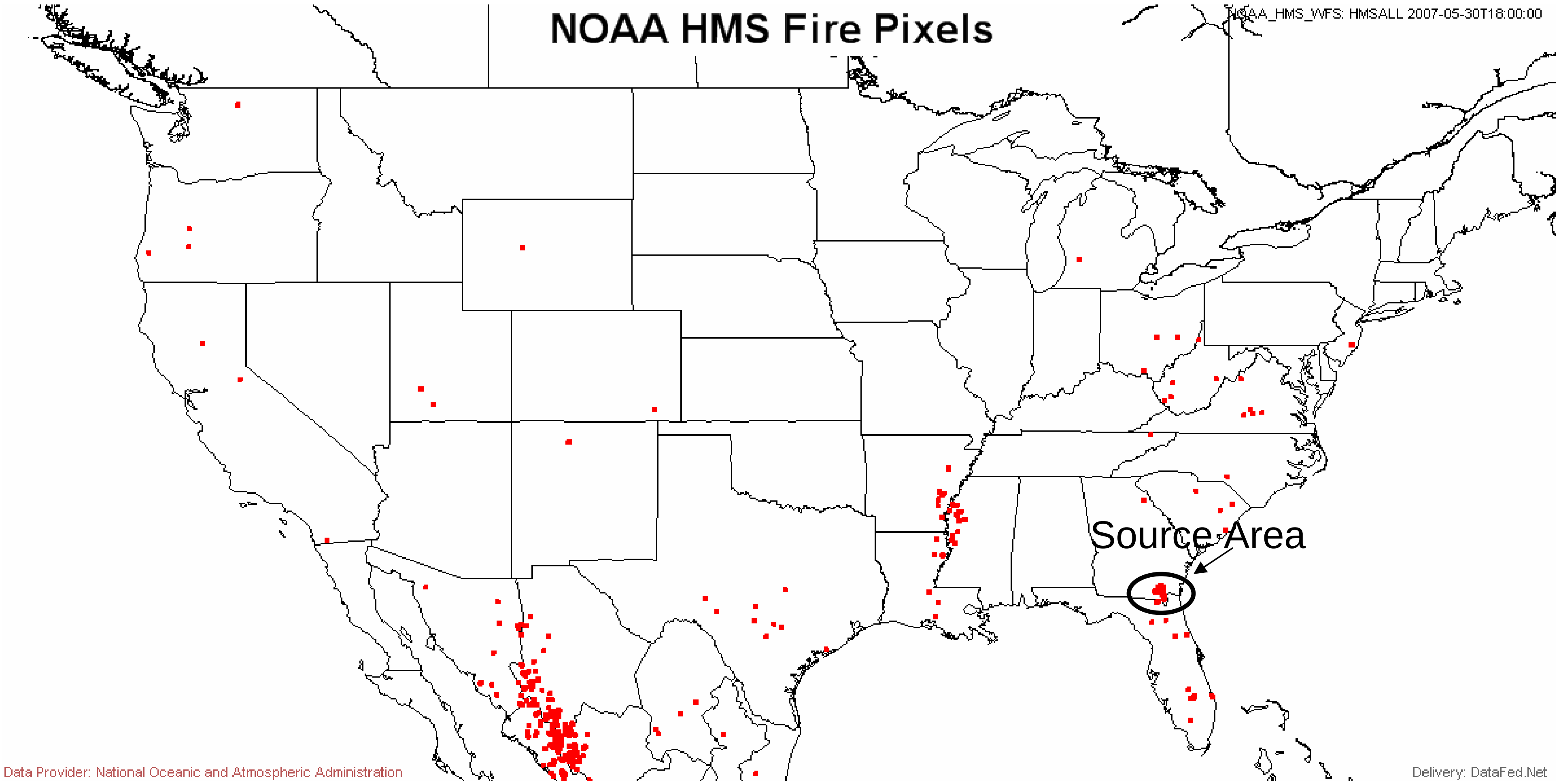
Exceptional Events Analysis Kentucky 6/2/07

Multiple sites flagged for fire impact from S. Georgia/N. Florida Fires

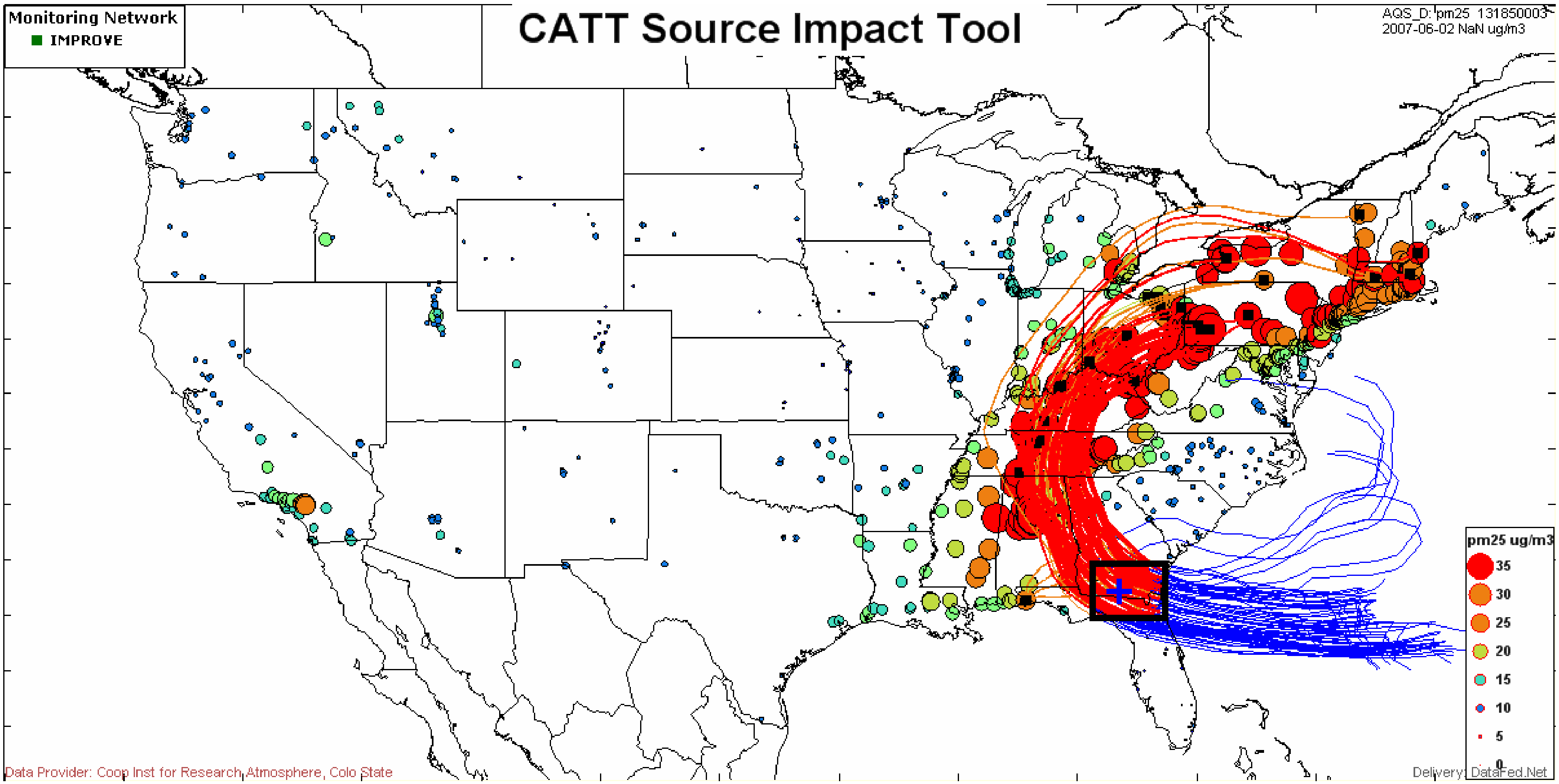
Sites Submitted for Exceptional Event Status (6/2/07)

Site ID	$PM_{2.5}$ (µg/m³)
210290006	36.2
211110043	34
211110044	36.8
211110048	37.2
211170007	40.1

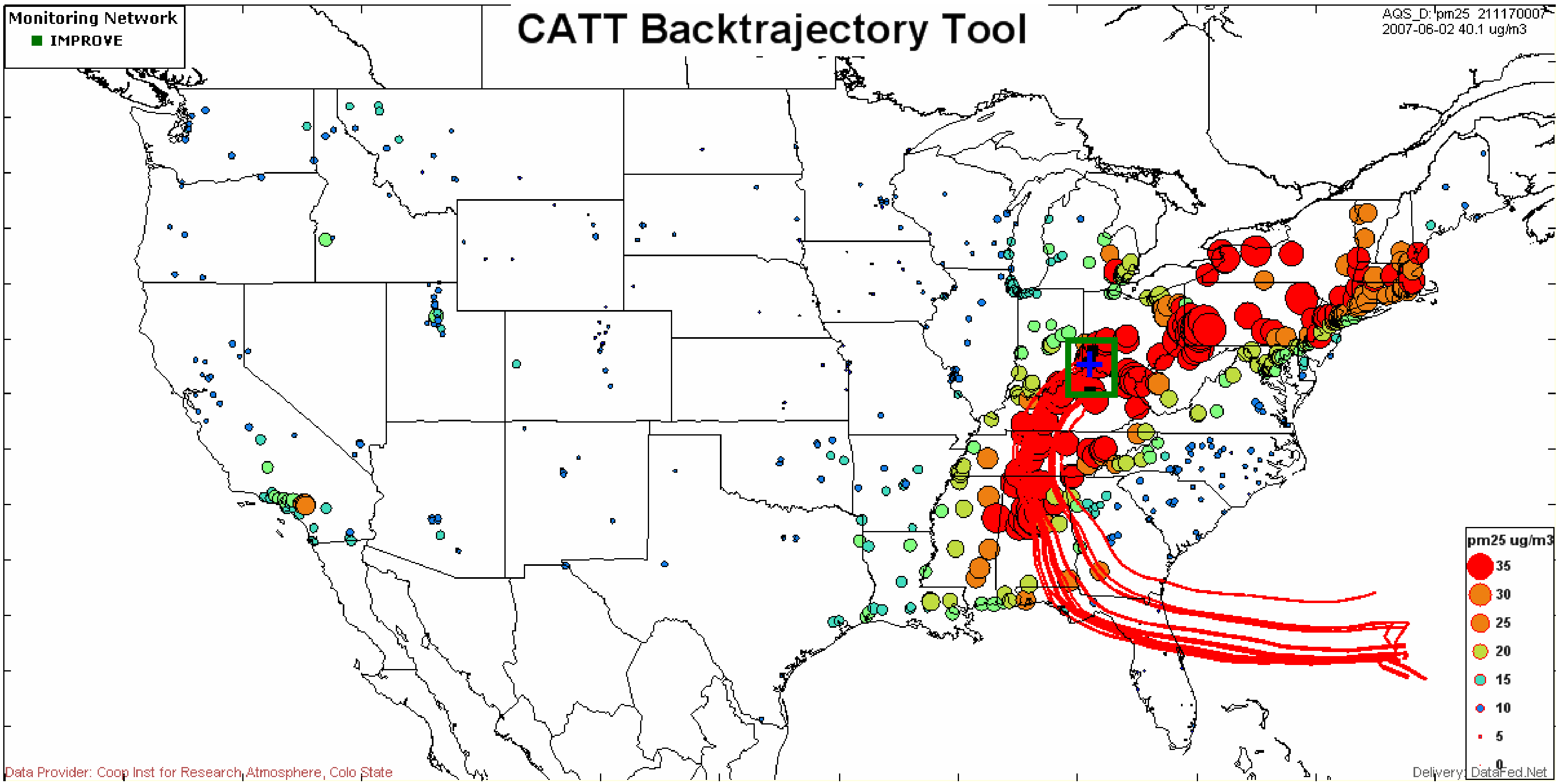




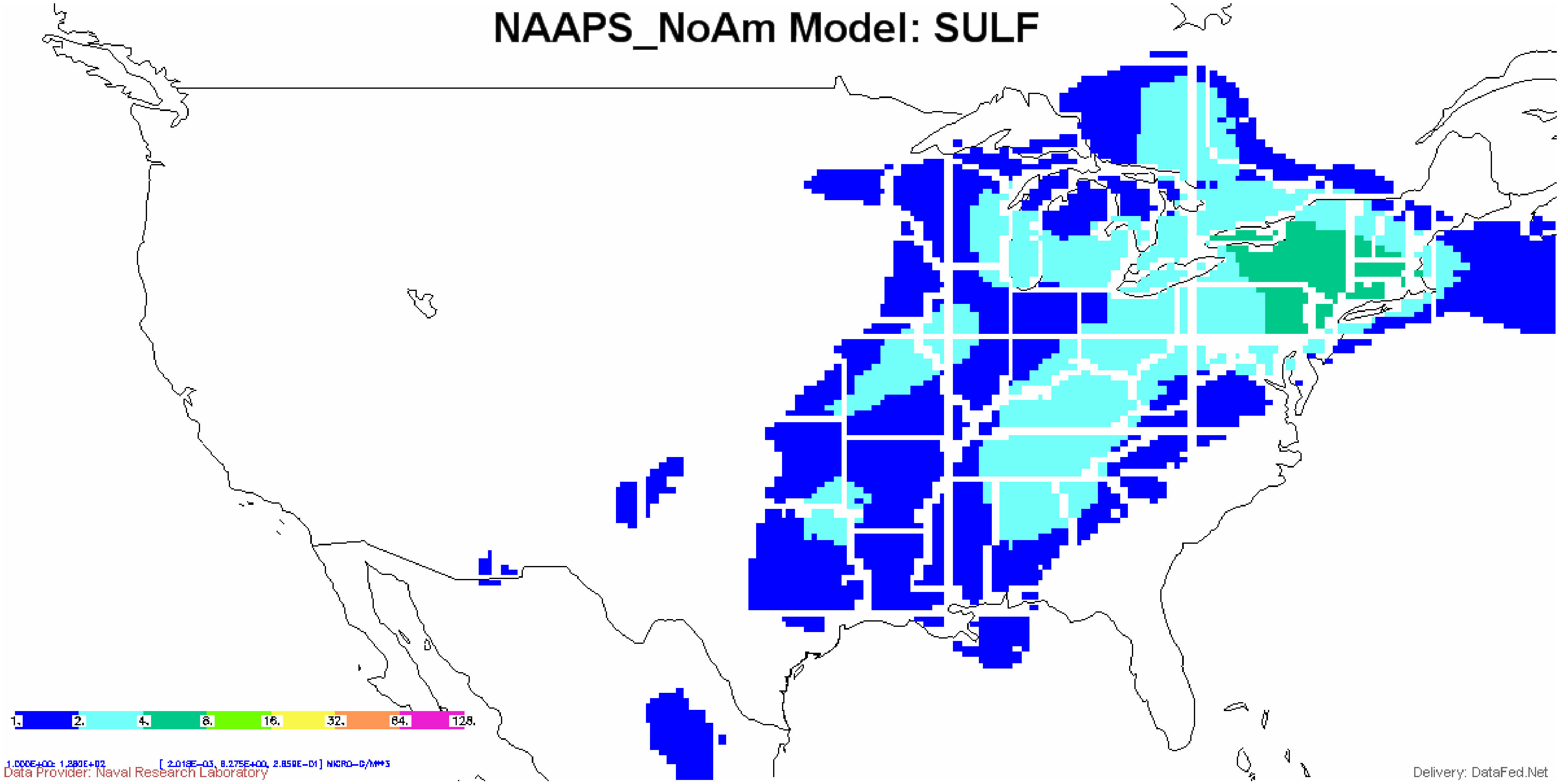
No fire pixels were evident in the area on 6/2/07, possible due to heavy cloud cover; this image is from 5/30/07



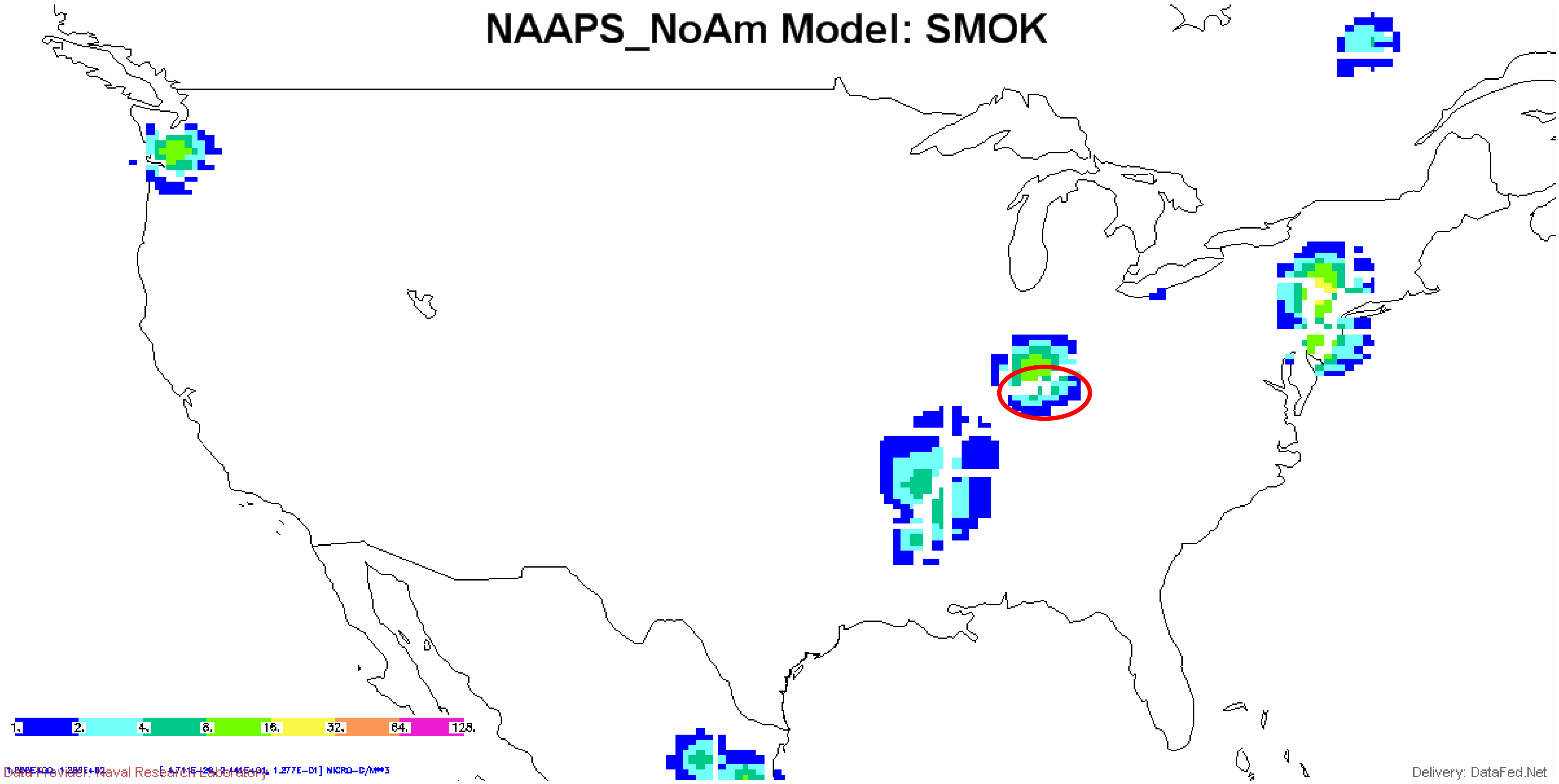
Source impact tool shows many trajectories passing through the fire region later passed through Kentucky



Back trajectory analysis highlights the trajectories that passed directly over the 211170007 site (blue cross), which were from the S. Georgia/N. Florida area



Modeled sulfate contributions are low-moderate

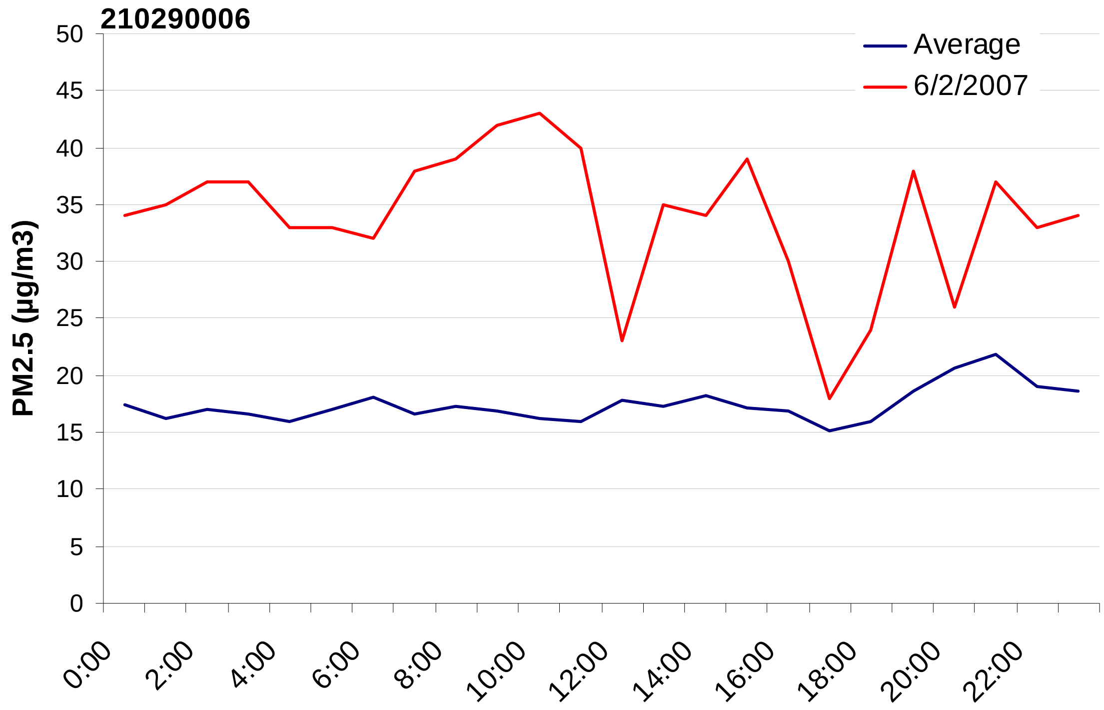


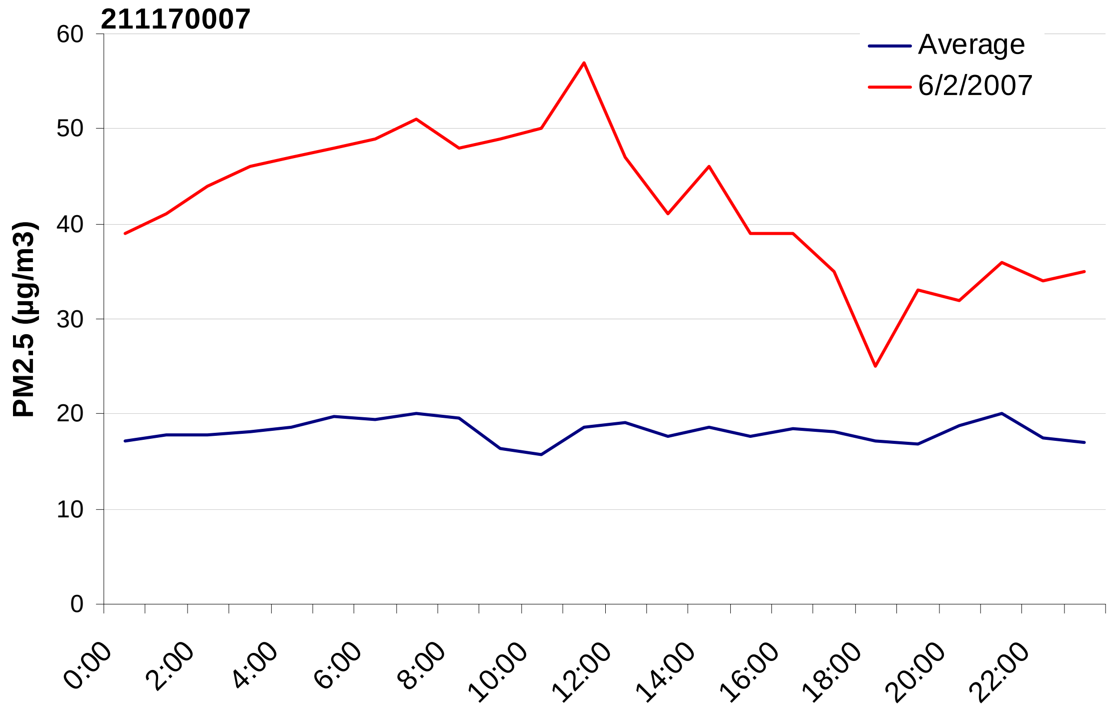
Some modeled smoke impact in KY indicated with red circle

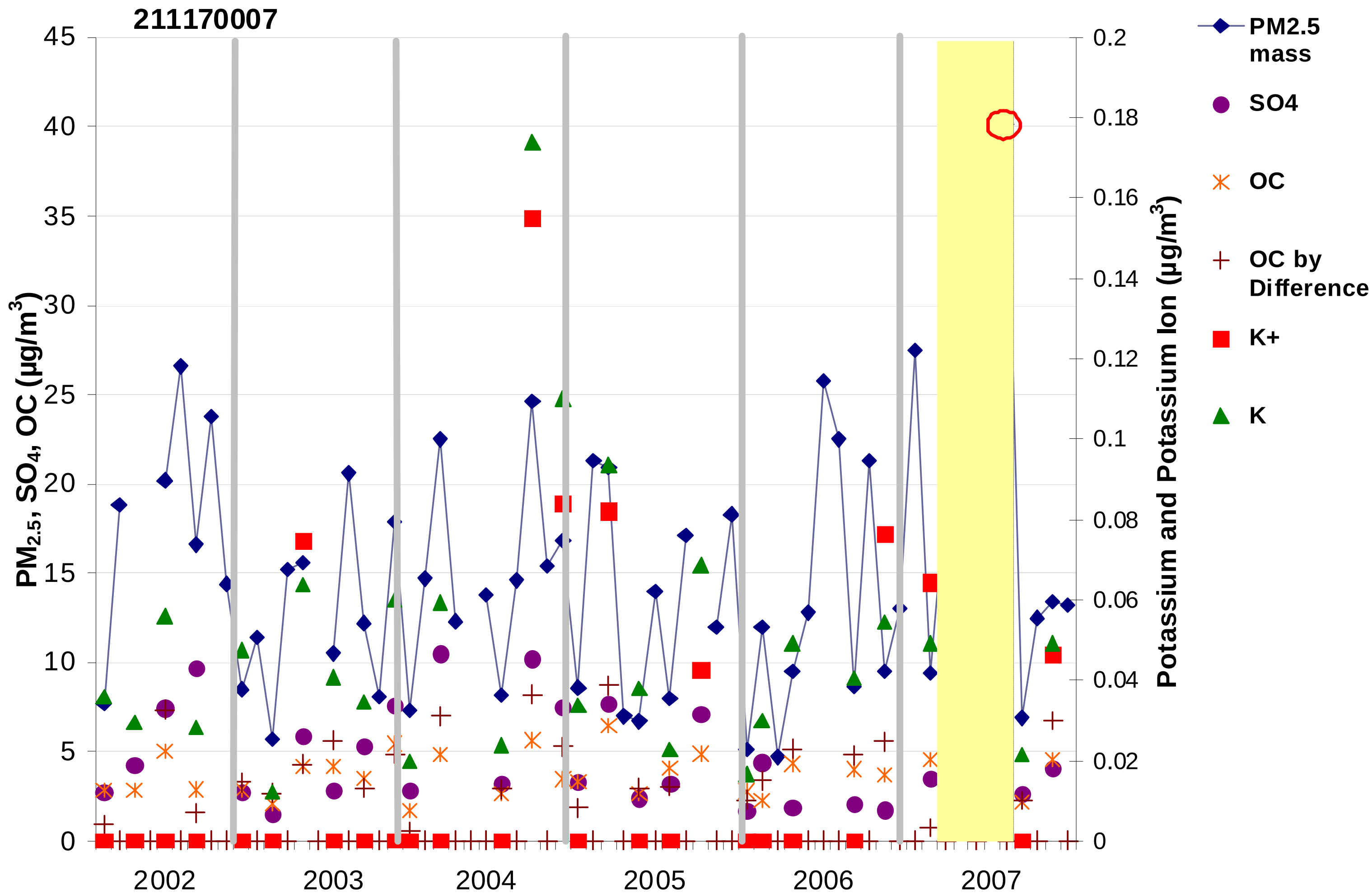
Diurnal profiles show much more variation than usual, as well concentrations more than 2x higher than average for June.

The average range of values over a day at each site was around 21 µg/m3. On 6/2/07, the range was slightly higher at 210290006 (25 µg/m3) and much higher at 211170007 (35 µg/m3). On high sulfate days (defined as days with a sulfate contribution >10 µg/m3), the range at 211170007 was only 16 µg/m3. No days had sulfate >10 µg/m3 at 210290006.

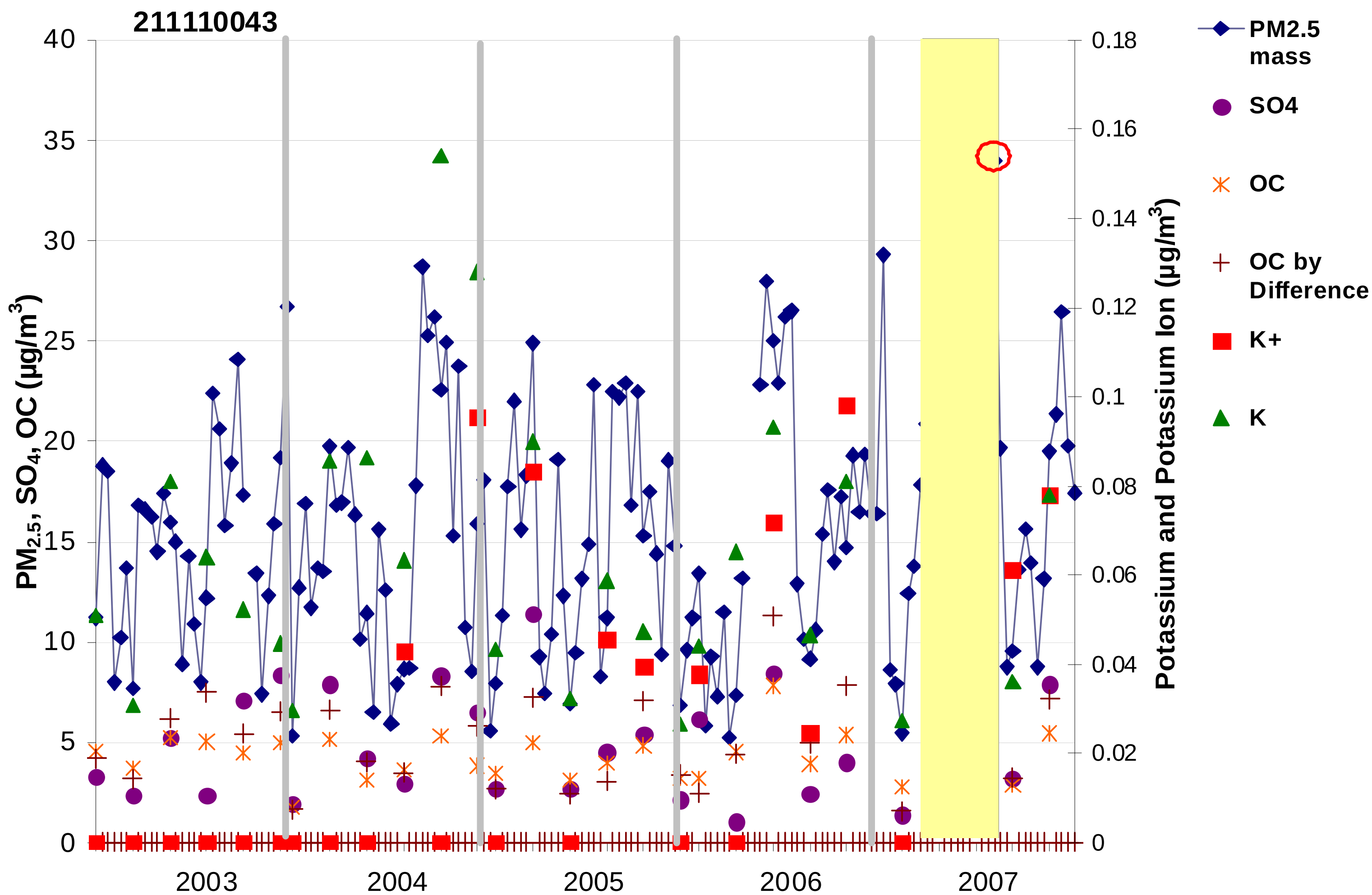
('average' presented here is the average per hour over all June data, 2000-2007)







Time series for multiple years (May 15-June 15) shows 6/2/07 is well above the normal range at 211170007. Individual years are delineated by a grey line. While there were no speciated measurements on 6/2/07, the two samples prior (highlighted in yellow) show high OC and potassium concentrations (indicative of smoke impact). However, SO_4 is also high, suggesting the fire impact may not be the only cause of high $PM_{2.5}$ concentrations.



At site 211110043, PM concentrations are high, but not extremely so. However, potassium concentrations are high for much of the month and, like at 211170007, OC concentrations are high in the samples preceding 6/2/07. SO4 is also slightly high.

Comparison to Historical Values

		mean	median	95th	6/2/2007
211110043	2007	19.8	18.5	34.8	34.0
	2000-2007	21.3	19.7	38.9	
211170007	2007	17.6	16.3	30.5	40.1
	2000-2007	19.1	17.1	36.5	

Summer data only (June-August) used in these statistics.

The 6/2/07 value at 211110043 was well above the mean/median concentrations for both summer 2007 and all summers 2000-2007, but was lower than the 95th percentile for all summers 2000-2007. This does not support the “but-for” clause.

The 6/2/07 value at 211170007 is well above mean, median, and 95th percentiles for summer 2007 and all summers 2000-2007. Without the event, the value on this day could have been below 35µg/m^3.

No speciated data was available on this day, OC/OM concentrations could not be compared to historical values.

Conclusions

- Trajectory analysis indicates smoke emissions from the S. Georgia/N. Florida area could be impacting Kentucky
- Likely not a sulfate event based on low(ish) sulfate
- Diurnal patterns are much more varied on 6/2/07, showing a buildup in concentrations over the morning- possibly due to a fire plume
- At the 211170007 site, the PM2.5 concentration on 6/2/07 was well above normal and obviously a unique event
- At the 211110043 site, the PM2.5 concentration was high on 6/2/07 compared to the rest of 6/07, but not compared to previous years
- There is likely impact from the Georgia/Florida fires throughout Kentucky on 6/2/07 (and nearby dates). The highest impact is evident at the 211170007 site, where concentrations would likely be much lower without the smoke contribution.

Exceptional Events Analysis
Kentucky
8/2/07-8/4/07

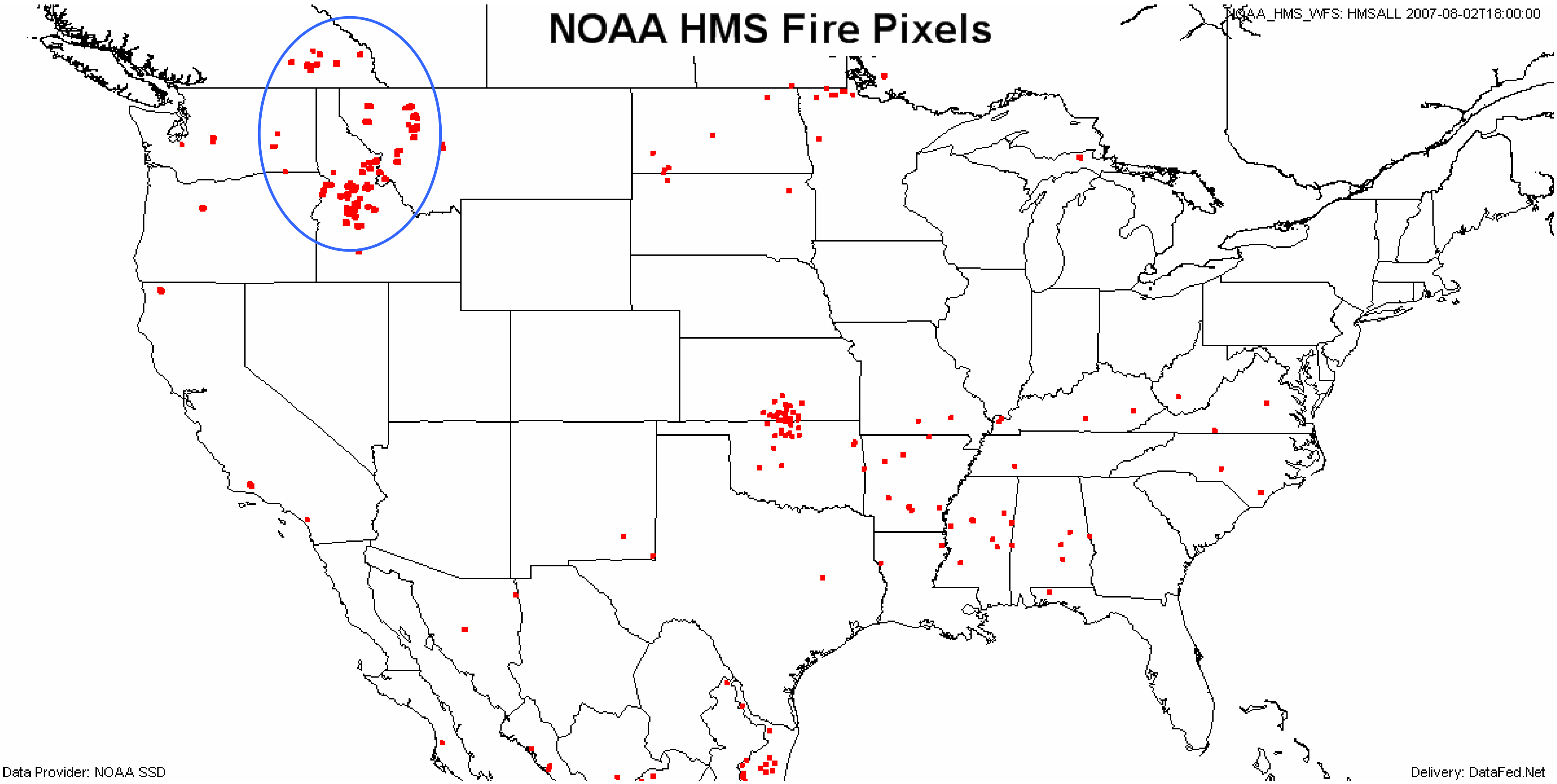
Four sites analyzed
(21-111-0043, 21-111-0044,
21-111-0048, 21-111-0051)
for possible fire impact
from western U.S. fires

Concentrations Under Consideration

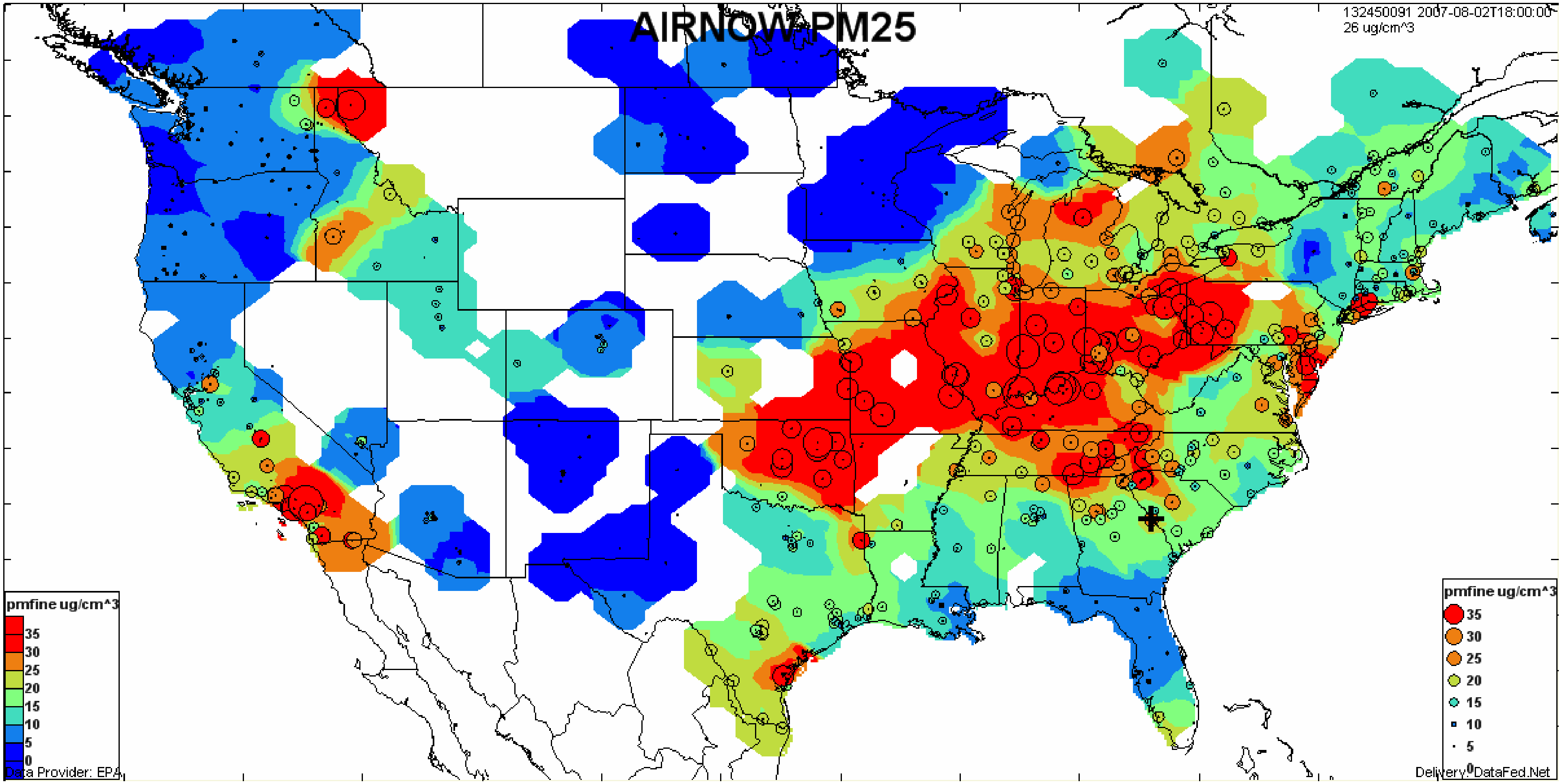
$PM_{2.5}$ concentrations in $\mu g/m^3$

Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
August 2, 2007	47.4		44.5		
August 3, 2007	40.4	47.2	40.3		
August 4, 2007	43.0		42.8	42.9	51.3

8/2/07



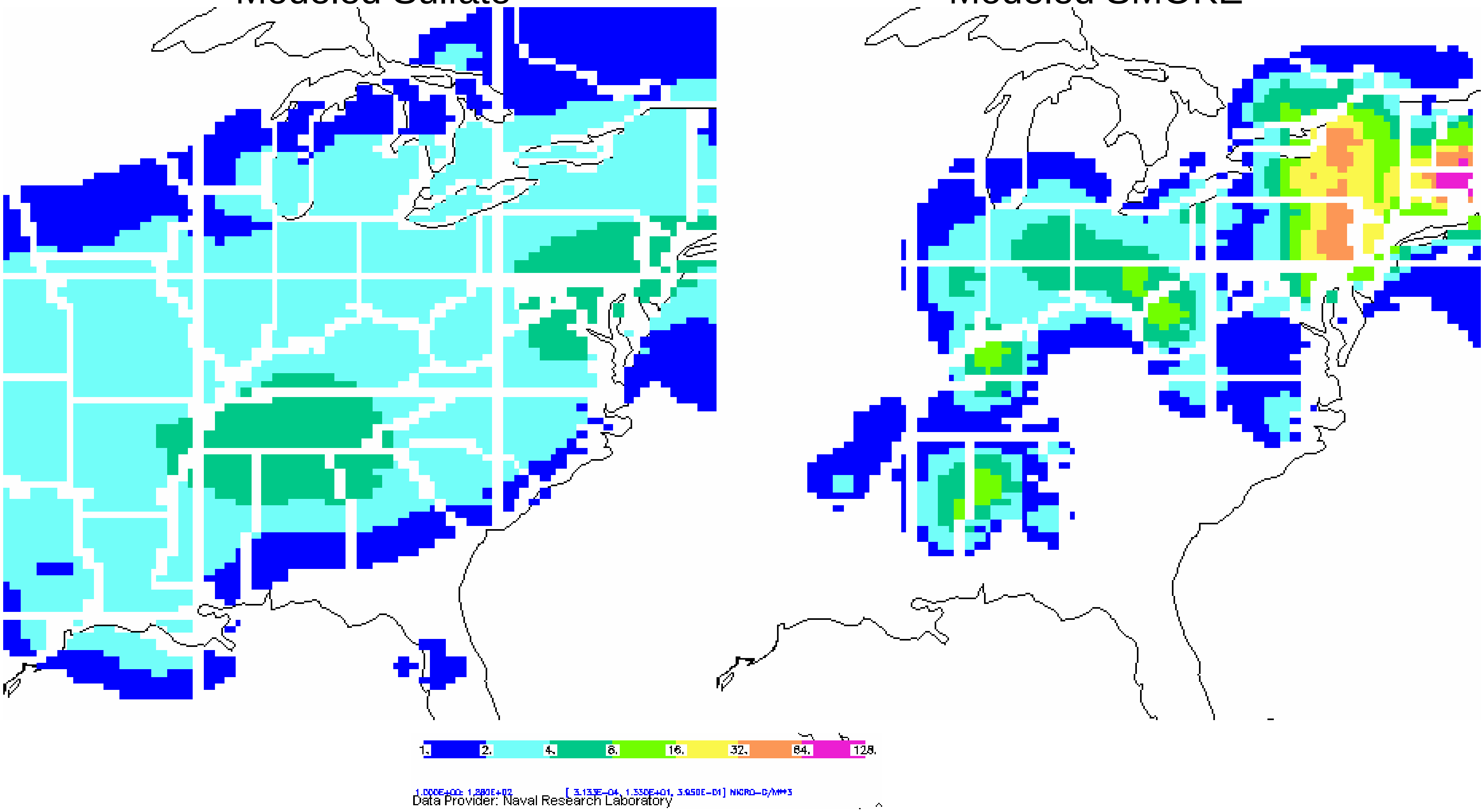
Several large fires in Montana/Idaho are believed to have impacted $PM_{2.5}$ concentrations in Kentucky. Similar fire detections were seen on 8/3/07 and 8/4/07.



$PM_{2.5}$ concentrations are high throughout the region on 8/2/07.
Similar concentrations were seen on 8/3/07 and 8/4/07.

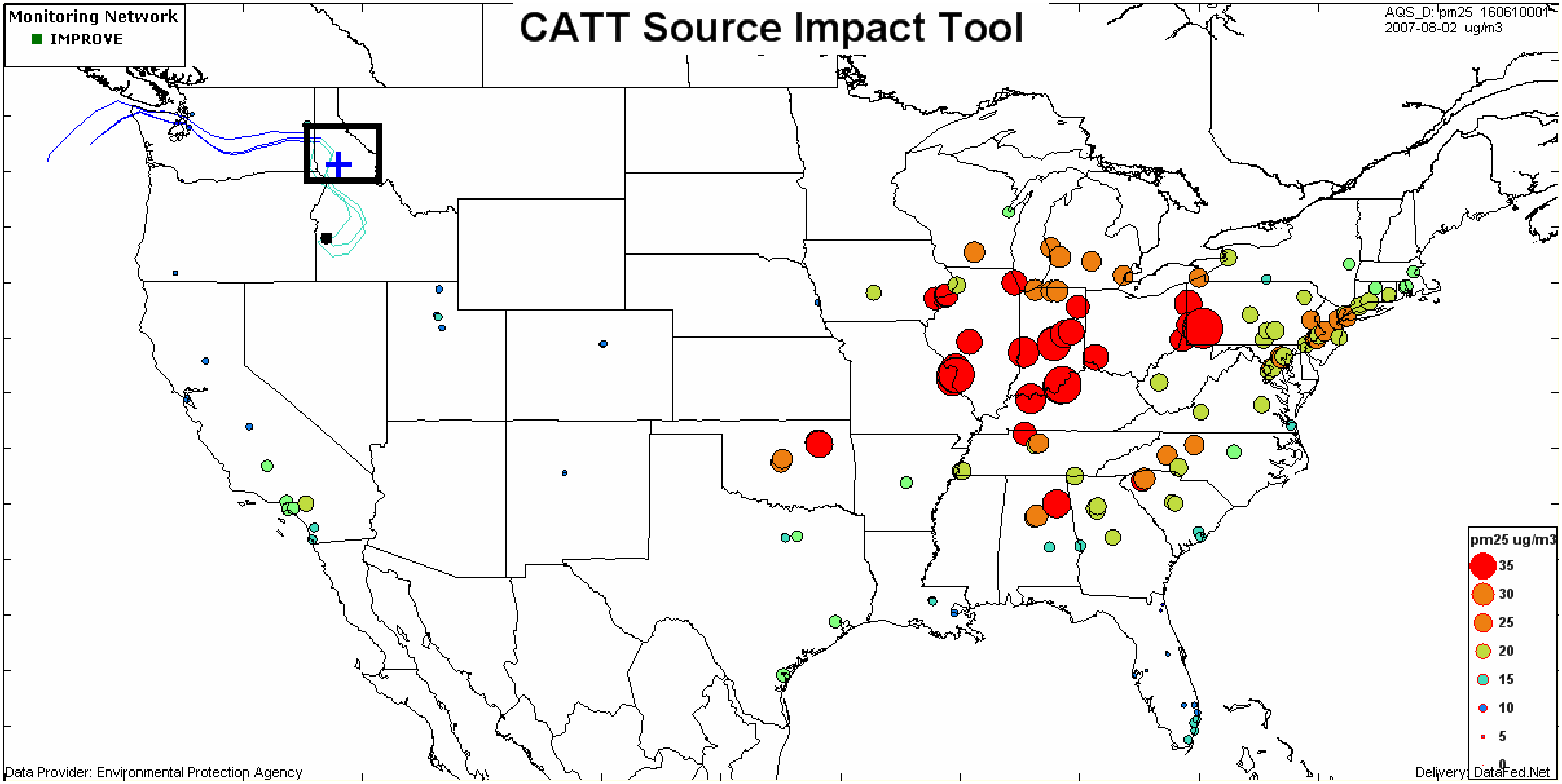
8/2/07

Modeled Sulfate Modeled SMOKE



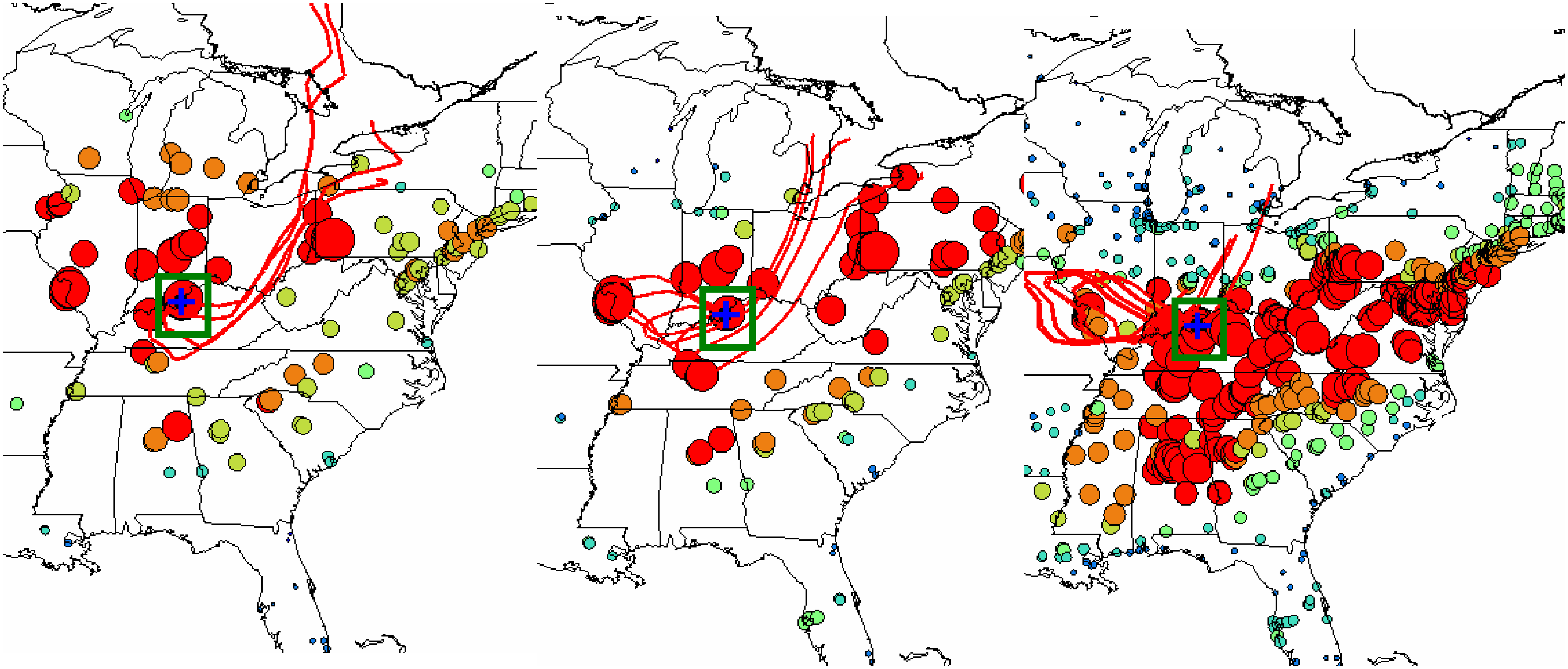
Modeled sulfate and modeled smoke were low/moderate in Kentucky on 8/2/07. (Same results on 8/3/07 and 8/4/07.)

8/2/07

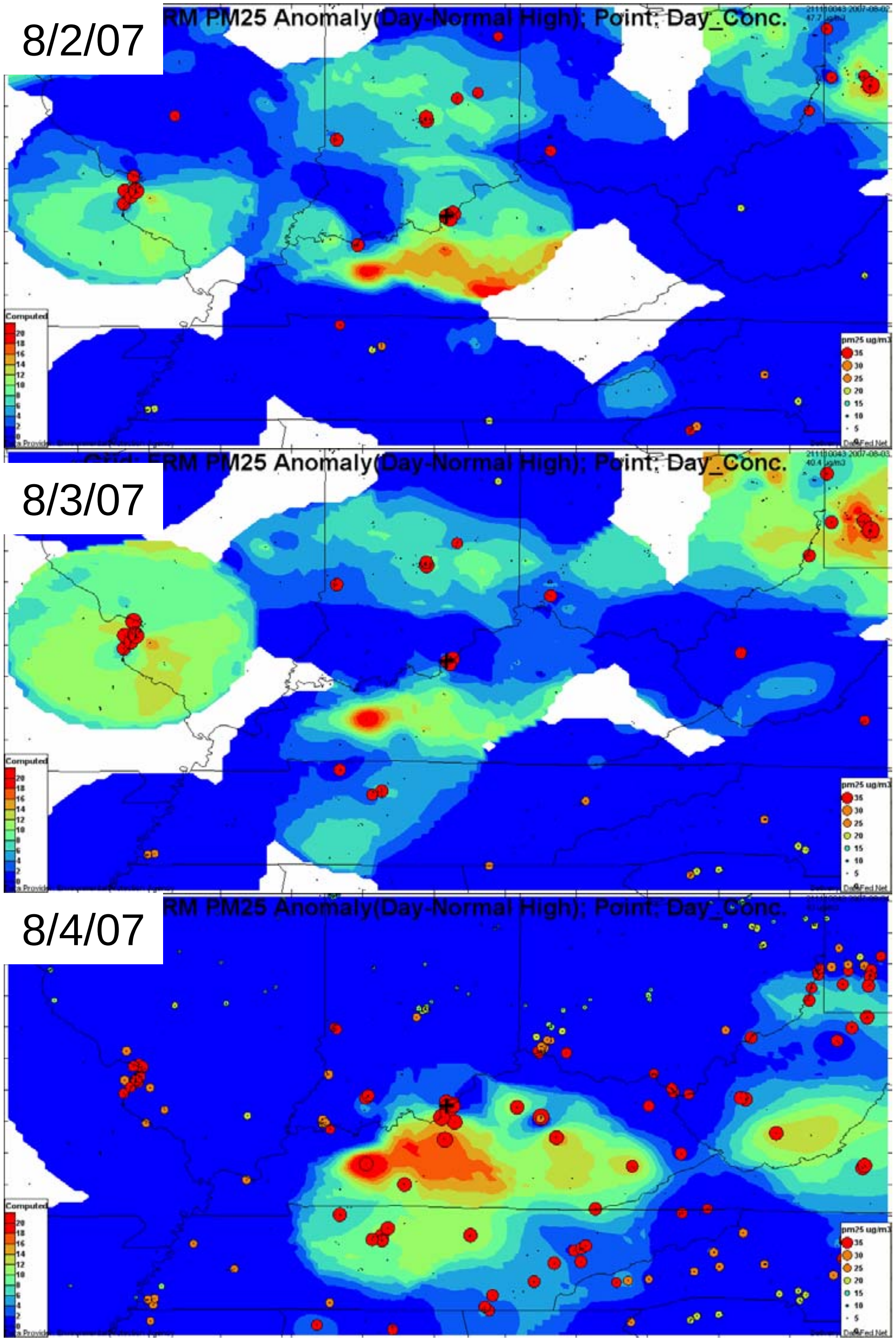


Source impact trajectories show no transport from fires in the Idaho/Montana area to Louisville. All three days were similar.

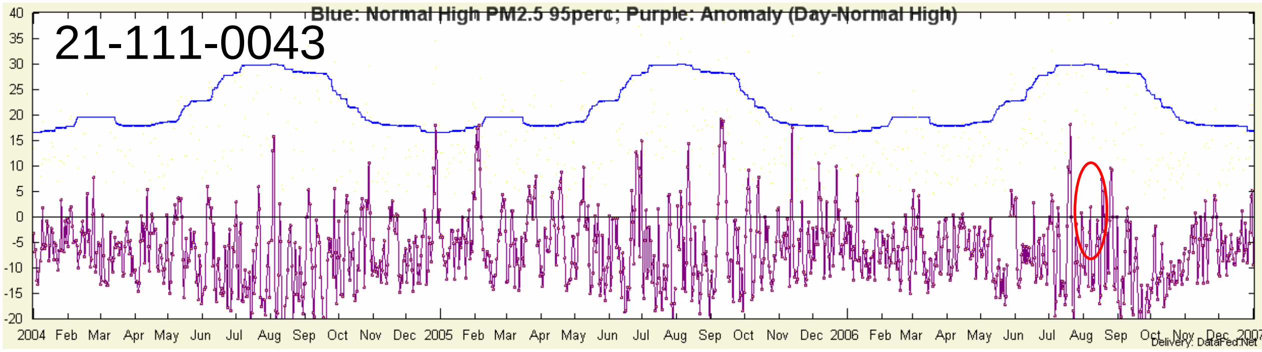
8/2/07 8/3/06 8/4/06

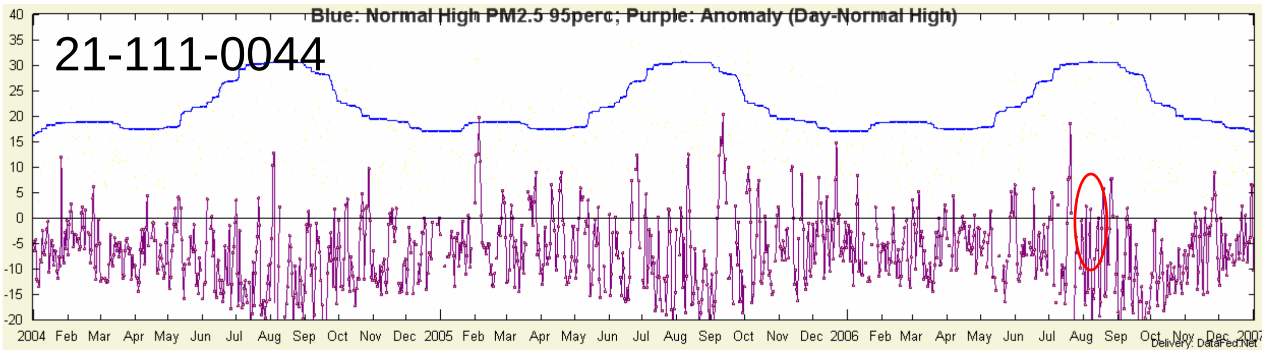


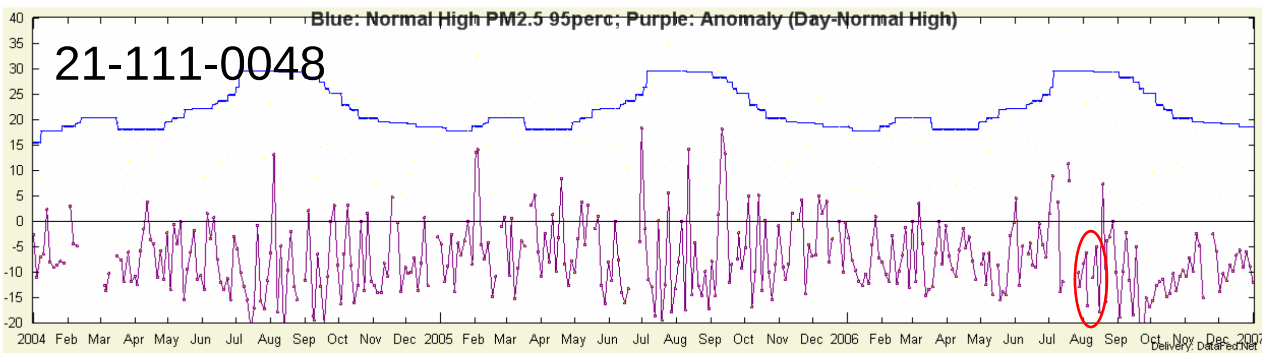
Back trajectories also show the Louisville site had no impact from the Idaho/Montana area.

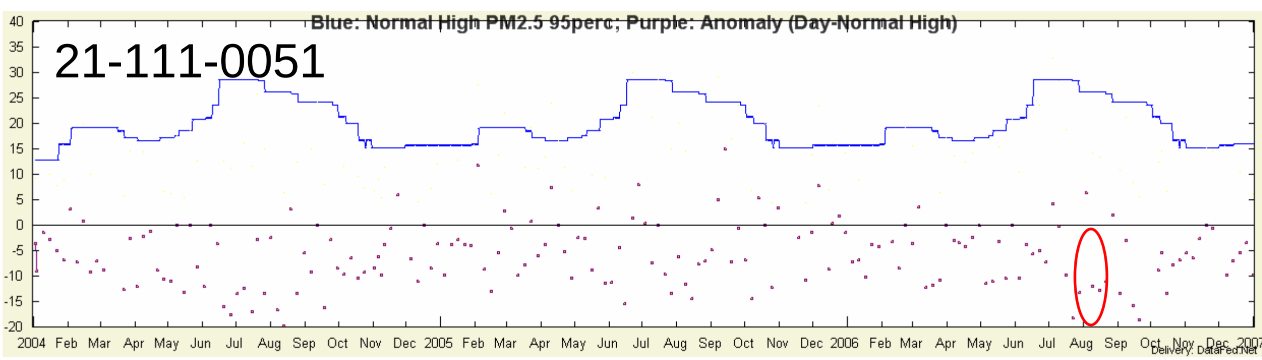


These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 8/2/07, 8/3/07, and 8/4/07, concentrations were close to the historical values, but throughout the rest of Kentucky, many high concentrations were seen.

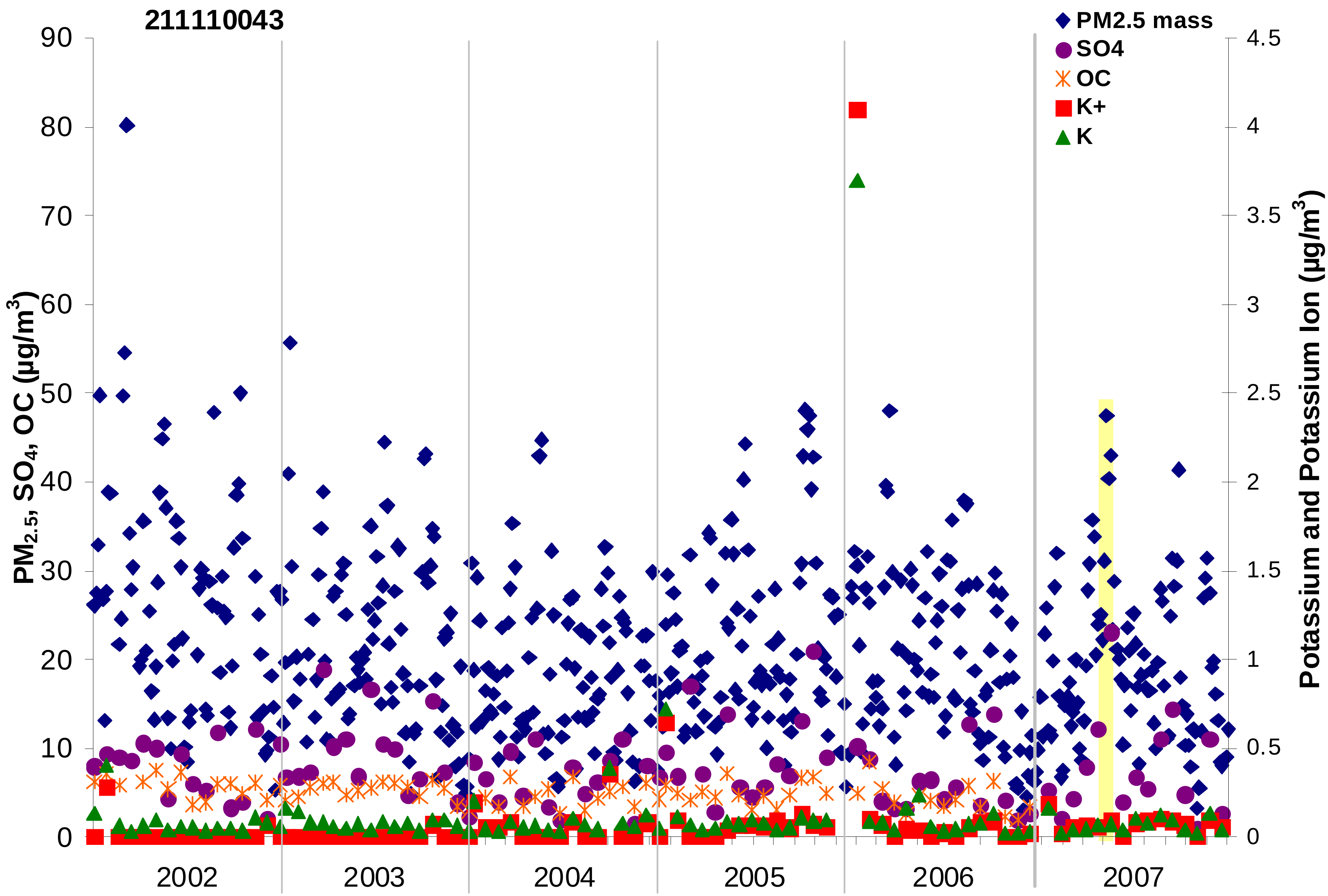




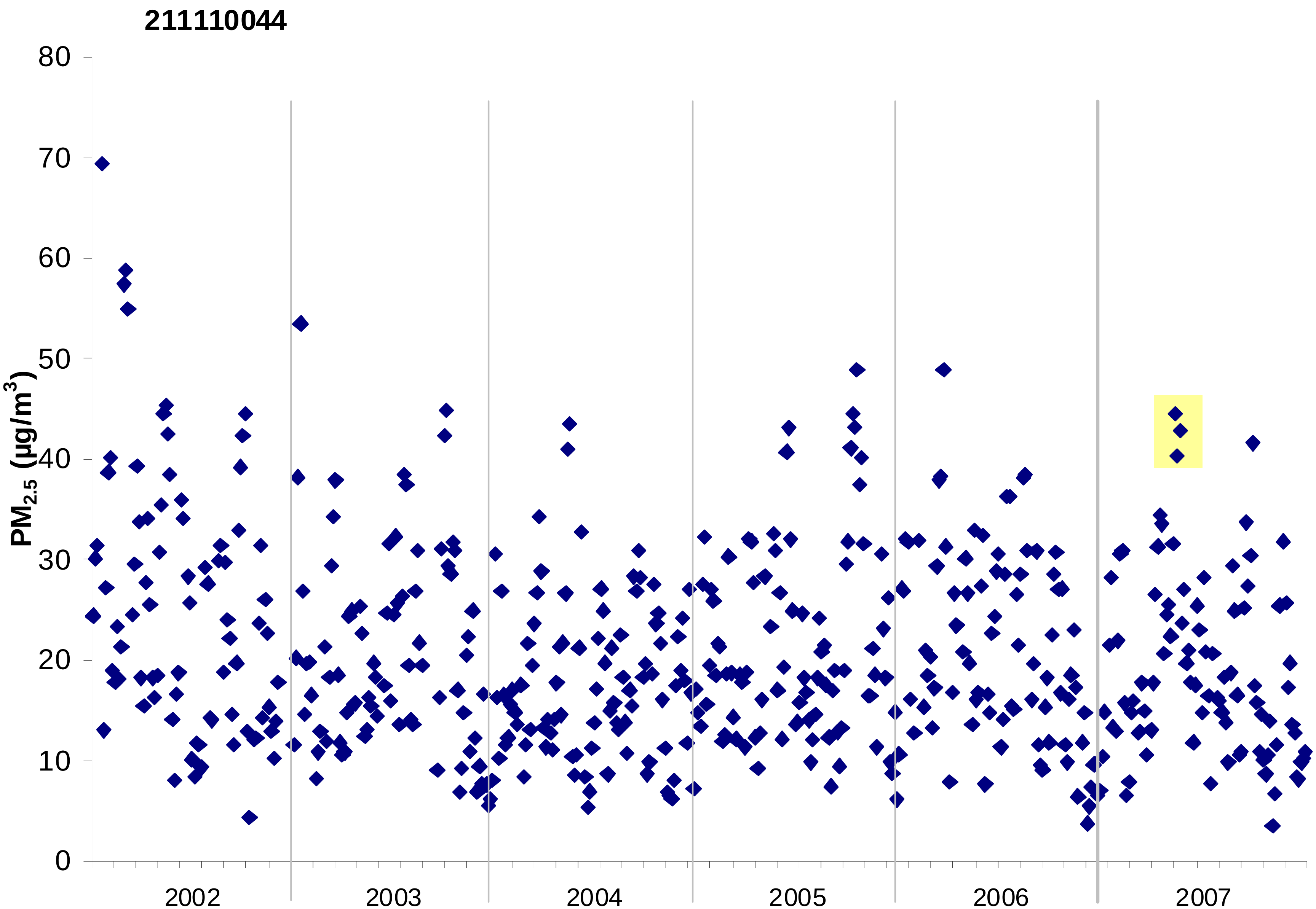




The purple lines show the difference between the given day and the historical 95th percentile concentration. On 8/2-8/4/07, concentrations were near or below the historical values.

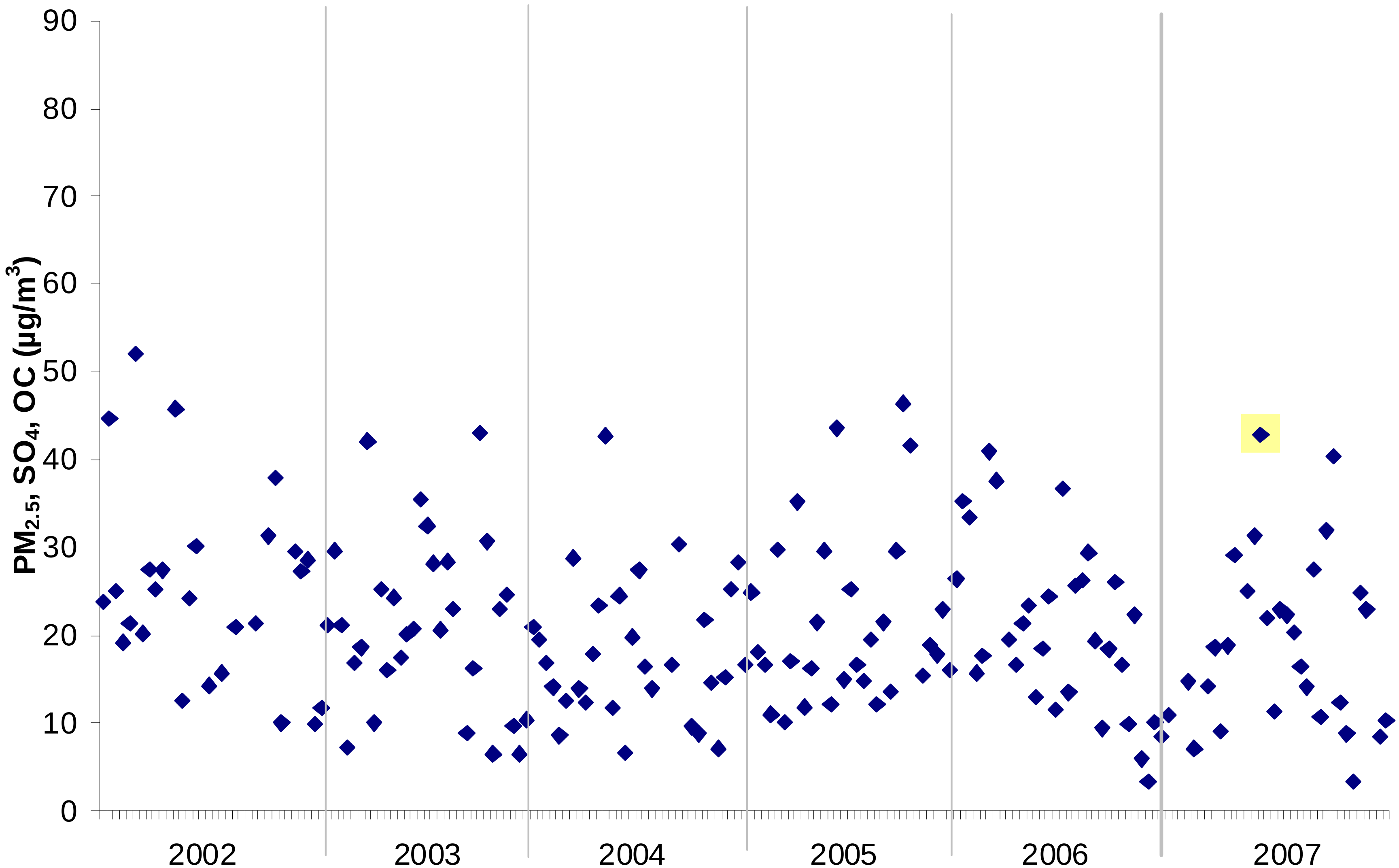


$PM_{2.5}$ concentrations were within the range of historical concentrations on 8/2-8/4/07 (highlighted in yellow). OC and potassium concentrations are not higher than normal, but sulfate is very high on 8/4/07.



PM$_{2.5}$ concentrations are high, but within the range of historical concentrations. No speciated data are available for this site.

211110048



As at the other sites, $PM_{2.5}$ concentrations at 21-111-0048 are within the range of historical concentrations.

Summary

- Trajectory analysis does not indicate any impact from the area of the fires on 8/2/07-8/4/07.
- $PM_{2.5}$ concentrations are within the historical range of concentrations.
- High sulfate concentrations at 21-111-0043 indicate a sulfate event.

Exceptional Events Analysis
Kentucky
9/6/07

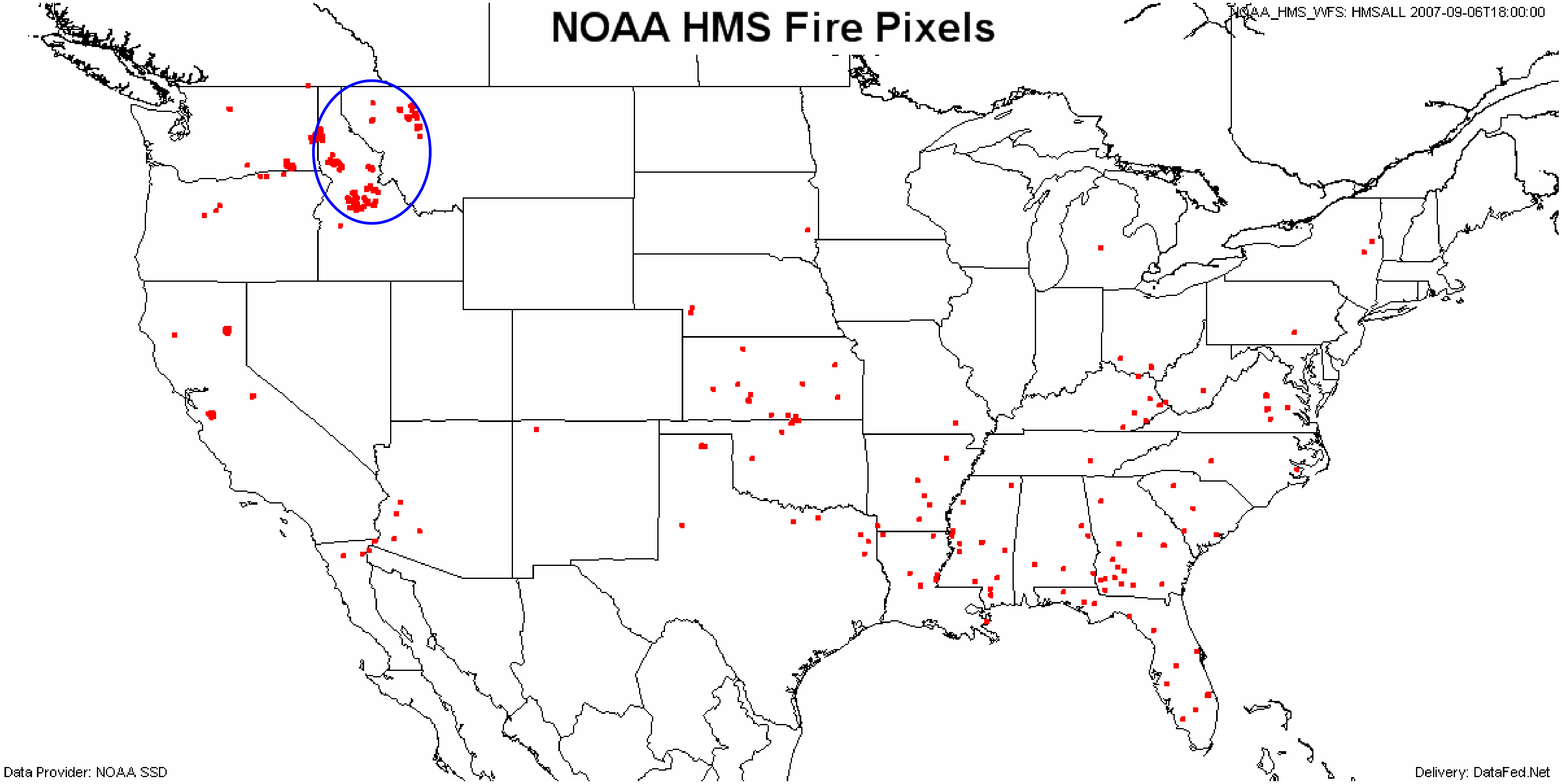
Three sites analyzed
(21-111-0043, 21-111-0044, 21-111-0048)
for possible fire impact
from Idaho/Montana fires

Concentrations Under Consideration

$PM_{2.5}$ concentrations in $\mu g/m^3$

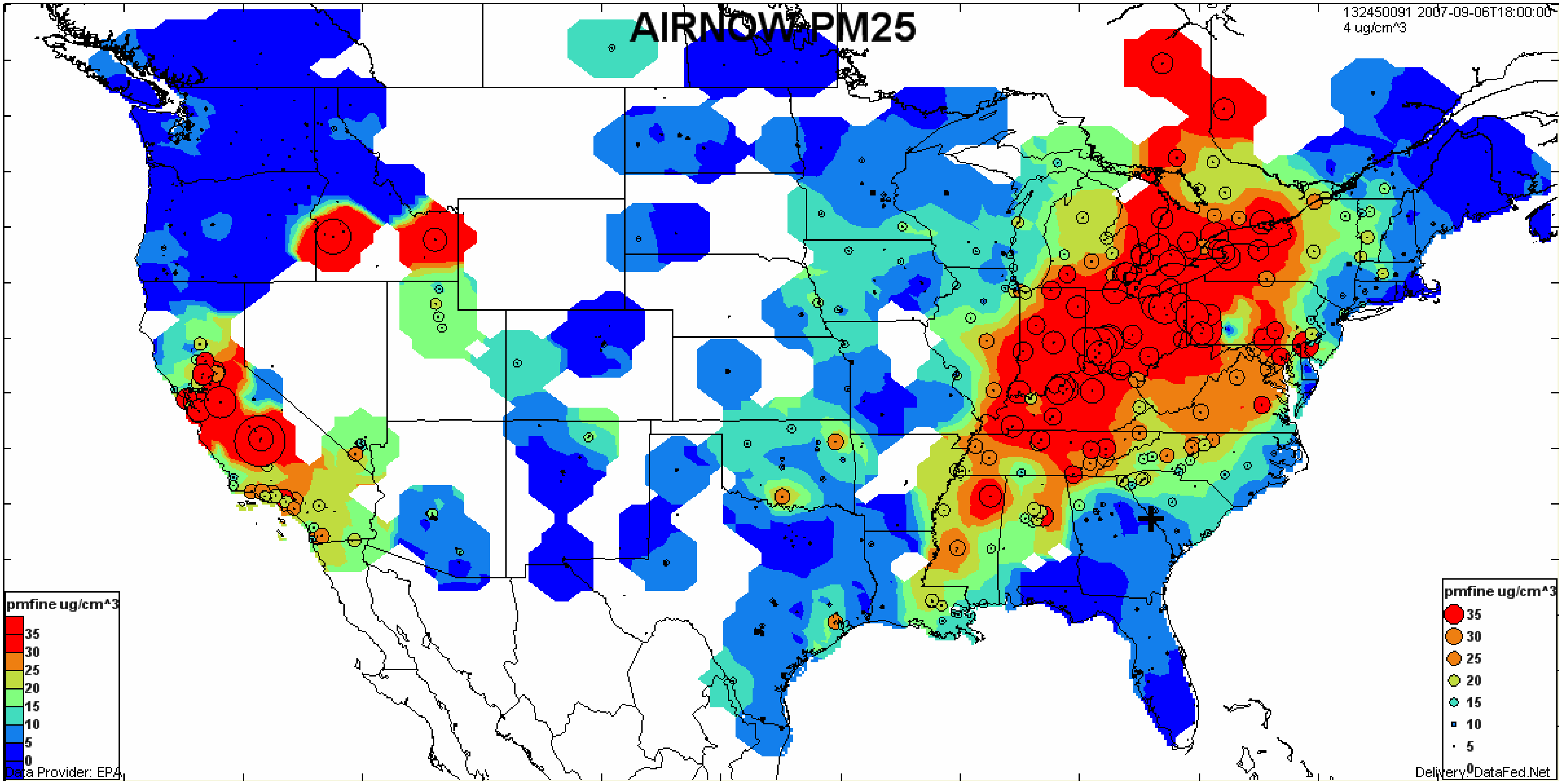
Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
September6, 2007	41.4		41.6	40.4	

9/6/07

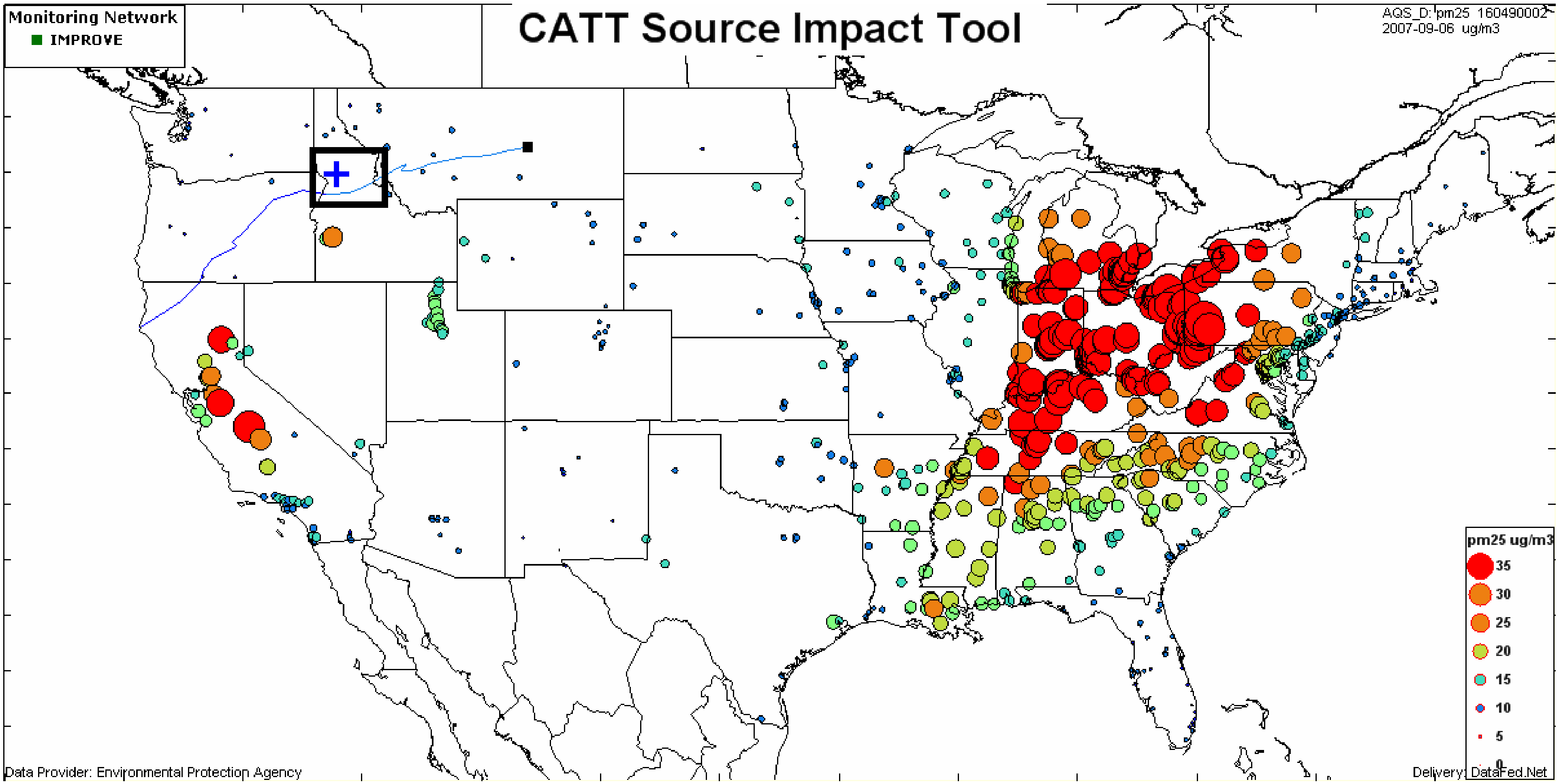


Fires in the Idaho/Montana area are believed to be impacting the Louisville area for 9/6/07.

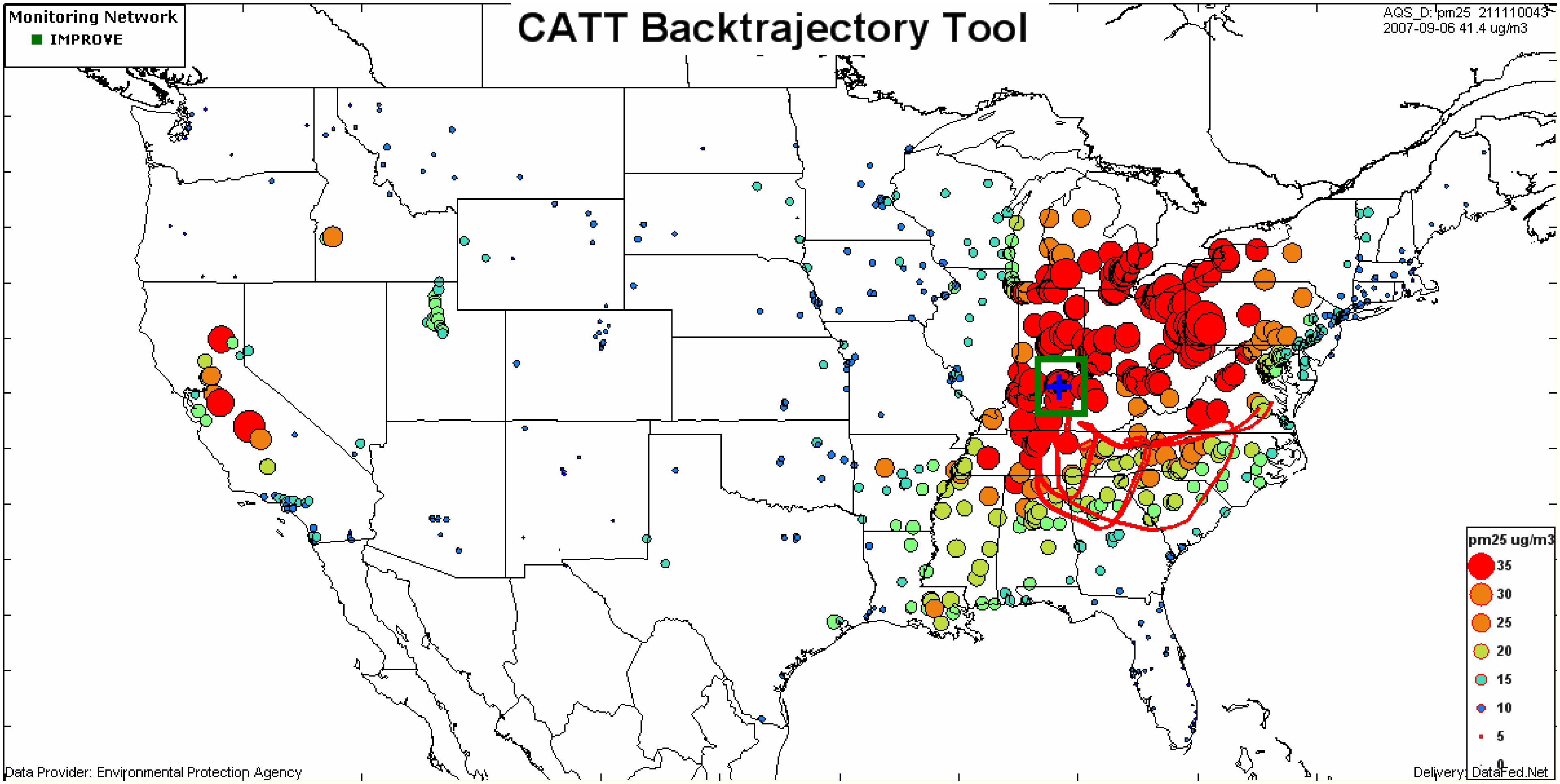
9/6/07



$PM_{2.5}$ concentrations were high throughout the region on 9/6/07. Sulfate and OC data were not available.



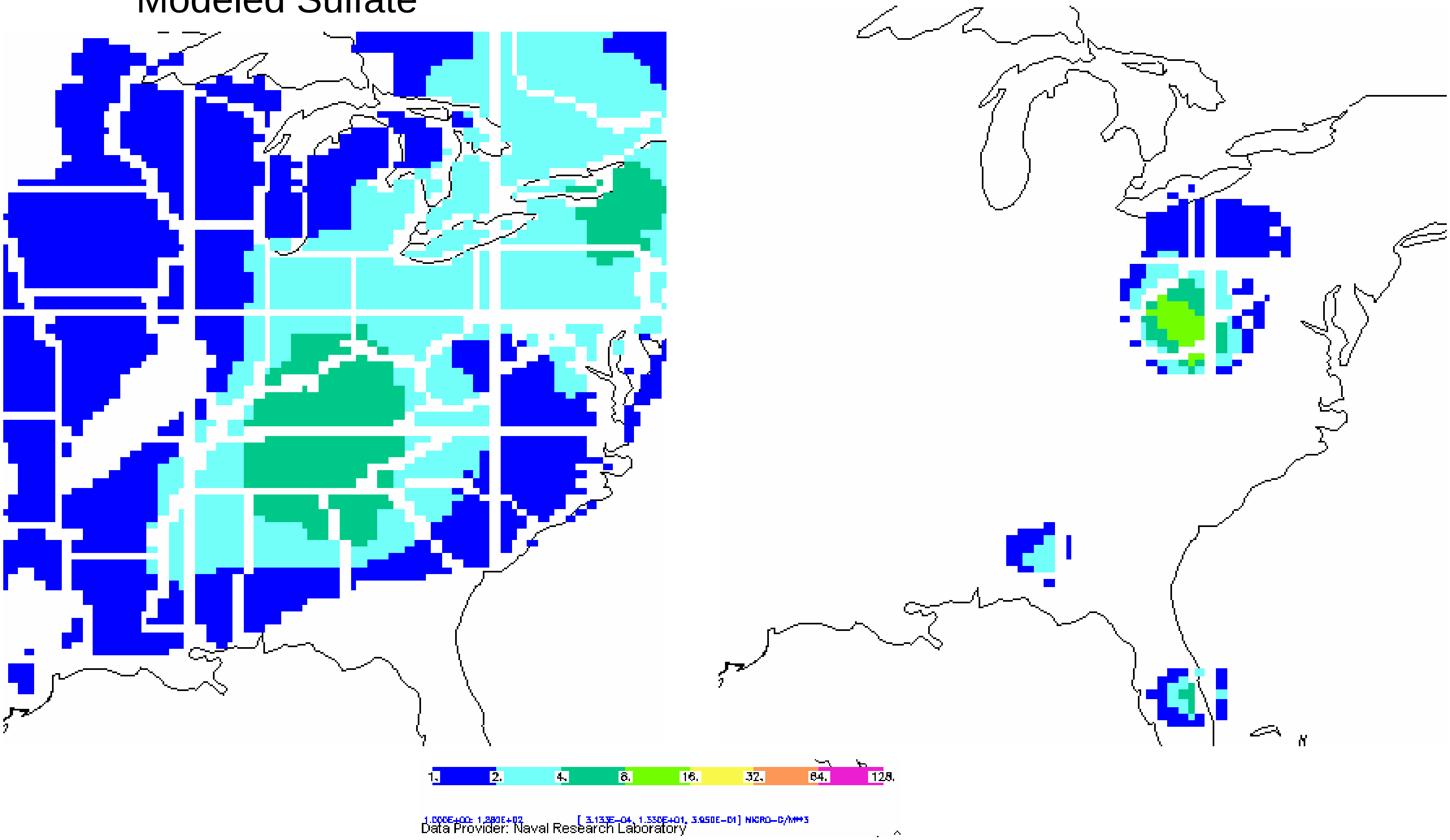
Source impact trajectories show no trajectories from the fire location impacting the Louisville area.



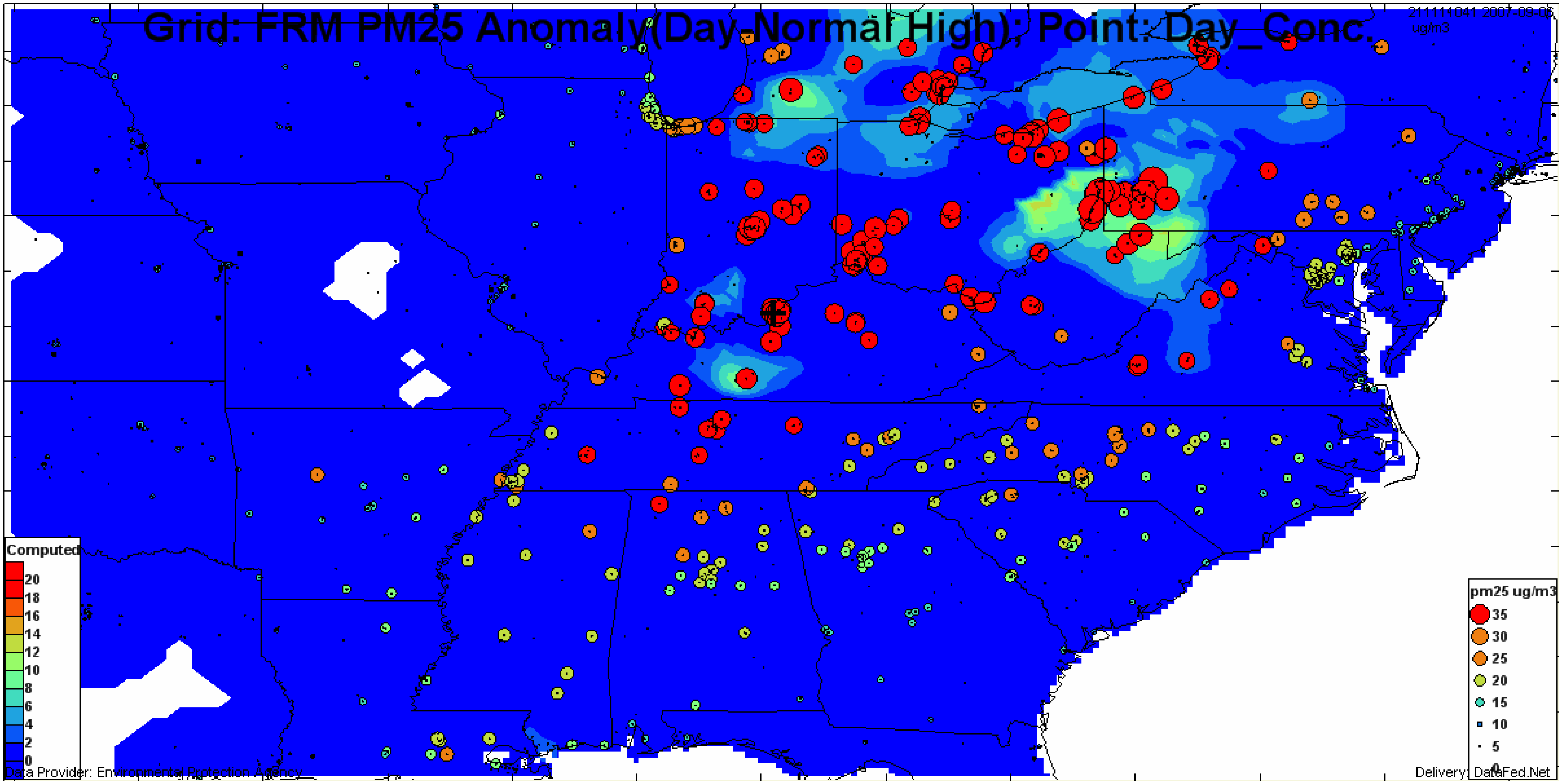
Back trajectories from the Louisville area agree with source impact trajectories: no impact from the fire area is seen.

Modeled Sulfate

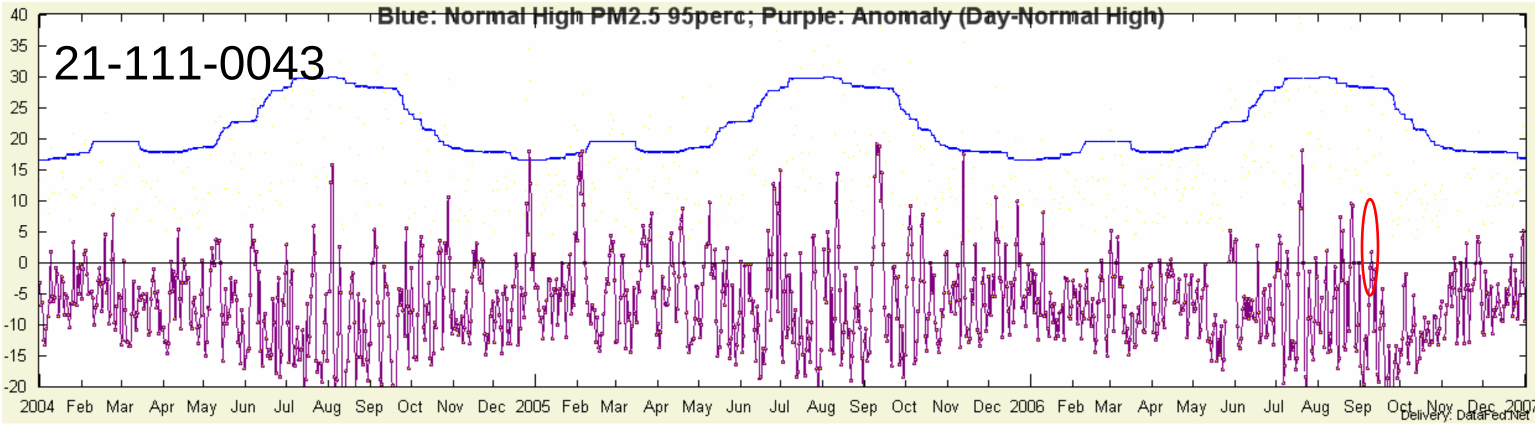
Modeled Smoke

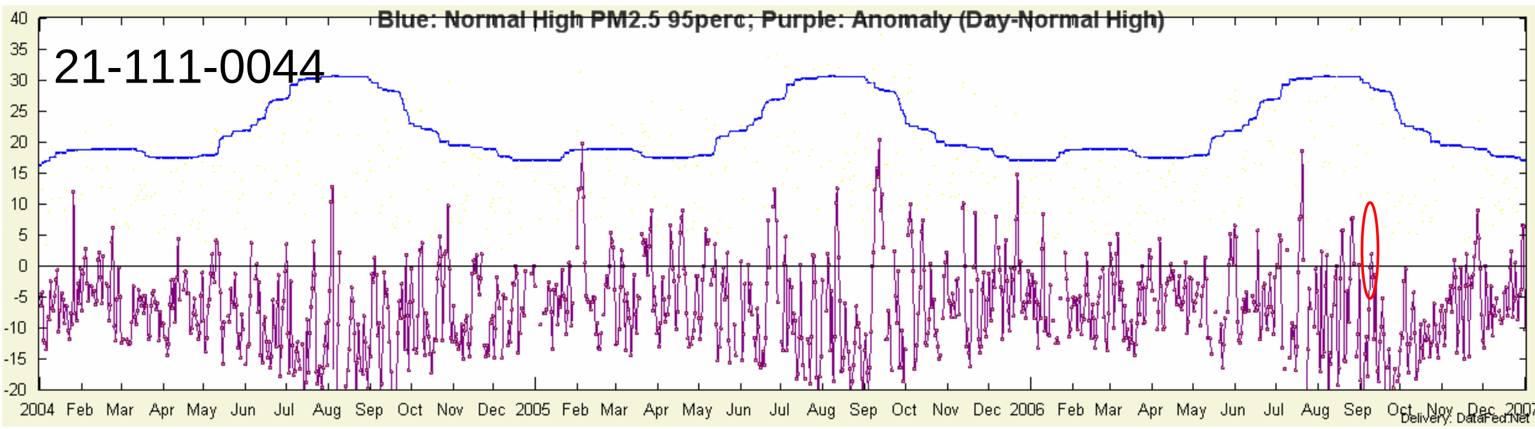


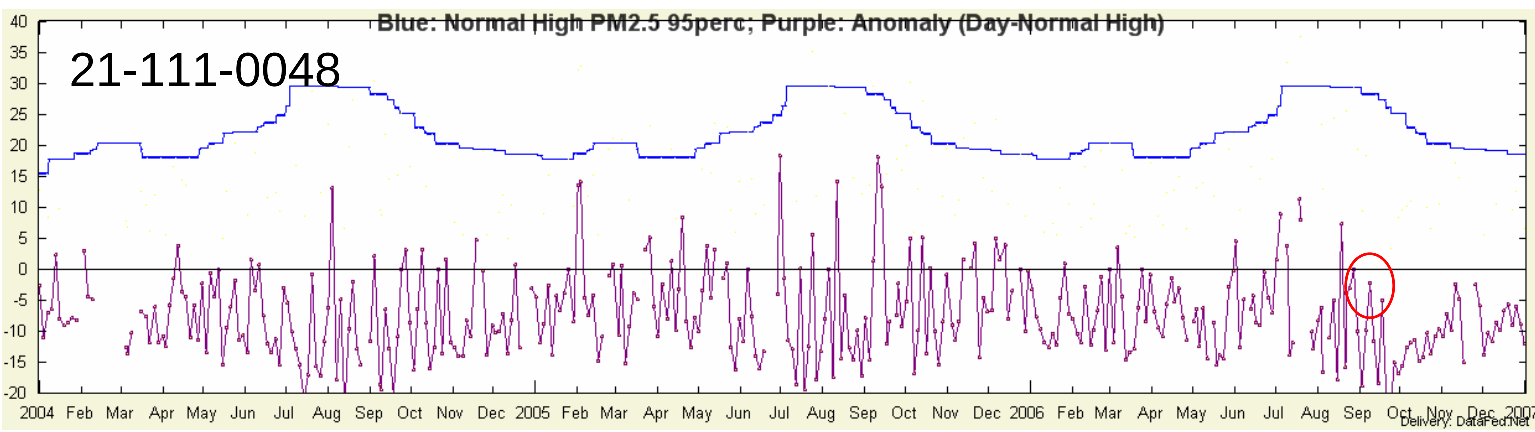
Modeled sulfate was low/moderate throughout the region and modeled smoke was low or zero throughout the region on 9/6/07.



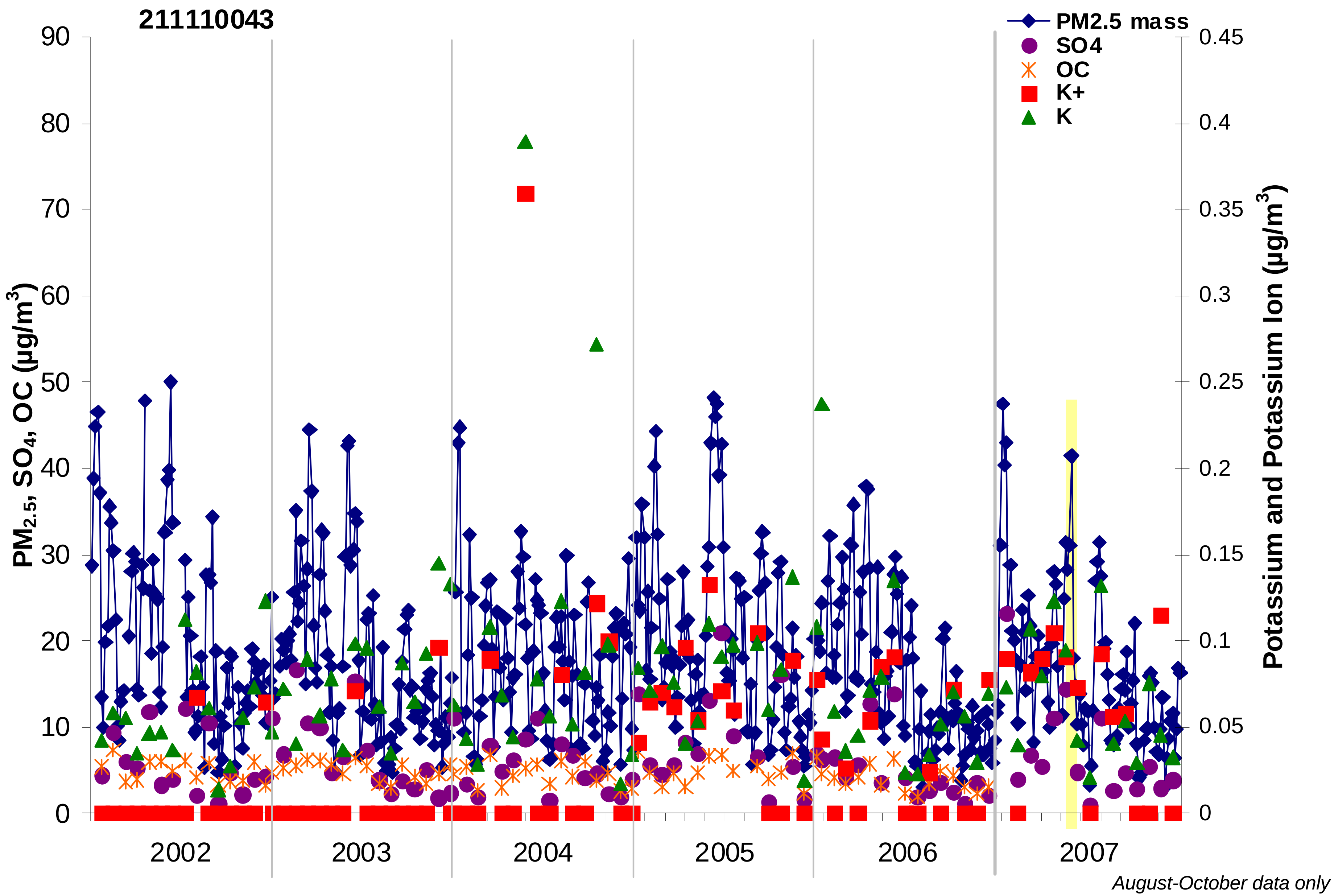
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 9/6/07, concentrations were very close to the historical values.



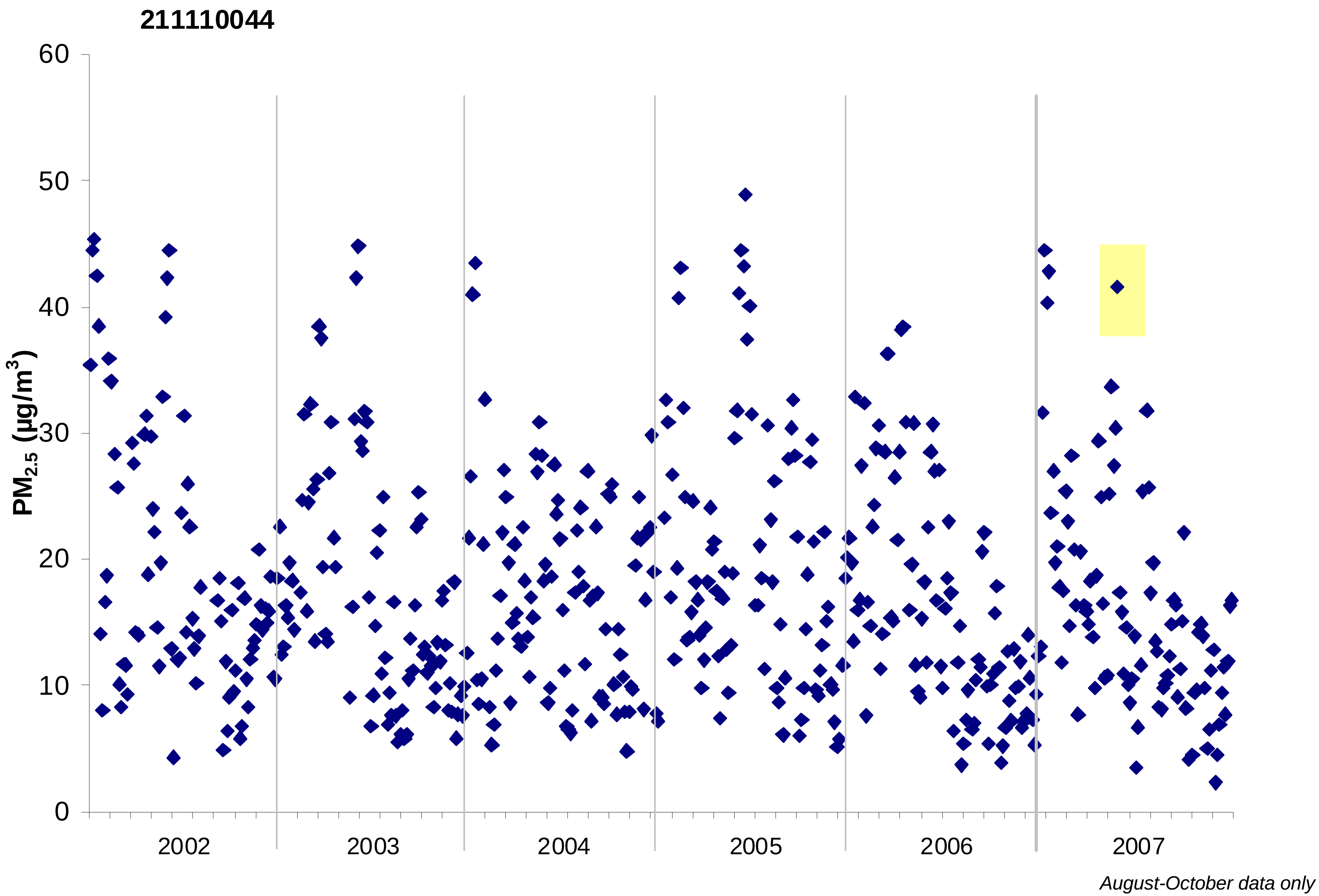




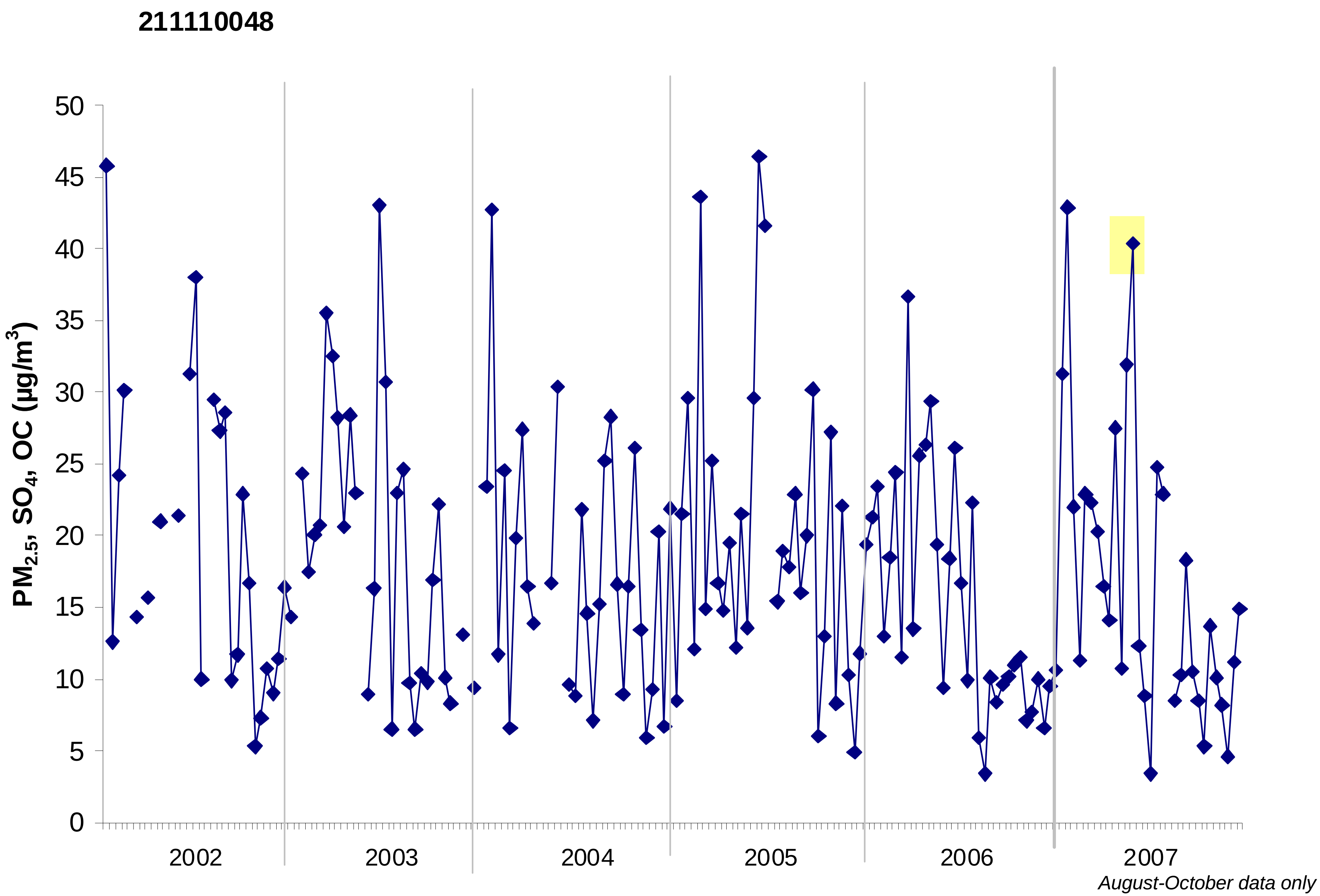
The purple lines show the difference between the given day and the historical 95th percentile concentration. On 9/6/07, concentrations were very close to historical values.



$PM_{2.5}$ concentrations were high on 9/6/07 (highlighted in yellow), but within the historical range of concentrations. OC concentrations were not available in 2007. Sulfate concentrations were high on the two samples prior to 9/6/07.



The PM$_{2.5}$ concentration is high but within the historical range of concentrations on 9/6/07 (highlighted in yellow).



The $PM_{2.5}$ concentration is high but within the historical range of concentrations on 9/6/07 (highlighted in yellow).

Summary

- Trajectories do not show a clear impact from the fire area on the Louisville area.
- Modeled sulfate concentrations were only moderate in the region on 9/6/07, but there was no modeled smoke impact.
- Meteorological conditions are conducive to a high $PM_{2.5}$ event (winds from the south likely transporting a humid air mass that would increase secondary particle formation and a strong upper level ridge limiting mixing).
- Concentrations at all sites are within the historical range and likely not impacted by forest fires.

Exceptional Events Analysis
Louisville, KY

Multiple sites (21-111-0043, 21-111-0044,2
21-111-0048, 21-111-0051) evaluated for
impact from fireworks

Years examined: 2004, 2005, 2006

Days Under Consideration

$PM_{2.5}$ concentrations in $\mu g/m^3$

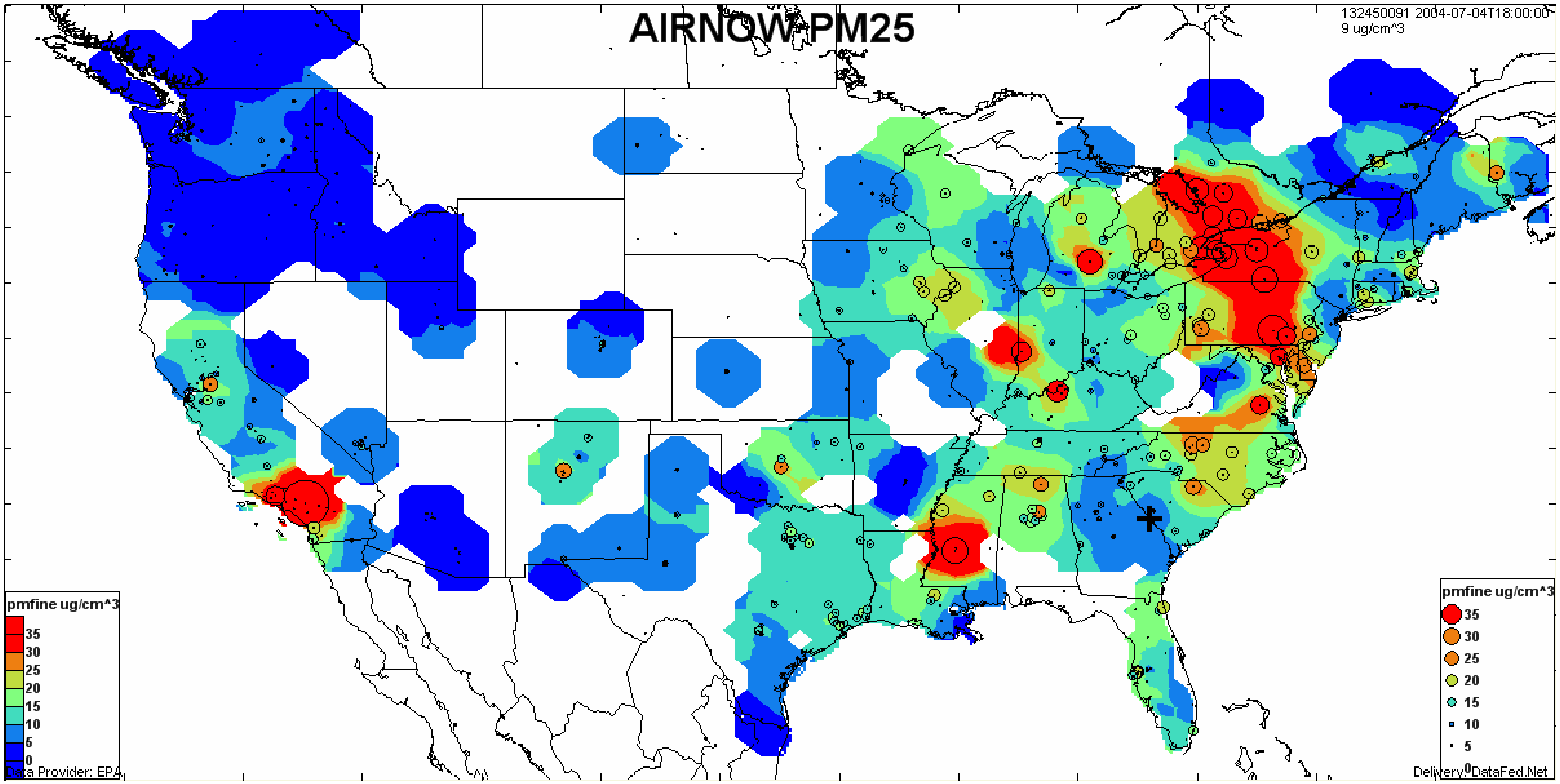
Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
July 4, 2004	33.1	26.4		
July 3, 2005	24.1	27.5	24.9	28.9
July 4, 2005	29.5	32.2		
July 3, 2006	31.7	32.1		
July 4, 2006	29.6	32.7	35.3	

2004

$PM_{2.5}$ concentrations in $\mu g/m^3$

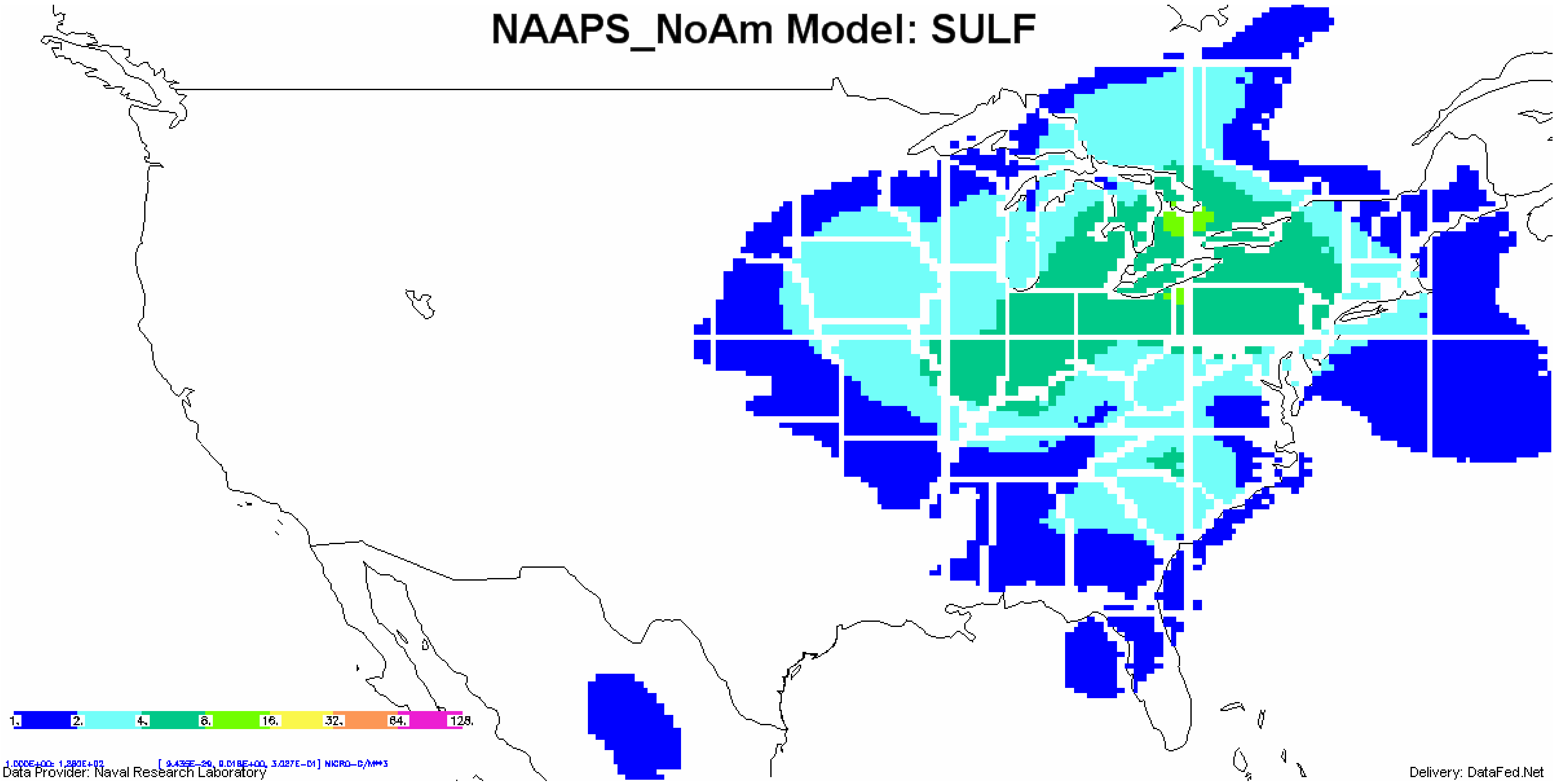
Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte
July 4, 2004	33.1	26.4

July 4, 2004 was flagged as exceptional at two sites. These values will be evaluated against the annual average $PM_{2.5}$ standard ($15\mu g/m^3$).



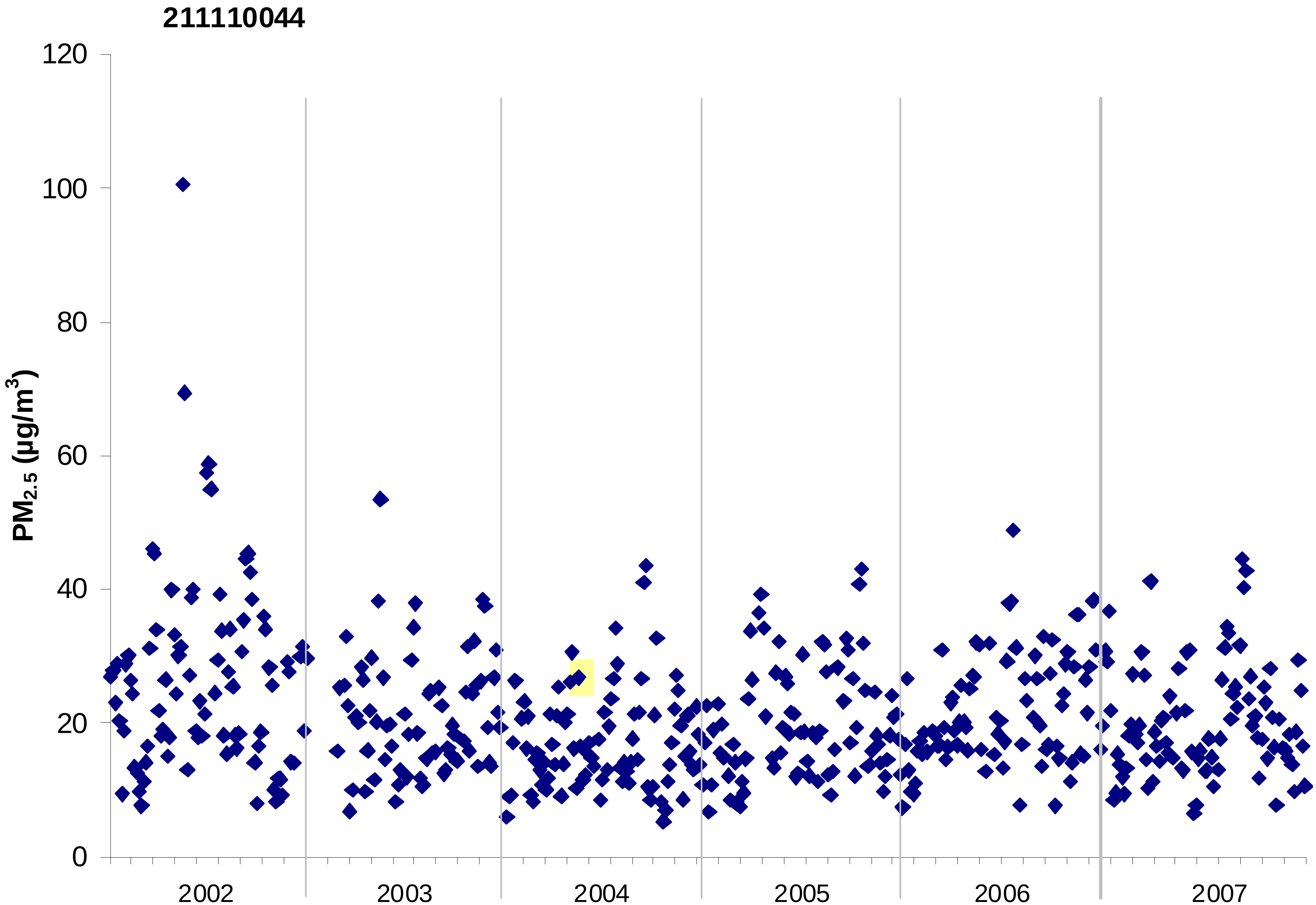
Relatively isolated areas of high PM2.5 are seen, indicating there was no regional event (i.e., from sulfate) causing high $PM_{2.5}$ concentrations.

http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/AIRNOW_PM25_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map



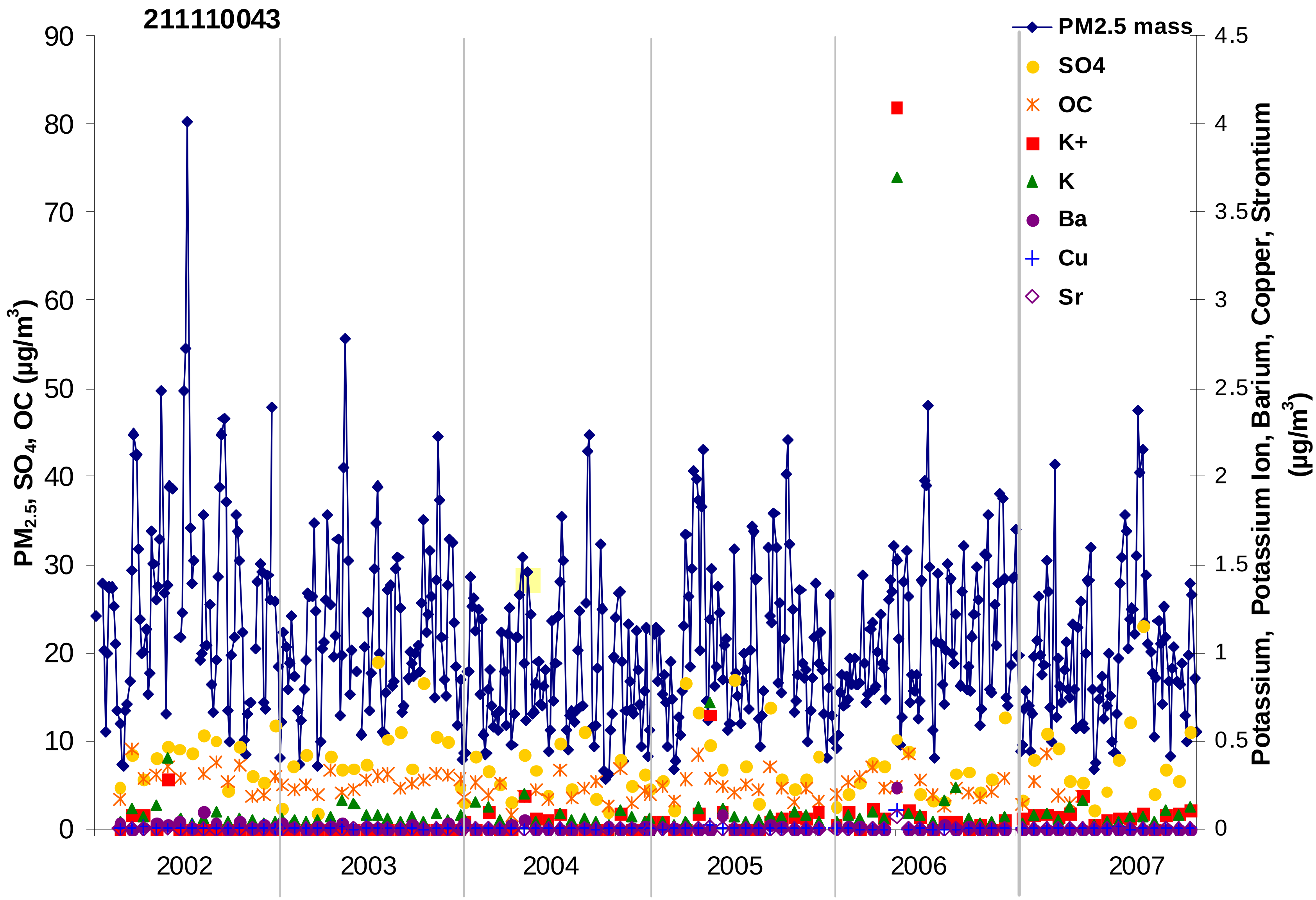
Modeled sulfate is low/moderate in Louisville on 7/4/04.

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf



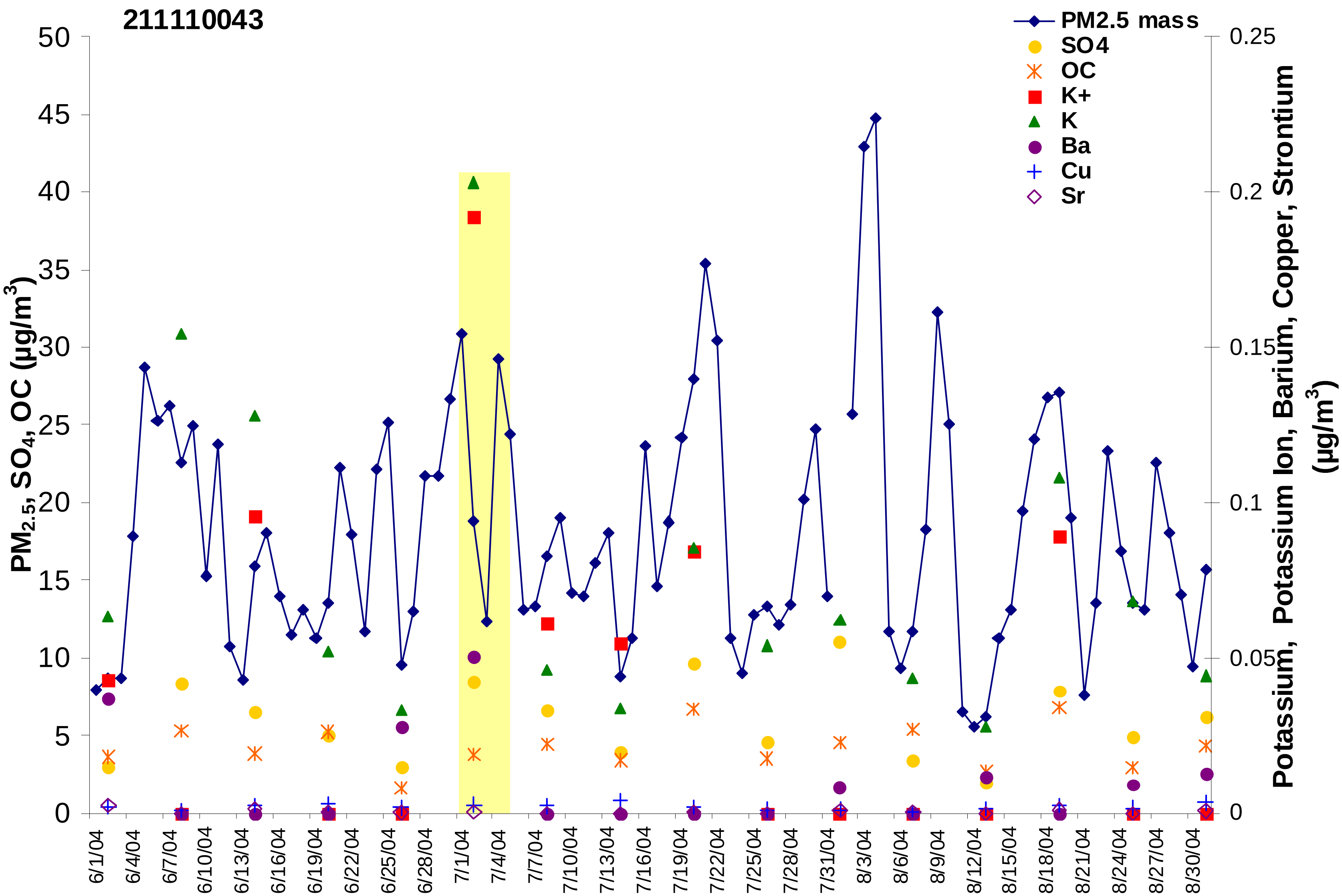
$PM_{2.5}$ concentrations at 21-111-0044 on 7/4/04 (highlighted in yellow) were well within the normal range of concentrations.

Data from AQS



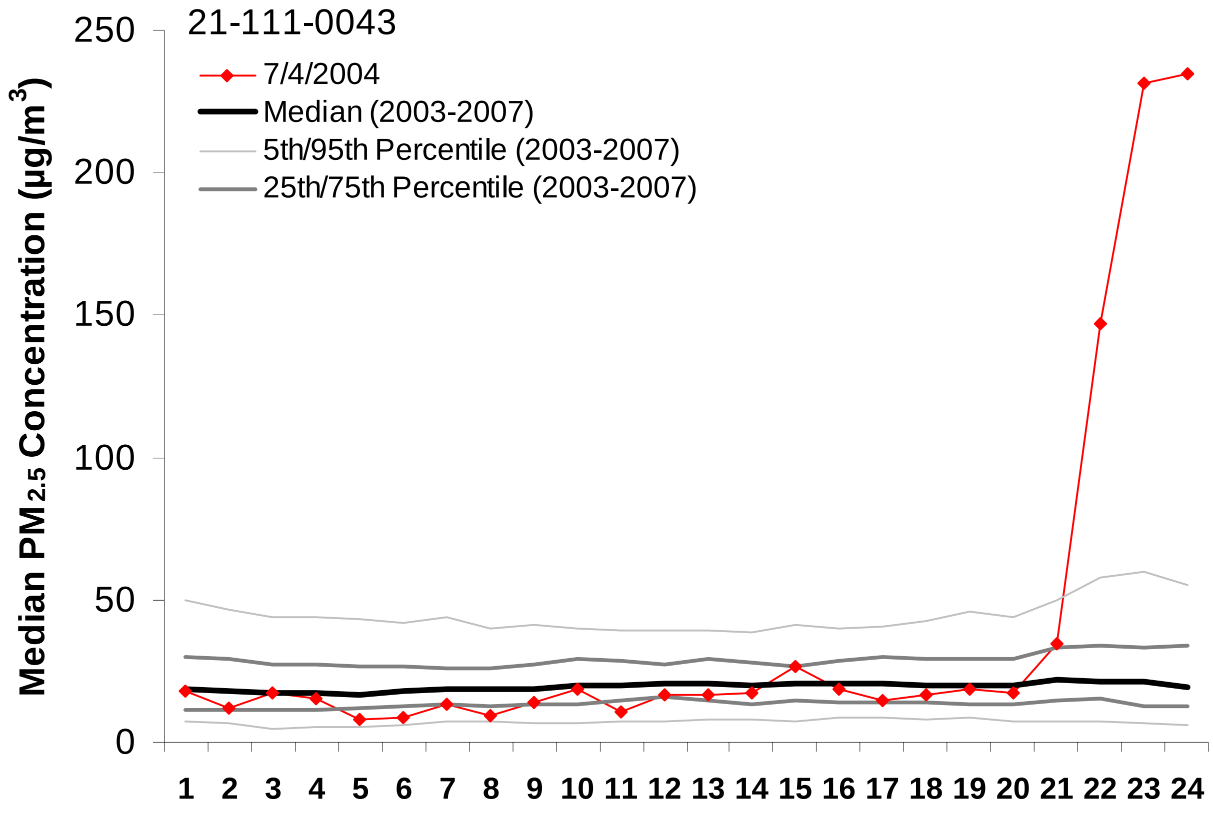
PM$_{2.5}$ concentrations at 21-111-0043 on 7/4/04 (highlighted in yellow) were well within the normal range of concentrations.

Data from AQS



Concentrations of various fireworks tracers are high on 7/2/04 (no measurements were available on 7/4/04).

Data from AQS



Hourly data show a clear increase in concentrations in the evening, as expected from fireworks. An upper-level trough of low pressure passing over the region led to enhanced vertical mixing in the atmosphere, limiting the impact of the fireworks. Concentrations returned to normal values within a few hours (not shown).

If the three highest hours (22-24) are replaced with the median or excluded, the 24-hour average decreases by about 60%.

The 24-hour filter measurement was also decreased by 60%, which decreased the quarterly average by 0.2µg/m^3 and the annual average by 0.05µg/m^3. This is not enough to bring the 3-year average below 15µg/m^3.

Hourly data is not available for site 21-111-0044, but it likely had a similar level of impact from fireworks.

Data from AQS

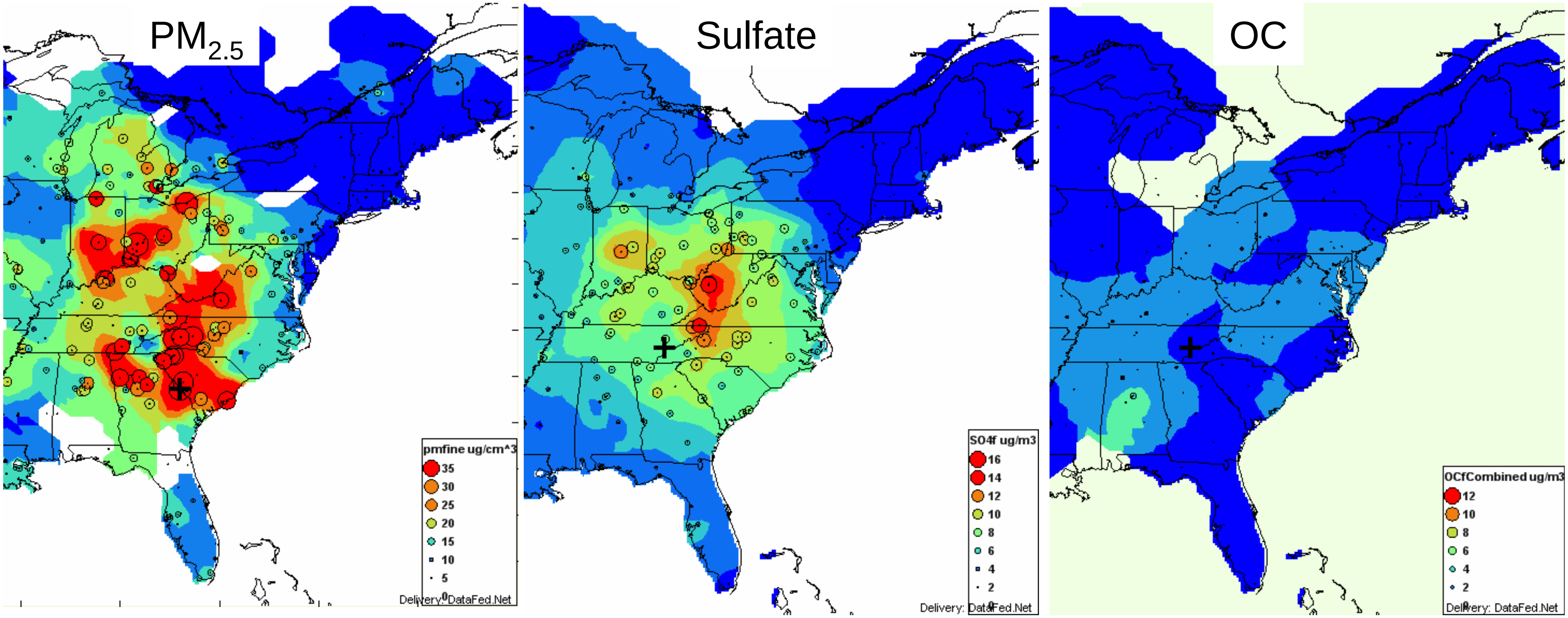
Summary: 2004

- A clear impact from fireworks was observed using hourly data and speciated data.
- Using the hourly data to estimate what the 24-hour average would be without the fireworks impact shows that the annual average and, therefore, 3-year average would not have been significantly impacted without the fireworks event.

2005

Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
July 3, 2005	24.1	27.5	24.9	28.9
July 4, 2005	29.5	32.2		

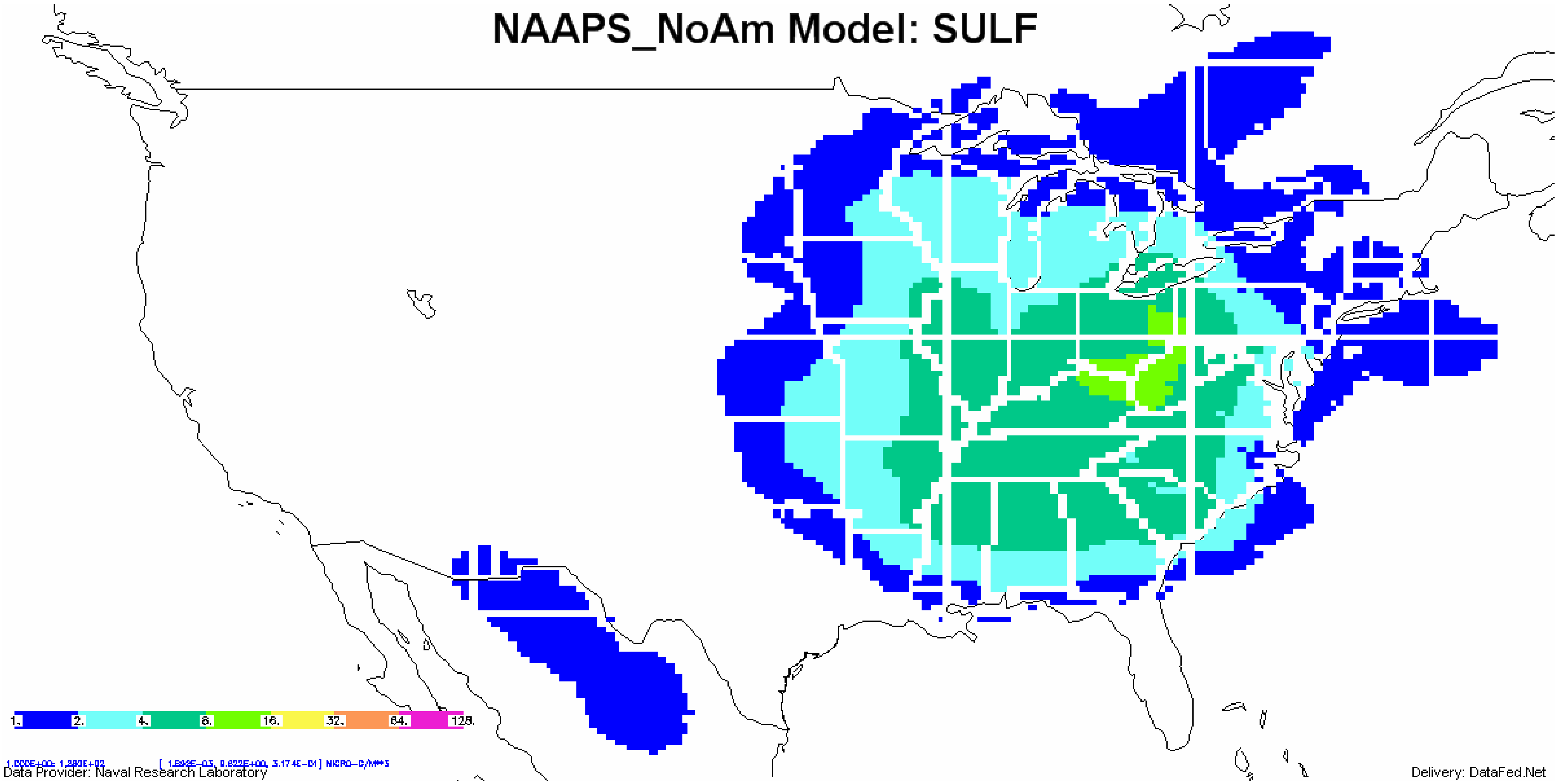
July 3, 2005 was flagged as exceptional at four sites and July 4, 2005 was flagged as exceptional at two sites. These values will be evaluated against the annual average $PM_{2.5}$ standard (15µg/m^3).



On 7/3/05, $PM_{2.5}$ concentrations were high in several areas throughout the region. Some high sulfate areas area also observed, but OC is low throughout the region.

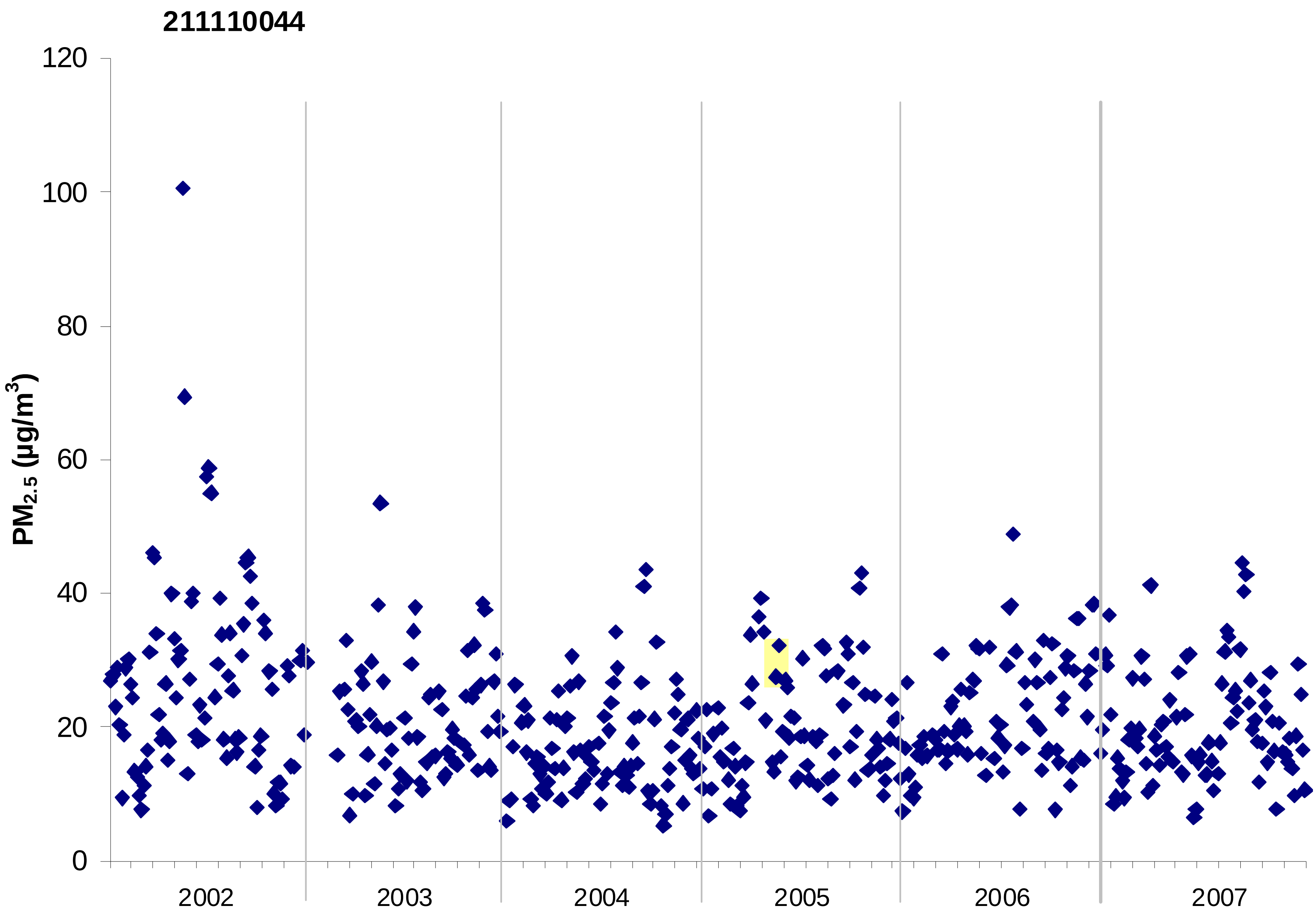
Sulfate and OC are not available on 7/4/05, but $PM_{2.5}$ showed similar areas of high concentrations.

http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/AIRNOW_PM25_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map



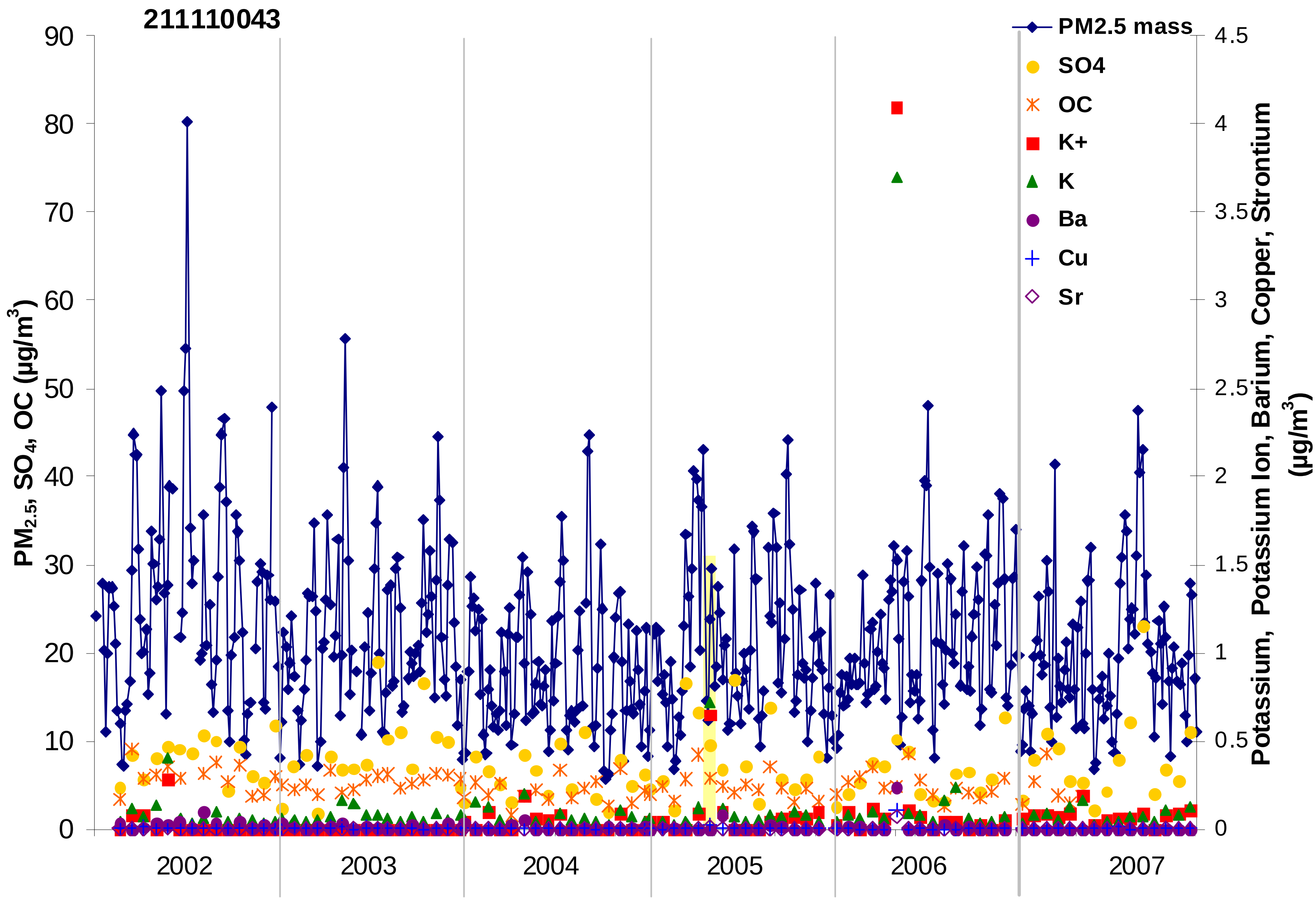
Modeled sulfate was moderate throughout Kentucky on 7/3/05. (Similar on 7/4/05)

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf



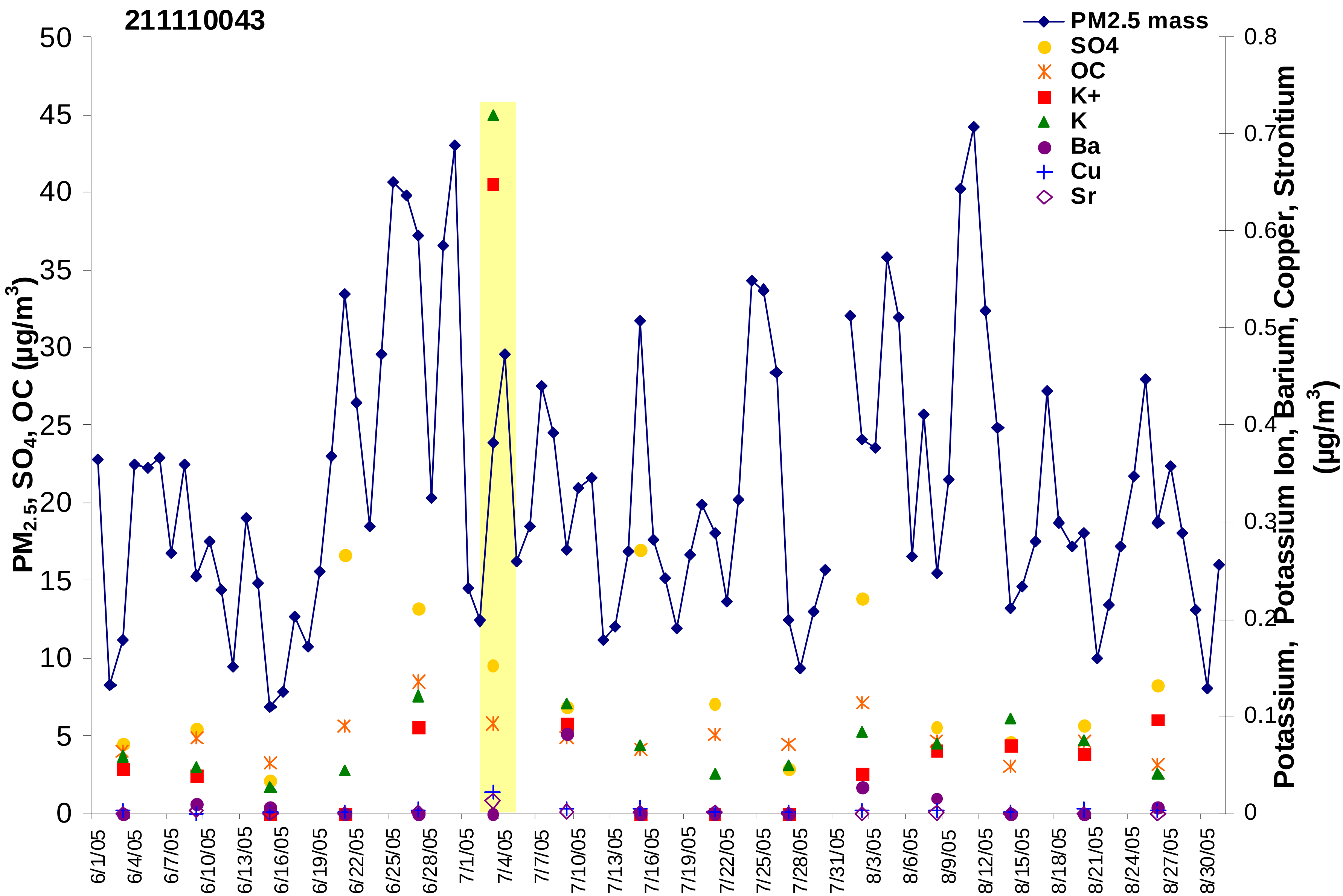
$PM_{2.5}$ concentrations at 21-111-0044 on 7/3/05-7/4/05 (highlighted in yellow) were well within the normal range of concentrations.

Data from AQS



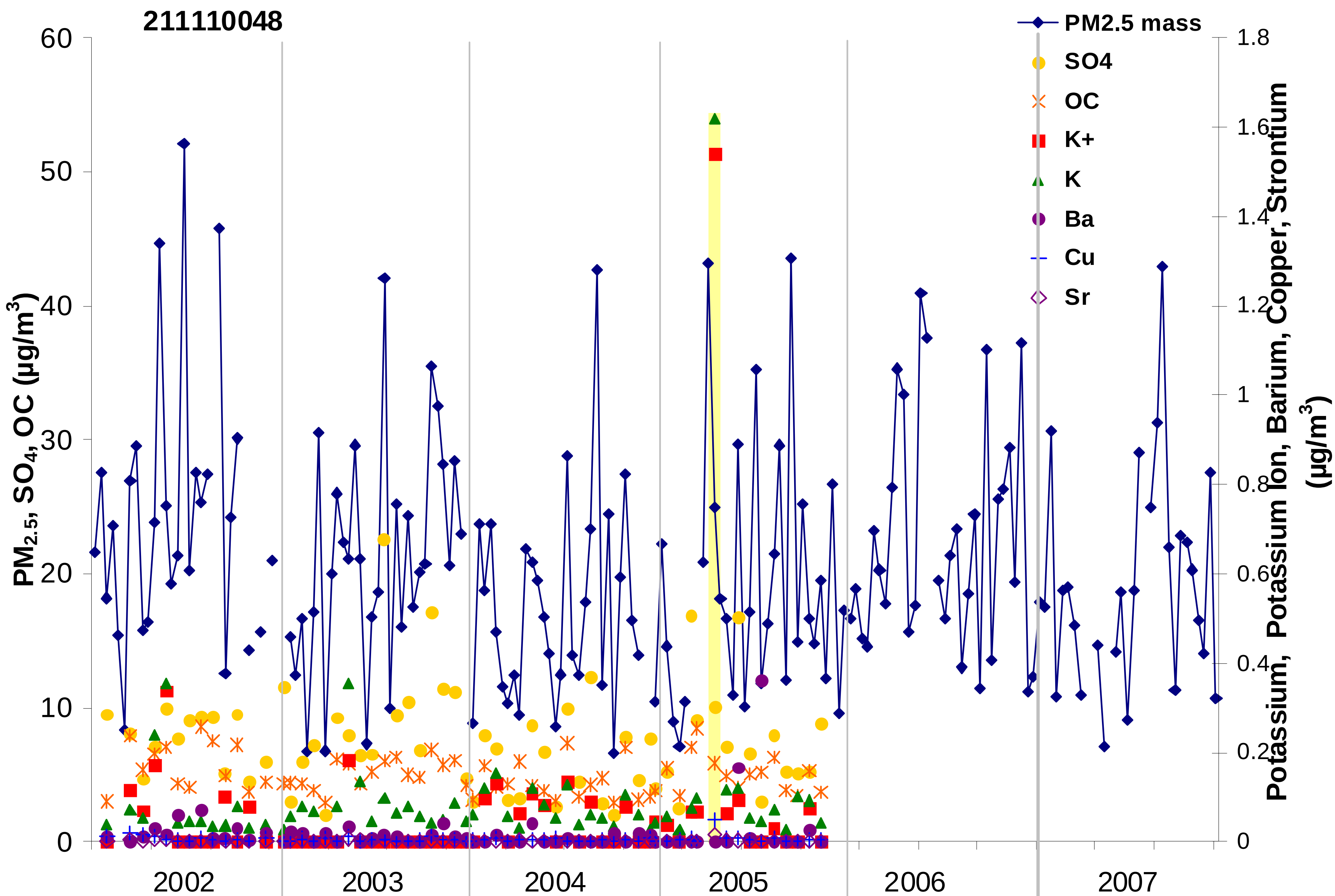
$PM_{2.5}$ concentrations at 21-111-0043 on 7/3/05-7/4/05 (highlighted in yellow) were well within the normal range of concentrations.

Data from AQS



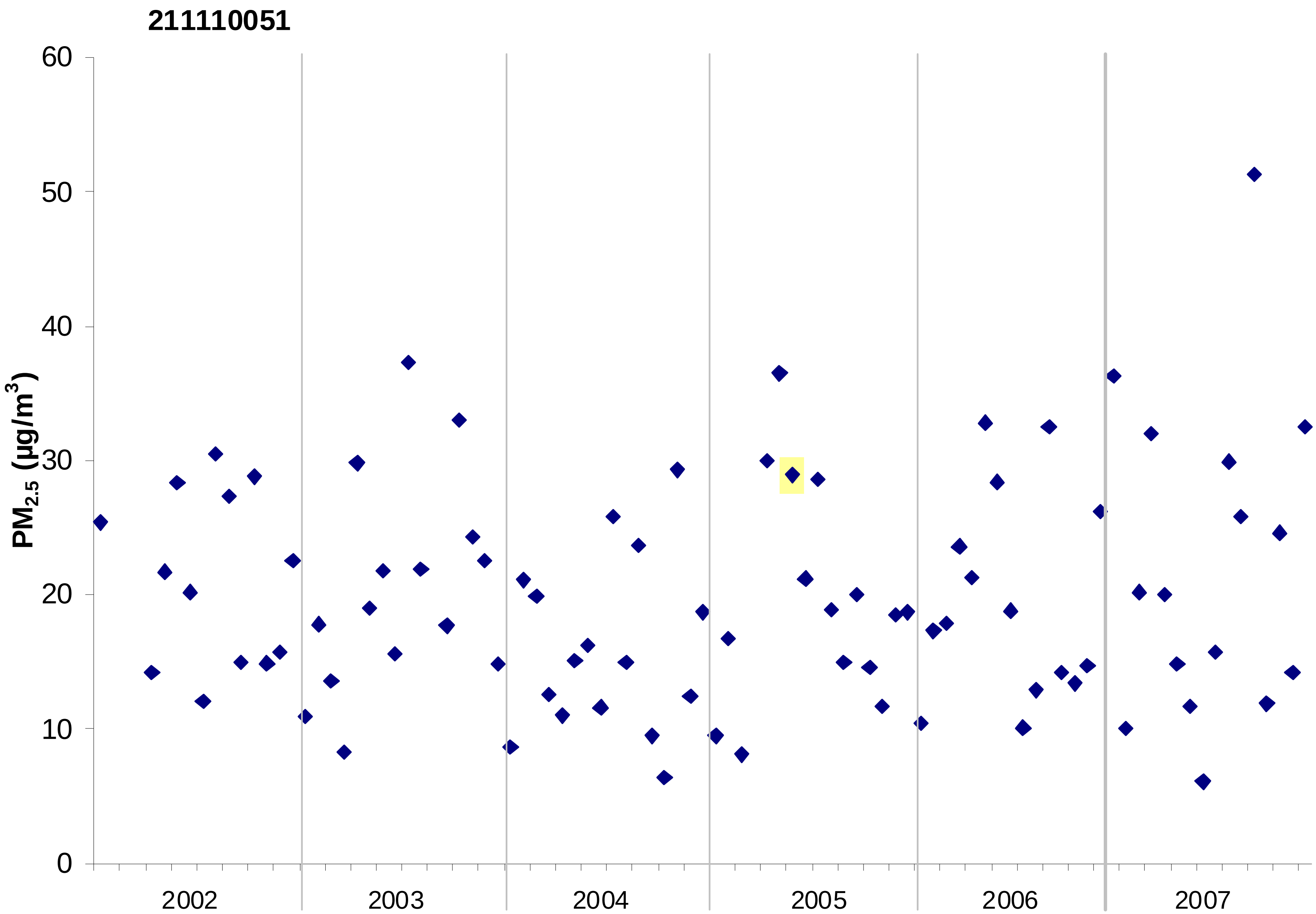
Concentrations of fireworks tracers at 21-111-0043 were high on 7/3/05 (measurements not available on 7/4/05).

Data from AQS



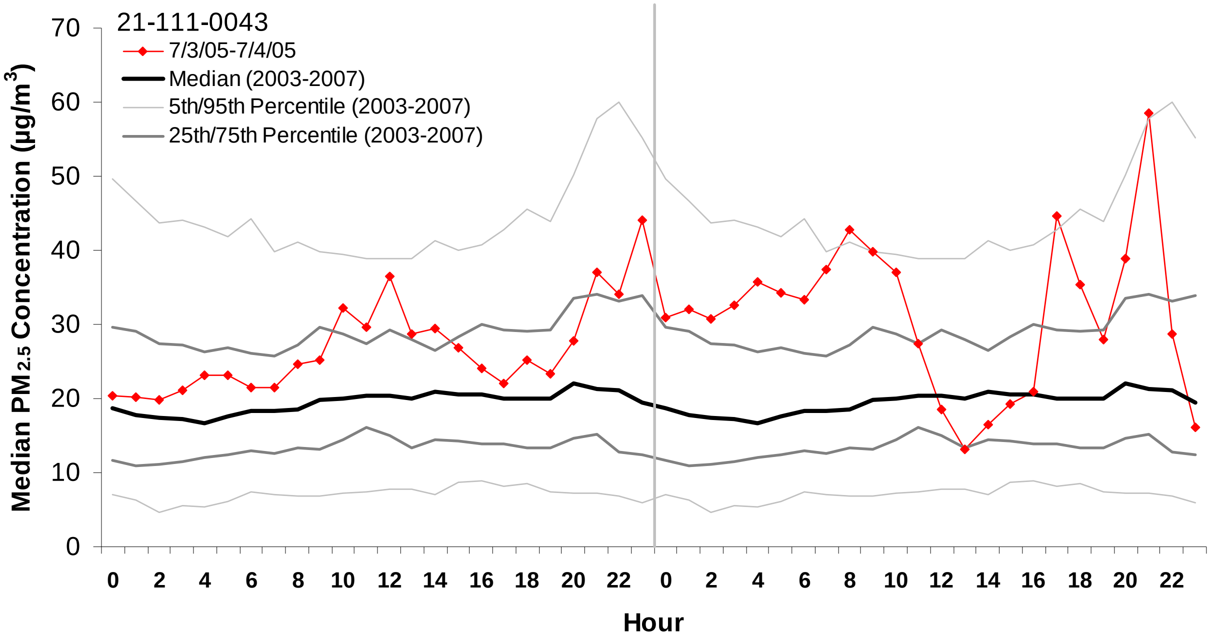
At 21-111-0048, concentrations of fireworks tracers were very high on 7/3/05; concentrations of $PM_{2.5}$ were within the typical range of concentrations.

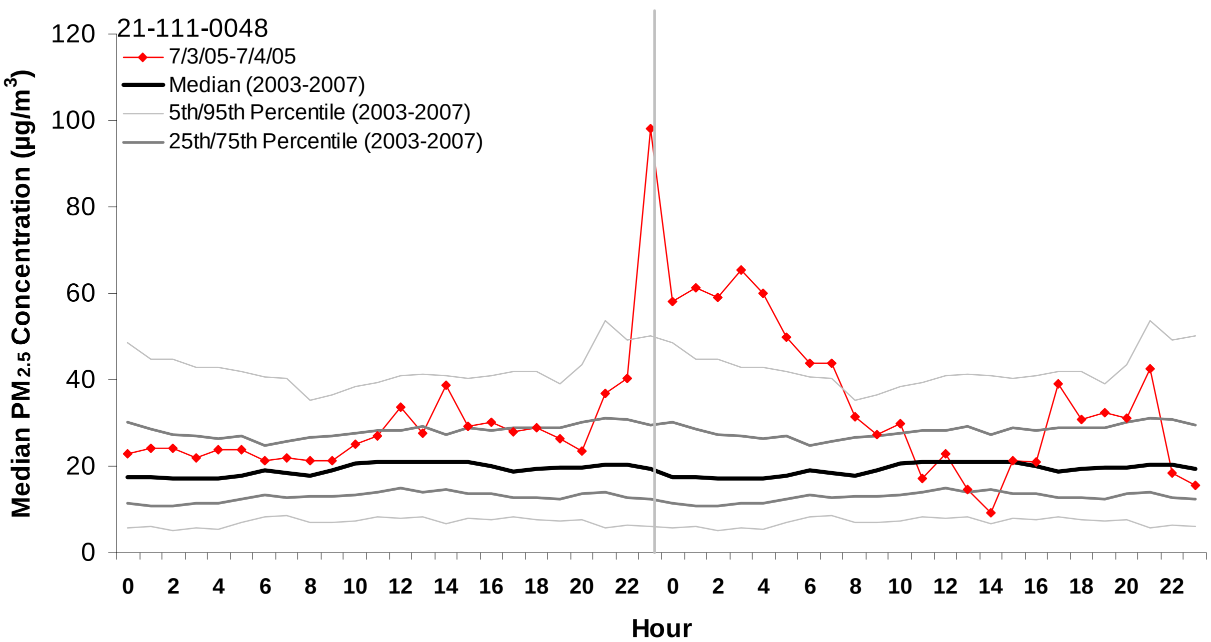
Data from AQS



Concentrations of PM2.5 at 21-111-0051 were within the historical range of concentrations on 7/3/05.

Data from AQS





No large increase in hourly concentrations, as expected from a single fireworks event, is seen at 21-111-0043. However, concentrations at several hours are near the 95th percentile of concentrations.
A large spike in concentration is seen at midnight on July 3rd. It's possible that because the 4th of July was on a Monday, large firework displays were set off the day before. Additionally, there was limited dispersion due to calm winds, an overnight surface inversion, and an strong subsidence inversion at 800 mb, which likely caused concentrations at 21-111-0048 to remain elevated for several hours.

Similar to the analysis for 7/4/04, the percent increase due to the fireworks was calculated and applied to the 24-hour filter measurement. The annual average decreased by less than 0.01µg/m^3 at 21-111-0043 and 0.02µg/m^3 at 21-111-0048, not enough to be below the standard or to affect the 3-year average.

Data from AQS

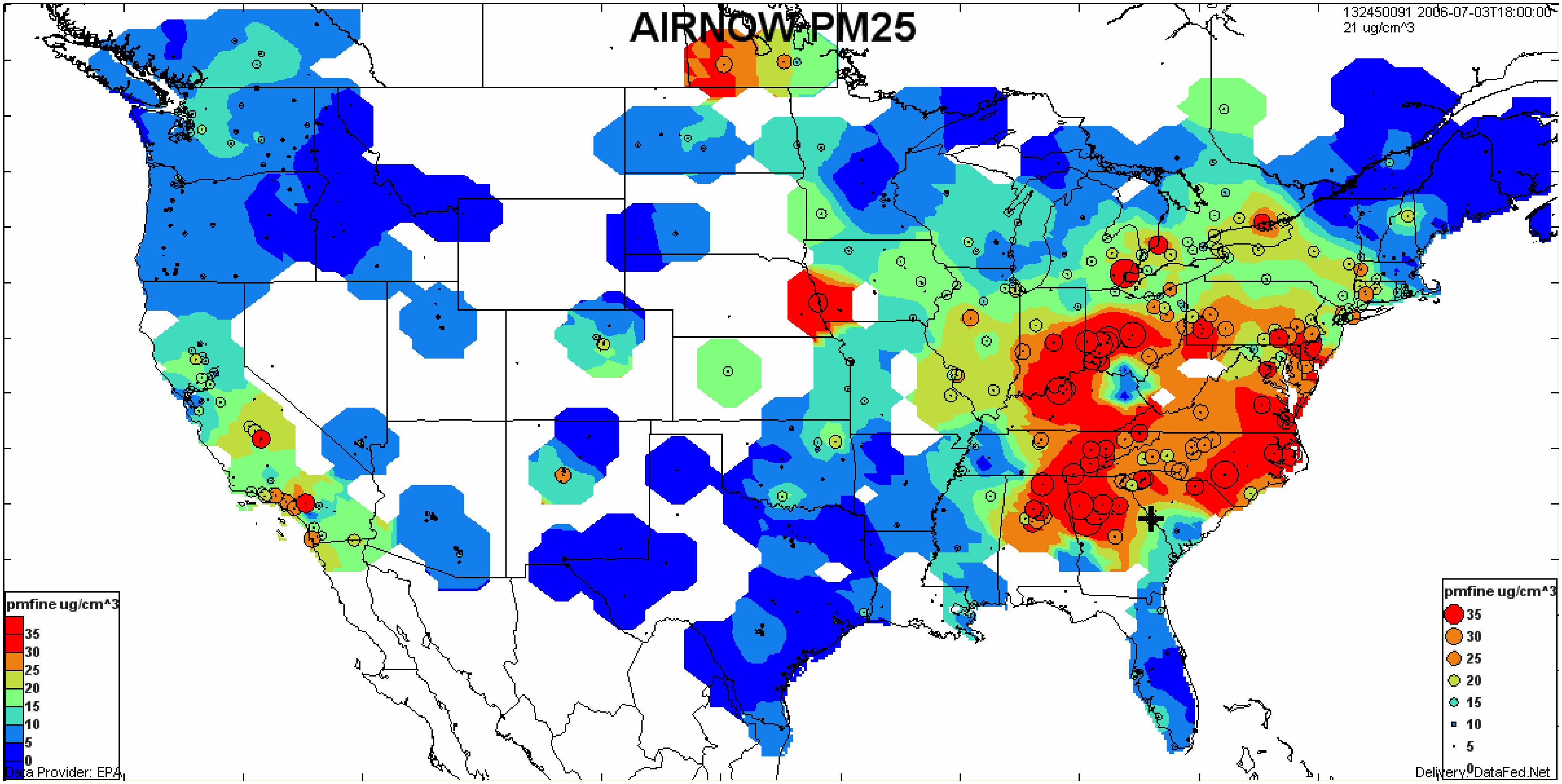
Summary: 2005

- Based on high concentrations of fireworks tracers and short (hourly) increases in PM2.5 concentrations on 7/3/05 and 7/4/05, it is likely that fireworks were impacting $PM_{2.5}$ concentrations.
- However, 24-hour concentrations were not exceptionally high and would likely not have been low enough without the influence of fireworks to impact the annual average.

2006

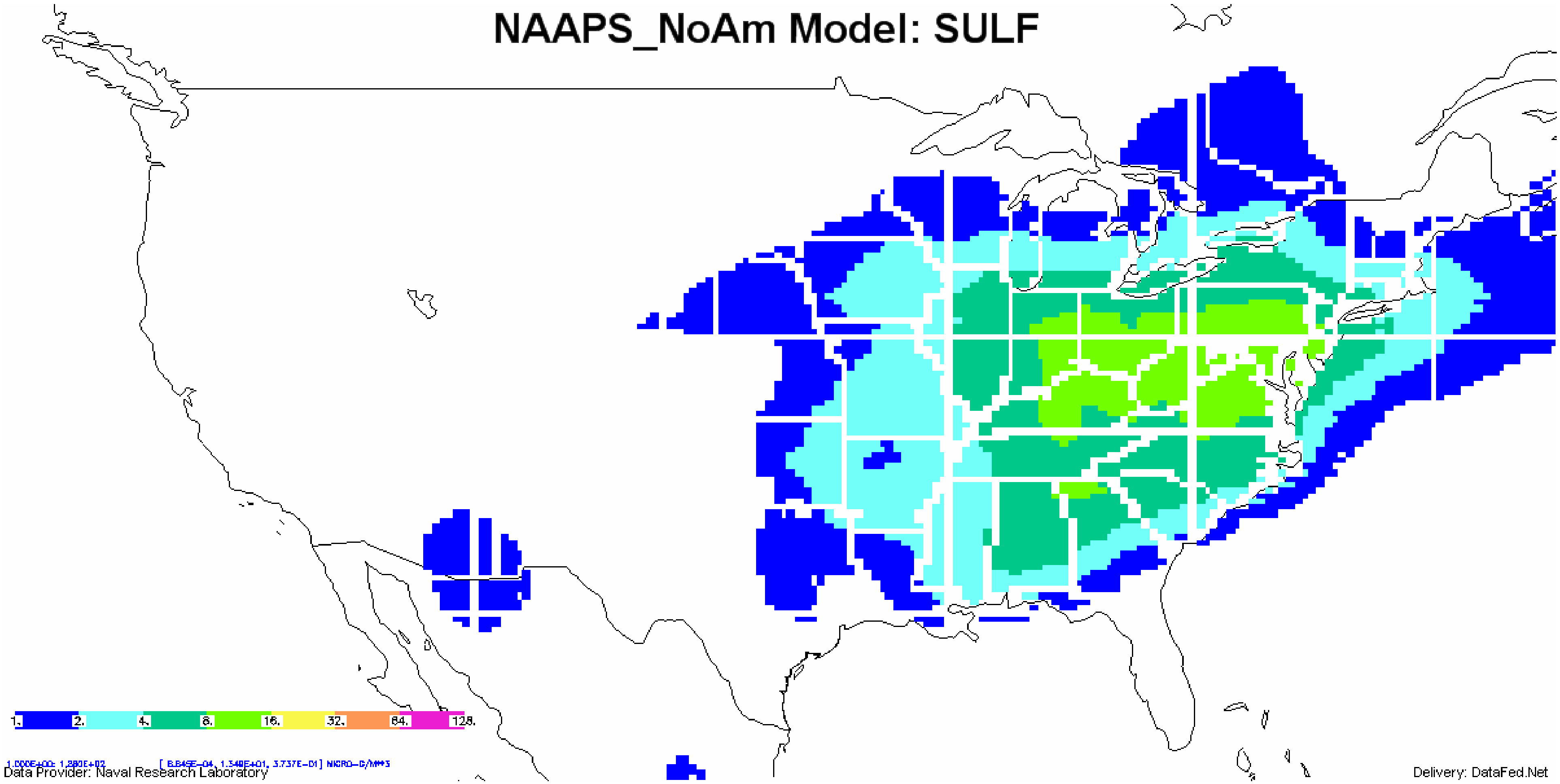
Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte	21-111-0048 Barret
July 3, 2006	31.7	32.1	
July 4, 2006	29.6	32.7	35.3

July 3, 2006 was flagged as exceptional at two sites and July 4, 2006 was flagged as exceptional at three sites. These values will be evaluated against the annual average $PM_{2.5}$ standard (15µg/m^3). The July 4, 2006 value at 21-111-0048 will also be evaluated against the 24-hour standard (35µg/m^3).



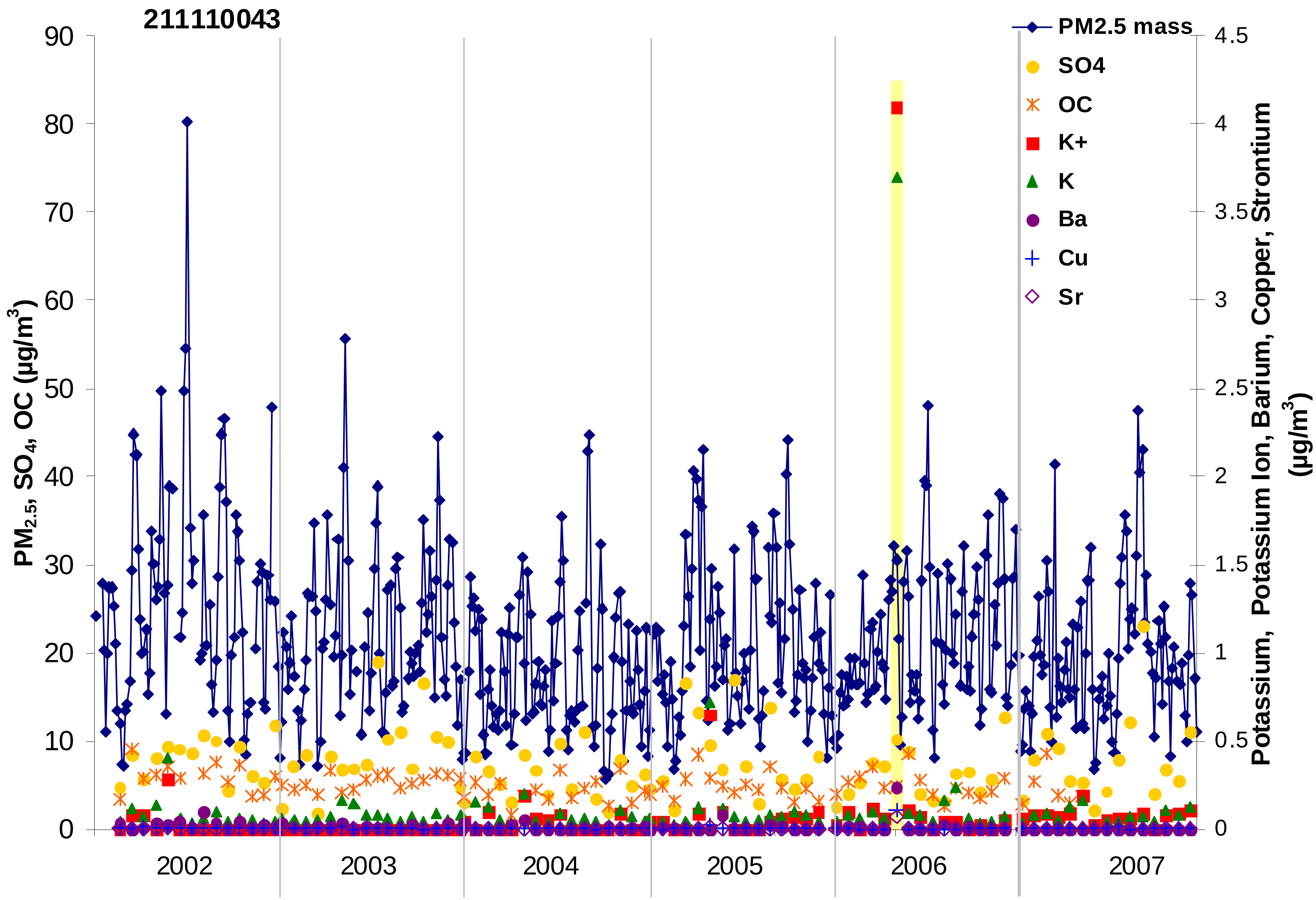
PM2.5 concentrations were high throughout the southeast on 7/3/06 (similar on 7/4/06).

http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/AIRNOW_PM25_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map



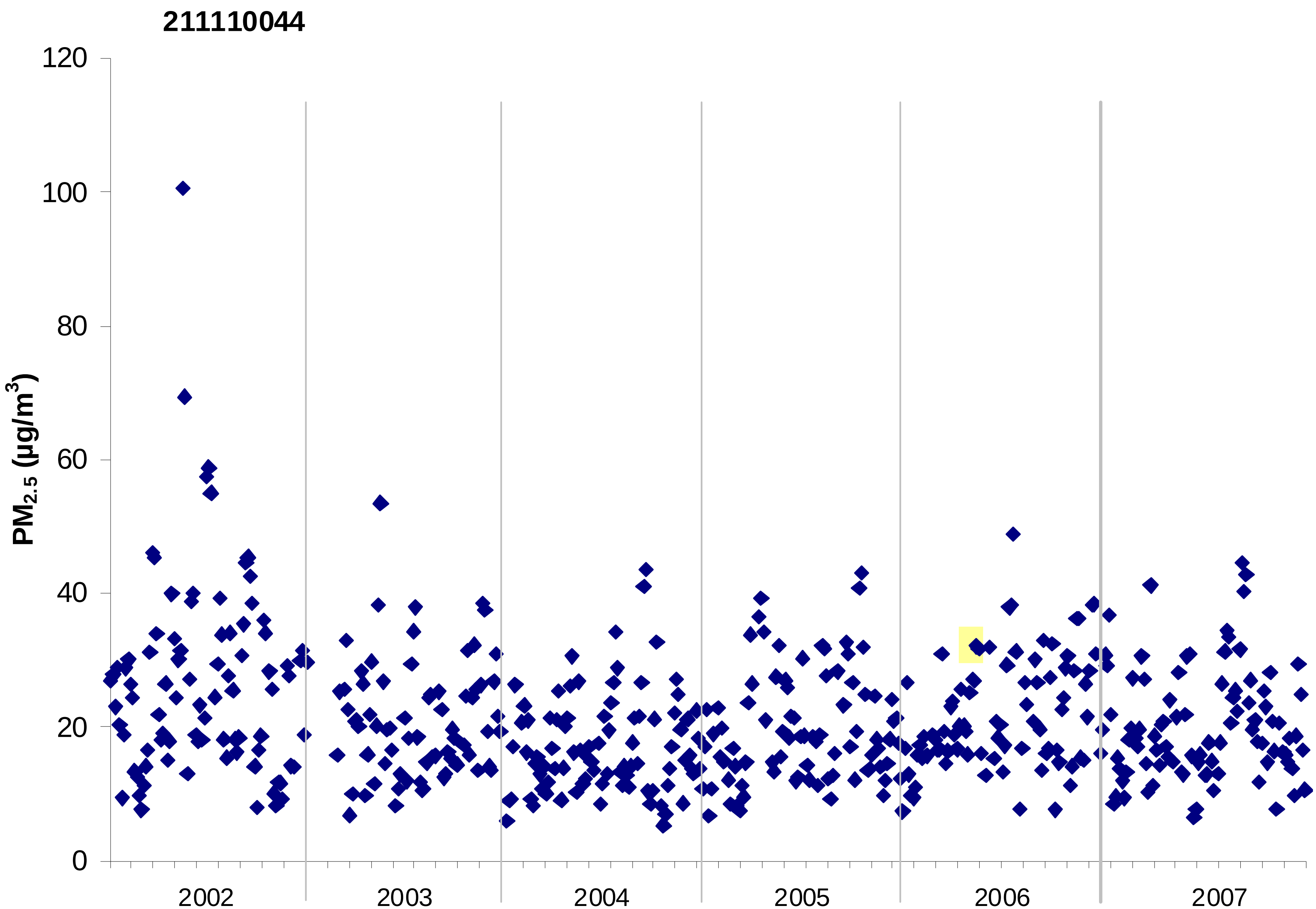
Modeled sulfate was moderate throughout the region on 7/3/06 (7/4/06 was similar).

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf



PM$_{2.5}$ concentrations at 21-111-0043 on 7/3/06-7/4/06 (highlighted in yellow) were well within the normal range of concentrations. Fireworks tracer species were high on 7/4/06.

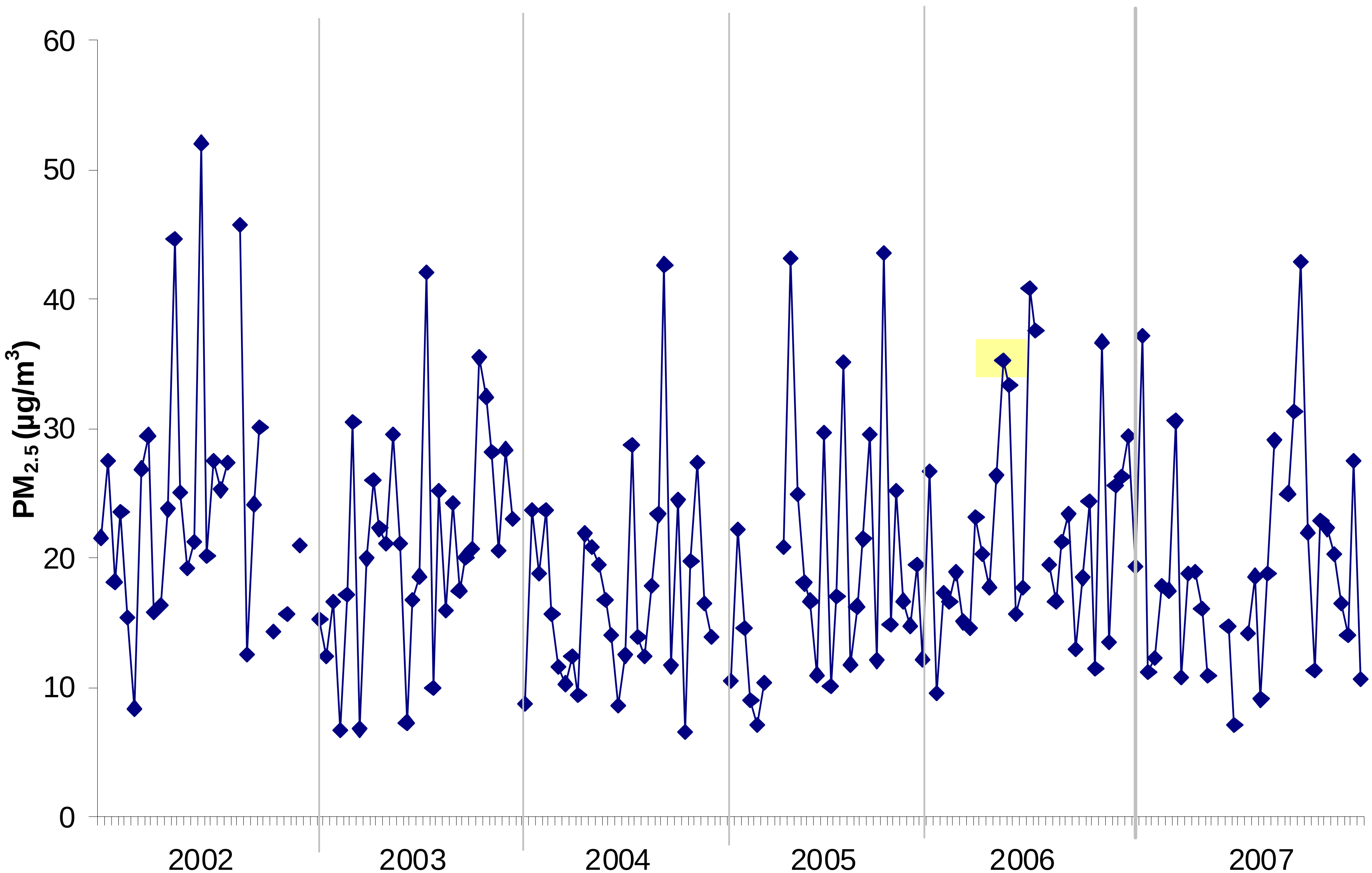
Data from AQS



$PM_{2.5}$ concentrations at 21-111-0044 on 7/3/06-7/4/06 (highlighted in yellow) were well within the normal range of concentrations.

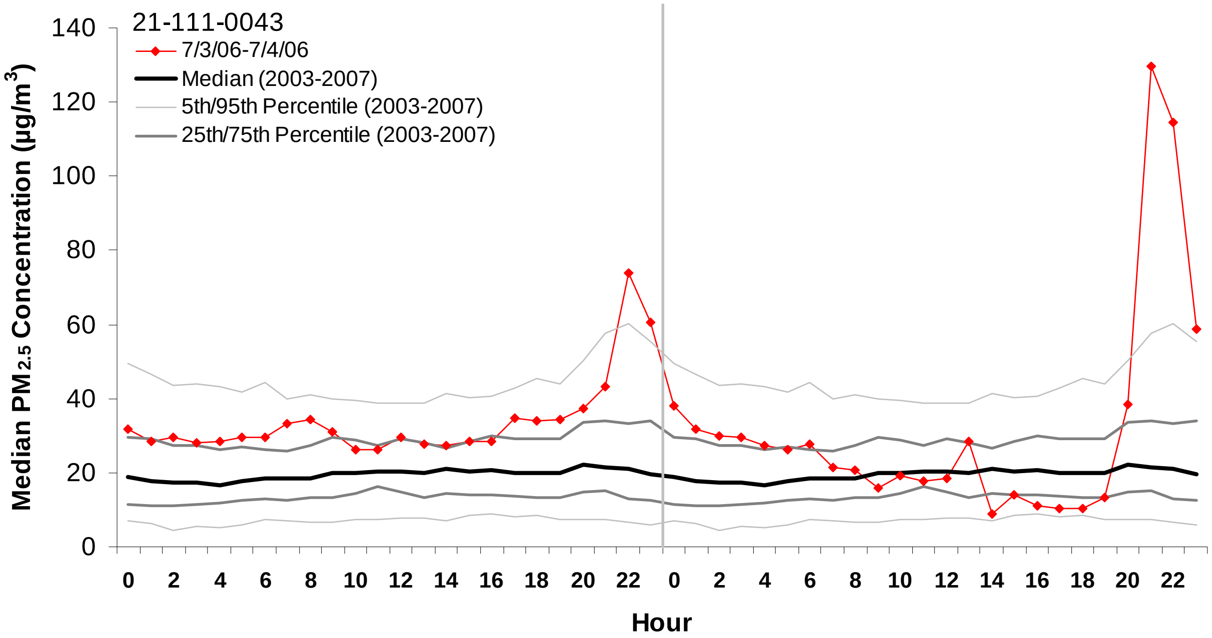
Data from AQS

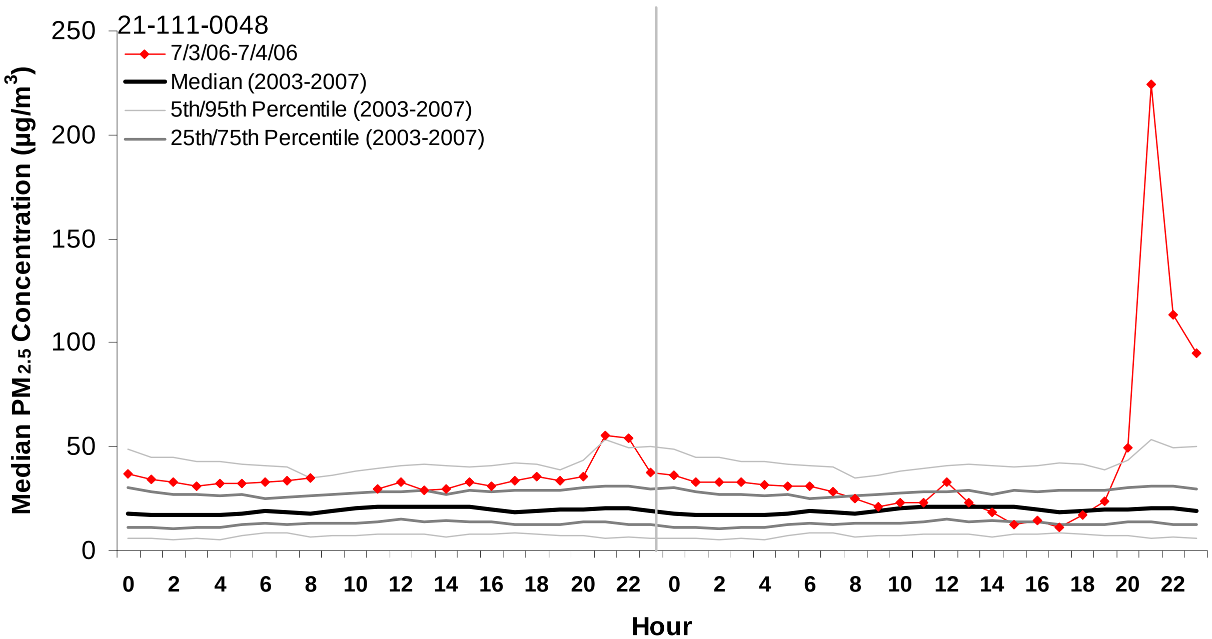
211110048



At 21-111-0048, concentrations of $PM_{2.5}$ were within the typical range of concentrations. Speciated data was not available for 2006 at this site.

Data from AQS





Large spikes in concentration were seen on 7/4/04 at hours 22-24. Smaller spikes were seen the previous night. The impact from the fireworks was limited to a few hours due to light/moderate winds throughout the night, a weak upper-level trough, and the lack of a surface inversion, all of which enhanced mixing.

As for other years, the percent increase due to the fireworks was calculated and applied to the 24-hour filter measurement. The annual average decreased 0.02µg/m^3 at both sites, not enough to be below the standard or to affect the 3-year average. At 21-111-0048, it is estimated that the 24-hr filter measurement (35.3µg/m^3) would be 38% lower (21.9µg/m^3) without the impact from fireworks. This would be well below the standard.

Data from AQS

Summary: 2006

- As in the previous years, high concentrations of fireworks tracers and short (hourly) increases in $PM_{2.5}$ concentrations on 7/3/05 and 7/4/05 indicate that fireworks were impacting $PM_{2.5}$ concentrations.
- 24-hour concentrations were not exceptionally high and would likely not have been low enough without the influence of fireworks to impact the annual average.
- July 4, 2006 was also evaluated against the 24-hour standard; it is likely this date would have been well below the standard without impact from fireworks.

Summary: 2004-2006

- There is evidence of impact from fireworks on/around July 4 for all years examined (2004-2006).
- Using hourly data, it is estimated that the impact of the fireworks on the annual average for each year is 0.01-0.02 μg/m^3, not enough to impact the design value at each site.
- One sample, July 4, 2006, 21-111-0048, was also above the 24-hour standard. This sample would likely have been well below the standard without the impact from fireworks.

EPA Technical Analysis for Paducah-Mayfield

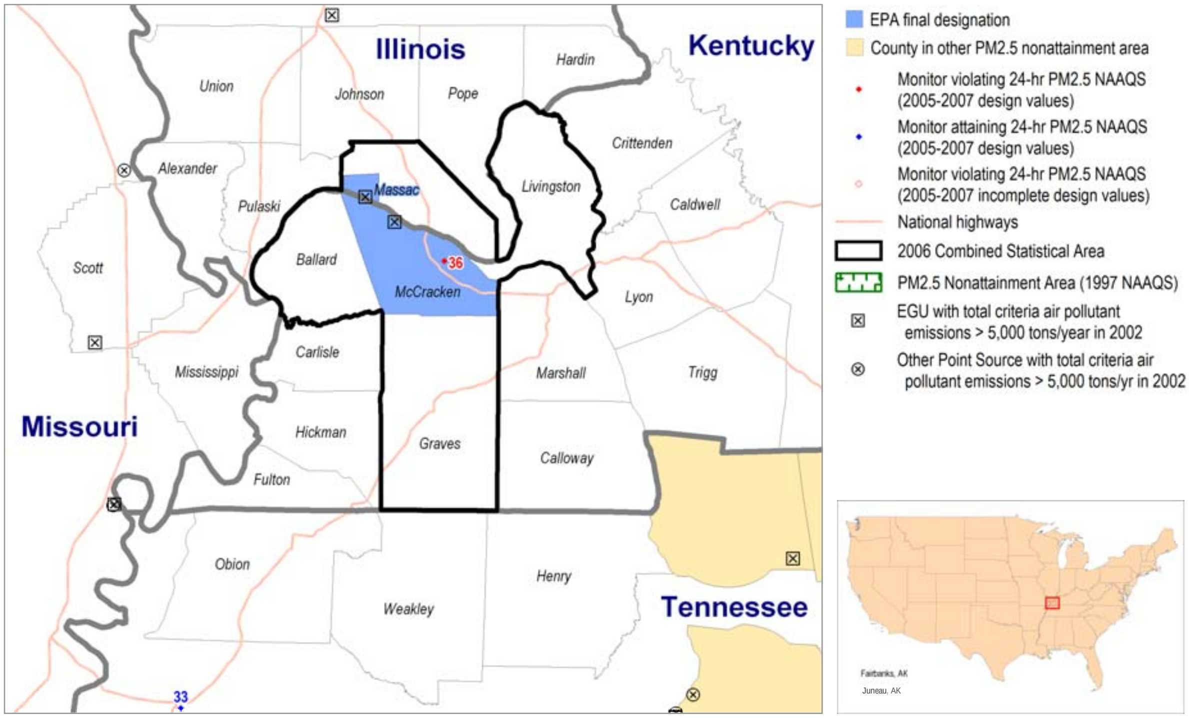
Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for Paducah Mayfield area identifies the counties with monitors that violate the 24-hour PM2.5 standard and evaluates nearby counties for contributions to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

We also used analytical tools and data such as pollution roses, fine particle composition monitoring data, back trajectory analyses, and the contributing emission score (CES) to evaluate these areas. (See additional discussion of the CES under factor 1 below.)

Figure 1 is a map of the counties in the nonattainment area and other relevant information such as the locations and design values of air quality monitors, and the metropolitan area boundary.

Figure 1. Paducah-Mayfield, KY-IL CSA



In December 2007, Kentucky recommended that no areas be designated as "nonattainment" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2004-2006. These data were from Federal Reference Method (FRM) monitors located in the State. At that time, the Paducah area did not have a violating monitor and was not under consideration for nonattainment status for the 24-hour PM2.5 standard.

In March of 2008, EPA also notified Kentucky that the McCracken County monitor in the Paducah area was violating based on 2005-2007 data. Kentucky submitted a second letter on June 25, 2008 to revise its recommendation yet still maintained that no Kentucky counties should be designated nonattainment for the standard.

In August 2008, EPA notified Kentucky of its intended designations. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the state in making final decisions on the designations.

In October 2008, Kentucky provided additional information to support their request for state-wide attainment. Kentucky claimed that the monitor in McCracken County, KY should be found to be in attainment due to exceptional events claims. See Attachment 3 in this document for further details on exceptional events in the Paducah-Mayfield area.

(Kentucky Division for Air Quality (KDAQ) letters dated December 7, 2007, June 25, 2008, and October 17, 2008)

Based on EPA's technical analysis described below, EPA has designated McCracken County as nonattainment for the 24-hour $PM_{2.5}$ air-quality standard as part of the Paducah-Mayfield nonattainment area, based upon currently available information. These counties are listed in the table below. A portion of Massac County, Illinois is also designated as part of the Paducah-Mayfield nonattainment area. Analysis of that county is contained in a separate document addressing nonattainment areas in the state of Illinois.

Paducah-Mayfield	State-Recommended Nonattainment Counties	EPA-Final Designated Nonattainment Counties
Kentucky	None	McCracken

The following is a technical analysis for the Kentucky portion of the Paducah-Mayfield area.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Paducah-Mayfield, KY-IL area. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State Recommended Nonattainment	CES	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SOx (tpy)	NOx (tpy)	VOCs (tpy)	NH_3 (tpy)
McCracken, KY	No	100	1,046	293	1,046	38,956	24,803	6,661	366
Massac, IL	No	66	1,799	159	1,799	26,884	12,369	2,612	417
Graves, KY	No	6	520	278	520	413	1,735	1,867	2,538
Ballard, KY	No	5	456	140	456	927	2,785	1,661	855
Livingston, KY	No	3	197	121	197	337	2,155	1,200	239

Note that the table may not include all counties considered in the 9-factor analysis, and that those counties not shown had no factors that indicated that they should be candidates for a nonattainment status.

McCracken County, KY has a CES score of 100, as well as high emissions levels. McCracken County contains one large electric generating unit (EGU) facility, and two chemical manufacturing facilities that contribute to the elevated emissions levels. Massac County, IL also has a relatively high CES score and emissions levels. Massac County has two EGU facilities, and one natural gas facility, one cement facility, and one chemical manufacturing facility. Based on the emissions levels and CES values, McCracken County, KY and Massac, IL are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in $\mu g/m^3$) for air quality monitors in counties in the Paducah-Mayfield area based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98th percentile values are 35 $\mu g/m^3$ or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Paducah-Mayfield area are shown in Table 2.

Table 2. Air Quality Data

County	State Recommended Nonattainment	24-hr PM2.5 Design Values, 2004-2006 (μg/m^3)	24-hr PM2.5 Design Values, 2005-2007 (μg/m^3)
McCracken County, KY	No	33	36

McCracken County, Kentucky shows a violation of the 2006 24-hour $PM_{2.5}$ standard. Therefore, this county is included in the Paducah-Mayfield nonattainment area. Note, however, that the absence of a violating monitor alone is not a sufficient reason to eliminate counties as candidates for nonattainment status. Each county has been evaluated based on the weight of evidence of the nine factors and other relevant information.

Under this factor, we also consider fine particle composition monitoring data. Air quality monitoring data on the composition of fine particle mass are available from the EPA Chemical Speciation Network and the IMPROVE monitoring network. Analysis of these data indicates that the days with the highest fine particle concentrations in the Paducah area occuring about 90% in the warm season and about 10% in the cool season. In the warm season, the average chemical composition of the highest days is 79% sulfate, 19% carbon, 2% crustal, and 0% nitrate. In the cool season, the average chemical composition of the highest days is 52% sulfate, 25% carbon, 21% nitrate, and 2% crustal. These data indicate that sources of SO2, direct PM2.5, and NOx emissions contribute to violations in the area.

Additionally, McCracken County is a nonattainment area candidate based on factor 1 and the CES score.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with an FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the area being evaluated, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

Table 3. Population

County	State Recom-mended Non-attainment	2005 Population	2005 Population Density (pop/sq mi)
McCracken, KY	No	64,690	241
Massac, IL	No	15,225	63
Graves, KY	No	37,650	68
Ballard, KY	No	8,262	30
Livingston, KY	No	9,783	29

McCracken County, Kentucky, has the highest population and population density of the counties listed above. In Kentucky, Graves, Ballard, and Livingston, Counties have moderately low populations and population densities compared to McCracken County, which supports eliminating them from, and based on this factor are not candidates for inclusion in the nonattainment area.

Note that McCracken County, which ranks high for this factor, is also high-ranking based on factors 1, 2, and the CES score.

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Paducah-Mayfield area, the percent of total commuters in each county who commute to other counties within the Paducah-Mayfield area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State Recom-mended Non-attainment	2005 VMT (millions of miles)	Number Commuting to any violating county	Percent Commuting to any violating county	Number Commuting into and within the statistical area	Percent Commuting into and within the statistical area
McCracken, KY	No	832	24,204	84	26,830	93
Graves, KY	No	435	2,350	15	12,880	83
Massac, IL	No	225	1,950	30	5,860	90
Livingston, KY	No	174	1,770	41	3,580	82
Ballard, KY	No	102	1,290	35	3,380	92

The listing of counties in Table 4 reflects a ranking based on the number of people commuting to other counties.

McCracken County shows the highest numbers for vehicle miles traveled, as well as those commuting into the CSA and any violating county. Graves, Ballard, and Livingston Counties have much lower VMT and numbers commuting into the statistical area compared to McCracken County, indicating low contribution from these counties on the basis of this factor, which further supports eliminating them from the nonattainment area.

McCracken County is also under consideration for a nonattainment designation based on factors 1, 2, 3, and the CES score.

Note: The 2005 VMT data used for Tables 4 and 5 of the 9-factor analysis has been derived using methodology similar to that described in "Documentation for the final 2002 Mobile National Emissions Inventory, Version 3, September 2007, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002_mobile_nei_version_3_report_092807.pdf
The 2005 VMT data were taken from documentation which is still draft, but which should be released in 2008.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in the Paducah-Mayfield area, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Paducah-Mayfield area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

Location	Population (2005)	Population Density	Population Growth (2000-2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Livingston, KY	9,783	29	622	1.68%	174	56
McCracken, KY	64,690	241	-21	-0.21%	832	26
Massac, IL	15,225	63	-24	-0.29%	225	25

Graves, KY	37,650	68	64	0.42%	435	21
Ballard, KY	8,262	30	-824	-1.26%	102	12

All of the counties in the Paducah-Mayfield CSA showed negligible population change between 2000 and 2005. VMT increased in all counties from 1996 to 2005. McCracken, KY, and Massac, IL had sizeable increases in VMT at 26 and 25 percent, respectively. Livingston, KY, a county with relatively low population, had the largest percentage increase in VMT for nearby counties; however, the total VMT for Livingston is still well below the level of McCracken county. Livingston County is not a candidate for inclusion in the nonattainment area due to its low ranking for other factors.

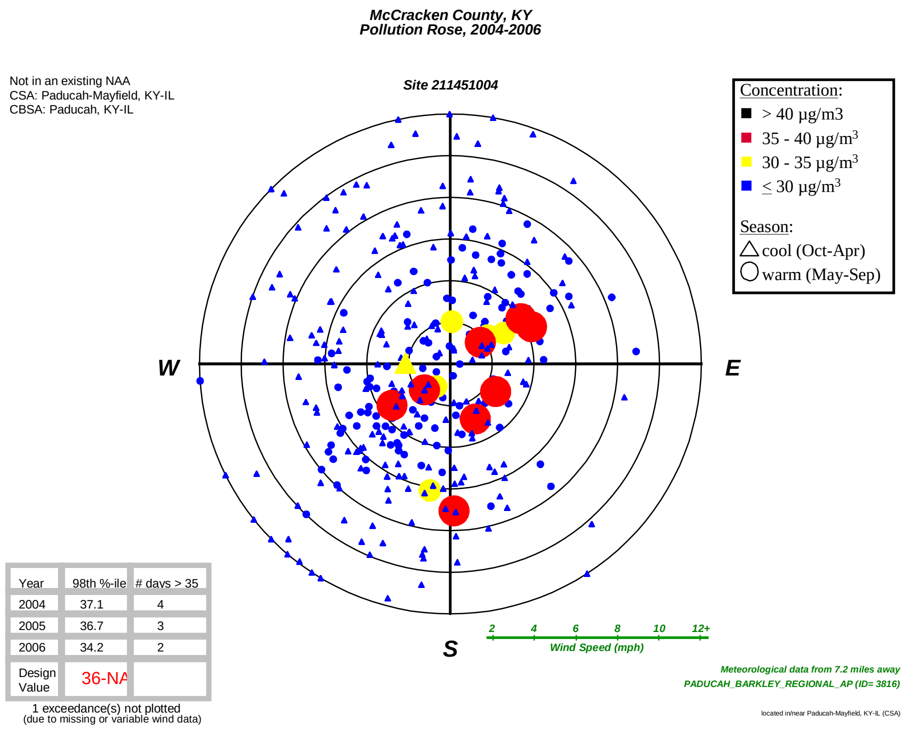
McCracken, KY is a nonattainment county candidate based on this and factors 1, 2, 3, 4, and the CES score.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on "high $PM_{2.5}$ days" for each of two seasons (an October-April "cold" season and a May-September "warm" season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a "pollution rose" to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

Figure 2. McCracken County, KY Pollution Rose



As shown in the pollution rose in Figure 2, on high PM2.5 days prevailing surface winds typically have low wind speeds and can come from all directions. When considered along with speciation monitoring data showing that most of the high days are in the warm season high sulfate levels, this meteorological information indicates that certain high days may occur under stagnant conditions.

Note: the meteorology factor is also considered in each county's Contributing Emissions Score because the method for deriving this metric included an analysis of trajectories of air masses for high $PM_{2.5}$ days.

Factor 7: Geography/topography (mountain ranges or other air basin boundaries)

The geography/topography analysis looks at physical features of the land that might have an effect on the air shed and, therefore, on the distribution of $PM_{2.5}$ over the Paducah-Mayfield area.

The Paducah-Mayfield area does not have any geographical or topographical barriers significantly limiting air-pollution transport within its air shed. The Ohio River separates McCracken County, KY from Massac County, IL; however, we do not expect this factor to have any impact on air pollution transport within the area's air shed. Therefore, this factor did not play a significant role in the decision-making process.

Factor 8: Jurisdictional boundaries (e.g., existing PM and ozone areas)

The Paducah-Mayfield area currently is attaining all other air quality standards. Therefore, this factor did not play a significant role in the decision-making process.

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Under this factor, the existing level of control of emission sources is taken into consideration. The emissions data used by EPA in this technical analysis and provided in Table 1 (under factor 1) represent emissions levels taking into account any control strategies implemented in the Paducah-Mayfield area before 2005 on stationary, mobile, and area sources. Data are presented for PM2.5 components that are directly emitted (carbonaceous PM2.5 and crustal PM2.5) and for pollutants which react in the atmosphere to form fine particles (e.g. SO_2, NO_X, VOC, and ammonia).

This factor considers emission controls currently implemented for major sources in the Paducah-Mayfield area.

In considering county-level emissions, EPA used data from the 2005 National Emissions Inventory, the most updated version of the national inventory available at the beginning of the designations process in late 2007. However, EPA recognized that for certain counties, emissions may have changed since 2005. For example, certain power plants or large sources of emissions in or near this area may have installed emission controls or otherwise significantly reduced emissions since 2005. Some States provided updated information on emissions and emission controls in their comments to EPA. EPA considered such additional information in making final designation decisions.

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or if it is required by a consent decree which also requires the controls to be included in federally enforceable permit upon termination of the consent decree. In making final decisions, EPA also considered whether a facility would continue to emit pollutants which contribute to PM2.5 exceedances even after emission controls are operational.

The emission estimates on Table 1 (under Factor 1) include any control strategies implemented by the states in the Paducah-Mayfield area before 2005 that may influence emissions of any component of $PM_{2.5}$ emissions (i.e., total carbon, SO_2, NOx, and crustal $PM_{2.5}$).

In the Paducah-Mayfield area, the majority of the emissions are from SO_2 and NO_X in McCracken and Massac Counties. The Tennessee Valley Authority's (TVA) Shawnee Fossil Plant is a major source in McCracken County, accounting for more than 30,000 tons of SO2 and 20,000 tons of NOx annually. It currently has low-NOx burners (LNB) and baghouses installed on all ten units, but no units have a scrubber for SO2. Unit 10 has a bubbling limestone bed to reduce SO_2. No additional controls were installed since 2005.

In Massac County, Illinois, the Joppa Steam plant is the major source of emissions. EPA has determined that while future scrubbers and baghouses are planned for the Joppa Steam Plant in 2013 and 2014, the current emissions of the plant (more than 25,000 tons SO2 and 5000 tons NOx annually) and meteorological data indicate that it currently contributes to PM2.5 NAAQS violations in the nearby Paducah area.

Based on analysis of this factor, EPA concludes that McCracken County contributes to its own violating monitor, and is also a candidate based on factors 1, 2, 3, 4, 5, and 6 and the CES score.

Conclusion

EPA concludes that based upon a review of the factors, the appropriate nonattainment boundary for the Paducah-Mayfield area includes McCracken County in Kentucky and part of Massac County in Illinois. Specifically, McCracken has high emissions that impact its violating monitor, relatively high population density and degree of urbanization, and the highest VMT and commuting in the area. This technical analysis shows that Graves, Ballard, and Livingston Counties do not contribute to the violating monitor in McCracken County based on low rankings for all factors. Therefore, they are not included in the nonattainment area. A partial county area of Massac County, Illinois is also included in the Paducah-Mayfield 2006 PM2.5 nonattainment area, on the basis of high current emissions from the Joppa Steam Plant located 16 miles from the violating monitor.

Additional information regarding responses to specific State comments can be found in EPA's Response to Comments document at
http://www.epa.gov/pmdesignations/2006standards/tech.htm.

<u>Attachment 2</u>

Description of the Contributing Emissions Score

The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Using this methodology, scores were developed for each county in and around the relevant metro area. The county with the highest contribution potential was assigned a score of 100, and other county scores were adjusted in relation to the highest county. The CES represents the relative maximum influence that emissions in that county have on a violating county. The CES, which reflects consideration of multiple factors, should be considered in evaluating the weight of evidence supporting designation decisions for each area.

The CES for each county was derived by incorporating the following significant information and variables that impact $PM_{2.5}$ transport:

- Major $PM_{2.5}$ components: total carbon (organic carbon (OC) and elemental carbon (EC)), SO_2, NO_X, and inorganic particles (crustal).
- $PM_{2.5}$ emissions for the highest (generally top 5%) $PM_{2.5}$ emission days (herein called "high days") for each of two seasons, cold (Oct-Apr) and warm (May-Sept)
- Meteorology on high days using the NOAA HYSPLIT model for determining trajectories of air masses for specified days
- The "urban increment" of a violating monitor, which is the urban $PM_{2.5}$ concentration that is in addition to a regional background $PM_{2.5}$ concentration, determined for each $PM_{2.5}$ component
- Distance from each potentially contributing county to a violating county or counties

A more detailed description of the CES can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

EPA Technical Analysis for Paducah-Mayfield

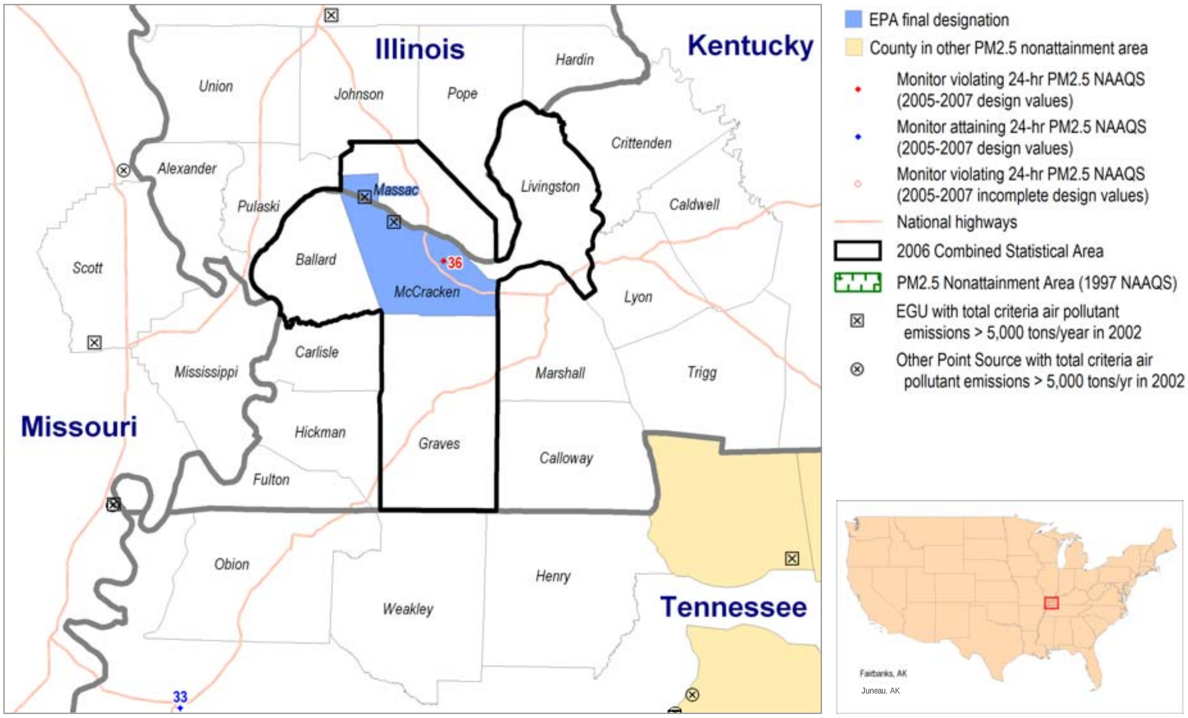
Pursuant to section 107(d) of the Clean Air Act, EPA must designate as nonattainment those areas that violate the NAAQS and those nearby areas that contribute to violations. This technical analysis for Paducah Mayfield area identifies the counties with monitors that violate the 24-hour PM2.5 standard and evaluates nearby counties for contributions to fine particle concentrations in the area. EPA has evaluated these counties based on the weight of evidence of the following nine factors recommended in EPA guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology
- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

We also used analytical tools and data such as pollution roses, fine particle composition monitoring data, back trajectory analyses, and the contributing emission score (CES) to evaluate these areas. (See additional discussion of the CES under factor 1 below.)

Figure 1 is a map of the counties in the nonattainment area and other relevant information such as the locations and design values of air quality monitors, and the metropolitan area boundary.

Figure 1. Paducah-Mayfield, KY-IL CSA



In December 2007, Kentucky recommended that no areas be designated as "nonattainment" for the 2006 24-hour $PM_{2.5}$ standard based on air quality data from 2004-2006. These data were from Federal Reference Method (FRM) monitors located in the State. At that time, the Paducah area did not have a violating monitor and was not under consideration for nonattainment status for the 24-hour PM2.5 standard.

In March of 2008, EPA also notified Kentucky that the McCracken County monitor in the Paducah area was violating based on 2005-2007 data. Kentucky submitted a second letter on June 25, 2008 to revise its recommendation yet still maintained that no Kentucky counties should be designated nonattainment for the standard.

In August 2008, EPA notified Kentucky of its intended designations. In this letter, EPA also requested that if the State wished to provide comments on EPA's intended designation, it should do so by October 20, 2008. EPA stated that it would consider any additional information (e.g., on power plants or partial county areas) provided by the state in making final decisions on the designations.

In October 2008, Kentucky provided additional information to support their request for state-wide attainment. Kentucky claimed that the monitor in McCracken County, KY should be found to be in attainment due to exceptional events claims. See Attachment 3 in this document for further details on exceptional events in the Paducah-Mayfield area.

(Kentucky Division for Air Quality (KDAQ) letters dated December 7, 2007, June 25, 2008, and October 17, 2008)

Based on EPA's technical analysis described below, EPA has designated McCracken County as nonattainment for the 24-hour $PM_{2.5}$ air-quality standard as part of the Paducah-Mayfield nonattainment area, based upon currently available information. These counties are listed in the table below. A portion of Massac County, Illinois is also designated as part of the Paducah-Mayfield nonattainment area. Analysis of that county is contained in a separate document addressing nonattainment areas in the state of Illinois.

Paducah-Mayfield	State-Recommended Nonattainment Counties	EPA-Final Designated Nonattainment Counties
Kentucky	None	McCracken

The following is a technical analysis for the Kentucky portion of the Paducah-Mayfield area.

Factor 1: Emissions data

For this factor, EPA evaluated county level emission data for the following $PM_{2.5}$ components and precursor pollutants: "$PM_{2.5}$ emissions total," "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," "SO_2," "NO_x," "VOCs," and "NH_3." "$PM_{2.5}$ emissions total" represents direct emissions of $PM_{2.5}$ and includes: "$PM_{2.5}$ emissions carbon," "$PM_{2.5}$ emissions other," primary sulfate (SO_4), and primary nitrate. (Although primary sulfate and primary nitrate, which are emitted directly from stacks rather than forming in atmospheric reactions with SO_2 and NO_x, are part of "$PM_{2.5}$ emissions total," they are not shown in Table 1 as separate items). "$PM_{2.5}$ emissions carbon" represents the sum of organic carbon (OC) and elemental carbon (EC) emissions, and "$PM_{2.5}$ emissions other" represents other inorganic particles (crustal). Emissions of SO_2 and NO_x, which are precursors of the secondary $PM_{2.5}$ components sulfate and nitrate, are also considered. VOCs (volatile organic compounds) and NH_3 (ammonia) are also potential $PM_{2.5}$ precursors and are included for consideration.

Emissions data were derived from the 2005 National Emissions Inventory (NEI), version 1. See http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html

EPA also considered the Contributing Emissions Score (CES) for each county. The CES is a metric that takes into consideration emissions data, meteorological data, and air quality monitoring information to provide a relative ranking of counties in and near an area. Note that this metric is not the exclusive manner for considering data for these factors. A summary of the CES is included in attachment 2, and a more detailed description can be found at http://www.epa.gov/ttn/naaqs/pm/pm25_2006_techinfo.html#C.

Table 1 shows emissions of $PM_{2.5}$ and precursor pollutants components (given in tons per year) and the CES for violating and potentially contributing counties in the Paducah-Mayfield, KY-IL area. Counties are listed in descending order by CES.

Table 1. $PM_{2.5}$ Related Emissions and Contributing Emissions Score

County	State Recommended Nonattainment	CES	$PM_{2.5}$ emissions total (tpy)	$PM_{2.5}$ emissions carbon (tpy)	$PM_{2.5}$ emissions other (tpy)	SOx (tpy)	NOx (tpy)	VOCs (tpy)	NH_3 (tpy)
McCracken, KY	No	100	1,046	293	1,046	38,956	24,803	6,661	366
Massac, IL	No	66	1,799	159	1,799	26,884	12,369	2,612	417
Graves, KY	No	6	520	278	520	413	1,735	1,867	2,538
Ballard, KY	No	5	456	140	456	927	2,785	1,661	855
Livingston, KY	No	3	197	121	197	337	2,155	1,200	239

Note that the table may not include all counties considered in the 9-factor analysis, and that those counties not shown had no factors that indicated that they should be candidates for a nonattainment status.

McCracken County, KY has a CES score of 100, as well as high emissions levels. McCracken County contains one large electric generating unit (EGU) facility, and two chemical manufacturing facilities that contribute to the elevated emissions levels. Massac County, IL also has a relatively high CES score and emissions levels. Massac County has two EGU facilities, and one natural gas facility, one cement facility, and one chemical manufacturing facility. Based on the emissions levels and CES values, McCracken County, KY and Massac, IL are candidates for a 24-hour $PM_{2.5}$ nonattainment designation.

Factor 2: Air quality data

This factor considers the 24-hour $PM_{2.5}$ design values (in $\mu g/m^3$) for air quality monitors in counties in the Paducah-Mayfield area based on data for the 2005-2007 period. A monitor's design value indicates whether that monitor attains a specified air quality standard. The 24-hour $PM_{2.5}$ standards are met when the 3-year average of a monitor's 98^{th} percentile values are 35 $\mu g/m^3$ or less. A design value is only valid if minimum data completeness criteria are met.

The 24-hour $PM_{2.5}$ design values for counties in the Paducah-Mayfield area are shown in Table 2.

Table 2. Air Quality Data

County	State Recommended Nonattainment	24-hr PM2.5 Design Values, 2004-2006 (μg/m^3)	24-hr PM2.5 Design Values, 2005-2007 (μg/m^3)
McCracken County, KY	No	33	36

McCracken County, Kentucky shows a violation of the 2006 24-hour $PM_{2.5}$ standard. Therefore, this county is included in the Paducah-Mayfield nonattainment area. Note, however, that the absence of a violating monitor alone is not a sufficient reason to eliminate counties as candidates for nonattainment status. Each county has been evaluated based on the weight of evidence of the nine factors and other relevant information.

Under this factor, we also consider fine particle composition monitoring data. Air quality monitoring data on the composition of fine particle mass are available from the EPA Chemical Speciation Network and the IMPROVE monitoring network. Analysis of these data indicates that the days with the highest fine particle concentrations in the Paducah area occuring about 90% in the warm season and about 10% in the cool season. In the warm season, the average chemical composition of the highest days is 79% sulfate, 19% carbon, 2% crustal, and 0% nitrate. In the cool season, the average chemical composition of the highest days is 52% sulfate, 25% carbon, 21% nitrate, and 2% crustal. These data indicate that sources of SO2, direct PM2.5, and NOx emissions contribute to violations in the area.

Additionally, McCracken County is a nonattainment area candidate based on factor 1 and the CES score.

Note: Eligible monitors for providing design value data generally include State and Local Air Monitoring Stations (SLAMS) at population-oriented locations with an FRM monitor. All data from Special Purpose Monitors (SPM) using an FRM is eligible for comparison to the relevant NAAQS, subject to the requirements given in the October 17, 2006 Revision to Ambient Air Monitoring Regulations (71 FR 61236). All monitors used to provide data must meet the monitor siting and eligibility requirements given in 71 FR 61236 to 61328 in order to be acceptable for comparison to the 24-hr PM2.5 NAAQS for designation purposes.

Factor 3: Population density and degree of urbanization (including commercial development)

Table 3 shows the 2005 population for each county in the area being evaluated, as well as the population density for each county in that area. Population data gives an indication of whether it is likely that population-based emissions might contribute to violations of the 24-hour $PM_{2.5}$ standards.

Table 3. Population

County	State Recom-mended Non-attainment	2005 Population	2005 Population Density (pop/sq mi)
McCracken, KY	No	64,690	241
Massac, IL	No	15,225	63
Graves, KY	No	37,650	68
Ballard, KY	No	8,262	30
Livingston, KY	No	9,783	29

McCracken County, Kentucky, has the highest population and population density of the counties listed above. In Kentucky, Graves, Ballard, and Livingston, Counties have moderately low populations and population densities compared to McCracken County, which supports eliminating them from, and based on this factor are not candidates for inclusion in the nonattainment area.

Note that McCracken County, which ranks high for this factor, is also high-ranking based on factors 1, 2, and the CES score.

Factor 4: Traffic and commuting patterns

This factor considers the number of commuters in each county who drive to another county within the Paducah-Mayfield area, the percent of total commuters in each county who commute to other counties within the Paducah-Mayfield area, as well as the total Vehicle Miles Traveled (VMT) for each county in millions of miles (see Table 4). A county with numerous commuters is generally an integral part of an urban area and is likely contributing to fine particle concentrations in the area.

Table 4. Traffic and Commuting Patterns

County	State Recom-mended Non-attainment	2005 VMT (millions of miles)	Number Commuting to any violating county	Percent Commuting to any violating county	Number Commuting into and within the statistical area	Percent Commuting into and within the statistical area
McCracken, KY	No	832	24,204	84	26,830	93
Graves, KY	No	435	2,350	15	12,880	83
Massac, IL	No	225	1,950	30	5,860	90
Livingston, KY	No	174	1,770	41	3,580	82
Ballard, KY	No	102	1,290	35	3,380	92

The listing of counties in Table 4 reflects a ranking based on the number of people commuting to other counties.

McCracken County shows the highest numbers for vehicle miles traveled, as well as those commuting into the CSA and any violating county. Graves, Ballard, and Livingston Counties have much lower VMT and numbers commuting into the statistical area compared to McCracken County, indicating low contribution from these counties on the basis of this factor, which further supports eliminating them from the nonattainment area.

McCracken County is also under consideration for a nonattainment designation based on factors 1, 2, 3, and the CES score.

Note: The 2005 VMT data used for Tables 4 and 5 of the 9-factor analysis has been derived using methodology similar to that described in "Documentation for the final 2002 Mobile National Emissions Inventory, Version 3, September 2007, prepared for the Emission Inventory Group, U.S. EPA. This document may be found at: ftp://ftp.epa.gov/EmisInventory/2002finalnei/documentation/mobile/2002_mobile_nei_version_3_report_092807.pdf
The 2005 VMT data were taken from documentation which is still draft, but which should be released in 2008.

Factor 5: Growth rates and patterns

This factor considers population growth for 2000-2005 and growth in vehicle miles traveled for 1996-2005 for counties in the Paducah-Mayfield area, as well as patterns of population and VMT growth. A county with rapid population or VMT growth is generally an integral part of an urban area and likely to be contributing to fine particle concentrations in the area.

Table 5 below shows population, population growth, VMT and VMT growth for counties that are included in the Paducah-Mayfield area. Counties are listed in descending order based on VMT growth between 1996 and 2005.

Table 5. Population and VMT Values and Percent Change.

Location	Population (2005)	Population Density	Population Growth (2000-2005)	Population % change (2000 - 2005)	2005 VMT (millions of miles)	VMT % change (1996 to 2005)
Livingston, KY	9,783	29	622	1.68%	174	56
McCracken, KY	64,690	241	-21	-0.21%	832	26
Massac, IL	15,225	63	-24	-0.29%	225	25

Graves, KY	37,650	68	64	0.42%	435	21
Ballard, KY	8,262	30	-824	-1.26%	102	12

All of the counties in the Paducah-Mayfield CSA showed negligible population change between 2000 and 2005. VMT increased in all counties; however, Livingston, KY more than doubled in VMT from 1996 to 2005, at 56 percent. Although that is the highest VMT percent in the area, Livingston County is not a candidate for inclusion in the nonattainment area due to its low ranking for other factors. Additionally, McCracken, KY, and Massac, IL had sizeable increases in VMT from 1996 to 2005, at 26 and 25 percent, respectively.

McCracken, KY is a nonattainment county candidate based on this and factors 1, 2, 3, 4, and the CES score.

Factor 6: Meteorology (weather/transport patterns)

For this factor, EPA considered data from National Weather Service instruments in the area. Wind direction and wind speed data for 2004-2006 were analyzed, with an emphasis on "high $PM_{2.5}$ days" for each of two seasons (an October-April "cold" season and a May-September "warm" season). These high days are defined as days where any FRM or FEM air quality monitors had 24-hour $PM_{2.5}$ concentrations above 95% on a frequency distribution curve of $PM_{2.5}$ 24-hour values.

For each air quality monitoring site, EPA developed a "pollution rose" to understand the prevailing wind direction and wind speed on the days with highest fine particle concentrations. The figure identifies 24-hour PM2.5 values by color; days exceeding 35 ug/m3 are denoted with a red or black icon. A dot indicates the day occurred in the warm season; a triangle indicates the day occurred in the cool season. The center of the figure indicates the location of the air quality monitoring site, and the location of the icon in relation to the center indicates the direction from which the wind was blowing on that day. An icon that is close to the center indicates a low average wind speed on that day. Higher wind speeds are indicated when the icon is further away from the center.

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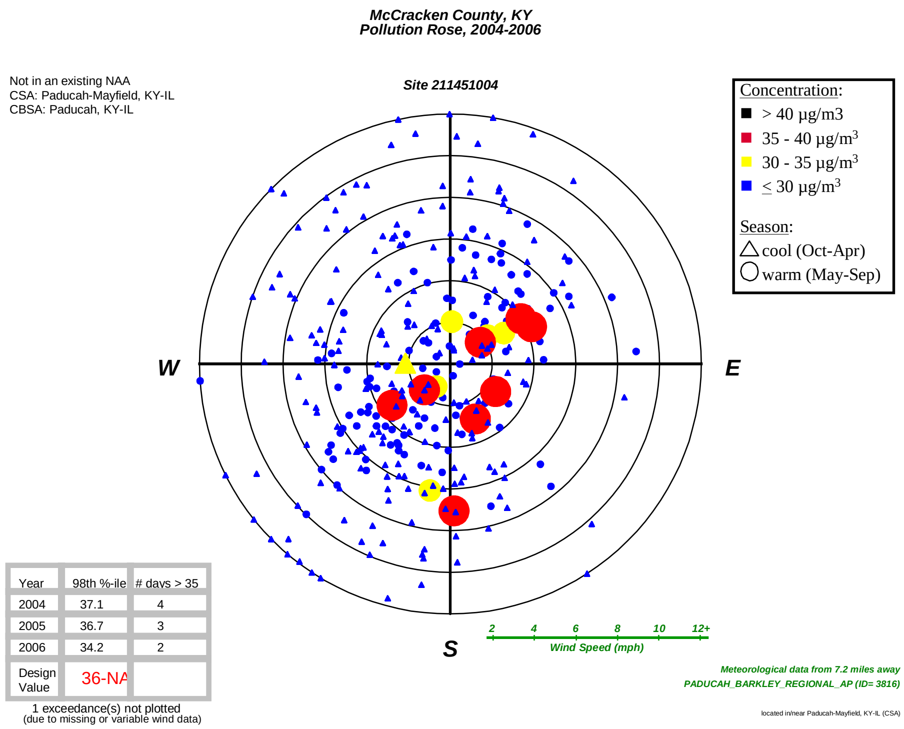

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$PM_{2.5}$ Exceptional Events Technical Support Document

U.S. Environmental Protection Agency
Region 4

State of Kentucky: Paducah KY-IL Metropolitan Statistical Area

2005-2007

Introduction

This document provides U.S Environmental Protection Agency (EPA) Region 4 rationale for concurrence or non-concurrence with exceptional event flags on the 24-hr average $PM_{2.5}$ concentrations recorded at various Air Quality System (AQS) sites within the Kentucky Department of Air Quality (KYDAQ) Ambient Air Monitoring Network. The exceptional event flags that EPA Region 4 has concurred with will be excluded from use in determinations of exceedances and National Ambient Air Quality Standards (NAAQS) violations.

According to 40 CFR 50.1(j):

> "*Exceptional event* means an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the Administrator in accordance with 40 CFR 50.14 to be an exceptional event. It does not include stagnation of air masses or meteorological inversions, a meteorological event involving high temperatures or lack of precipitation, or air pollution relating to source noncompliance."

§50.14(b)(2) also states:

> "EPA shall exclude data from use in determinations of exceedances and NAAQS violations where a State demonstrates to EPA's satisfaction that emissions from fireworks displays caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section. Such data will be treated in the same manner as exceptional events under this rule, provided a State demonstrates that such use of fireworks is significantly integral to traditional national, ethnic, or other cultural events including, but not limited to July Fourth celebrations which satisfy the requirements of this section."

Finally, §50.14(c)(3)(iii) states:

"The demonstration to justify data exclusion shall provide evidence that:

(A) The event satisfies the criteria set forth in 40 CFR 50.1(j);
(B) There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area;
(C) The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and
(D) There would have been no exceedance or violation but for the event.

Each $PM_{2.5}$ 24-hr average concentration requested for exclusion was first evaluated against these criteria using a two-step analysis. This analysis was designed to compare the requested value to historical values observed at the site and determine whether any exceedances could have been caused by the suspected event.

Step 1: Monthly Average Comparison

Using 24-hr $PM_{2.5}$ data from AQS for 2004-2007, a comparison three-year monthly average was calculated. The three-year monthly average concentration was calculated excluding data from the year in which the data in question was collected. For example, a requested value in May 2006 was compared to the average of all the samples collected at the site during May 2004, May 2005, and May 2007. If the three-year average was greater than the annual $PM_{2.5}$ NAAQS (15.0 $\mu g/m^3$) and the requested value was less than the 24-hr $PM_{2.5}$ NAAQS (35 $\mu g/m^3$), then EPA concurrence was not given to the requested value. This is because in EPA's judgment there is insufficient evidence that "there would have been no exceedance or violation but for the event" as required by §50.14(c)(3)(iii)(D) because the normally expected concentration at the site (the three-year monthly mean concentration) is in excess of the NAAQS.

Step 2: Monthly 84th Percentile Comparison

Using 24-hr $PM_{2.5}$ data from AQS for 2004-2007, a comparison three-year upper 84th percentile was calculated for the month in which the requested value was collected. The three-year monthly 84th percentile was calculated excluding data from the year in which the data in question was collected. For example, a requested value in May 2006 was compared to the upper 84th percentile calculated from of all the samples collected at the site during May 2004, May 2005, and May 2007. The calculated three-year monthly upper 84th percentile was considered to represent the range of normally expected high values at that site due to normal local and background sources If the requested value was below the calculated three-year monthly upper 84th percentile, EPA concurrence was not given to the requested value. This is because in EPA's judgment that there is insufficient evidence to demonstrate that the NAAQS exceedance was caused by the suspected event as required by §50.14(c)(3)(iii)(D) and not by normal local and background sources at the site.

If a requested value did not meet the requirements described in one or more of the above steps and the State did not submit compelling evidence to demonstrate that the event satisfied the exceptional event criteria, then EPA concurrence was not given to the exceptional event flag on the requested value. The values that did meet all of the conditions described above were then evaluated against the requirements of §50.14(c)(3)(iii).

Summary of maps and graphs used

A variety of maps and graphs were used in this document. Unless otherwise noted, these products were obtained from the DATAFED Data Views Catalog, which can be accessed at http://datafedwiki.wustl.edu/index.php/Data_Views_Catalog. This includes maps using data from AQS, the National Aeronautics and Space Administration (NASA), and the Navy Aerosol Analysis and Prediction System (NAAPS). Also, unless otherwise noted, all ambient air monitoring data used in this analysis was obtained from the EPA AQS database.

The following discussion will demonstrate that the 24-hr average $PM_{2.5}$ concentrations observed at various Kentucky Department of Air Quality network monitoring sites on the following dates meet or fail to meet the criteria laid out in the Exceptional Events Rule, §50.14.

Exceedance Date(s): June 21, 2005, June 24, 2005
MSA(s): Paducah, KY-IL
Event Description: Monitoring sites downwind of western Kentucky fires.

Table 1 - Site-specific information used in analysis ($\mu g/m^3$)

AQS	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-145 -1004	6/21/2005	36.9	16.3	22.8	27.0	NO
21-145 -1004	6/24/2005	37.1	16.3	22.8	27.0	NO

DETAILED DISCUSSION OF EVIDENCE

A. EVENT DISCRIPTION:

Documentation submitted by the Kentucky DAQ claims that smoke from wildfires in western Kentucky caused NAAQS exceedances at the site listed above. The requested values that passed both steps with concentrations of 36.9$\mu g/m^3$ and 37.1$\mu g/m^3$ were collected on June 21 and June 24, 2005, respectively. However, the documentation submitted by the Kentucky DAQ did not demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance "but for" the events on June 21 and June 24, 2005.

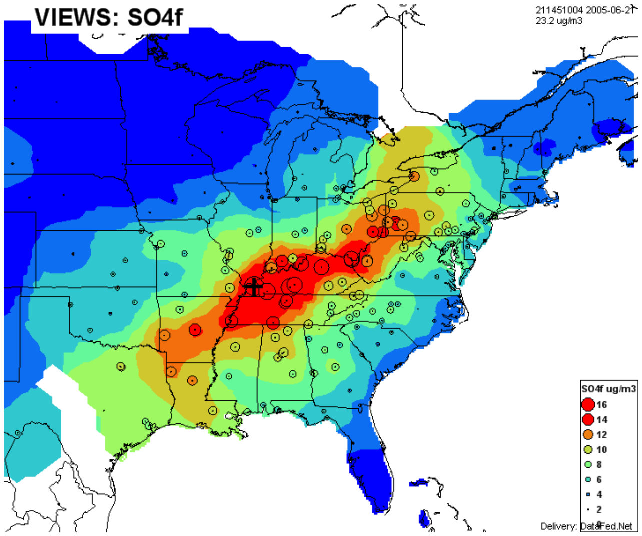
B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

KYDAQ submittal consisted of National Oceanic and Atmospheric Administration (NOAA) map of "hot spots", a wind rose and historical data for the month of June (2002 -2006). PM2.5 speciation data was collected in the Paducah area during this time period as seen in Figure 5. High aerosol particulate concentrations can be seen in the source region on June 21 and June 24, 2005, in Figures 1-4. The wind speed and wind direction suggests impact for the location of the local fires to the Paducah site. This evidence alone is insufficient to establish a causal relationship between the local wildfires and the exceedance of the 24-hr NAAQS.

C. COMPARISON TO BACKGROUND LEVELS

The sulfate measured at the Paducah site was approximately 4 times higher than the seasonal[1] average versus the organic carbon which was 1.3 higher. Sulfate and organic carbon concentrations on the 21st and 24th, respectively are illustrated in Figures 1 – 4. A widespread sulfate event is evident across the southeast U.S. on these days. Thereby indicating that exceedance was more likely caused by the increased level of sulfates mass measured that day as opposed to the organic carbon mass measured.

[1] Seasonal June – August 2004 -2005



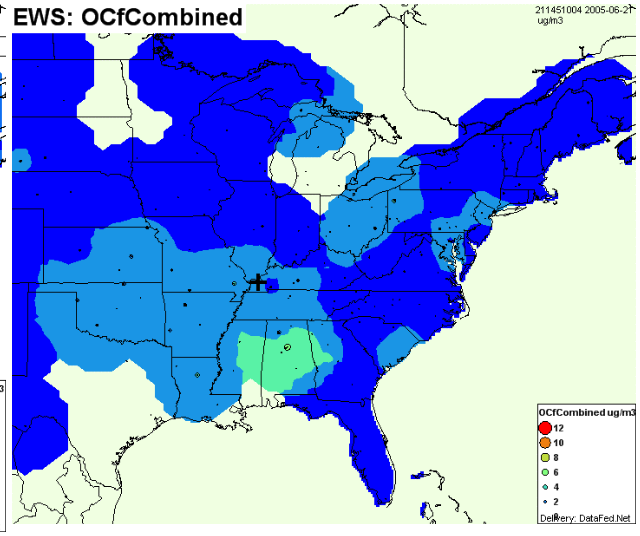
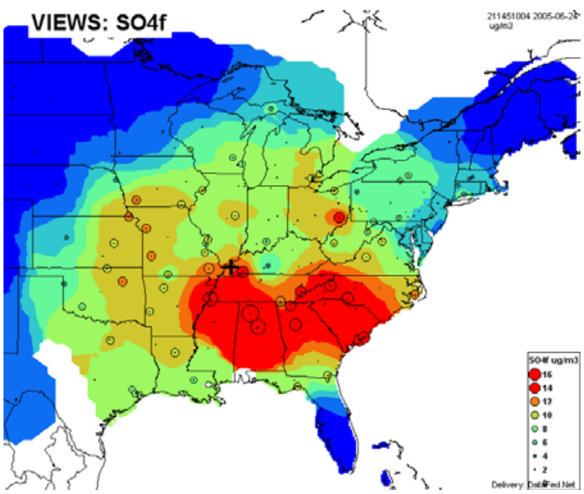


Figure 1: Paducah SO4 Concentrations, June 21, 2005 Figure 2: Paducah OC Concentrations, June 21, 2005



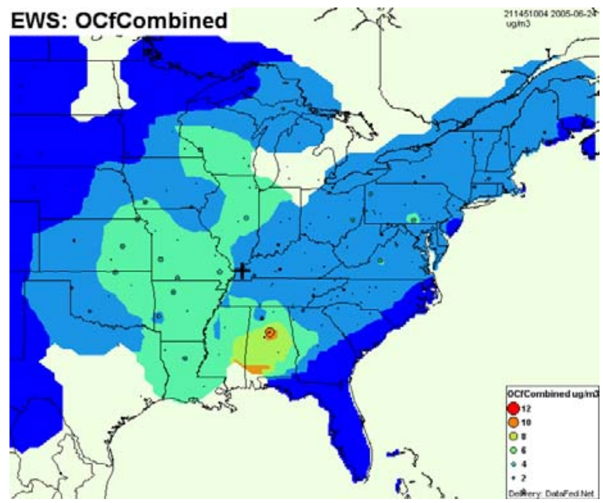


Figure 3: Paducah SO4 Concentrations, June 24, 2005 Figure 4: Paducah OC Concentrations, June 24, 2005

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

The requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met. Speciated fine particulate matter data collected at the Paducah site on June 21, 2005 measured sulfate and organic carbon levels of 23.2 µg/m^3 and 6.13µg/m^3, respectively (Figure 5). The increased levels of sulfate negates the possibility that there would have been no exceedance of the NAAQS "but for" this event.

To demonstrate that there would have been an exceedance or violation of the 24hour NAAQS, the following graphs represents the "estimated particulate matter "but for" speciated organic carbon and sulfate mass (Figure 6)." The portion of organic matter mass attributable to the fire is defined by the following equation[2]: OMinc = 2(OCd – OCavg), where OMinc is the organic mass increment; OCd and OCavg are the daily and typical (average) measured organic carbon. The Sulfate mass increment is calculated using the following: SO_4Minc = 1.7(SO_4d – SO_4 avg). The particulate matter mass has clearly been impacted by the increase in sulfates and conversely the organic matter attributes very little to the PM mass measured on June 21.

[2] "Species Contributions to PM2.5 Mass Concentrations (Turpin and Lim 2001)"

Figure 5: Paducah Speciation Data

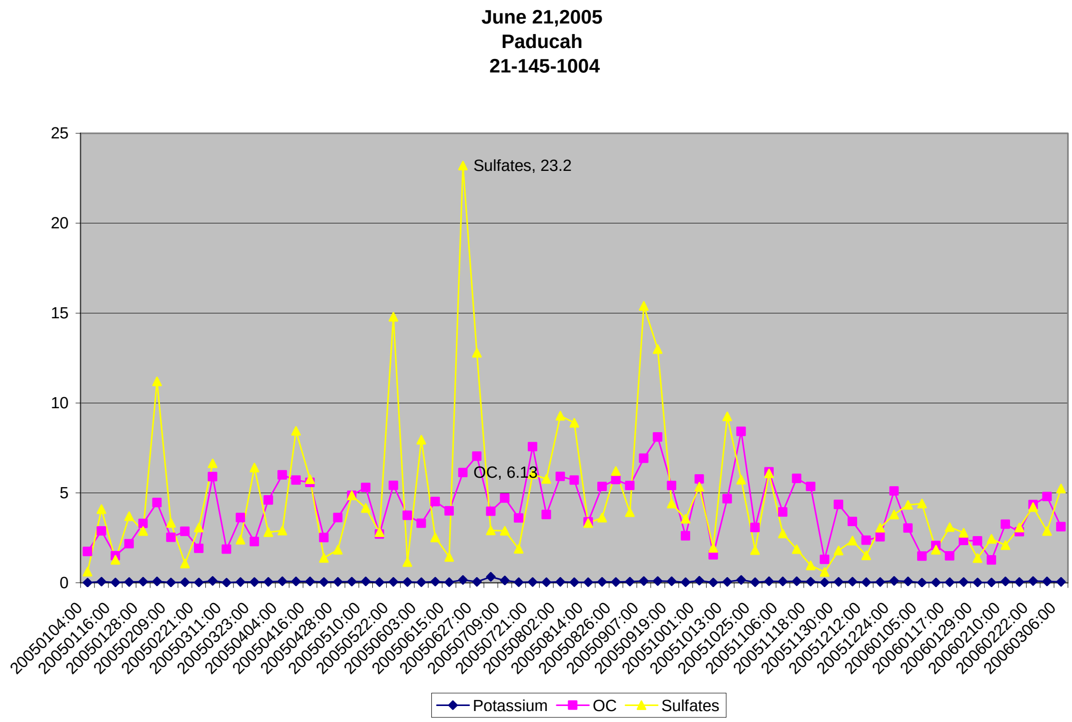
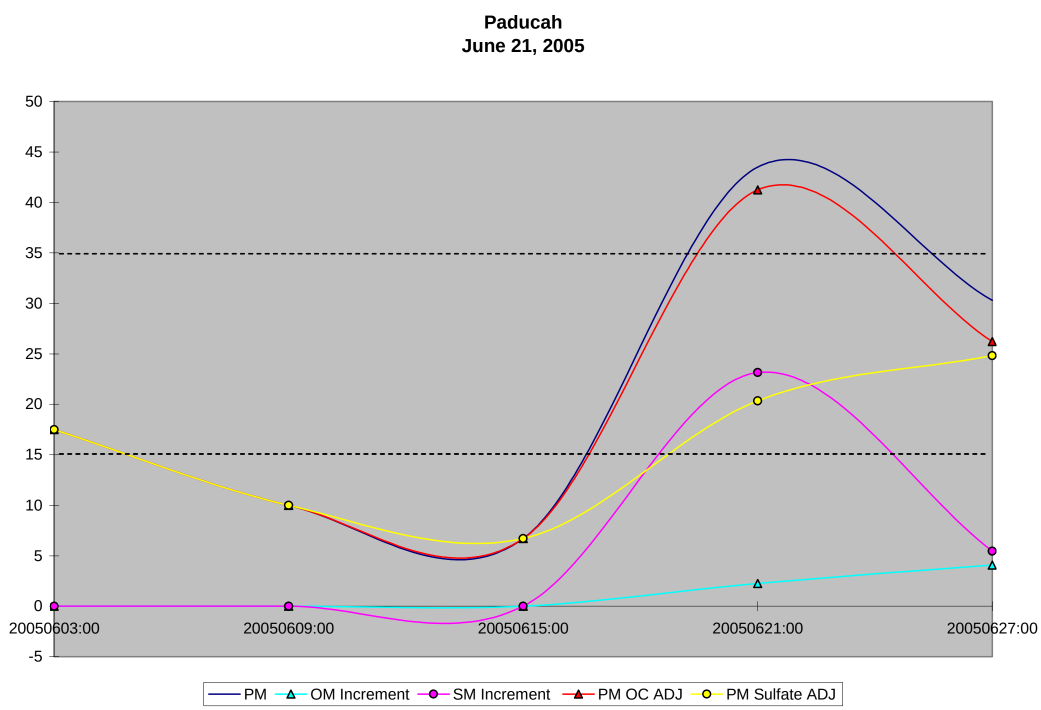


Figure 6: Paducah "But For" Demonstration



Exceedance Date(s): September 10, 2005
MSA(s): Paducah, KY-IL
Event Description: Monitoring sites surrounded by Arkansas/Mississippi wildfires.

Table 2 - Site-specific information used in analysis (μg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-145-1004	9/10/2005	39.6	15.2	22.4	35.3	No

DETAILED DISCUSSION OF EVIDENCE

A. EVENT DISCRIPTION:

Documentation submitted by the Kentucky DAQ claims that smoke from wildfires in Arkansas and Mississippi caused NAAQS exceedances at the site listed above. The only requested value that passed both steps with a concentration of 39.6μg/m^3 was collected on September 10, 2005. The documentation submitted by the Kentucky DAQ did not demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance "but for" the event on September 10, 2005.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

KYDAQ submittal consisted of National Oceanic and Atmospheric Administration (NOAA) map "Hot Spots", wind rose graphs of meteorological data and historical data for the month of September (2002 -2006). The causal relationship suggested is solely based on wind speed and wind direction. This evidence alone is insufficient to establish a causal relationship between the Arkansas and Mississippi wildfires and the exceedance of the 24-hr NAAQS.

C. COMPARISON TO BACKGROUND LEVELS

The 24-hr average $PM_{2.5}$ concentration is above the 30-day mean, and the calculated 95th percentile. A widespread sulfate event is evident across the Eastern U.S. on September 10, 2005 (Figure 7). The seasonal[3] average for sulfate is 4.8μgm/m^3 and for organic carbon is 4.7μg/m^3 at the Paducah site thereby indicating that the exceedance was more likely caused by the increased level of sulfates mass measured that day as opposed to the organic carbon mass measured.

[3] Seasonal average September – November 2004 - 2006

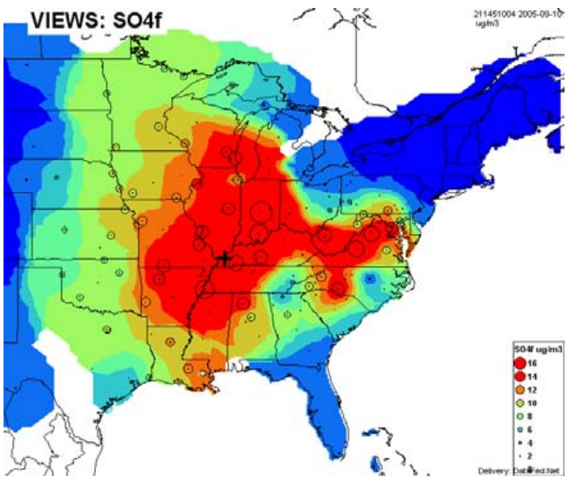


Figure 7: SO_4 Concentrations, Sept. 10, 2005

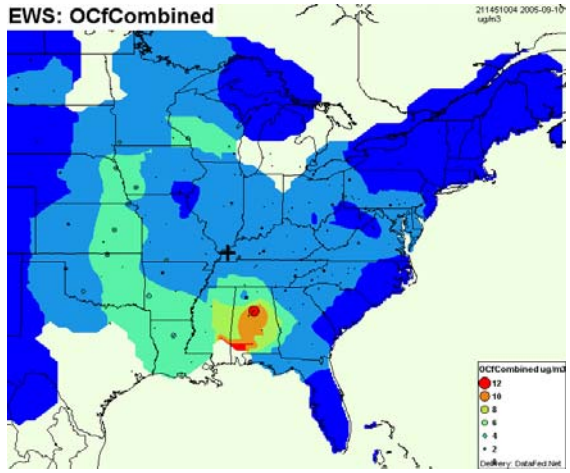


Figure 8: OC Concentrations, Sept. 10, 2005

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

The requirement to establish that there would have been no exceedance "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met. This is supported by widespread elevated sulfate levels over the entire Eastern U.S. coupled with the organic carbon levels equal to the seasonal[4] average. This suggests that the elevated $PM_{2.5}$ levels observed at the Paducah site on September 10, 2005, were not caused by transport of airborne particulate matter attributed to the Arkansas/Mississippi wildfire event, but due to increased levels of sulfates.

[4] Seasonal (June - August)

Exceedance Date(s): July 19, 2006
MSA(s): Paducah, KY-IL
Event Description: Monitoring sites in western Kentucky blanketed with a smoke plume from the Arkansas/Mississippi wildfires.

Table 3 - Site-specific information used in analysis (µg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-145-1004	7/19/2006	36.7	17.4	23.9	34.1	No

DETAILED DISCUSSION OF EVIDENCE

A. EVENT DISCRIPTION:

Documentation submitted by the Kentucky DAQ claims that smoke from wildfires in Arkansas and Mississippi caused NAAQS exceedance at the site listed above. The only requested value that passed both steps with a concentration of 36.7µg/m^3 was collected on July 19, 2006. The documentation submitted by the Kentucky DAQ did not demonstrate a clear causal relationship between the measured concentration and the event, and did not demonstrate that there would have been no exceedance "but for" the event on July 19, 2006.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

KYDAQ submittal consisted of National Oceanic and Atmospheric Administration (NOAA) analyzed smoke map wind rose graphs of meteorological data and historical data for the month of July (2002-2006.) The causal relationship suggested that Western Kentucky was blanketed with a smoke plume from the Arkansas and local wildfires; and that local meteorological conditions indicated calm winds from the southeast. This evidence alone is insufficient to establish a causal relationship between the Arkansas and Mississippi wildfires and the exceedance of the 24-hr NAAQS.

C. COMPARISON TO BACKGROUND LEVELS

The 24-hr average $PM_{2.5}$ concentration is above the 30-day mean, and the calculated 95th percentile. A widespread sulfate event is evident across the entire state of Kentucky on July 19, 2006. Organic carbon is shown to be above average concentrations only in Alabama and parts of Georgia and Mississippi (Figure 11). The seasonal[5] average for sulfate is 3.9µg/m^3 and for organic carbon is 4.7µg/m^3 at the Paducah site. The State of Kentucky including the Paducah site (Figures 10-11) has sulfate levels between 14 and 16µg/m^3 and organic carbon levels in the range of 4µg/m^3. Thereby indicating that exceedance was more likely caused by the increased level of sulfates mass measured that day as opposed to the organic carbon mass measured.

[5] Seasonal average (September - November 2004 and 2005)
AQS Database OC unadjusted 88305, Sulfates 88403

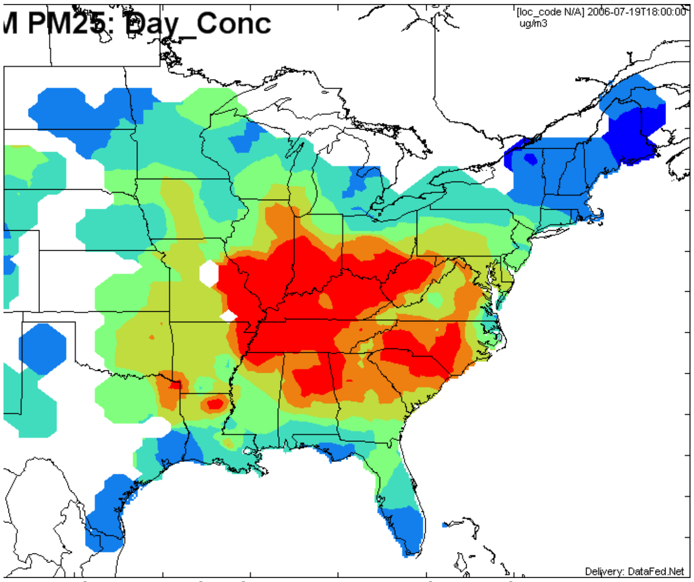
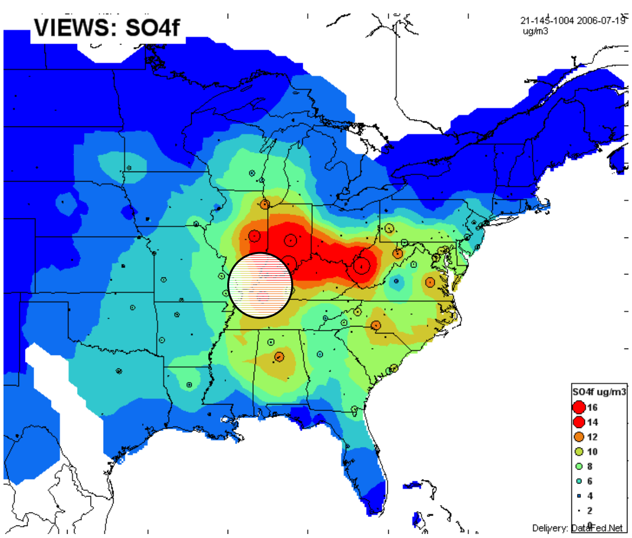


Figure 9: Paducah $PM_{2.5}$ Concentrations, July 19, 2006



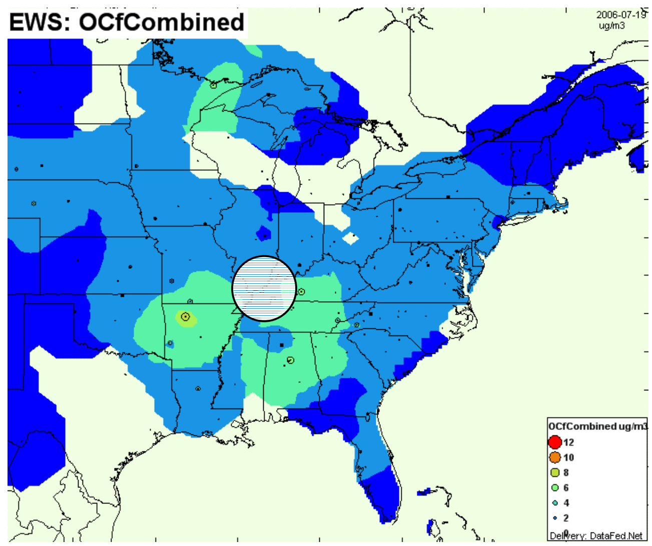


Figure 10: Paducah SO4 Concentrations, July 19, 2006

Figure 11: Paducah OC Concentrations, July 19, 2006

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

The requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has not been met. The widespread sulfate over parts of Tennessee, Kentucky, Illinois, Indiana, Ohio and West Virginia, suggest a regional impact combined with stagnant wind conditions. The levels of organic carbon measured are at or below the seasonal[6] averages suggests that the elevated $PM_{2.5}$ levels observed at the Paducah site on July 19, 2006, were not caused by transport of airborne particulate matter attributed to a wildfire event, but due to high sulfate levels.

[6] Seasonal average (June – August 2004 and 2005) AQS Data base OC unadjusted 88305, Sulfates 88403

Exceedance Date(s): May 24 - June 2, 2007
MSA(s): Paducah, KY-IL
Event Description: Monitoring site impacted by smoke plumes from the Southeast Georgia/Florida wildfires.

Table 4 - Site-specific information used in analysis (µg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-145-1004	5/24/2007	39.4	12.1	16.8	19.1	Yes

A. EVENT DISCRIPTION:

Documentation submitted by the Kentucky DAQ claims that smoke from the Southeast Georgia/Florida wildfires (see Figures 12 and 13) caused an exceedance of the 24-hr PM2.5 NAAQS on May 24, 2007. The requested value of 39.4µg/m^3 passed both steps.

Due to the amount of acreage consumed from these wildfires, copious smoke impacted sites around Region 4 from May through the first week of June, in many cases causing very large increases in the 24 hour $PM_{2.5}$ mass. The documentation submitted by the Kentucky DAQ demonstrates a clear causal relationship between the measured concentration and the event, and that there would have been no exceedance "but for" the event on May 24, 2007.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

KYDAQ provided PM2.5 speciation and meteorological documentation (including National Oceanic and Atmospheric Administration (NOAA) smoke analysis maps, Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) models, and wind rose graphs along with statistical analysis of the data). The overall body of evidence was sufficient to establish a causal relationship between the Southeast Georgia/Florida wildfires and the exceedance.

The Bugaboo Scrub Fire wildfire (a.k.a. Big Turnaround fire) (Figure 12) raged from May to June in 2007 and was the largest fire in the history of both Georgia and Florida. The "Bugaboo" scrub fire, started in the Okefenokee Swamp, the majority of which is located in Georgia. It was previously known as the Sweat Farm Road Fire (Figure 13), which merged with the Big Turnaround fire.

Fig. 12: Big Turnaround fire 4/29/07 Blaine Eckberg, USFWS

Fig. 13: GA Forestry Commission - Sweat Farm Road Fire on 4/28/07

C. COMPARISON TO BACKGROUND LEVELS

Figure 14 shows wind trajectories maps and measured concentrations. The blue lines indicate air mass movement. The red lines indicate the direction of travel at the point of exit. The organic carbon map (Figure 16) indicates organic carbon levels are approximately 2 times higher than the seasonal average[7] of 4.4µg/m^3, where as the sulfate maps (Figure 15) show levels that are equal to the seasonal levels of 6.1µg/m^3. This is a strong indication that the exceedance was due to the smoke plume traveling from the Southeast Georgia/Florida wildfires.

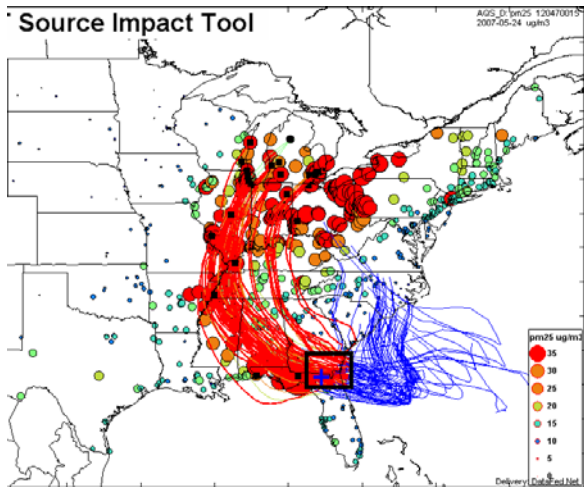


Figure 14 Paducah Combined Aerosol Trajectory Tool (CATT) Back Trajectory May 24, 2007

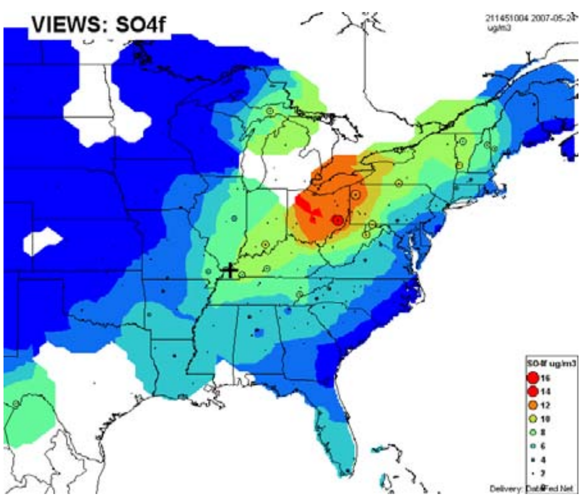


Figure 15: Paducah SO4f Concentration 5/24/07

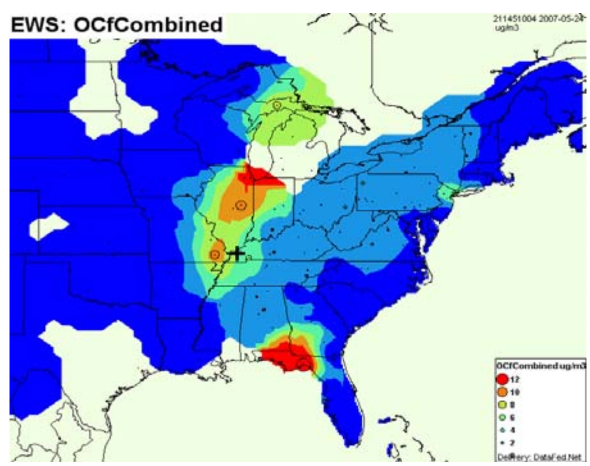


Figure 16: Paducah OC Concentration 5/24/07

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

In order to quantify the impacts of the fire on observed PM2.5 concentrations, speciation data collected at the Clarksville, TN site (47-125-0009) and the Southwick, KY site in Louisville, KY (21-111-0043) on May 24, 2007, was used to approximate the organic mass increment of the observed PM2.5 mass that was caused by the wildfire. (These sites were chosen due to their proximity to the Paducah site.) The organic mass increment was calculated using the following equation[8],

[7] Seasonal average (May – July 2004 and 2005) AQS Data base OC unadjusted 88305, Sulfates 88403

[8] "Species Contributions to PM2.5 Mass Concentrations (Turpin and Lim 2001)"

$$OMI = (OC_{observed} - OC_{average}) \times 2.0 \qquad \textit{(Eq. 2)}$$

Where OMI is the organic mass increment due to smoke from the wildfire, $OC_{observed}$ is the observed organic carbon mass, and $OC_{average}$ is the average organic carbon mass observed at the nearby Southwick, KY (2005-2006) and Clarksville, TN (2007) sites during the month of May. A multiplier of 2.0 is used to approximate the total PM2.5 mass associated with smoke from wildfires.[9] In order to approximate the PM2.5 concentration that would have been observed but for the fire, the OMI was subtracted from the observed 24-hr average PM2.5 concentration. This procedure was then repeated for each day that PM2.5 speciation data was collected during May 2007 to compare impacts of smoke on different days. The results of this analysis are shown in Figure 17. This figure shows the calculated OMI and the adjusted PM2.5 mass (Observed PM2.5 – OMI). The graph demonstrates that without the PM2.5 mass emitted by the fire on May 24, 2007, the 24-hr average PM2.5 concentration would have been approximately 35.1µg/m^3, and thus that there would have been no exceedance but for the wildfire.

The overall body of evidence suggests that there would have been no NAAQS exceedance during this period but for the Southeast Georgia/Florida wildfires. EPA concurrence was given to the value requested.

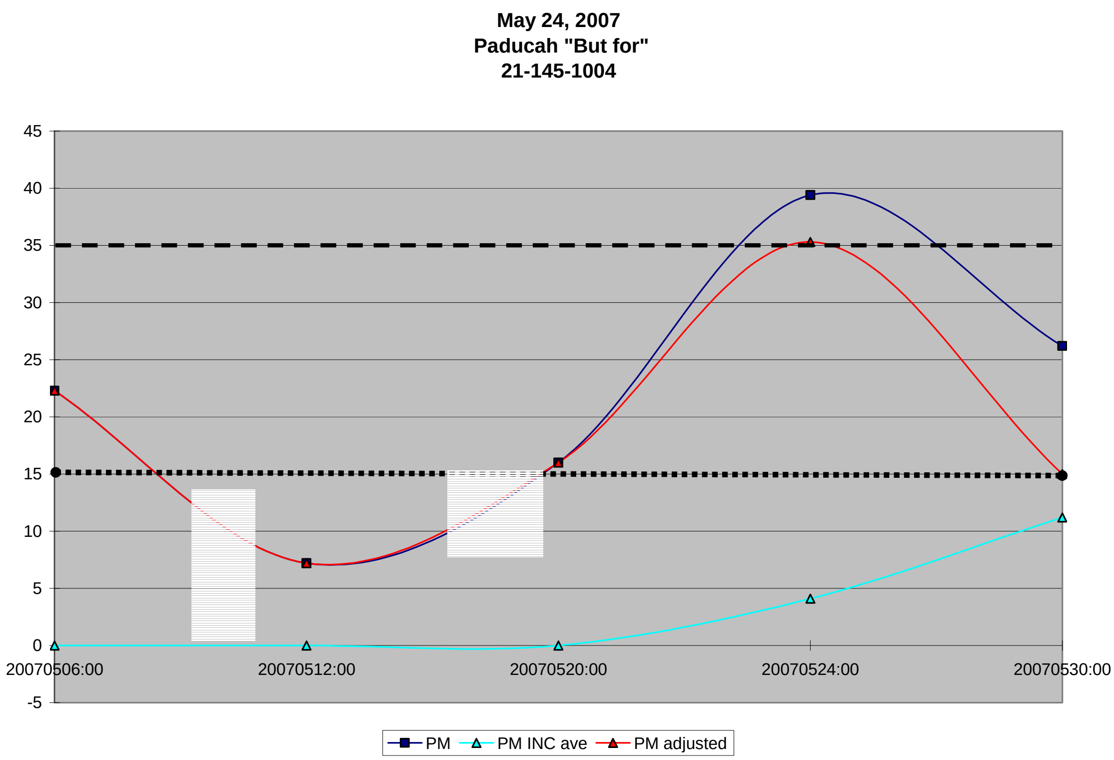


Figure 17: Paducah "But for" Demonstration

[9] "Species Contributions to PM2.5 Mass Concentrations (Turpin and Lim 2001)"

Attachment 3

$PM_{2.5}$ Exceptional Events Technical Support Document

U.S. Environmental Protection Agency Region 4

Commonwealth of Kentucky:
Kenton
Cincinnati – Middletown – Wilmington
OH - KY- IN
Combined Statistical Area

2005 - 2007

Introduction

This document provides U.S Environmental Protection Agency (EPA) Region 4 rationale for concurrence or non-concurrence with an exceptional event flag on the 24-hr average $PM_{2.5}$ concentration recorded at various Air Quality System (AQS) sites within the Kentucky Department of Energy and Environmental Protection Ambient Air Monitoring Network. The exceptional event flags that EPA Region 4 has concurred with will be excluded from use in determinations of exceedances and National Ambient Air Quality Standards (NAAQS) violations.

According to 40 CFR 50.1(j):

> "Exceptional event means an event that affects air quality, is not reasonably controllable or preventable, is an event caused by human activity that is unlikely to recur at a particular location or a natural event, and is determined by the Administrator in accordance with 40 CFR 50.14 to be an exceptional event. It does not include stagnation of air masses or meteorological inversions, a meteorological event involving high temperatures or lack of precipitation, or air pollution relating to source noncompliance."

§50.14(b)(2) also states:

> "EPA shall exclude data from use in determinations of exceedances and NAAQS violations where a State demonstrates to EPA's satisfaction that emissions from fireworks displays caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section. Such data will be treated in the same manner as exceptional events under this rule, provided a State demonstrates that such use of fireworks is significantly integral to traditional national, ethnic, or other cultural events including, but not limited to July Fourth celebrations which satisfy the requirements of this section."

Finally, §50.14(c)(3)(iii) states:

"The demonstration to justify data exclusion shall provide evidence that:

(A) The event satisfies the criteria set forth in 40 CFR 50.1(j);
(B) There is a clear causal relationship between the measurement under consideration and the event that is claimed to have affected the air quality in the area;
(C) The event is associated with a measured concentration in excess of normal historical fluctuations, including background; and
(D) There would have been no exceedance or violation but for the event.

Each $PM_{2.5}$ 24-hr average concentration requested for exclusion was first evaluated against these criteria using a two-step analysis. This analysis was designed to compare the requested value to historical values observed at the site in order determine whether any exceedances could have been caused by the suspected event.

Screening Test 1: Monthly Average Comparison

Using 24-hr $PM_{2.5}$ data from AQS for 2004-2007, a comparison three-year monthly average was calculated. The three-year monthly average concentration was calculated using data from the three previous years. For example, a requested value in May 2007 was compared to the average of all the samples collected at the site during May 2004, May 2005, and May 2006. If the three-year average was greater than the annual $PM_{2.5}$ NAAQS (15 µg/m^3) and the requested value was less than the 24-hr $PM_{2.5}$ NAAQS (35.5 µg/m^3 by rounding conventions), then EPA concurrence was not given to the requested value. This is because failing this test confirmed EPA's judgment that there is insufficient evidence that "there would have been no exceedance or violation but for the event" as required by §50.14(c)(3)(iii)(D) because the normally expected concentration at the site (the three-year monthly mean concentration) is in excess of the NAAQS.

Screening Test 2: Monthly 84th Percentile Comparison

Using 24-hr $PM_{2.5}$ data from AQS for 2004-2007, a comparison three-year upper 84th percentile was calculated for the month in which the requested value was collected. The three-year monthly 84th percentile was calculated using data from the three previous years For example, a requested value in May 2007 was compared to the upper 84th percentile calculated from of all the samples collected at the site during May 2004, May 2005, and May 2006. The calculated three-year monthly upper 84th percentile was considered to represent the range of normally expected high values at that site due to normal local and background sources If the requested value was below the calculated three-year monthly upper 84th percentile, EPA concurrence was not given to the requested value This is because failing this test confirmed EPA's judgment that there is insufficient evidence to demonstrate that the NAAQS exceedance was caused by the suspected event as required by §50.14(c)(3)(iii)(D) and not by normal local and background sources at the site.

If a requested value did not pass one or more of the above screening tests and the State did not submit compelling evidence to demonstrate that the event satisfied the exceptional event criteria, then EPA concurrence was not given to the exceptional event flag on the requested value. The values that did pass both of the above screening tests were then evaluated against the requirements of §50.14(c)(3)(iii).

Arkansas, Mississippi and Texas Wildfires

Exceedance Date:	September 10 - 13, 2005
MSA:	Kenton, Cincinnati-Middletown
Event Description:	Smoke impact from Arkansas, Mississippi and Texas wildfires

Table 1: site-specific information used in analysis (µg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84th Percentile	95th Percentile	EPA Concurrence
21-117-0007	9/10/2005	52.7	16.7	24.6	35.9	No
21-117-0007	9/13/2005	42.1	16.7	24.6	35.9	No

Notes: [1]Three-year monthly average above 15µg/m^3 and observed concentration is below 35µg/m^3
[2]Observed concentration is below 84 percentile

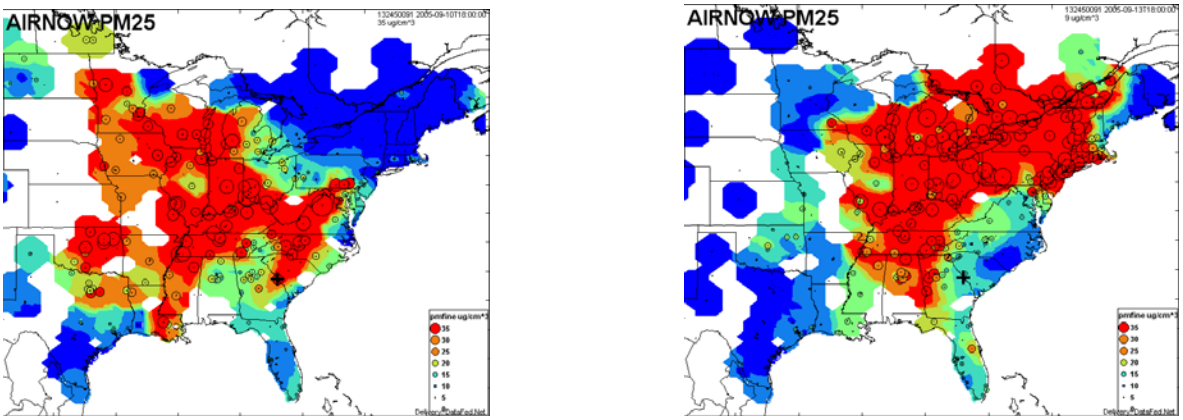
A. EVENT DESCRIPTION

The Commonwealth of Kentucky submitted documentation to support its claim that smoke from Arkansas and Mississippi wildfires caused NAAQS exceedances at the site listed above. Both of the requested values passed the two-step analysis. However, documentation submitted by Kentucky did not clearly demonstrate a clear causal relationship between the measured concentration and the event nor did it demonstrate that there would have been no exceedance or violation but for the event. EPA concurrence was not given to these exceptional event flags.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

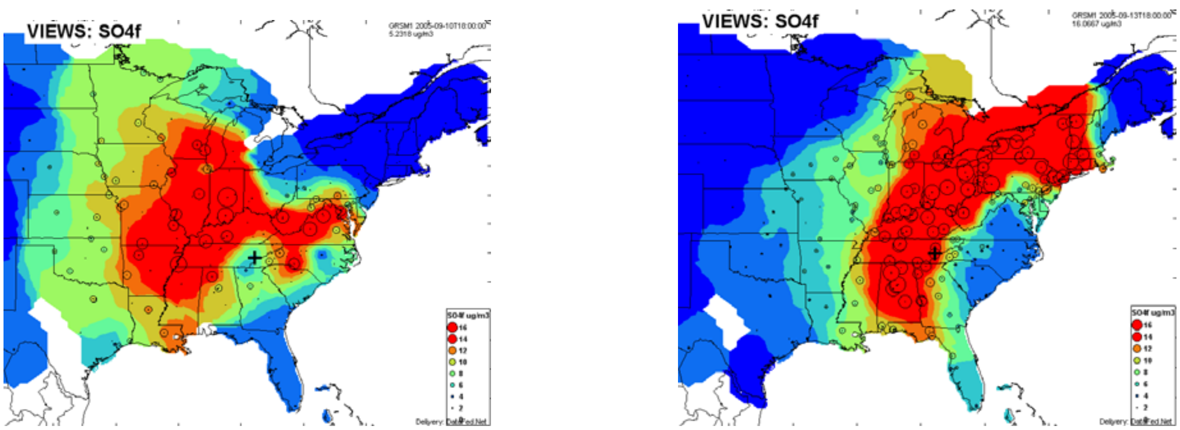
The demonstration provided the historical daily $PM_{2.5}$ measured values for the month of September for years 2002 through 2006, wind rose graphs and National Oceanic and Atmospheric Administration (NOAA) analyzed smoke plume maps. The supporting documentation did not clearly summarize the nature of the causal relationship between the exceedance and impact from Arkansas and Mississippi wildfire smoke.

The maps obtained from the www.datafed.net website show detectable organic carbon and sulfate levels for September 10th and 13th. The maps shown in Figures 1 and 2 depict an area of high $PM_{2.5}$ and sulfate concentrations overlapping each other on both dates. The maps in Figure 3 show the spatially averaged levels for organic carbon to be 4 µg/m^3. The higher sulfate value in Figure 2 suggests that there was possibly a high regional haze event that may have occurred on September 13 that could have contributed to any high PM concentrations recorded at monitors within the area. A causal connection between the Arkansas and Mississippi wildfires and the observed exceedance of the $PM_{2.5}$ NAAQS cannot be demonstrated as required in §50.14(c)(3)(iii)(C).



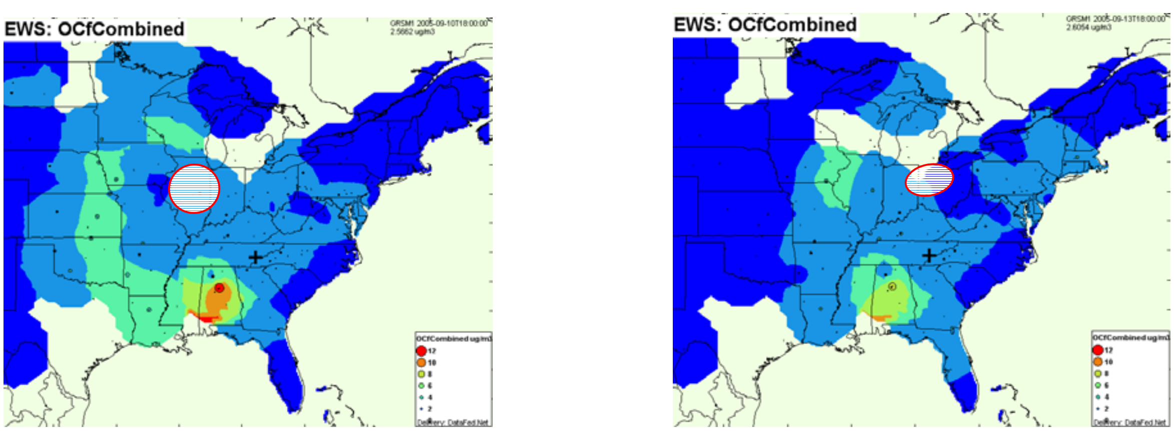
September 10, 2005 September 10, 2005

Figure 1: $PM_{2.5}$ Concentrations



September 13, 2005 September 13, 2005

Figure 2: Sulfate Concentrations



September 10, 2005 September 13, 2005

Figure 3: Organic Carbon Concentrations

C. COMPARISON TO BACKGROUND LEVELS

The 24-hr average $PM_{2.5}$ concentrations measured at the sites are above the monthly mean and calculated 95th percentile. On September 13, 2005, the $PM_{2.5}$ speciated monitor at the Covington site in Kenton County measured 6.6 µg/m^3 organic carbon and 21.8 µg/m^3 sulfates (Fig. 4). The sulfates measured this day are approximately 3 times higher than the three-year monthly average for this site and accounted for 47% of the speciated $PM_{2.5}$ mass. Although organic carbon was 1.3 times higher than the three-year monthly average it accounted for only14% of the speciated $PM_{2.5}$ mass.

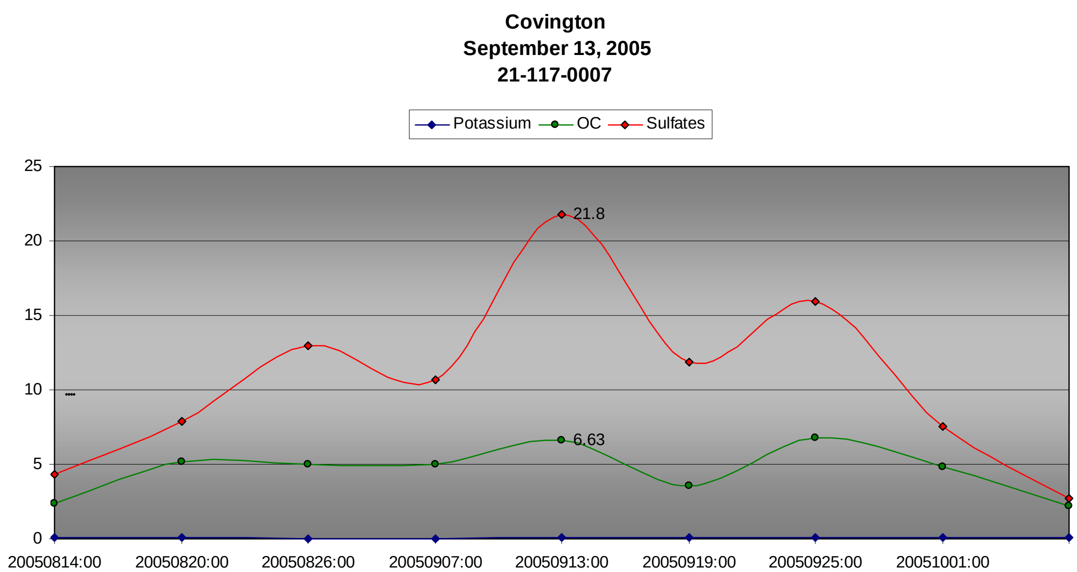


Figure 4: Covington Speciation

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

To demonstrate that there would or would not have been an exceedance or violation of the 24-hour NAAQS the following graph represents the "estimated particulate matter "but for" speciated organic carbon and sulfate mass (Figure 5)." The portion of organic matter mass attributable to the fire is defined by the following equation: $OMinc = 2(OC_{observed} - OC_{average})$, where OMinc is the organic mass increment and $OC_{observed}$ and $OC_{average}$ are the daily and typical (average) measured organic carbon. The sulfate mass increment is calculated using the following: $SMinc = 1.7(S_{observered} – S_{average})$[1]. Using the equations described above the $PM_{2.5}$ speciated mass attributable to the smoke is calculated to be 2.53 µg/m^3, whereas the sulfate contribution is calculated to be 25.06 µg/m^3 (Figure 5). Accounting for the ammonium and water associated with the measured sulfate, its PM2.5 mass would be approximately 40 ug/m3. Thus the sulfate alone would account for the exceedance. Secondly, the estimated smoke increment is only 2.5ug/m3, so "but for" this smoke, there would still be an exceedance.

---

[1] "Species Contributions to PM2.5 Mass Concentrations (Turpin and Lim 2001)"

Therefore, the requirement to establish that there would have been no exceedance or violation "but for" this event, as found in §50.14(c)(3)(iii)(B), has not been met. Region 4 does not concur with the request to flag data on September 10 and 13, 2005.

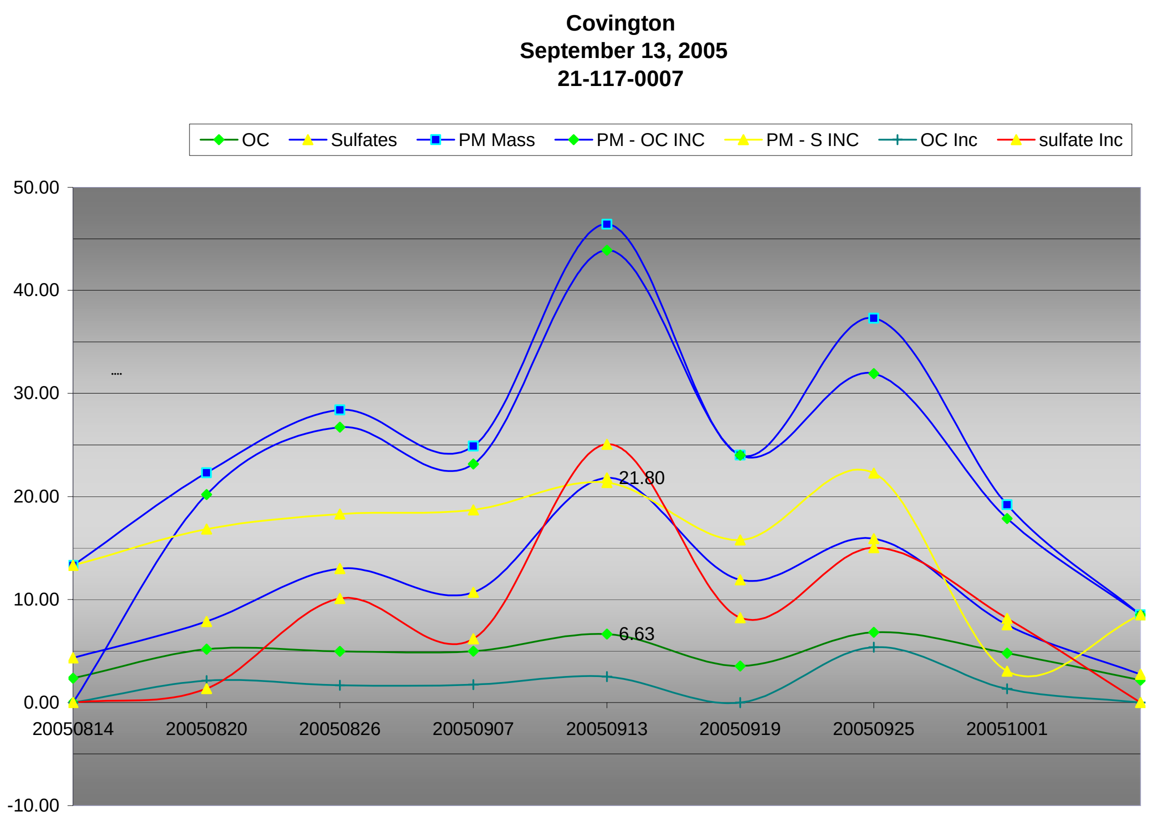


Figure 5: Covington "But For"

Georgia Wild Fires

Exceedance Date:	June 2, 2007
MSA:	Kenton, Cincinnati-Middletown
Event Description:	Smoke impact from Southeast Georgia and Northeast Florida wildfires

Table 2: site-specific information used in analysis (µg/m^3)

AQS ID	Date	Observed Concentration	Monthly Mean	84^{th} Percentile	95^{th} Percentile	EPA Concurrence
21-117-0007	6/2/2007	40.1	15.1	21.8	24.7	Yes

Notes: [1]Three-year monthly average above 15µg/m^3 and observed concentration is below 35µg/m^3
[2]Observed concentration is below 84 percentile

A. EVENT DESCRIPTION

The Commonwealth of Kentucky submitted documentation to support its claim that smoke from Georgia wildfires caused the NAAQS exceedances at the Covington site in Kenton County, KY. The flagged value passes the two-step analysis. Documentation submitted by Kentucky was sufficient to make a determination of a clear causal relationship between the flagged value and the event, and that there would have not been an exceedance "but for" the event as required by of §50.14(c)(3)(iii). Therefore, U.S. Environmental Agency Region 4 concurs with Kentucky's request to flag on June 2, 2007.

B. CAUSAL CONNECTION BETWEEN THE EVENT AND AIR QUALITY

Figure 6, "Source Impact Tool" shows a wind trajectory map and measured concentrations. The blue lines indicate air mass movement. The red lines indicate the direction of travel at the point of exit. The map indicates that the air mass travels from the South Georgia and North Florida wildfires and passes over the Commonwealth on June 2, 2007. Figure 7, an AIRNOW $PM_{2.5}$ daily concentration map, shows that an elevated ground level concentration of $PM_{2.5}$ was measured on June 2, 2007, which reflected the path of the air mass that passed through the South Georgia and North Florida wildfires.

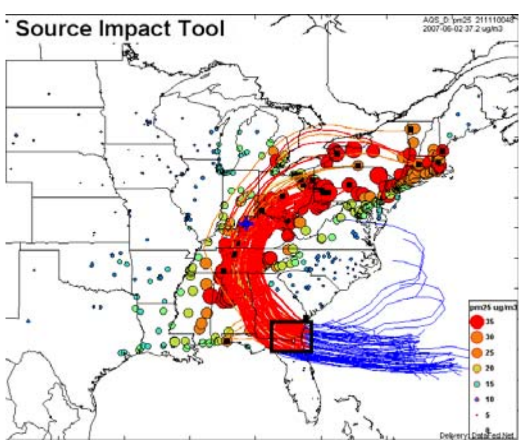


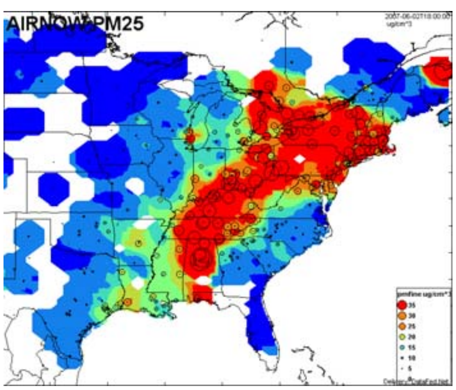
Figure 6: Air Mass Trajectory June 2, 2007

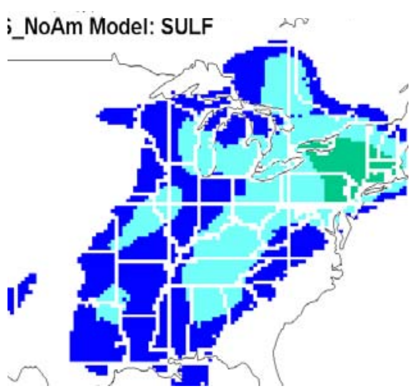
C. COMPARISON TO BACKGROUND LEVELS

The 24-hr average $PM_{2.5}$ concentration is above the 30-day mean, and the calculated 95th percentile. Figure 8 shows spatially averaged sulfate concentrations that are below the three-year monthly average of 5.0 µg/m^3. Figure 9 does show moderate levels of modeled smoke, however, this could be due to cloud coverage.

D. DEMONSTRATION OF NO EXCEEDANCE "BUT FOR" THE EVENT

The analysis found in Sonoma's Exceptional Event Analysis, Kentucky, page 24[2], found that "there is likely impact from the Georgia/Florida fires throughout Kentucky on 6/2/07." The elevated $PM_{2.5}$ ground level concentration footprint in Figure 7 mirrors the path of the air mass trajectory. Although sulfate and carbon speciation measurements were not available on June 2, the Sonoma analysis used the modeled sulfate and smoke from the Navy Aerosol Analysis and Prediction System (NAAPS) model. These data supplement the strong evidence provided by the trajectory pattern and consistent spatial pattern of high PM2.5 and help EPA establish that the event was exceptional. The below average sulfate concentrations seen in Figure 8 suggest that the high $PM_{2.5}$ concentrations measured in Kenton County were caused by the South Georgia and North Florida wildfires. After reviewing the Sonoma analysis and the maps obtained from the www.datafed.net website[3], EPA concurs with the request for exclusion of flagged data. The requirement to establish that there would have been no exceedance or violation "but for" this event, as found in Section §50.14(c)(3)(iii)(B), has been met. Region 4 concurs with the request to flag data as indicated in Table 6 above.





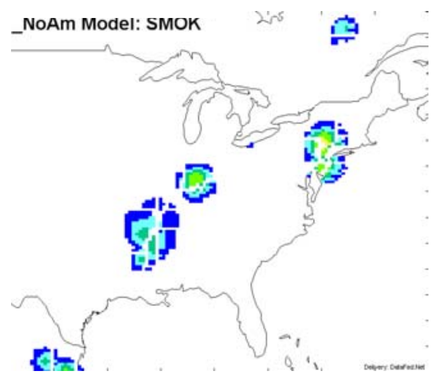


Figure 7: $PM_{2.5}$ Concentration **Figure 8: Modeled Sulfate** **Figure 9: Modeled Smoke**

June 2, 2007

[2] Exceptional Event Analysis, Sonoma Technology Inc., Sep 30, 2008, pg 24- 35
[3] http://datafedwiki.wustl.edu/index.php/Data_Views_Catalog

Exceptional Events Analysis, Kentucky

Prepared by:

Katie S. Wade
Sonoma Technology, Inc.
Petaluma, CA

Neil Frank
US Environmental Protection Agency
Research Triangle Park, NC

September 30, 2008

Sonoma Technology, Inc.
Air Quality Research and Innovative Solutions

905418

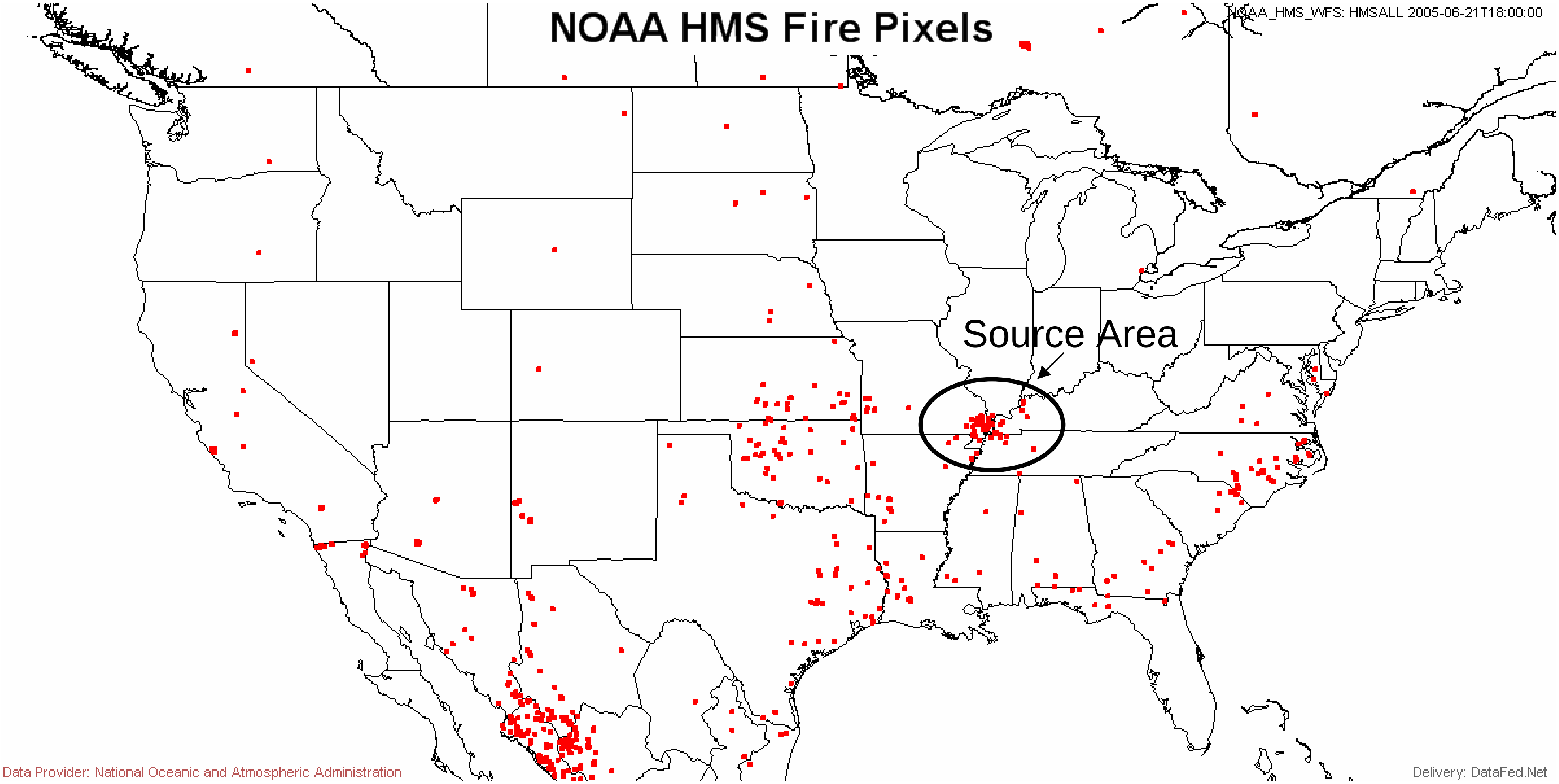
Overview

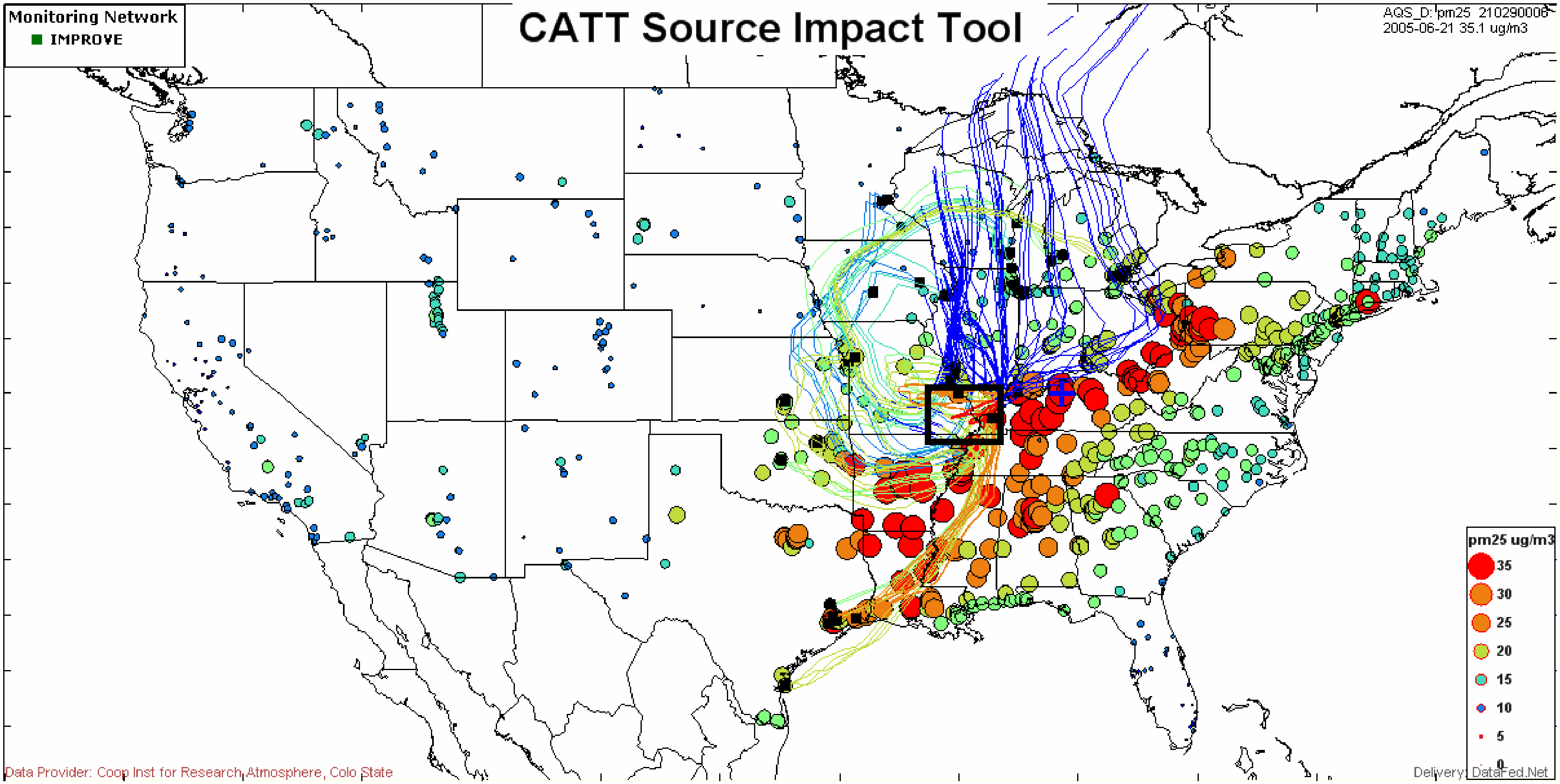
The following slides detail the analysis of three exceptional events (wildfires) during the summers of 2005, 2006, and 2007 in Kentucky.

Publicly available data (from EPA's Air Quality System and AirNow Tech) and tools (from DataFed) were used in this analysis.

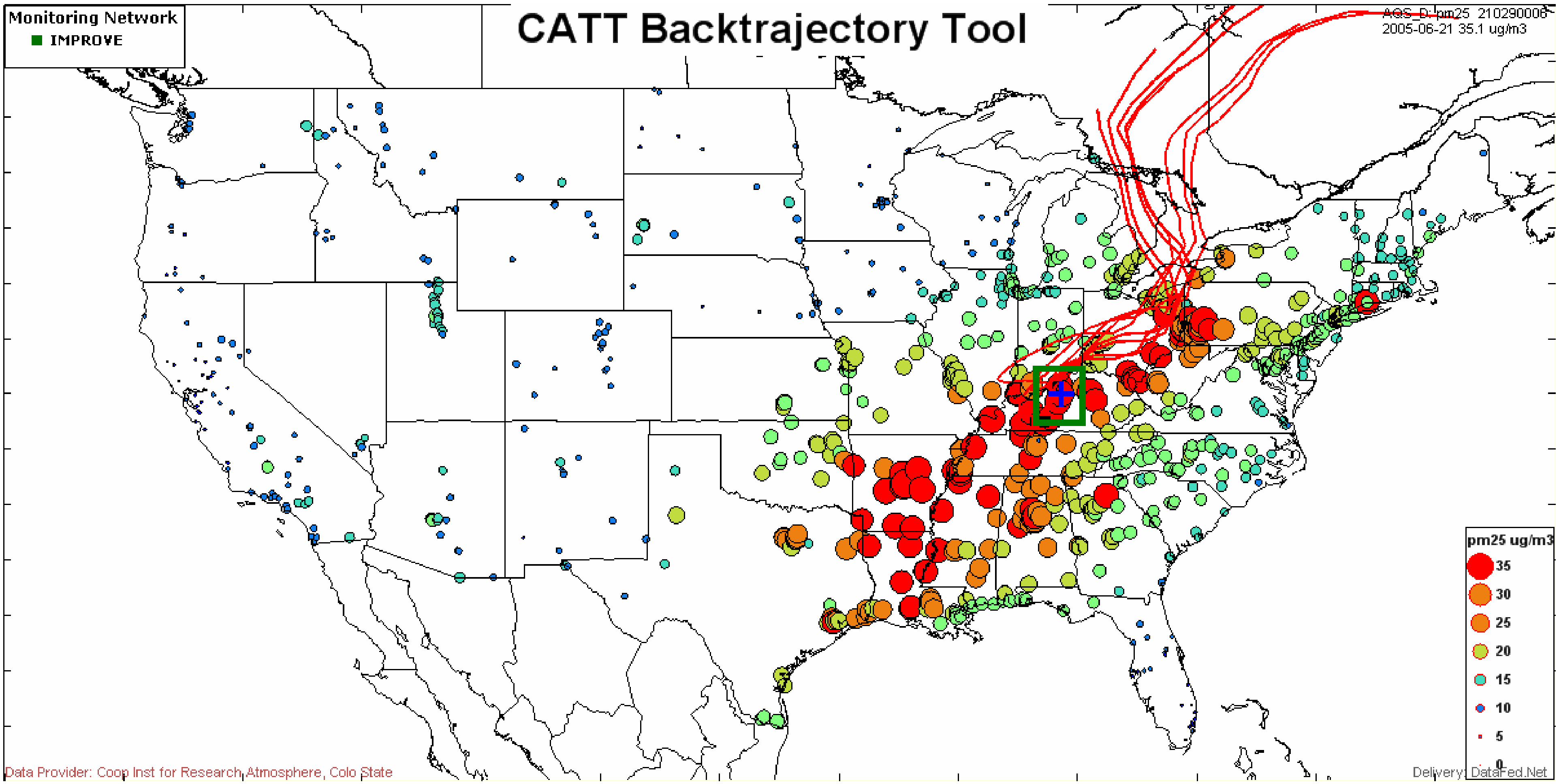
Exceptional Events Analysis
Kentucky
6/21/05

Two sites flagged (210290006 and 211451004) for possible fire impact from local/Missouri fires

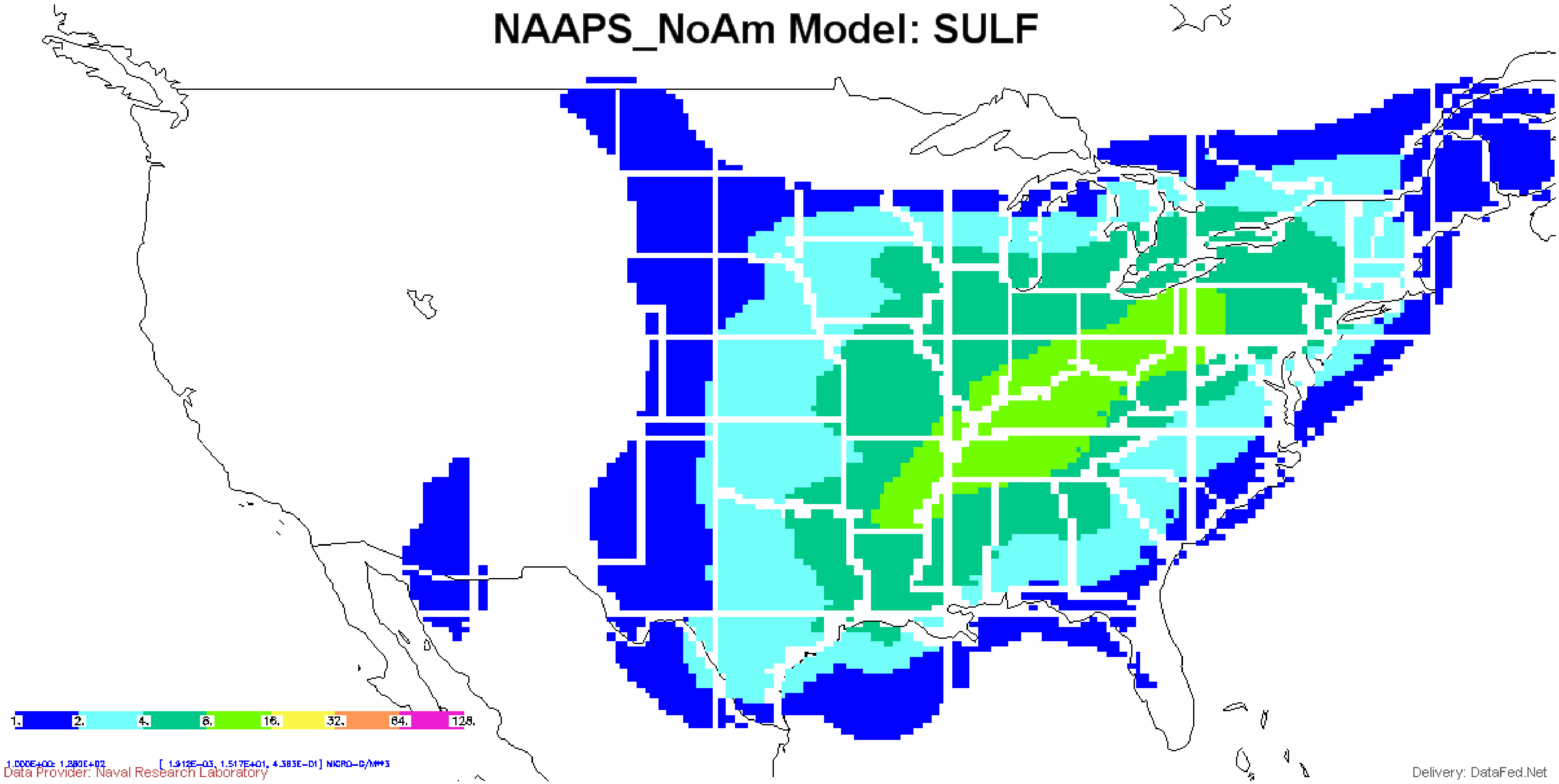

NOAA HMS Fire Pixels
NOAA_HMS_WFS: HMSALL 2005-06-21T18:00:00
Source Area
Data Provider: National Oceanic and Atmospheric Administration
Delivery: DataFed.Net



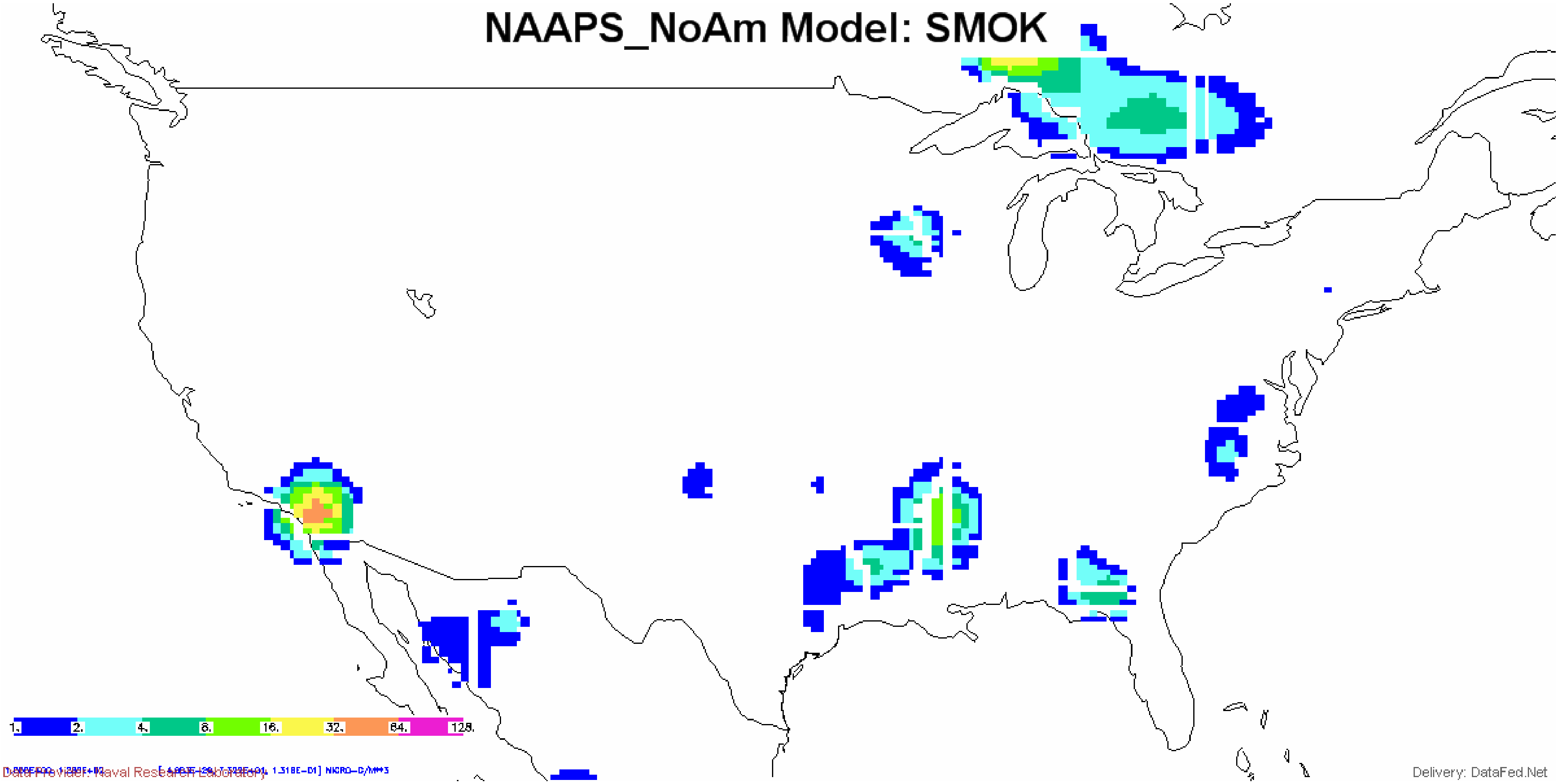
Source impact tool shows many trajectories passing through the fire region later did not pass through Kentucky



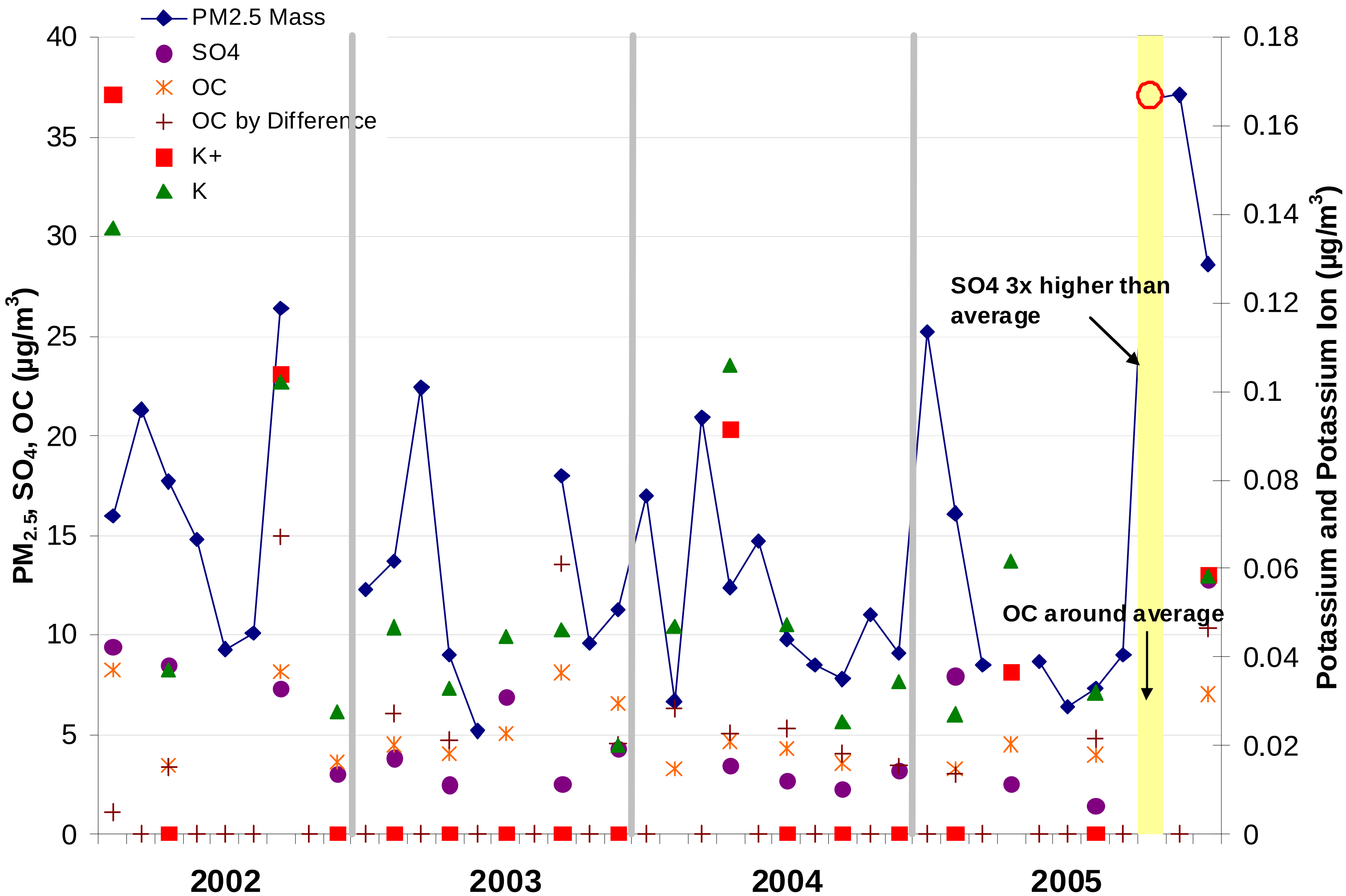
Source impact tool shows many trajectories passing through the fire region later did not pass through Kentucky



NAAPS model shows moderate/high SO4 in Kentucky



NAAPS model shows no smoke in Kentucky



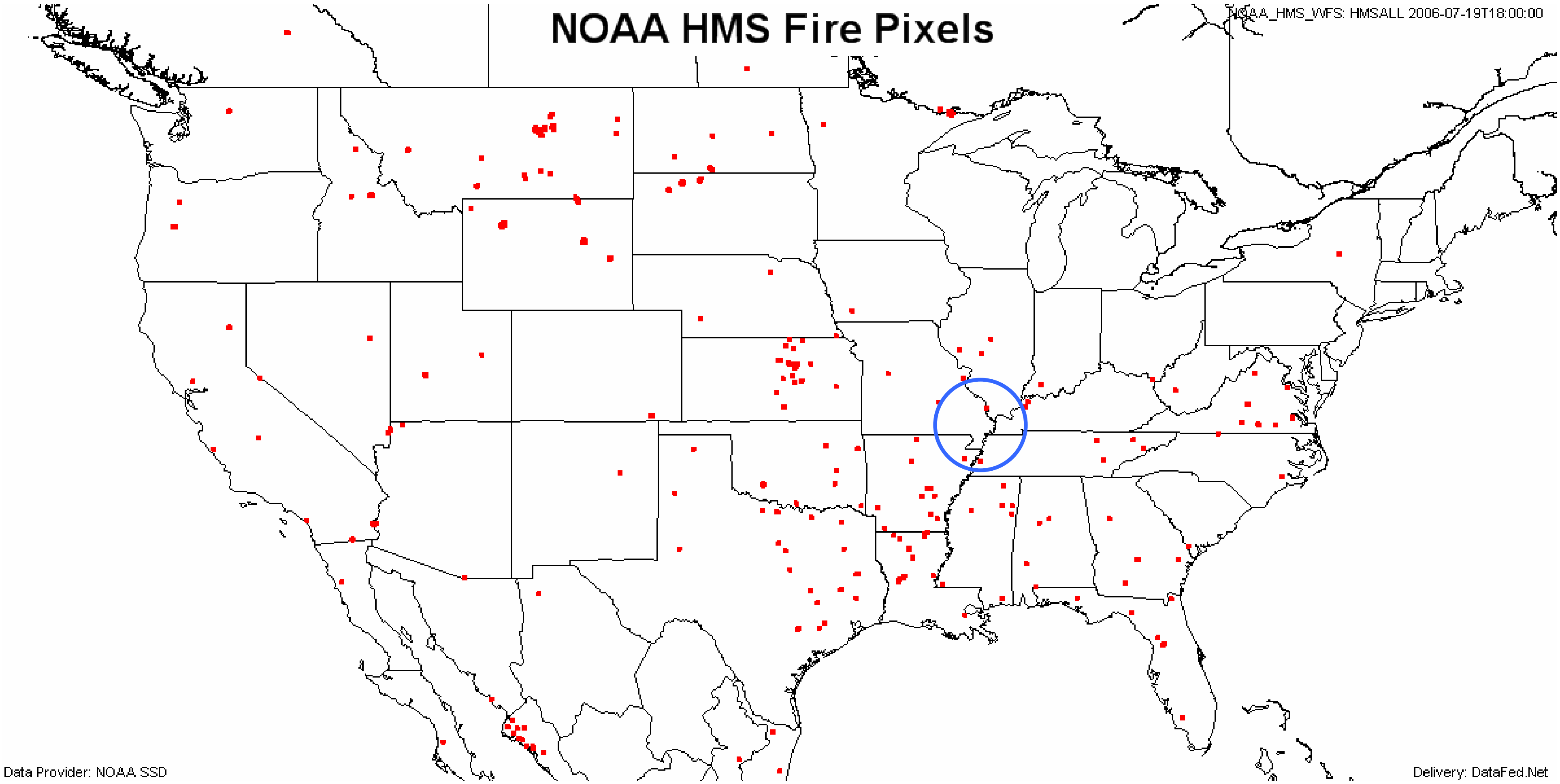
Time series for multiple June's shows 6/21/05 (highlighted in yellow) has much higher sulfate than average and only moderate OC concentrations. Potassium concentrations are very high, which indicates smoke impact, but that impact is likely not driving the mass on this date.
Individual years are delineated by a grey line.

Conclusions

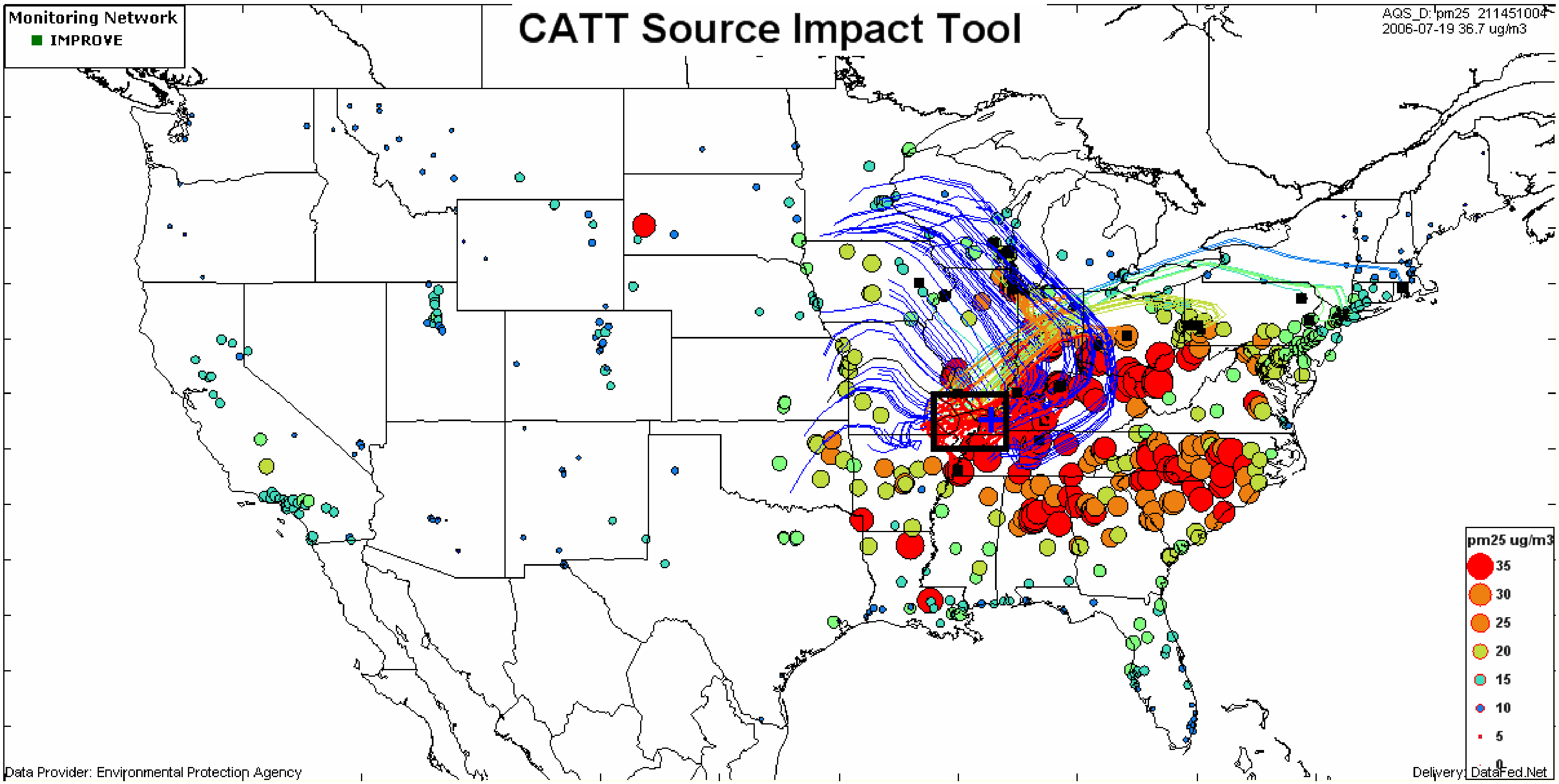
- Trajectory analysis shows impact from NE, not fire area
- High sulfate and low OC values indicate a sulfate event rather than a fire event

Exceptional Events Analysis
Kentucky
7/19/06

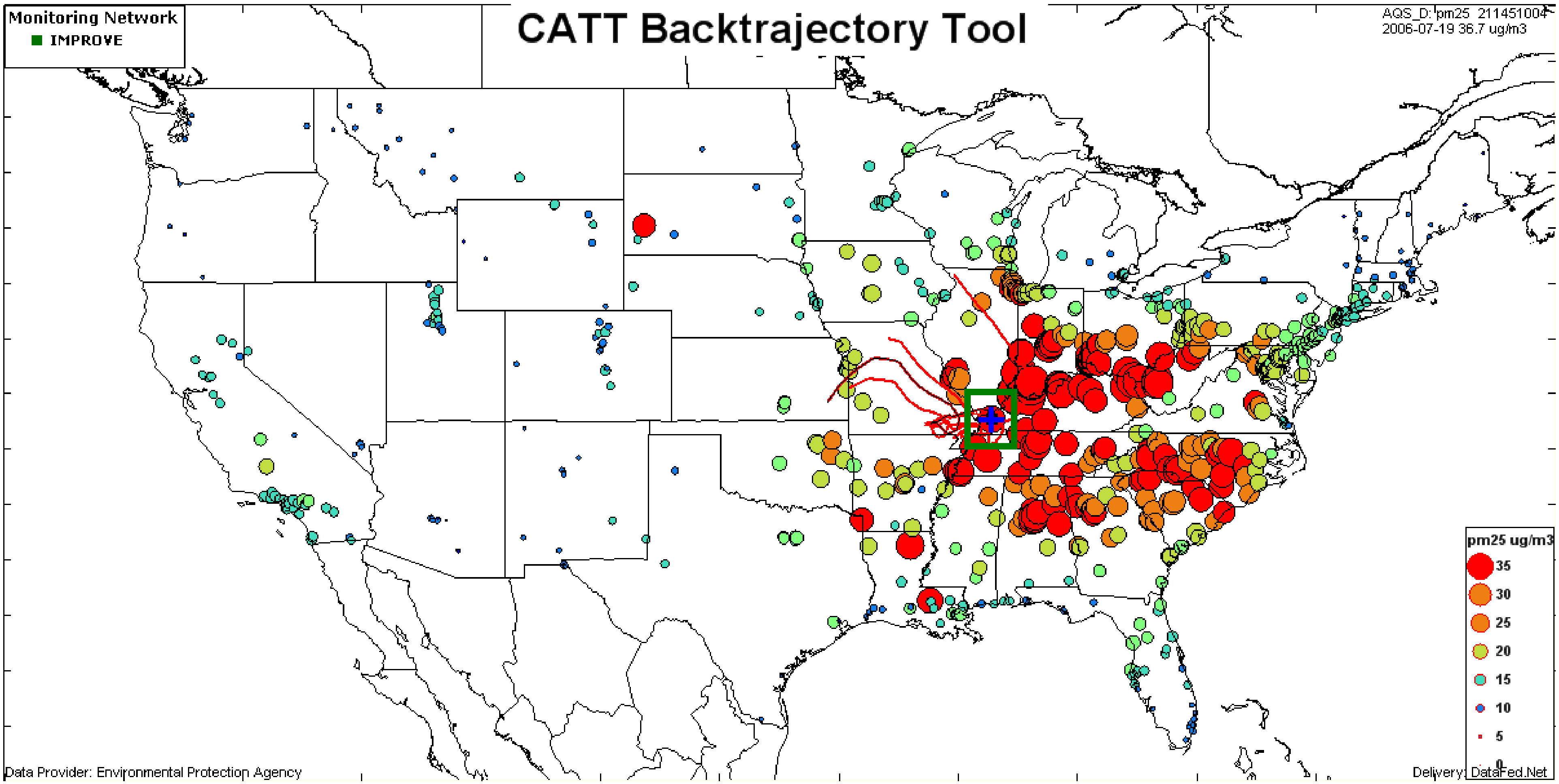
One site analyzed (211451004) for possible fire impact from Arkansas/local fires



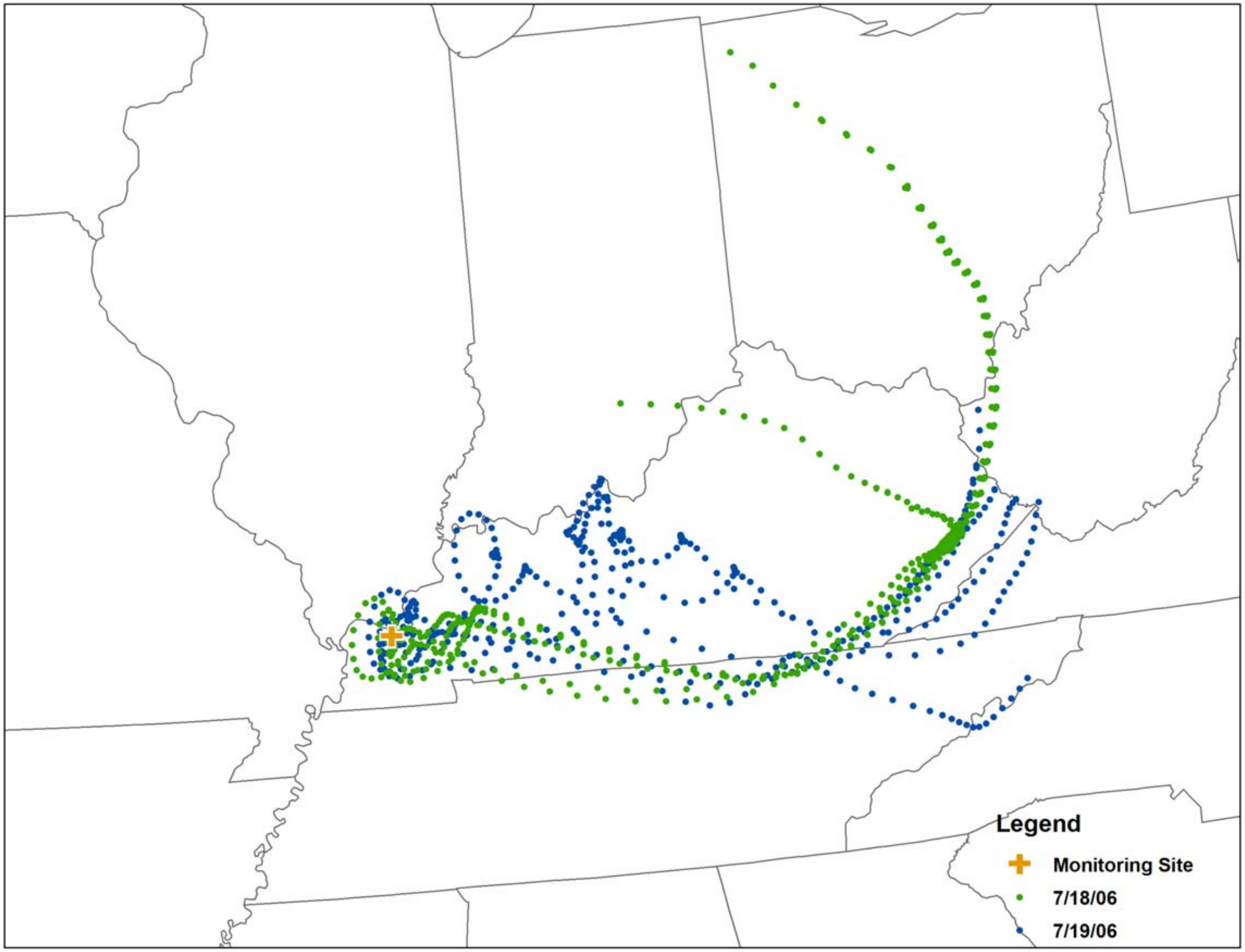
Some fires were observed in the area; however the magnitude is unknown and none of them appear to be very large (none had multiple pixels).



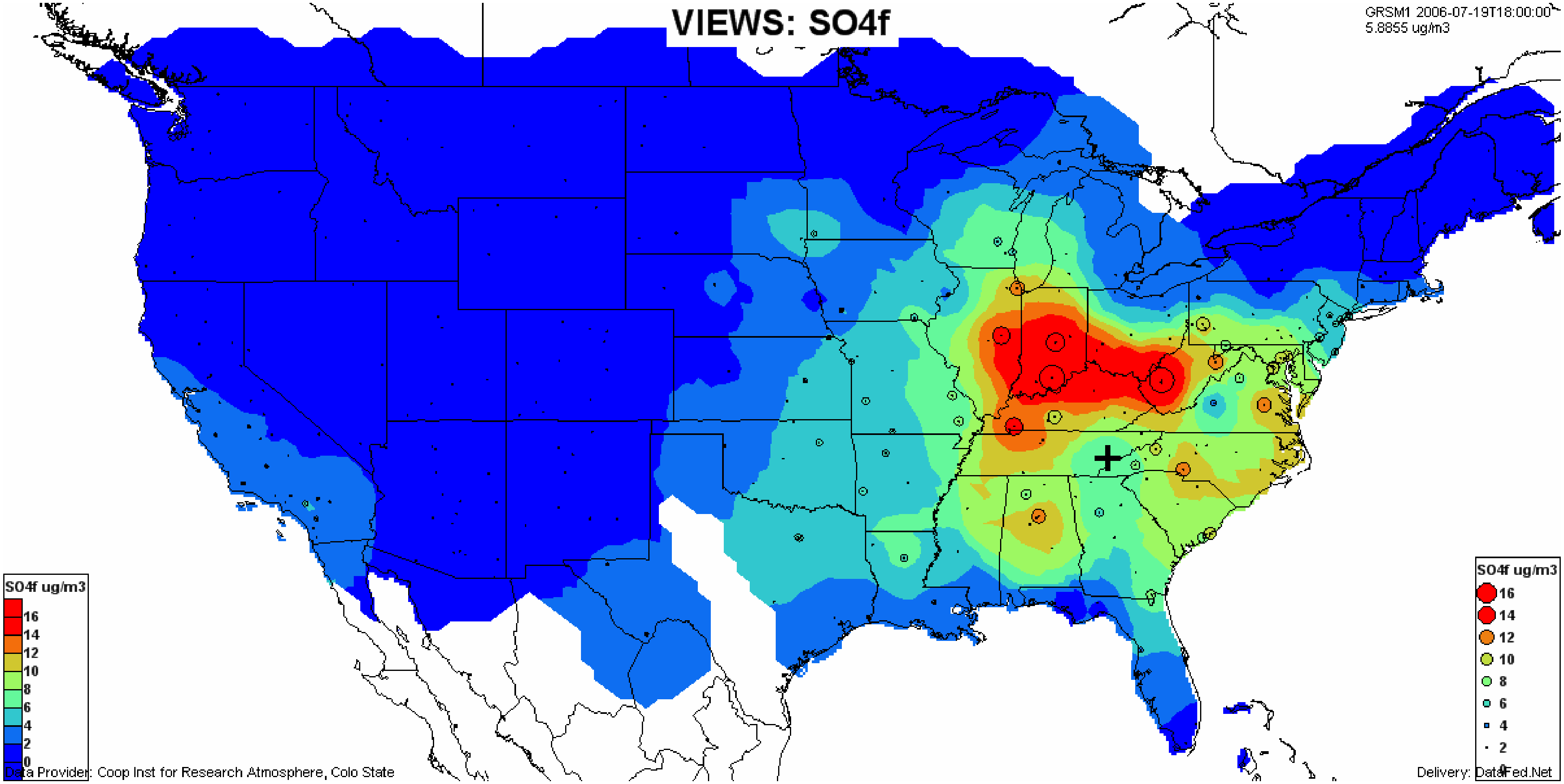
Source impact trajectories are difficult to interpret. Some trajectories from the fire area did pass through western Kentucky.



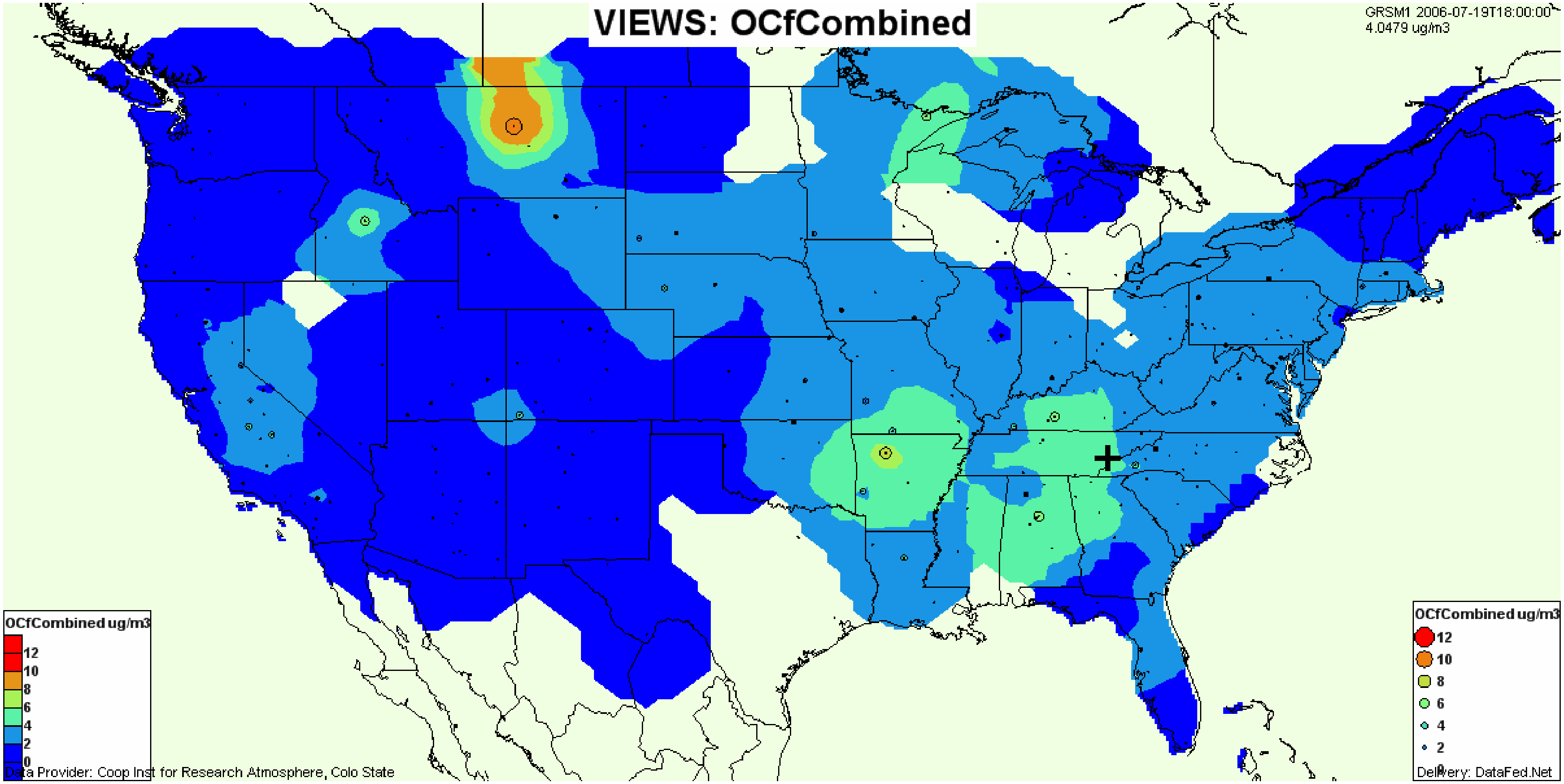
The lack of strong trajectories on 7/19/06 indicates stagnant conditions and local influence.



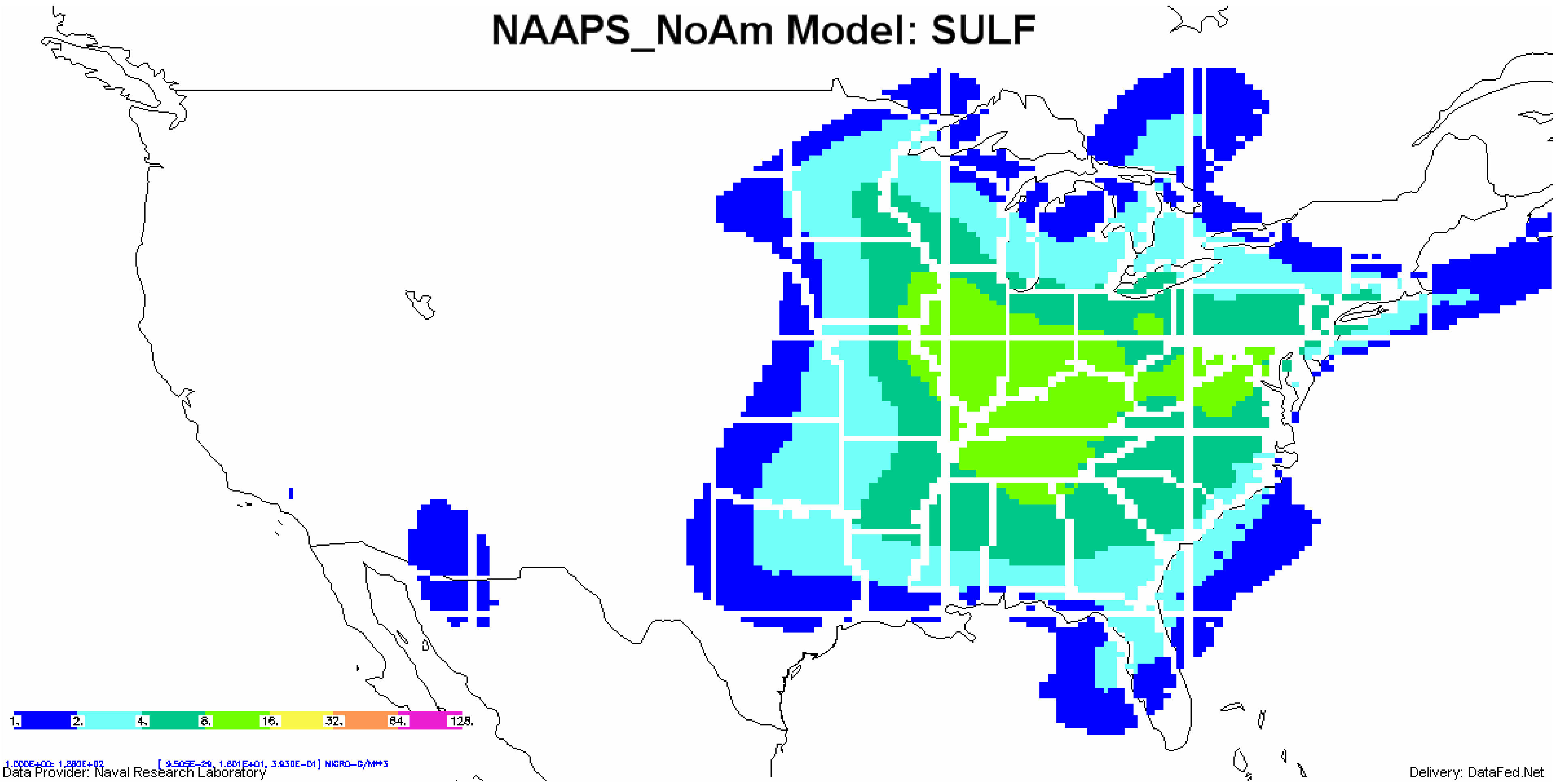
72-hour back trajectories on 7/18/06 and 7/19/06 show stagnant conditions with some influence from the east/north east.



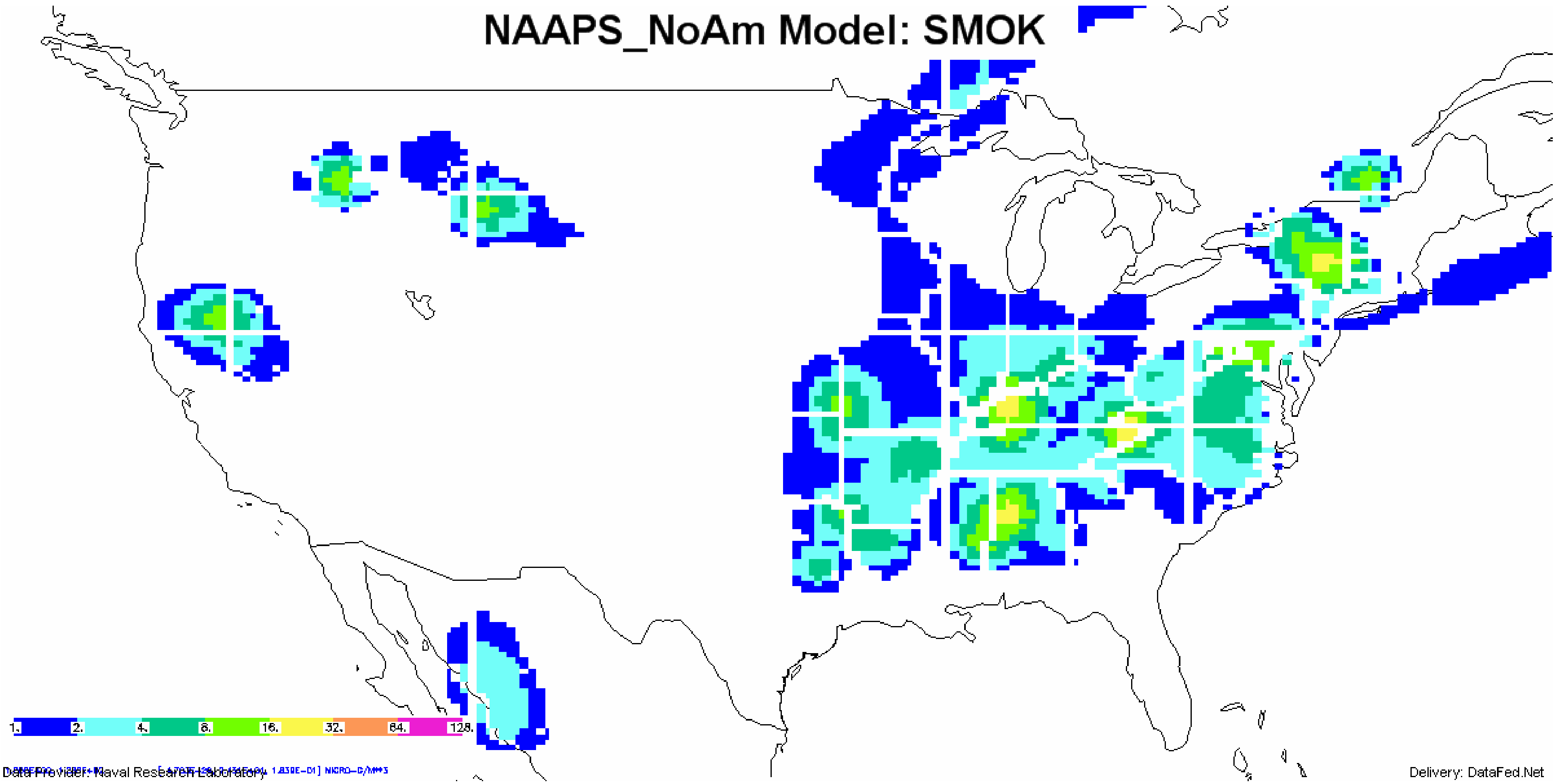
Regional sulfate concentrations were very high on 7/19/06



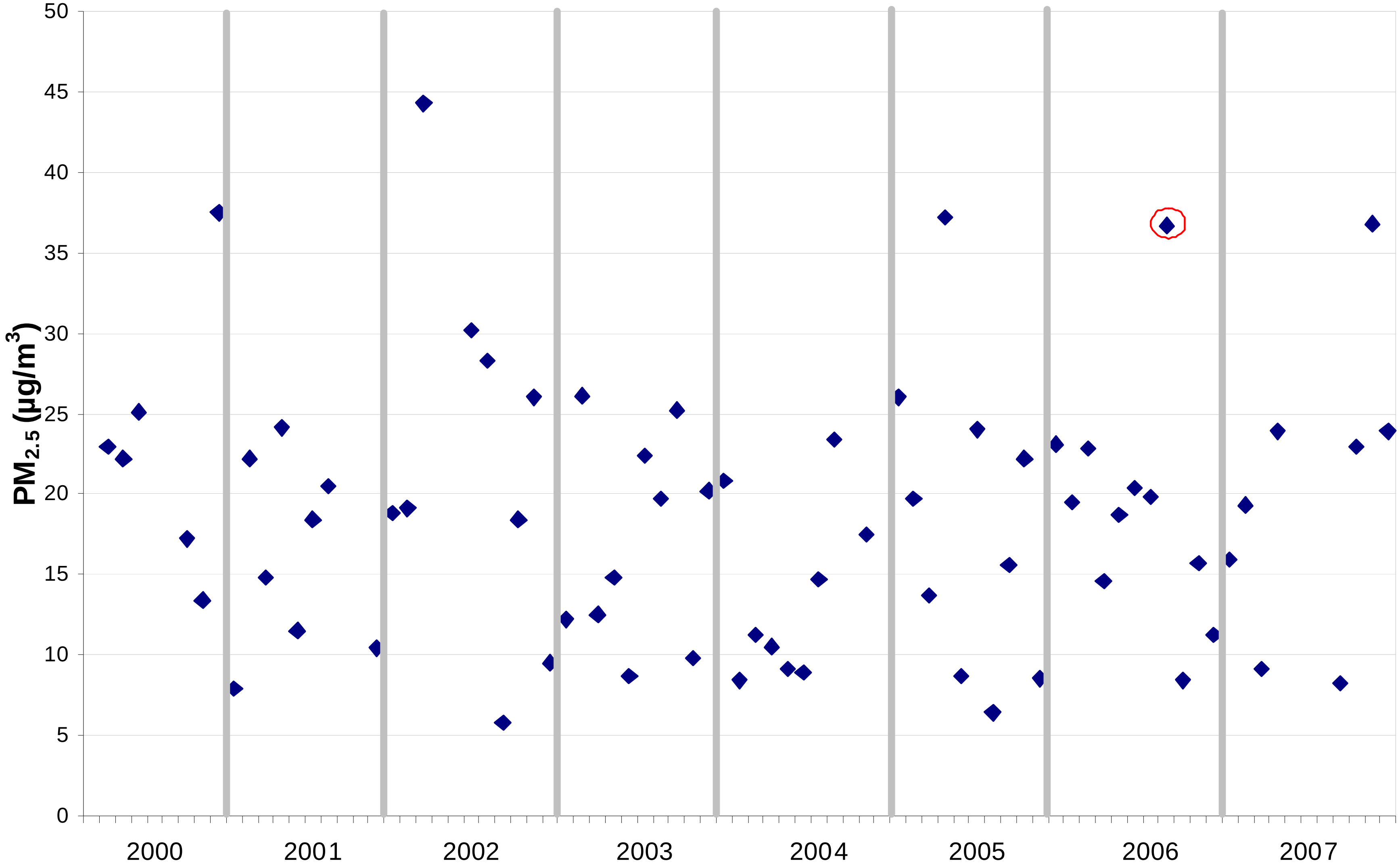
Regional OC concentrations were low/moderate on 7/19/06



Model output indicated moderate/high sulfate concentrations



Model output indicated moderate OC concentrations



Although the concentration on 7/19/06 is high, it is within the historical range of values.

Comparison to Historical Values

	Mean	Median	95th
2006	20.3	19.5	37.8
2000-2007	17.9	16.9	34.5

Summer data only (June-August) used in these statistics.

The 7/19/16 value of 36.7 µg/m^3 is within the 95th percentile of summer concentrations for 2006 and just above the 95th percentile of summer concentrations for 2000-2007.

Meteorological Conditions

- Met conditions in the area were conducive to high PM (regardless of whether nearby fires were impacting the site):
  - Persistent surface high pressure over the previous 3 days led to calm to light surface winds, limiting pollutant dispersion.
  - Weak upper-level ridge of high pressure led to warm temperatures aloft, limiting vertical mixing.
  - Persistent high dew point temperatures (frequently above 70 degrees F) over the previous 3 days enhanced secondary particle production.

Summary

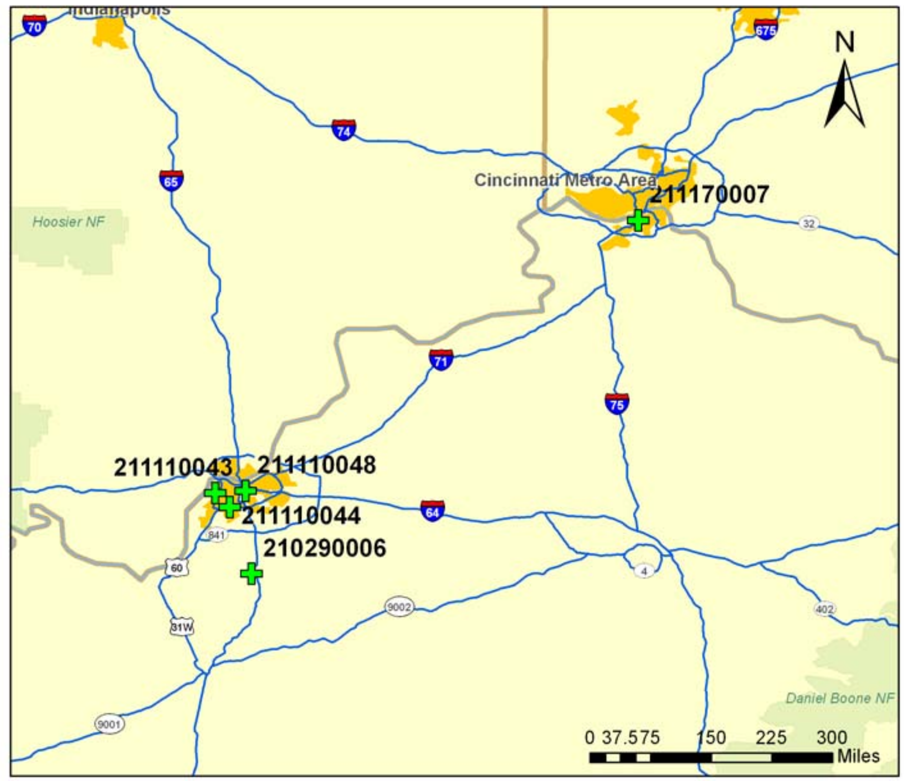
Although there could be some impact from forest fires on 7/19/06, stagnant winds, temperature inversion, and high humidity all led to increased secondary PM formation. This supports the hypothesis that there was a regional sulfate episode on this day that was likely a more important contributor than forest fires to high $PM_{2.5}$ concentrations. Without any impact from fires, the $PM_{2.5}$ concentrations would still have been higher than normal.

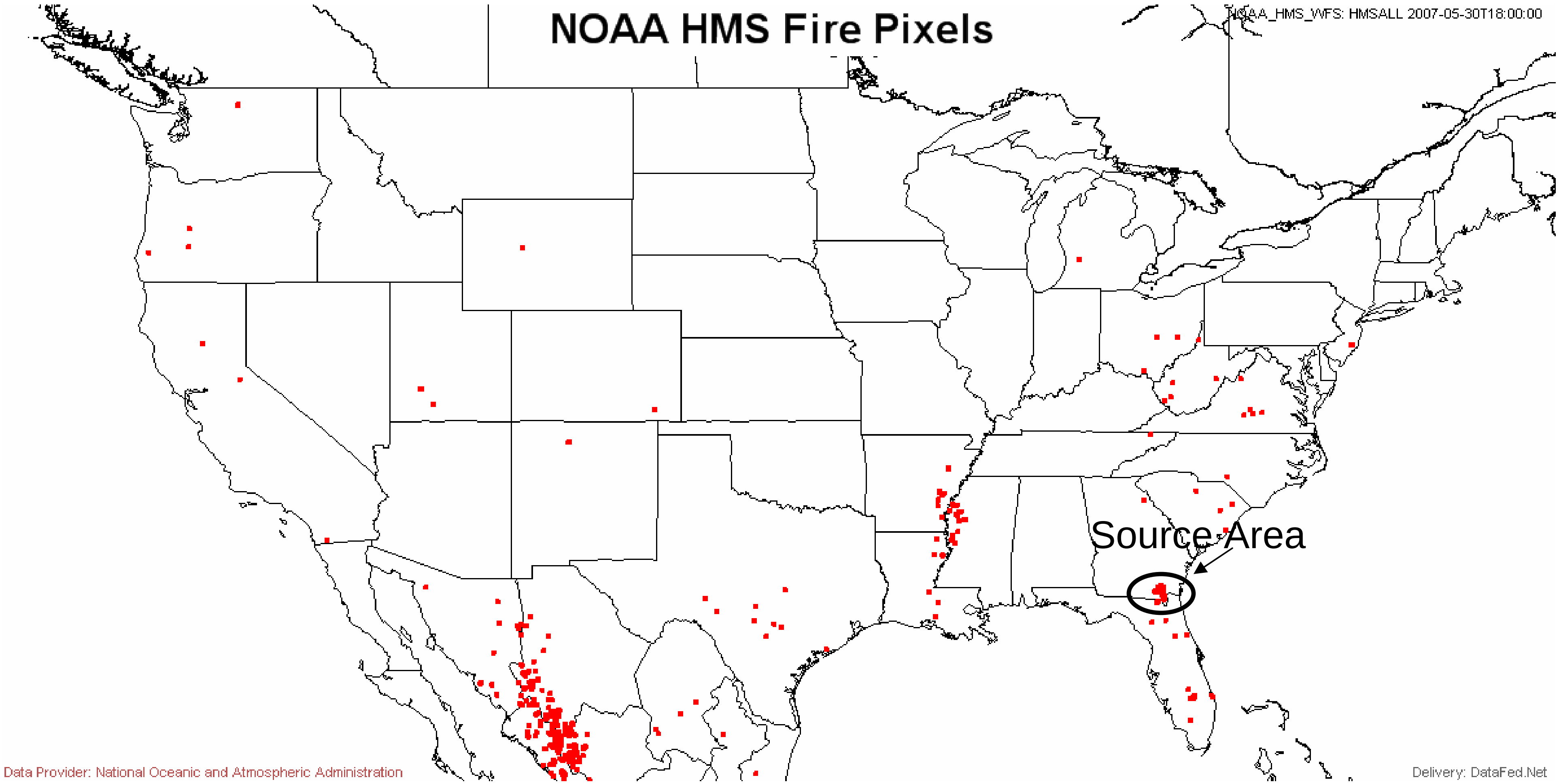
Exceptional Events Analysis Kentucky 6/2/07

Multiple sites flagged for fire impact from S. Georgia/N. Florida Fires

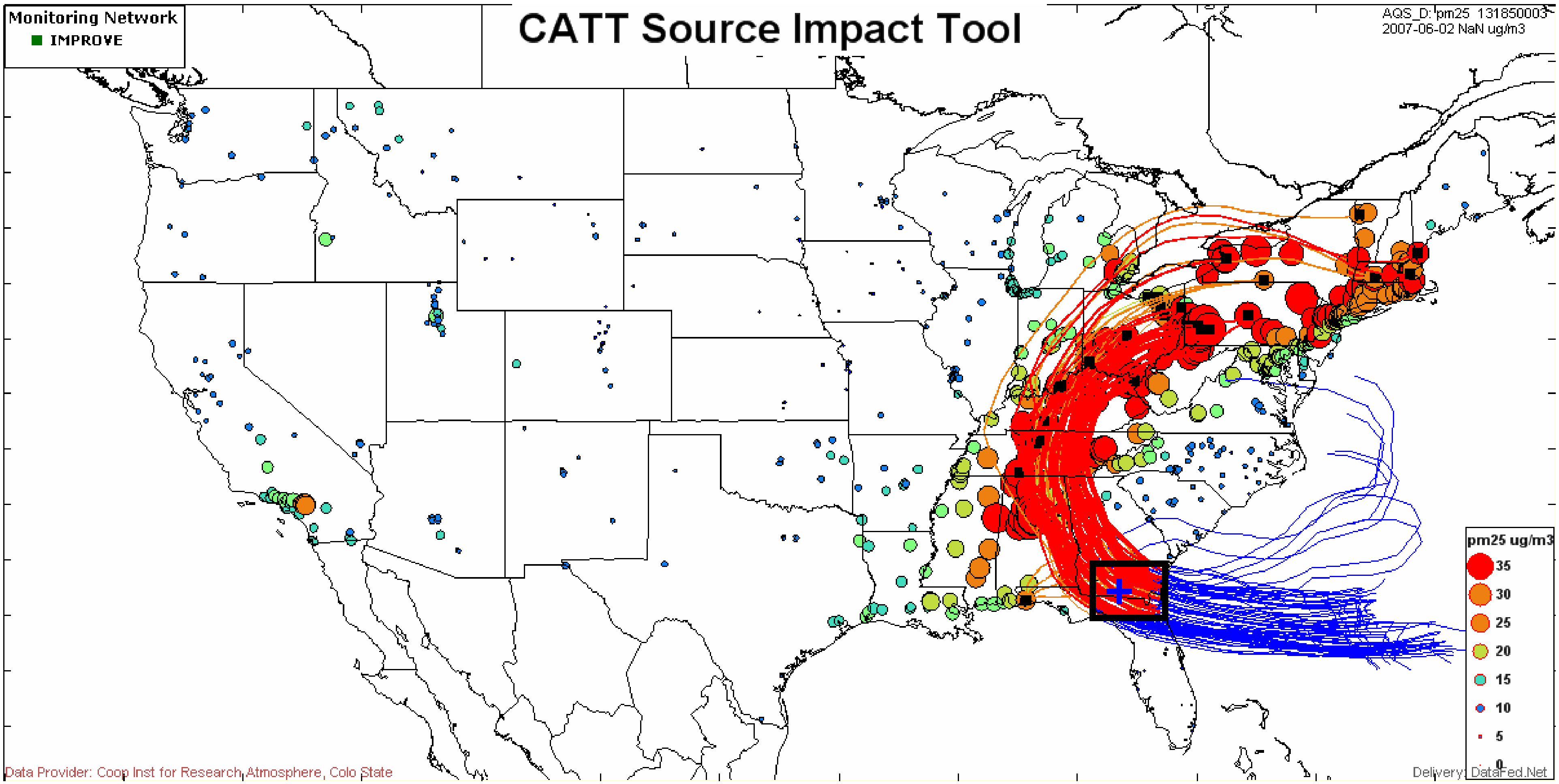
Sites Submitted for Exceptional Event Status (6/2/07)

Site ID	$PM_{2.5}$ (µg/m^3)
210290006	36.2
211110043	34
211110044	36.8
211110048	37.2
211170007	40.1

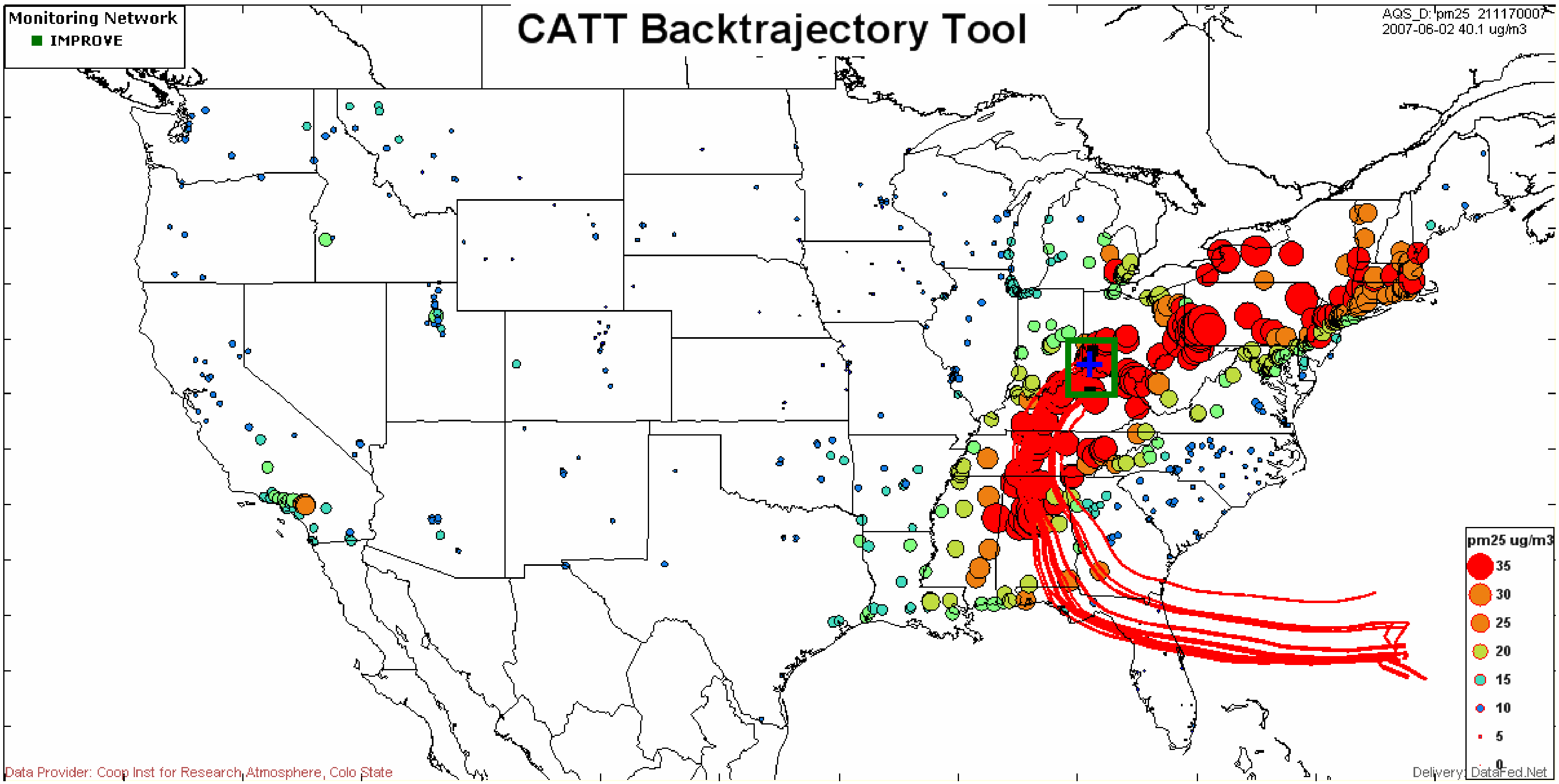




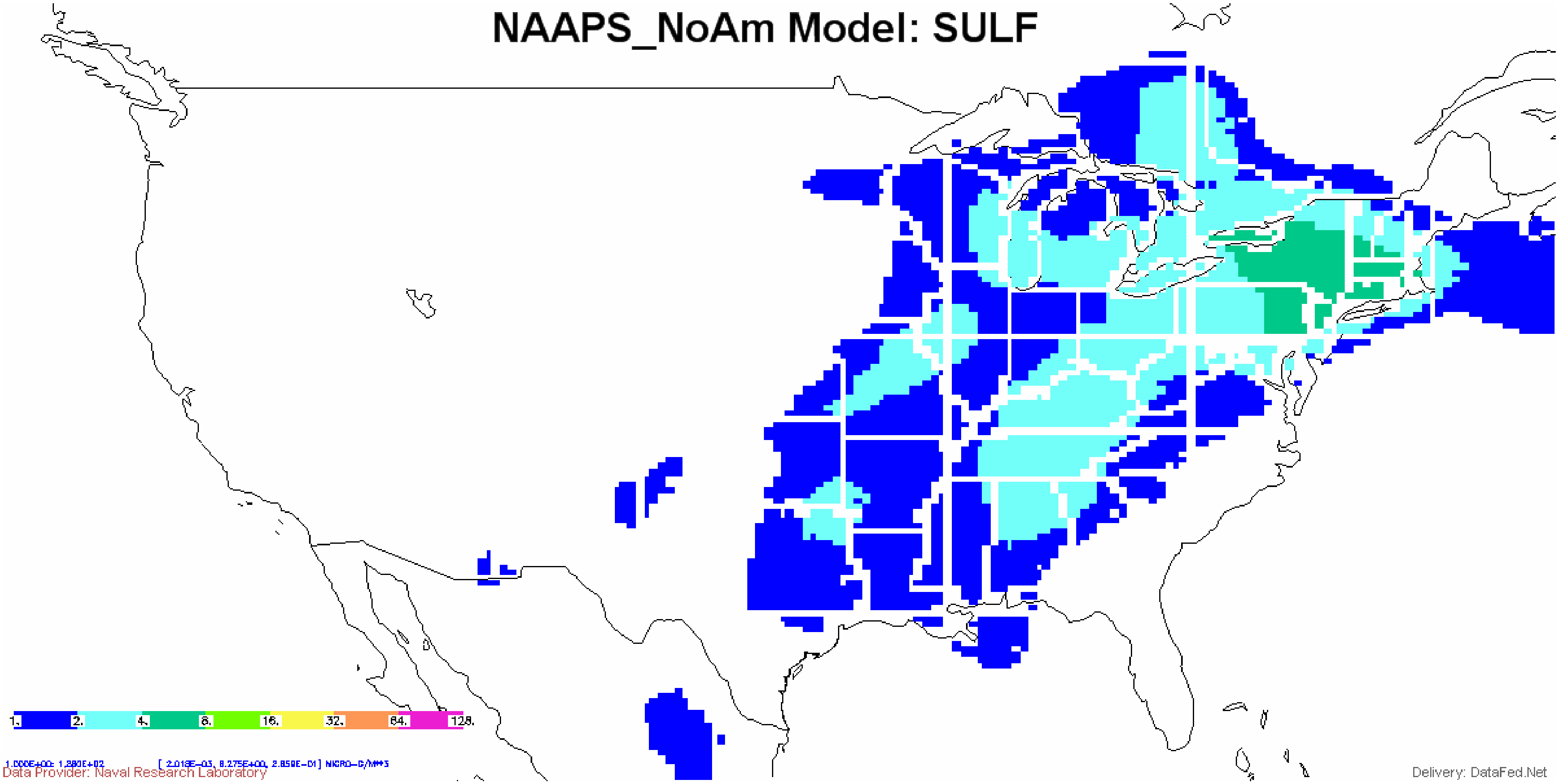
No fire pixels were evident in the area on 6/2/07, possible due to heavy cloud cover; this image is from 5/30/07



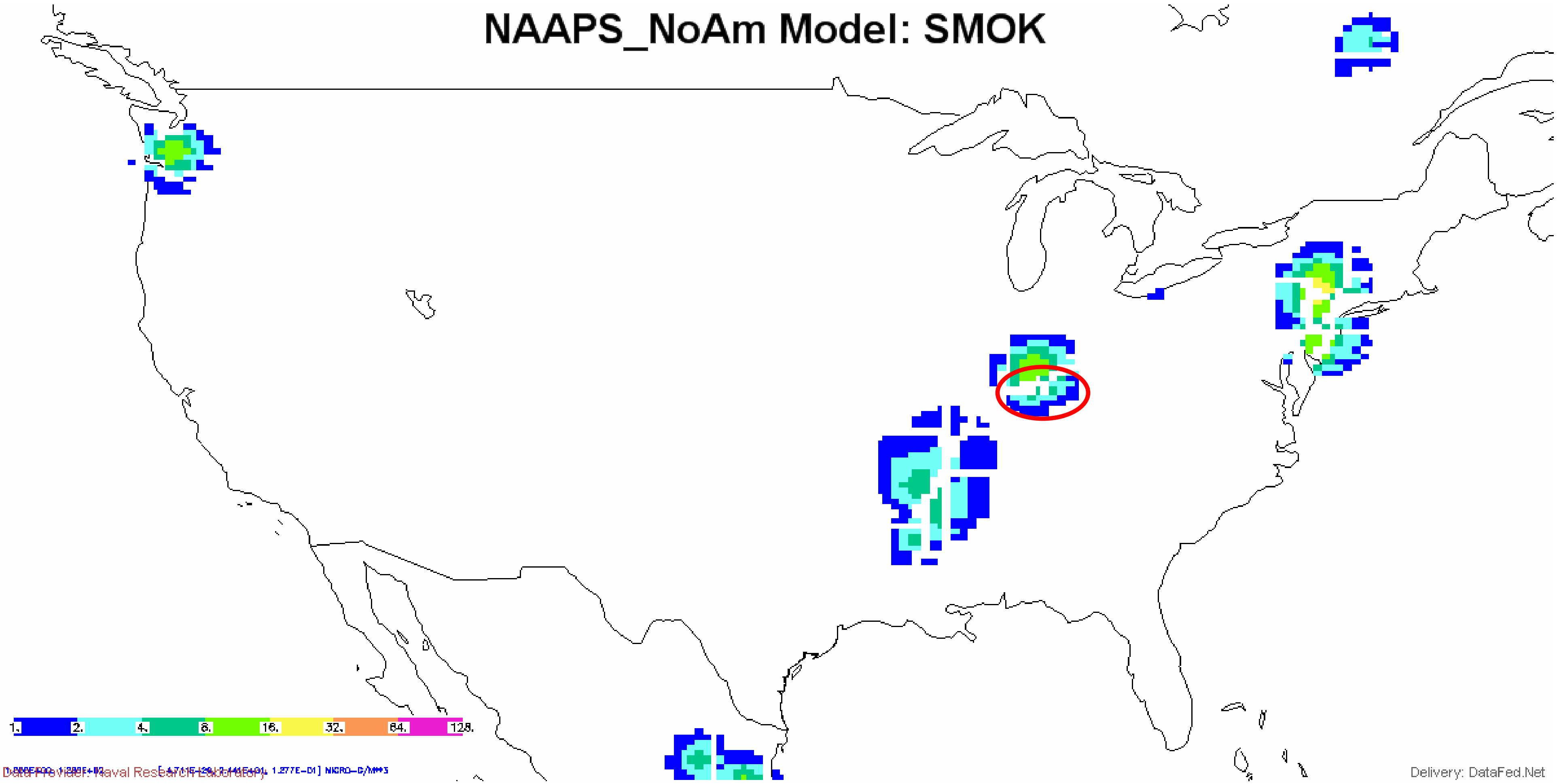
Source impact tool shows many trajectories passing through the fire region later passed through Kentucky



Back trajectory analysis highlights the trajectories that passed directly over the 211170007 site (blue cross), which were from the S. Georgia/N. Florida area



Modeled sulfate contributions are low-moderate

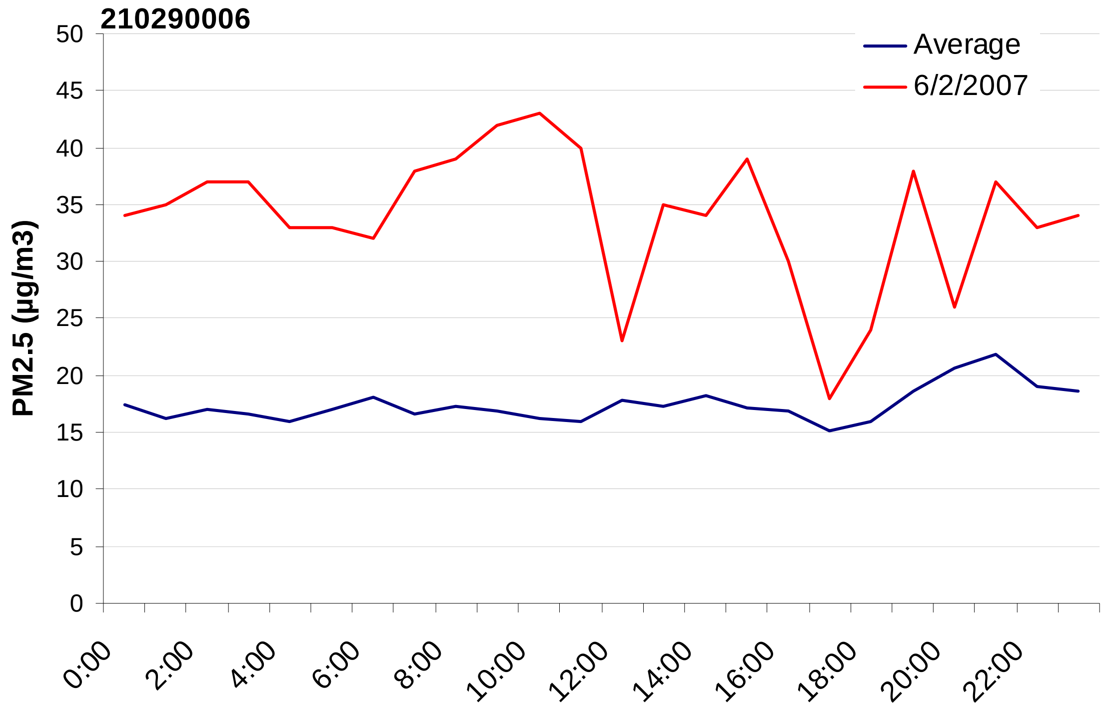


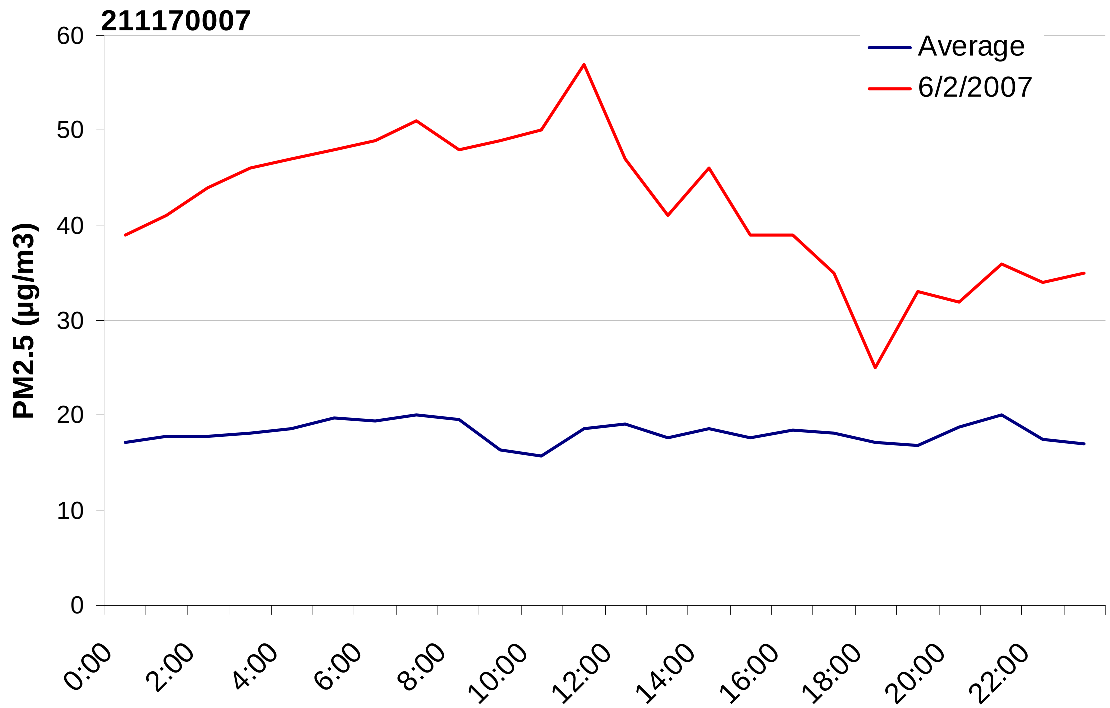
Some modeled smoke impact in KY indicated with red circle

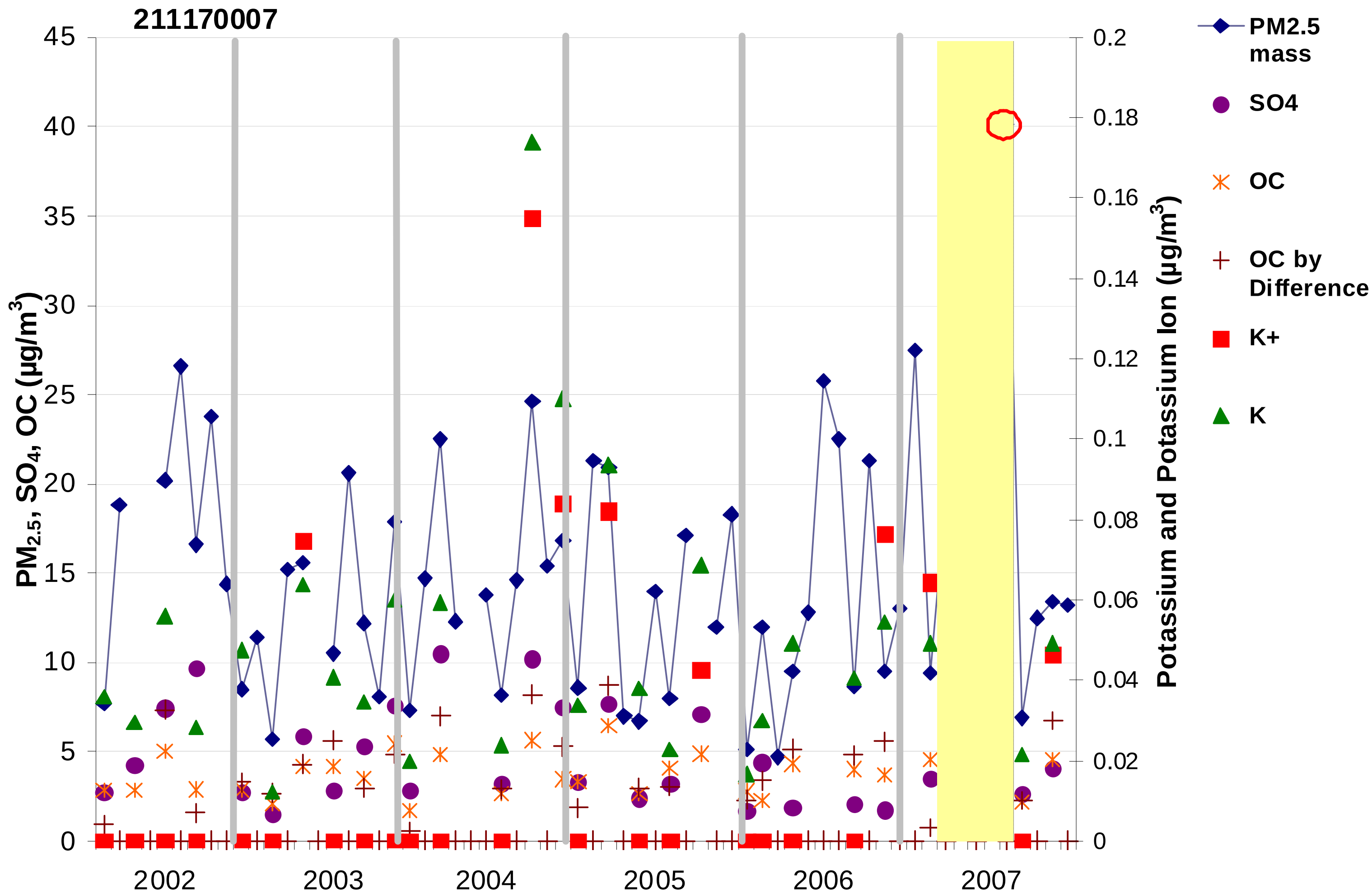
Diurnal profiles show much more variation than usual, as well concentrations more than 2x higher than average for June.

The average range of values over a day at each site was around 21 µg/m^3. On 6/2/07, the range was slightly higher at 210290006 (25 µg/m^3) and much higher at 211170007 (35 µg/m3). On high sulfate days (defined as days with a sulfate contribution >10 µg/m^3), the range at 211170007 was only 16 µg/m^3. No days had sulfate >10 µg/m^3 at 210290006.

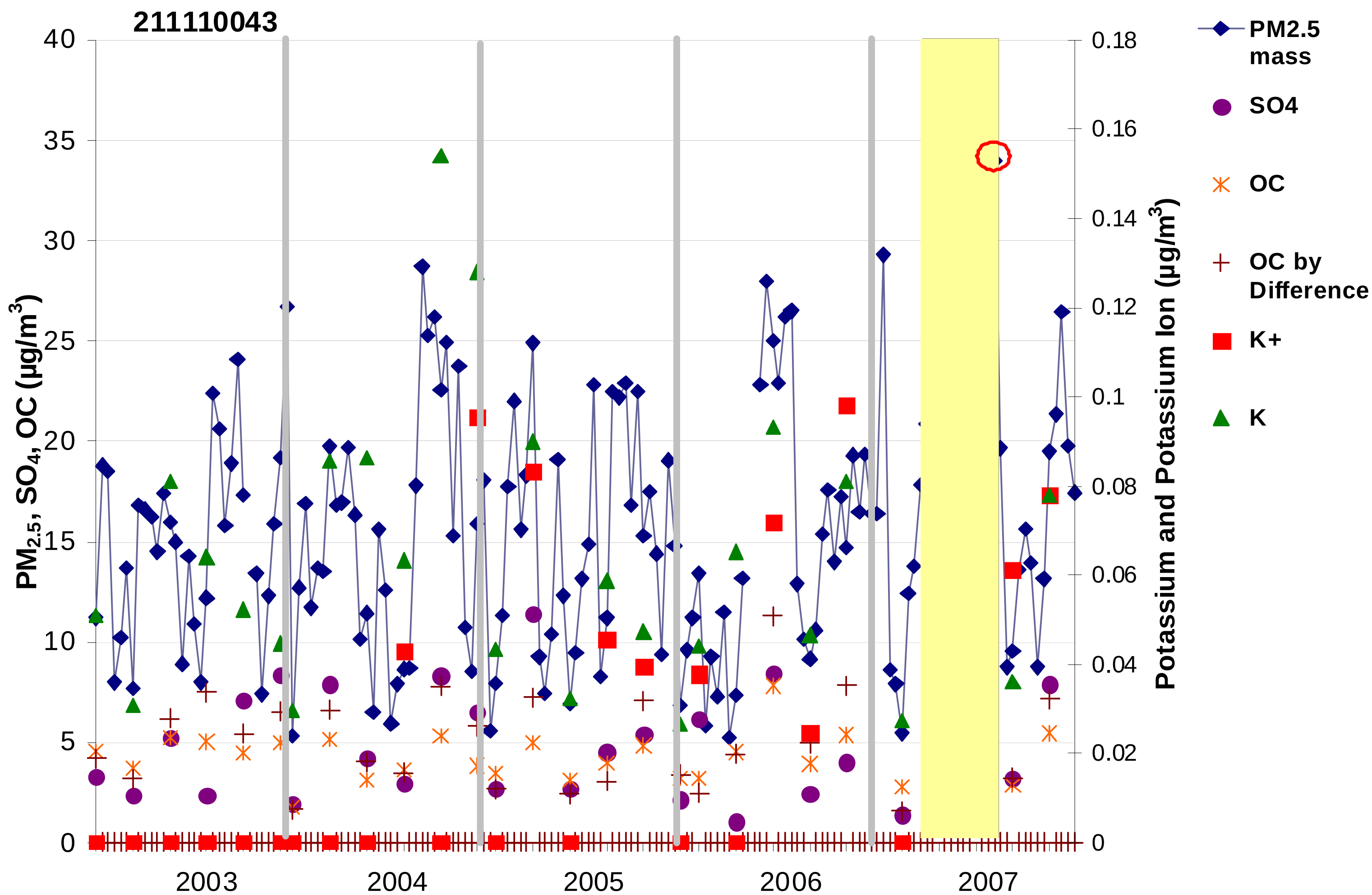
('average' presented here is the average per hour over all June data, 2000-2007)







Time series for multiple years (May 15-June 15) shows 6/2/07 is well above the normal range at 211170007. Individual years are delineated by a grey line. While there were no speciated measurements on 6/2/07, the two samples prior (highlighted in yellow) show high OC and potassium concentrations (indicative of smoke impact). However, SO_4 is also high, suggesting the fire impact may not be the only cause of high $PM_{2.5}$ concentrations.



At site 211110043, PM concentrations are high, but not extremely so. However, potassium concentrations are high for much of the month and, like at 211170007, OC concentrations are high in the samples preceding 6/2/07. SO4 is also slightly high.

Comparison to Historical Values

		mean	median	95th	6/2/2007
211110043	2007	19.8	18.5	34.8	34.0
	2000-2007	21.3	19.7	38.9	
211170007	2007	17.6	16.3	30.5	40.1
	2000-2007	19.1	17.1	36.5	

Summer data only (June-August) used in these statistics.

The 6/2/07 value at 211110043 was well above the mean/median concentrations for both summer 2007 and all summers 2000-2007, but was lower than the 95th percentile for all summers 2000-2007. This does not support the "but-for" clause.

The 6/2/07 value at 211170007 is well above mean, median, and 95th percentiles for summer 2007 and all summers 2000-2007. Without the event, the value on this day could have been below 35µg/m^3.

No speciated data was available on this day, OC/OM concentrations could not be compared to historical values.

Conclusions

- Trajectory analysis indicates smoke emissions from the S. Georgia/N. Florida area could be impacting Kentucky
- Likely not a sulfate event based on low(ish) sulfate
- Diurnal patterns are much more varied on 6/2/07, showing a buildup in concentrations over the morning- possibly due to a fire plume
- At the 211170007 site, the PM2.5 concentration on 6/2/07 was well above normal and obviously a unique event
- At the 211110043 site, the PM2.5 concentration was high on 6/2/07 compared to the rest of 6/07, but not compared to previous years
- There is likely impact from the Georgia/Florida fires throughout Kentucky on 6/2/07 (and nearby dates). The highest impact is evident at the 211170007 site, where concentrations would likely be much lower without the smoke contribution.

Attachment 4

$PM_{2.5}$ Exceptional Events Technical Support Document

U.S. Environmental Protection Agency Region 4

Commonwealth of Kentucky

2008

Exceptional Events Analysis Louisville, Kentucky

Prepared by:

Katie S. Wade
Sonoma Technology, Inc.
Petaluma, CA

Neil Frank
US Environmental Protection Agency
Research Triangle Park, NC

September 30, 2008

Sonoma Technology, Inc.
Air Quality Research and Innovative Solutions

905418

Overview

The following slides detail the analysis of several exceptional events (wildfires and fireworks) during the summers of 2004, 2005, 2006, and 2007 in Louisville, Kentucky.

Publicly available data (from EPA's Air Quality System and AirNow Tech) and tools (from DataFed) were used in this analysis.

Exceptional Events Analysis
Kentucky
7/21/04

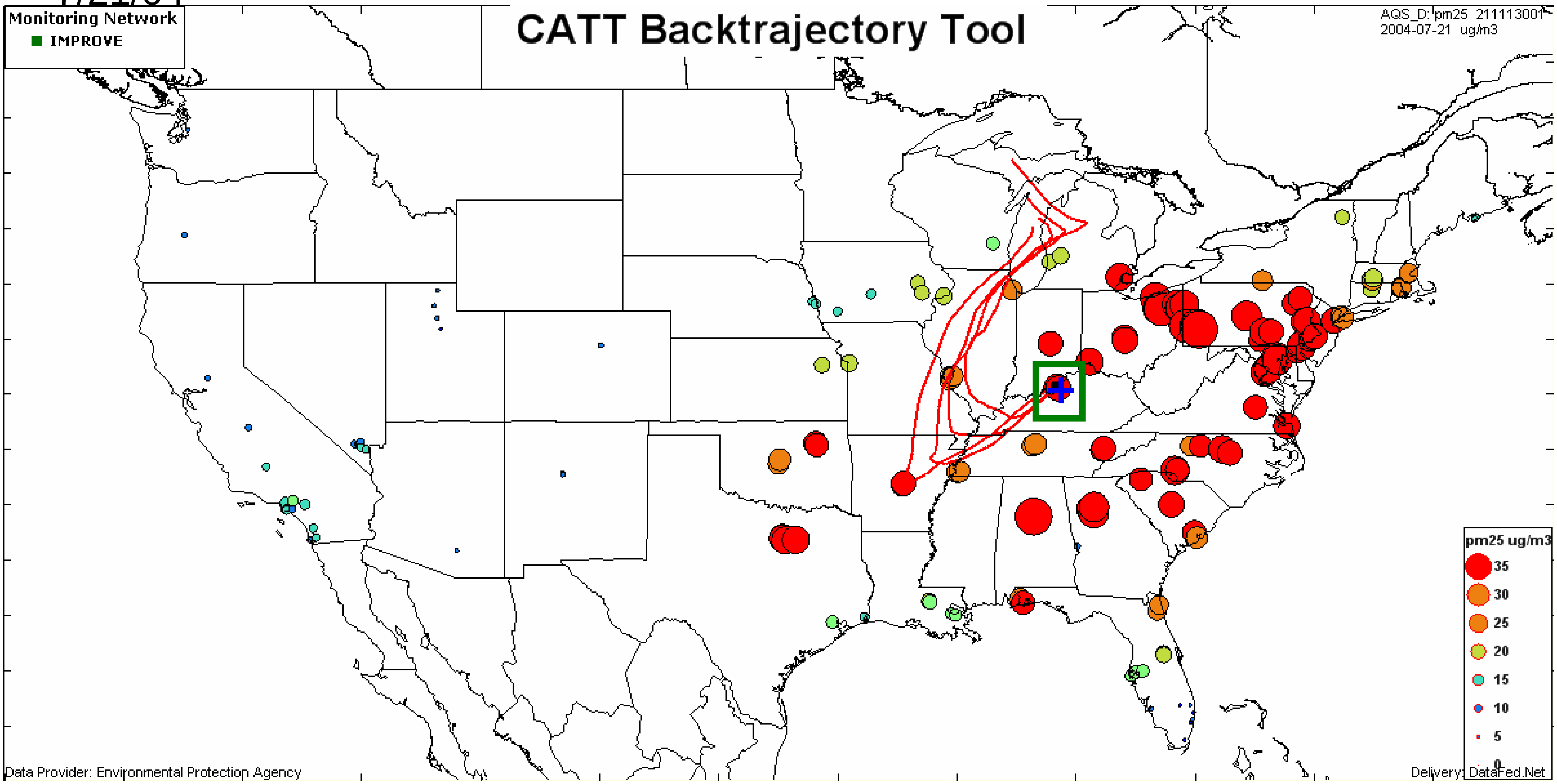
two sites analyzed
(21-111-0043, 21-111-0044) for possible
fire impact
from Canadian fires

Concentrations Under Consideration

- 21-111-0043: 35.1 µg/m^3
- 21-111-0044: 34.2µg/m^3

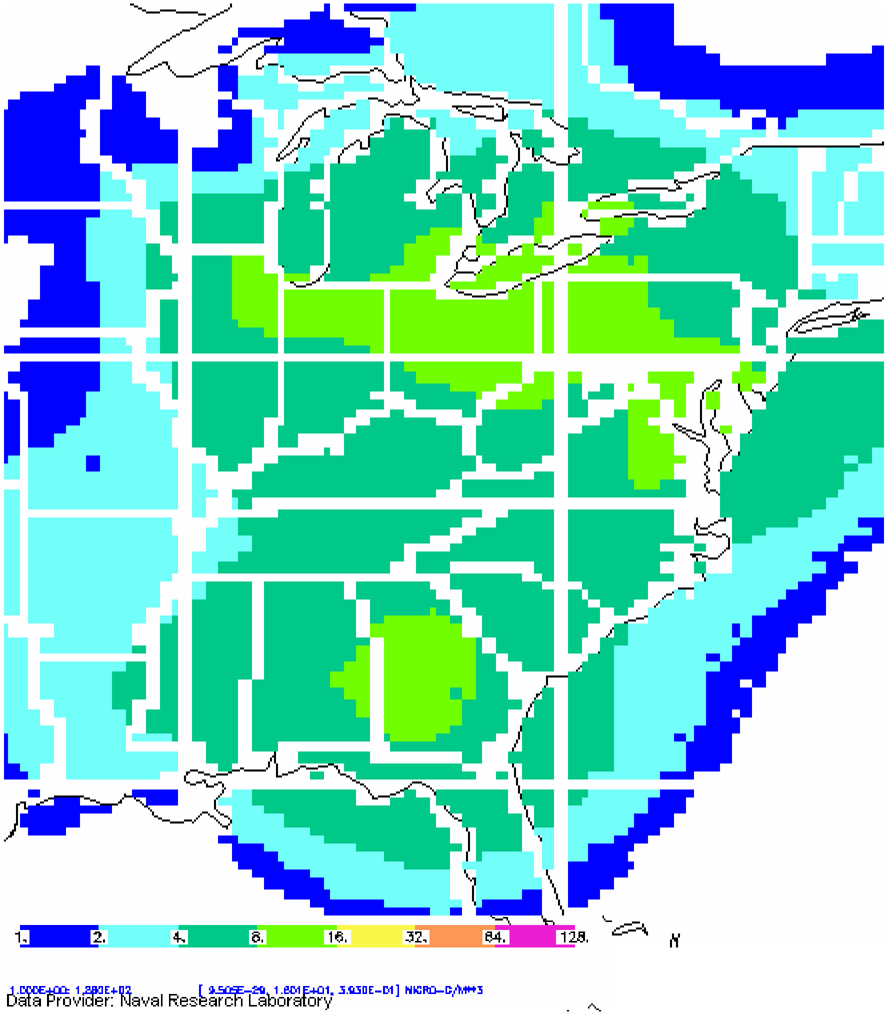
No fires were observed in Canada on 7/21/04; however a large fire was observed in Alaska.

7/21/04

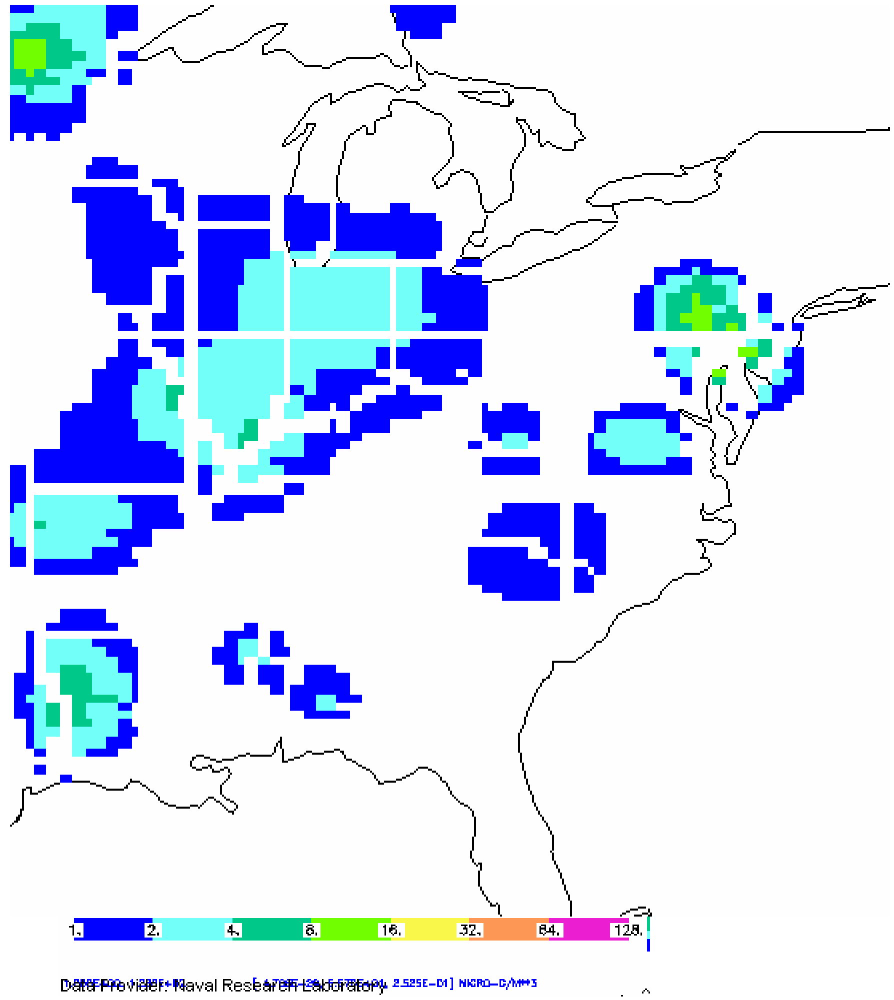


Back trajectories indicate stagnant conditions, with possible influence from the north (but not as far as Canada/Alaska). Also, $PM_{2.5}$ concentrations were high throughout the region, the Louisville area was not unique.

Modeled Sulfate

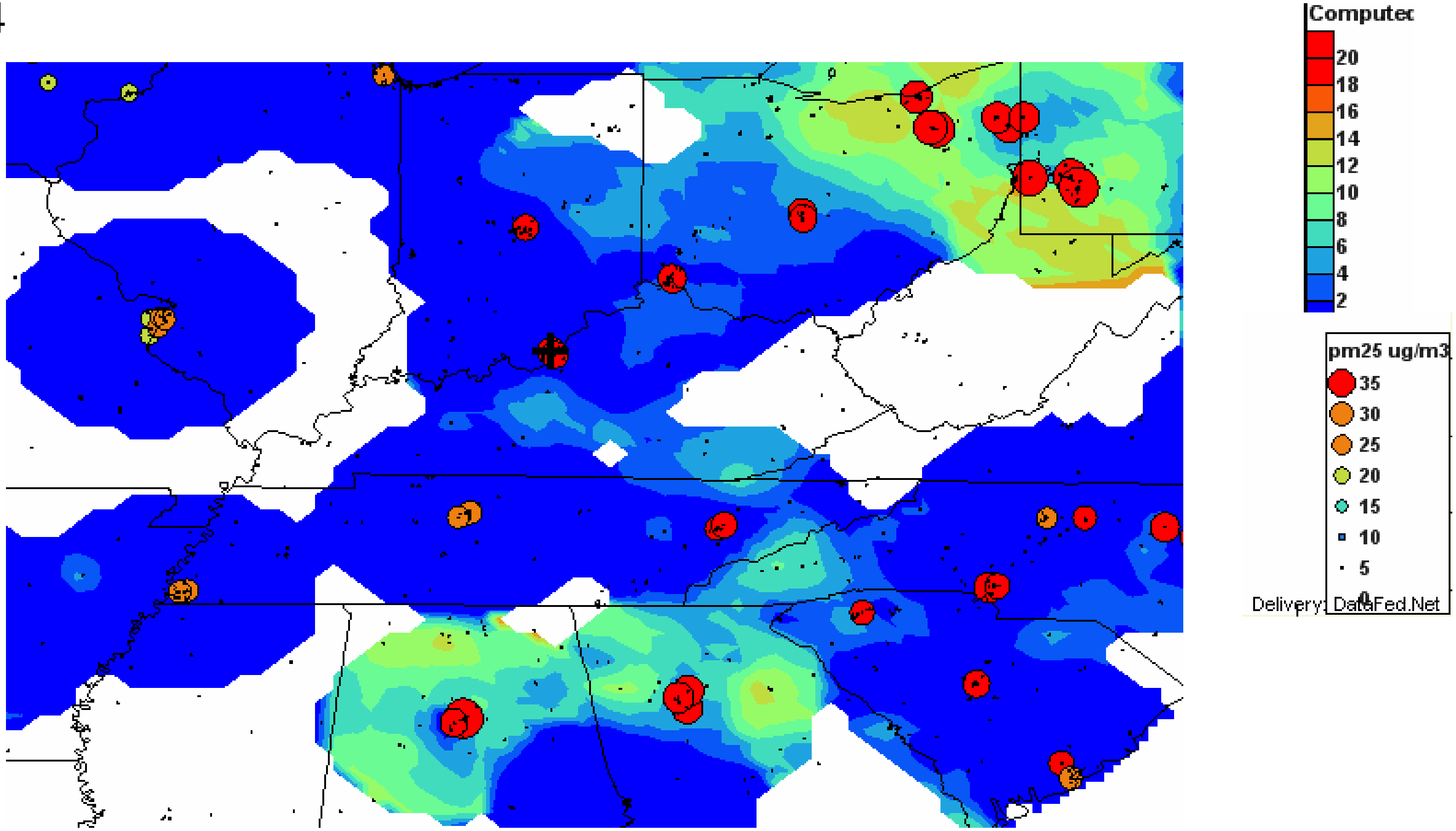


Modeled Smoke

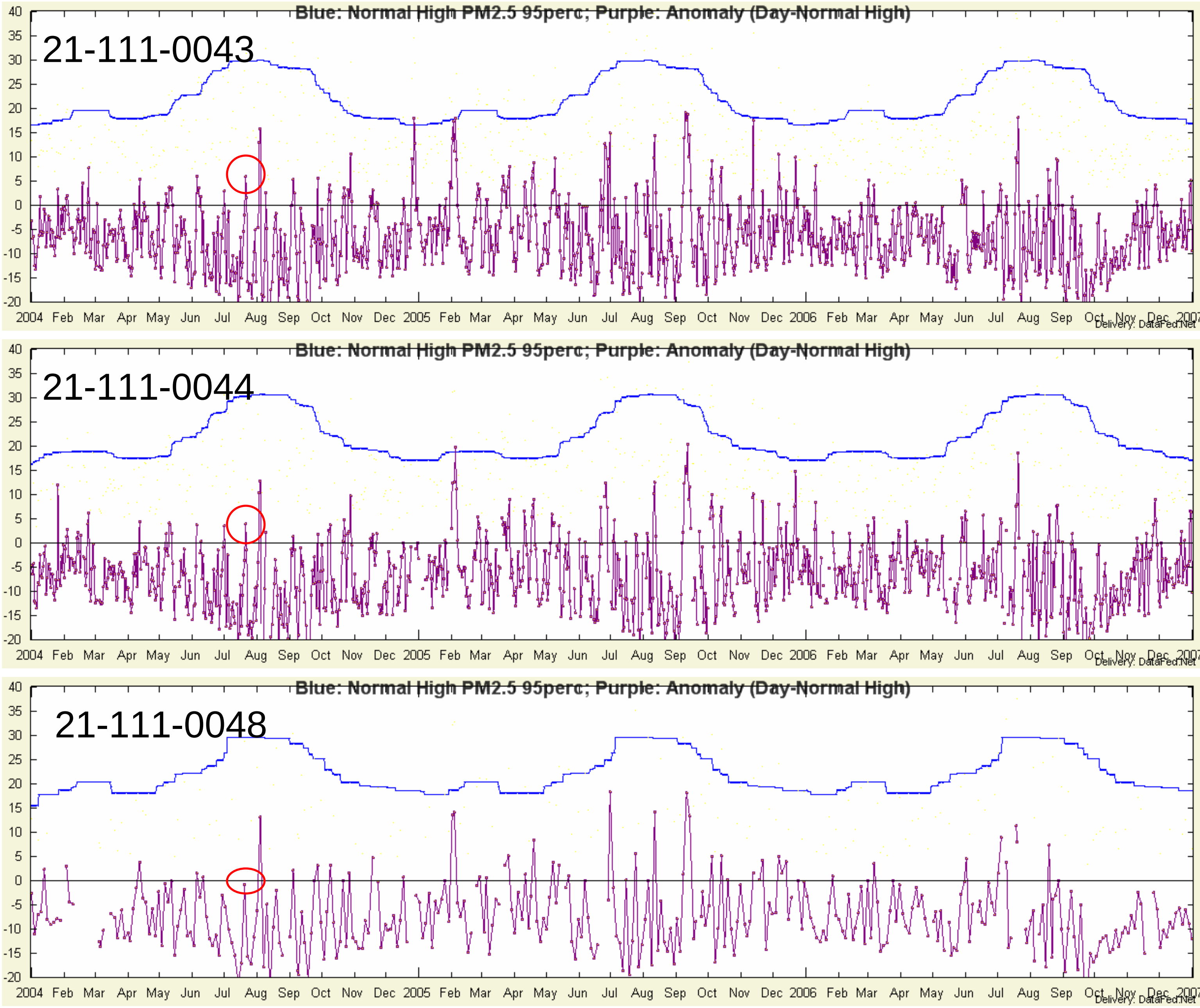


Model output indicated moderate/high sulfate concentrations and low smoke concentrations throughout the region on 7/21/04.

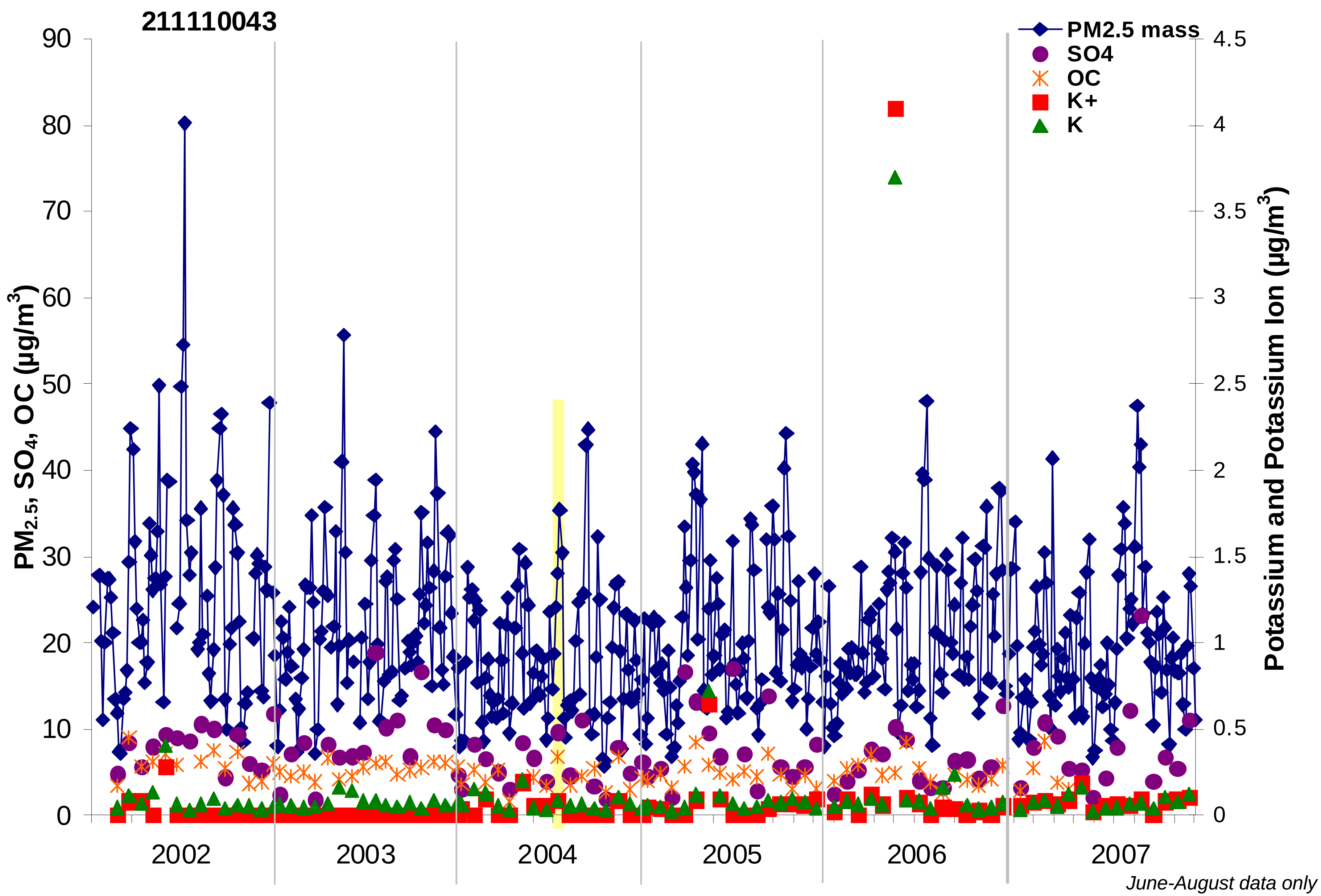
7/21/04



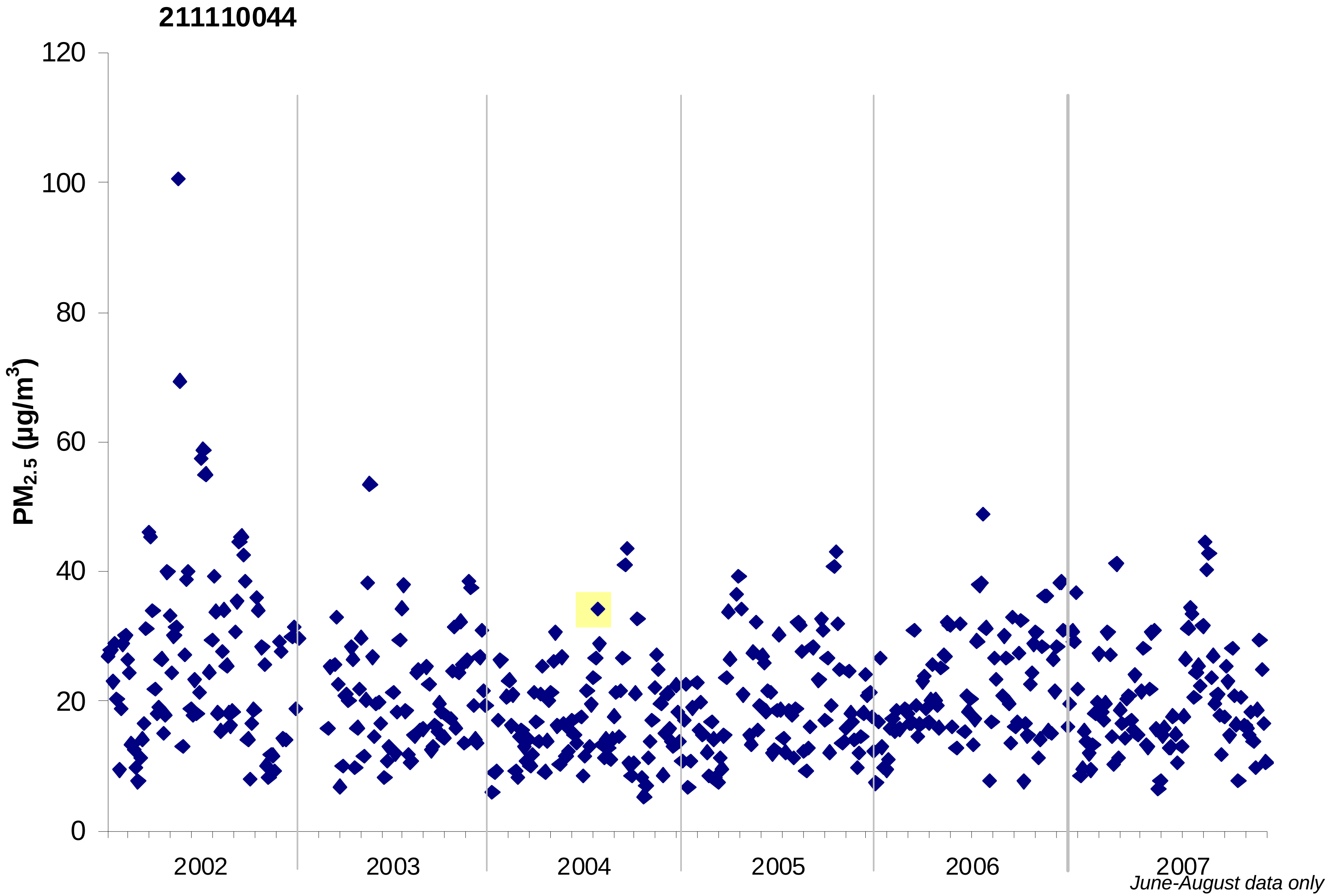
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 7/21/04, concentrations were very close to the historical values throughout Kentucky.



The purple lines show the difference between the given day and the historical 95th percentile concentration. On 7/21/04, concentrations were within 5 µg/m^3 of historical values.



At site 21-111-0043, $PM_{2.5}$, OC and potassium (indicators of fire impact) are within the normal range of values on 7/21/04 (highlighted in yellow). Sulfate is at the high end of the concentration range on 7/20/04.



At site 21-111-0044, $PM_{2.5}$ is high on 7/21/04, but not outside the historical range of concentrations.

Comparison to Historical Values

		Mean	Median	95th Percentile	7/21/2004
21-111-0043	2006	21.5	19.3	36.6	35.4
	2002-2007	21.3	19.5	38.9	
21-111-0044	2006	22.2	20.2	37.7	34.2
	2002-2007	21.2	18.9	38.5	

Summer data only (June-August) used in these statistics.

The concentrations on 7/21/04 are within the historical 95th percentiles of concentrations.

Summary

- Trajectory analysis does not support long-range transport of $PM_{2.5}$ from Canada/Alaska to Louisville.
- Concentrations were within the normal range of concentrations and likely not impacted by forest fires.

Exceptional Events Analysis
Kentucky
8/3/04-8/4/04

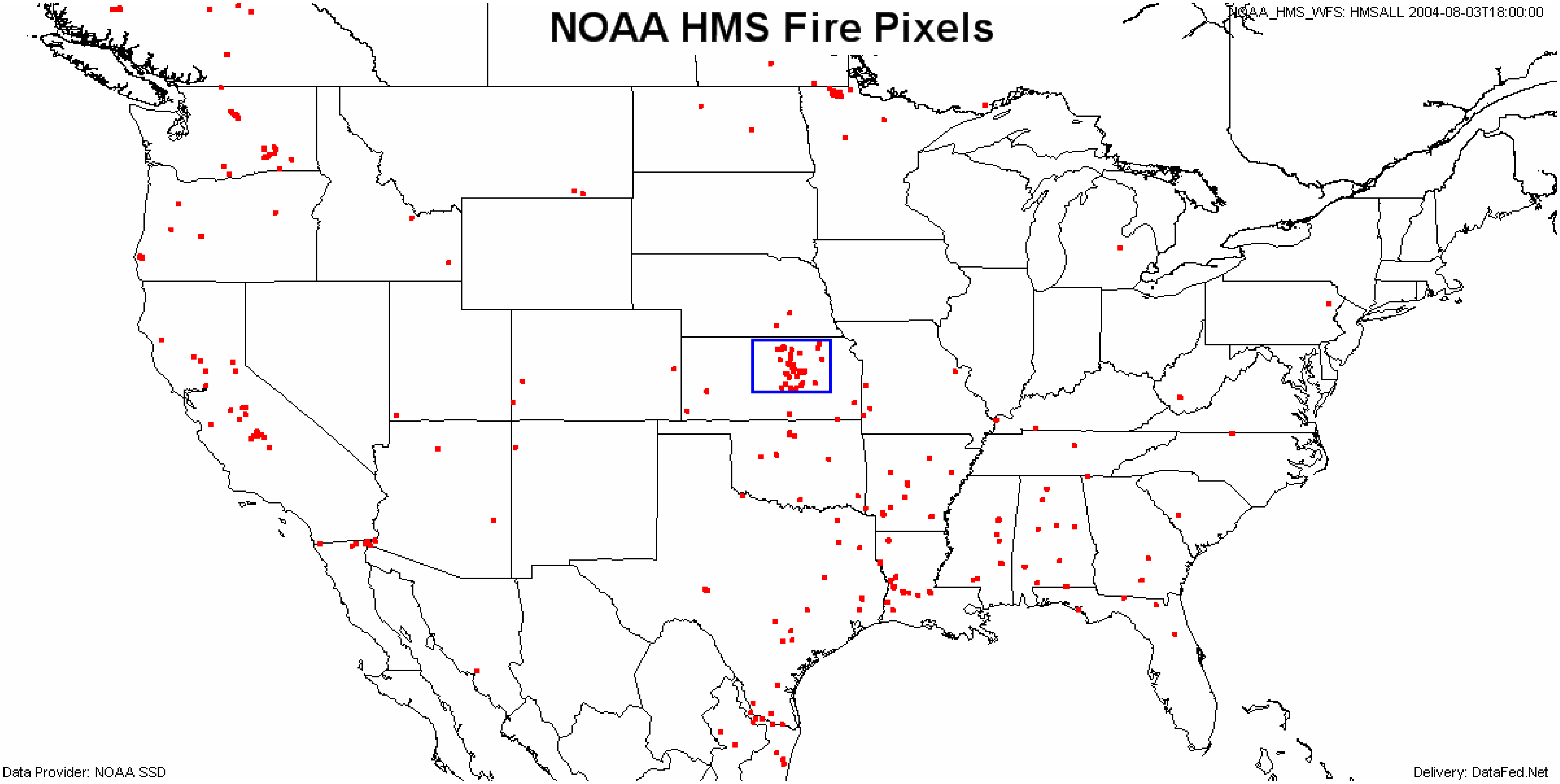
Three sites analyzed
(21-111-0043, 21-111-0044, 21-111-0048)
for possible fire impact
from Kansas fires

Concentrations Under Consideration

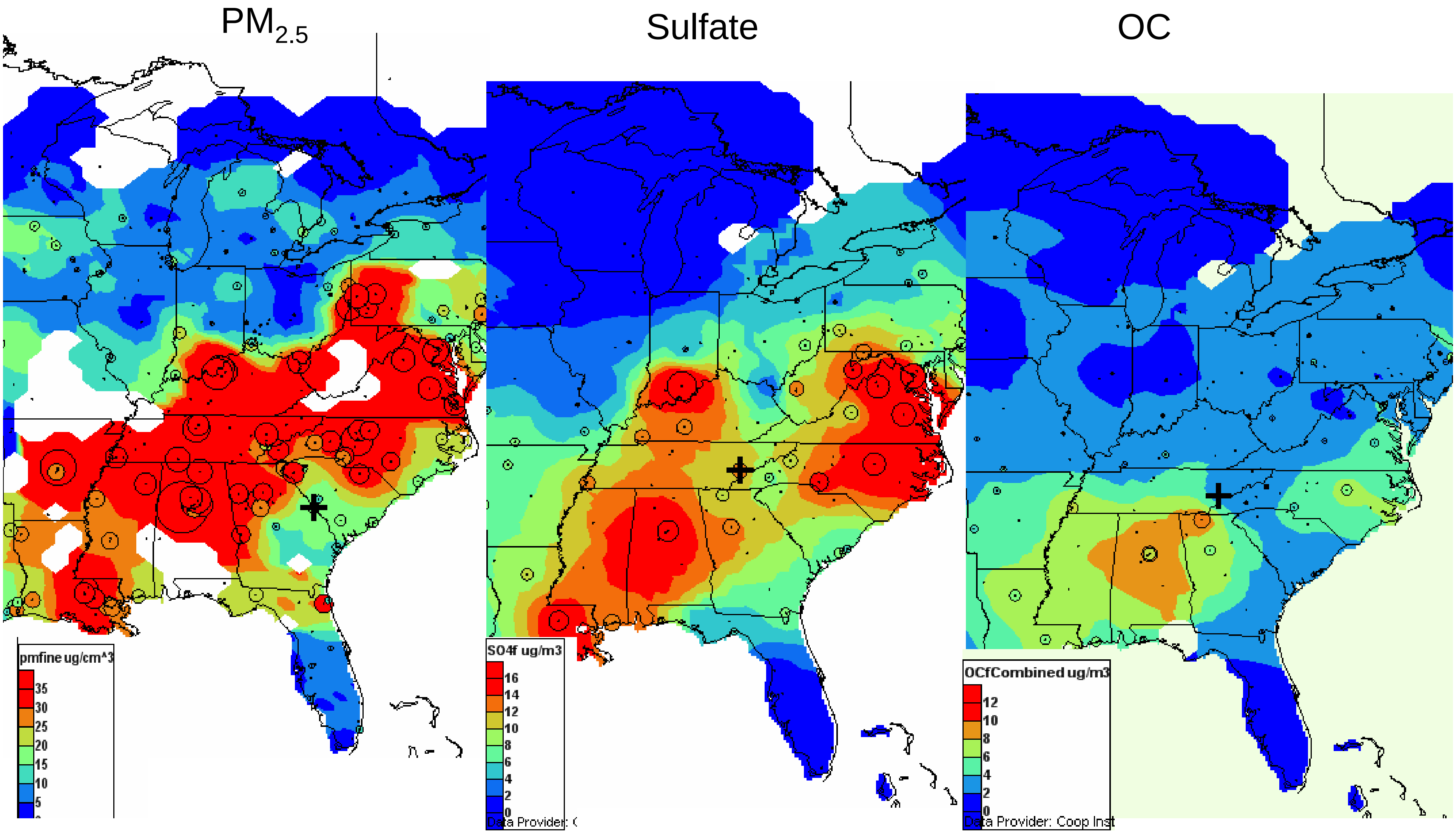
$PM_{2.5}$ concentrations in $\mu g/m^3$

Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret
August 3, 2004	42	43.8	41	
August 4, 2004	43.7	45.8	43.5	42.7

8/3/04



The fire believed to have impacted Louisville is a large (detected with multiple pixels) fire in central Kansas.

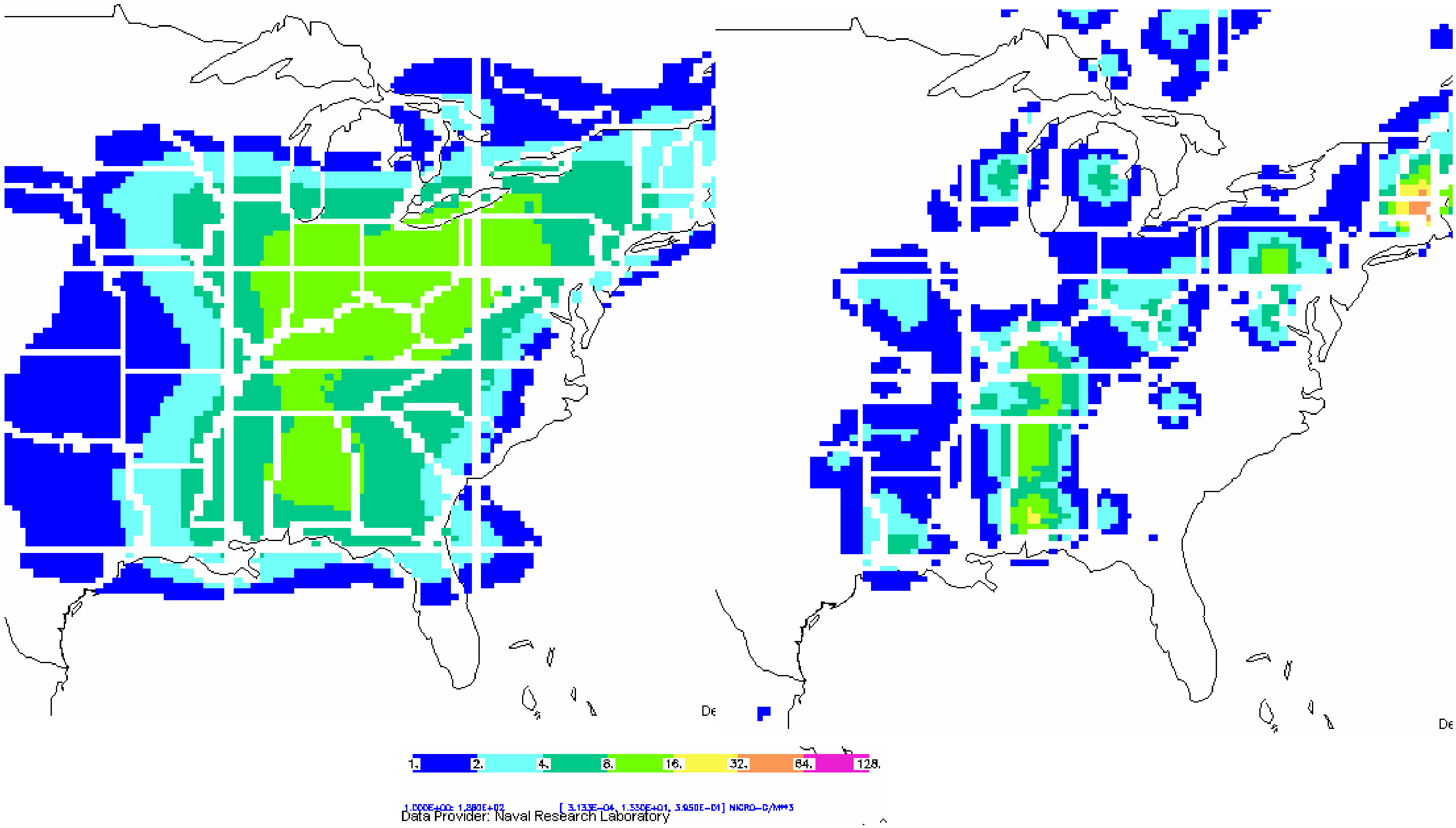


$PM_{2.5}$ and sulfate concentrations are high throughout the southeast, while OC concentrations are low/moderate.

8/3/04

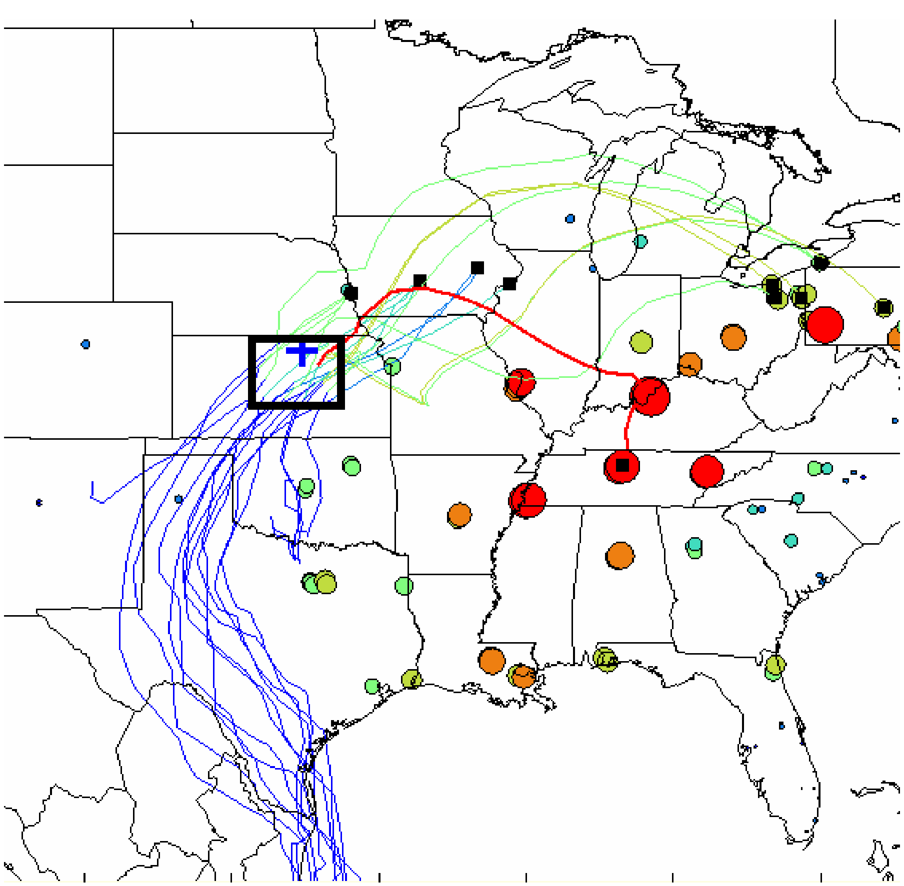
Modeled Sulfate

Modeled OC

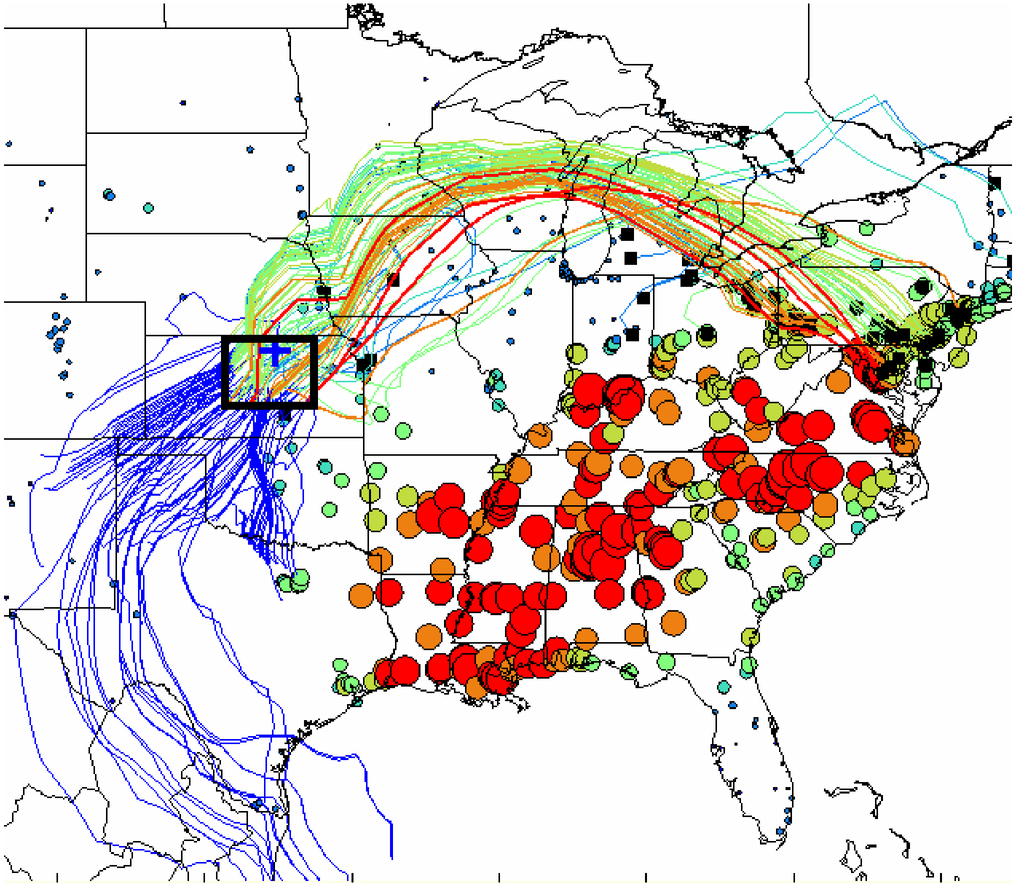


Modeled sulfate was moderate/high and modeled OC was moderate/low (lower on 8/4/04) on 8/3/04 and 8/4/04. (Only 8/3/04 shown here)

8/3/04

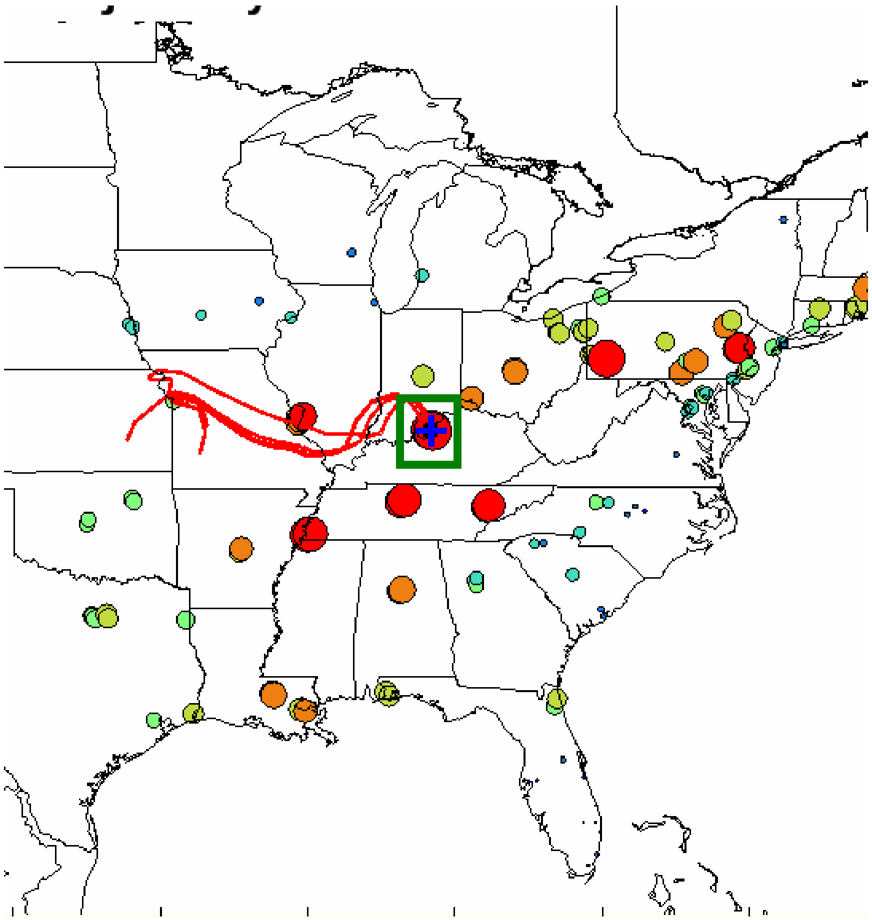


8/4/04

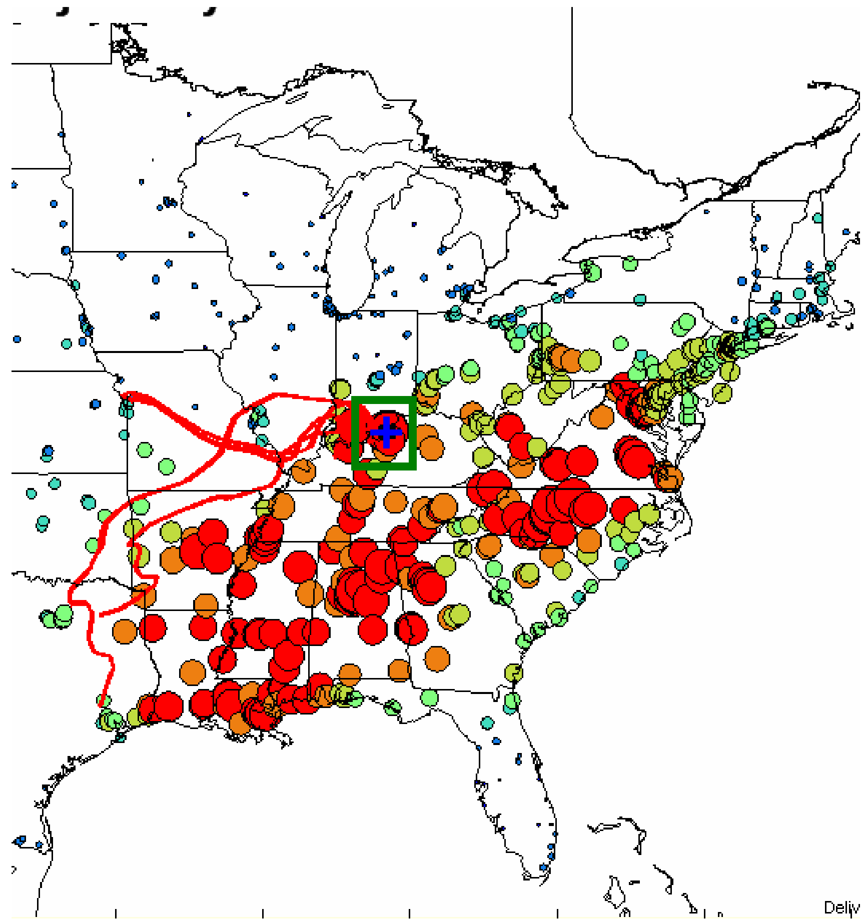


Source impact trajectories show the Louisville site had no impact from the fires in Kansas.

8/3/04

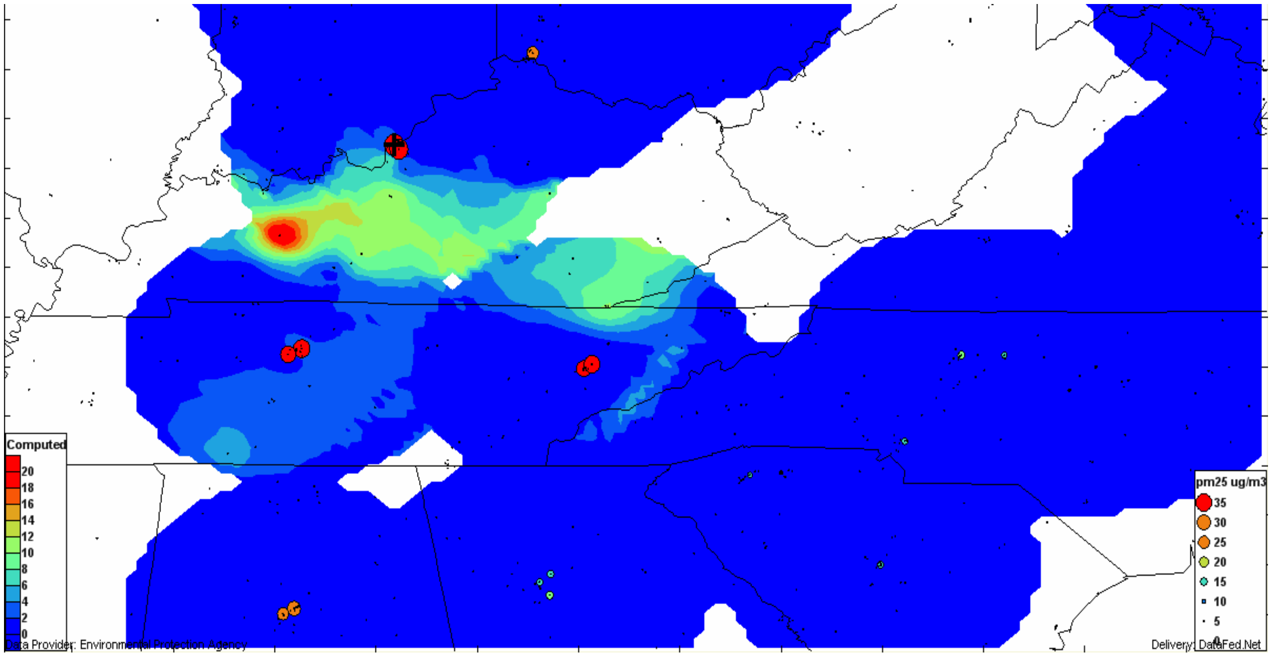


8/4/04

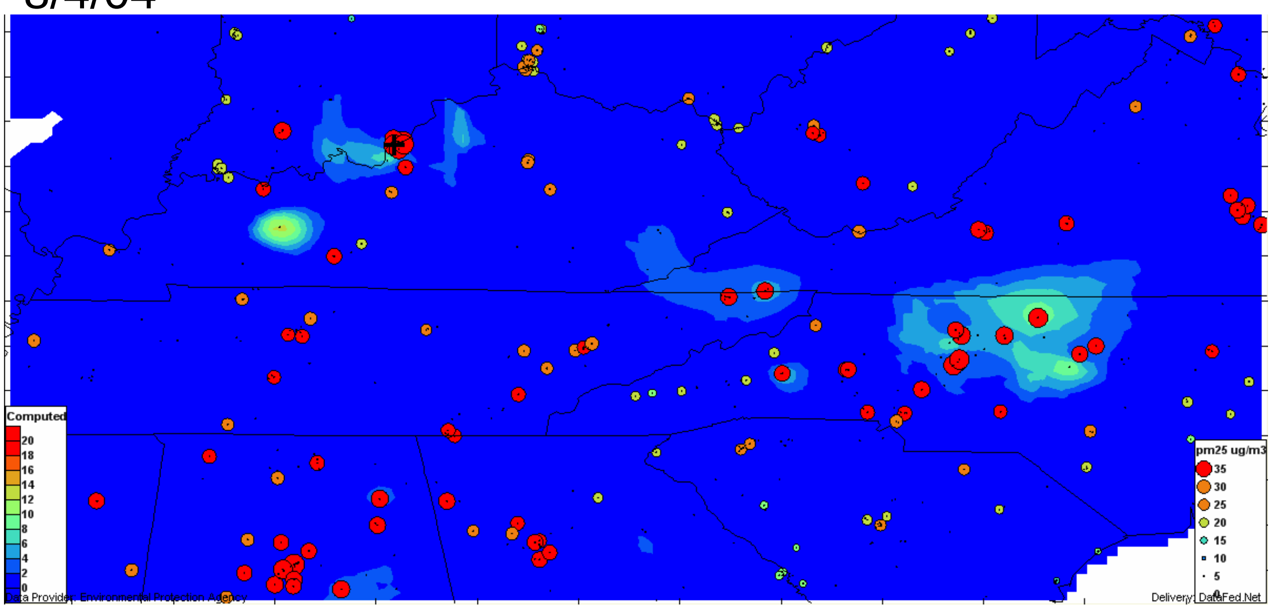


Back trajectories also show no impact from the Kansas fires. Winds appear slow moving (i.e., did not travel far in 72 hours), making them unlikely to transport much smoke from Kansas.

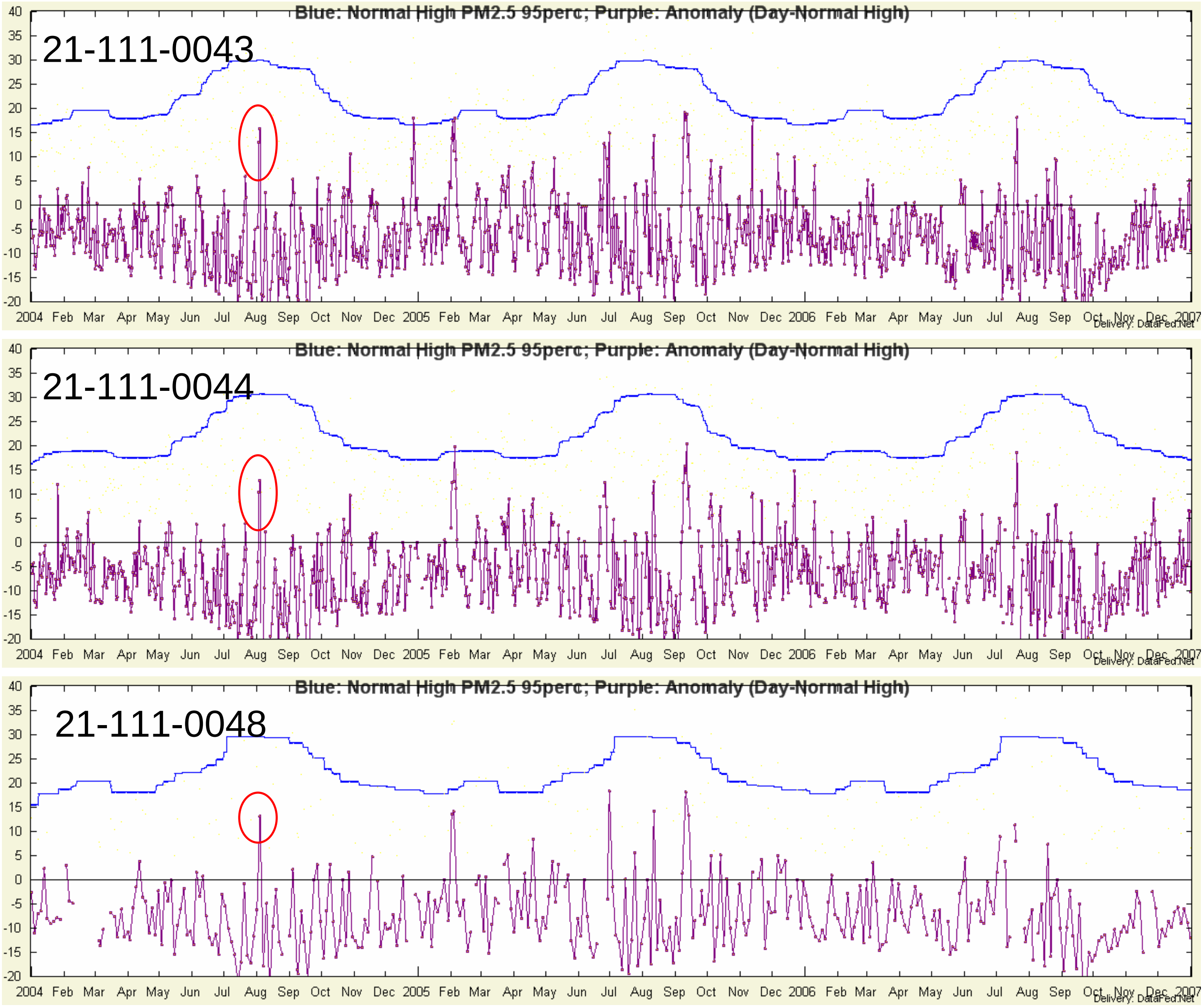
8/3/04



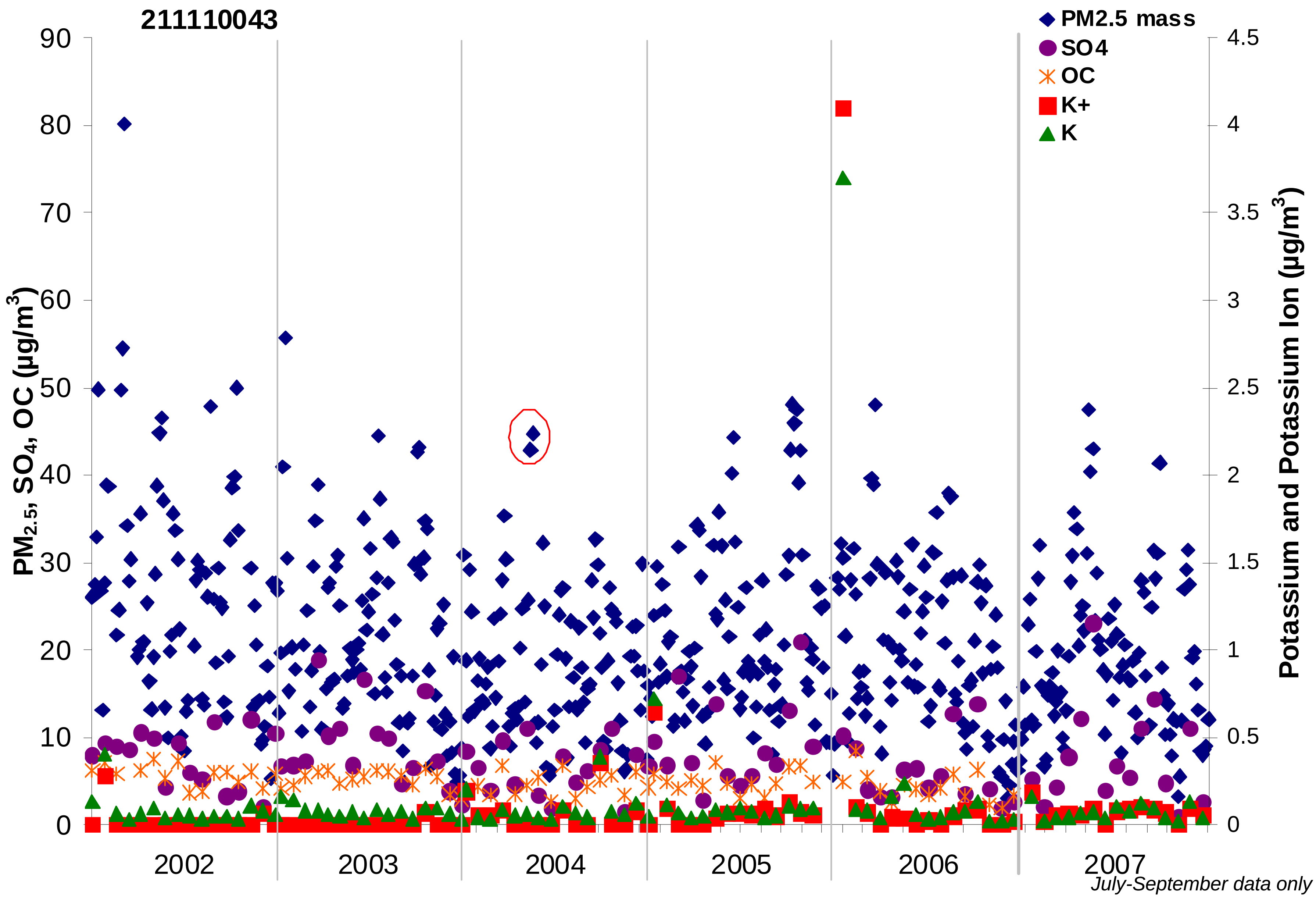
8/4/04



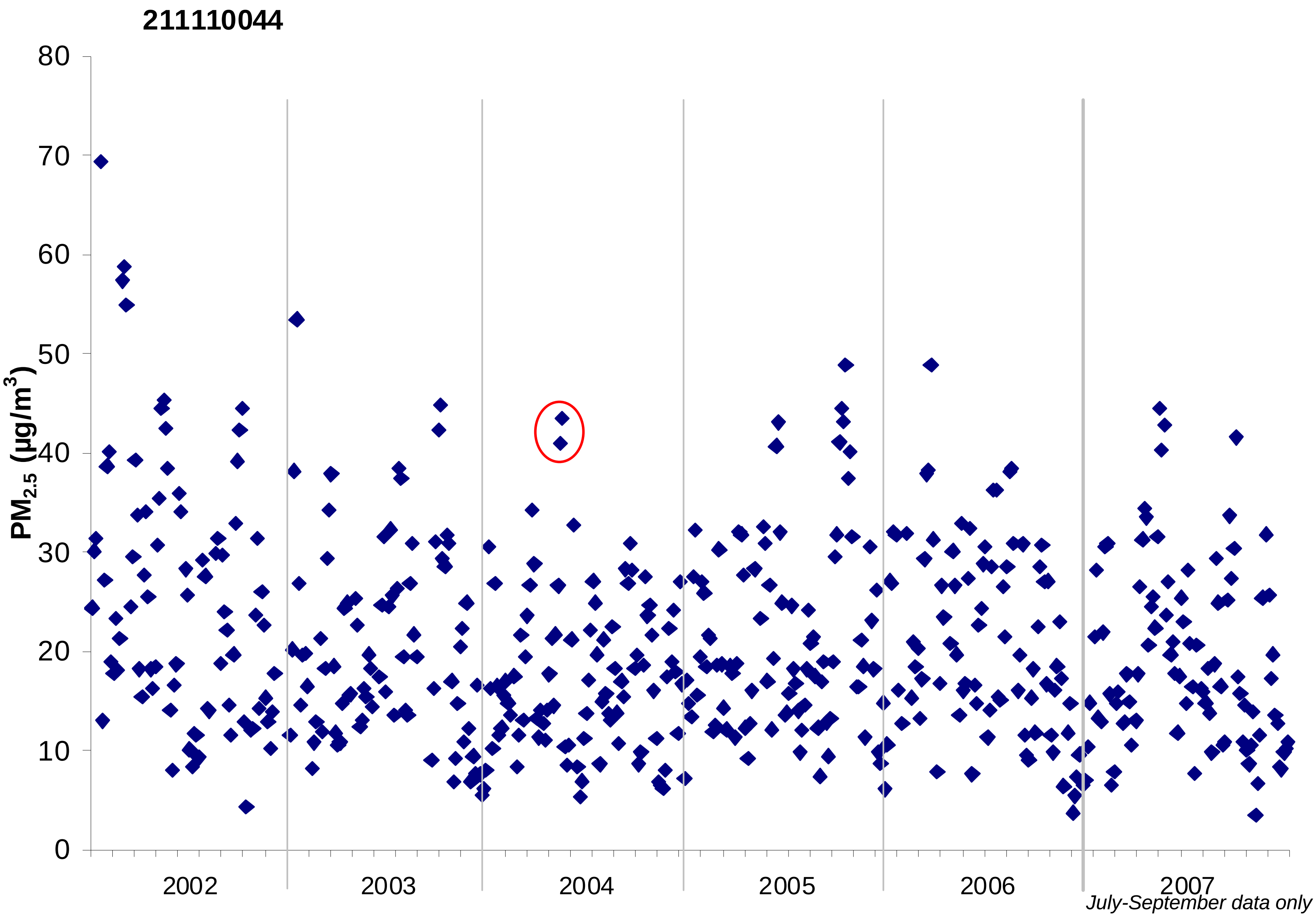
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 8/3/04 and 8/4/04, concentrations were very close to the historical values.



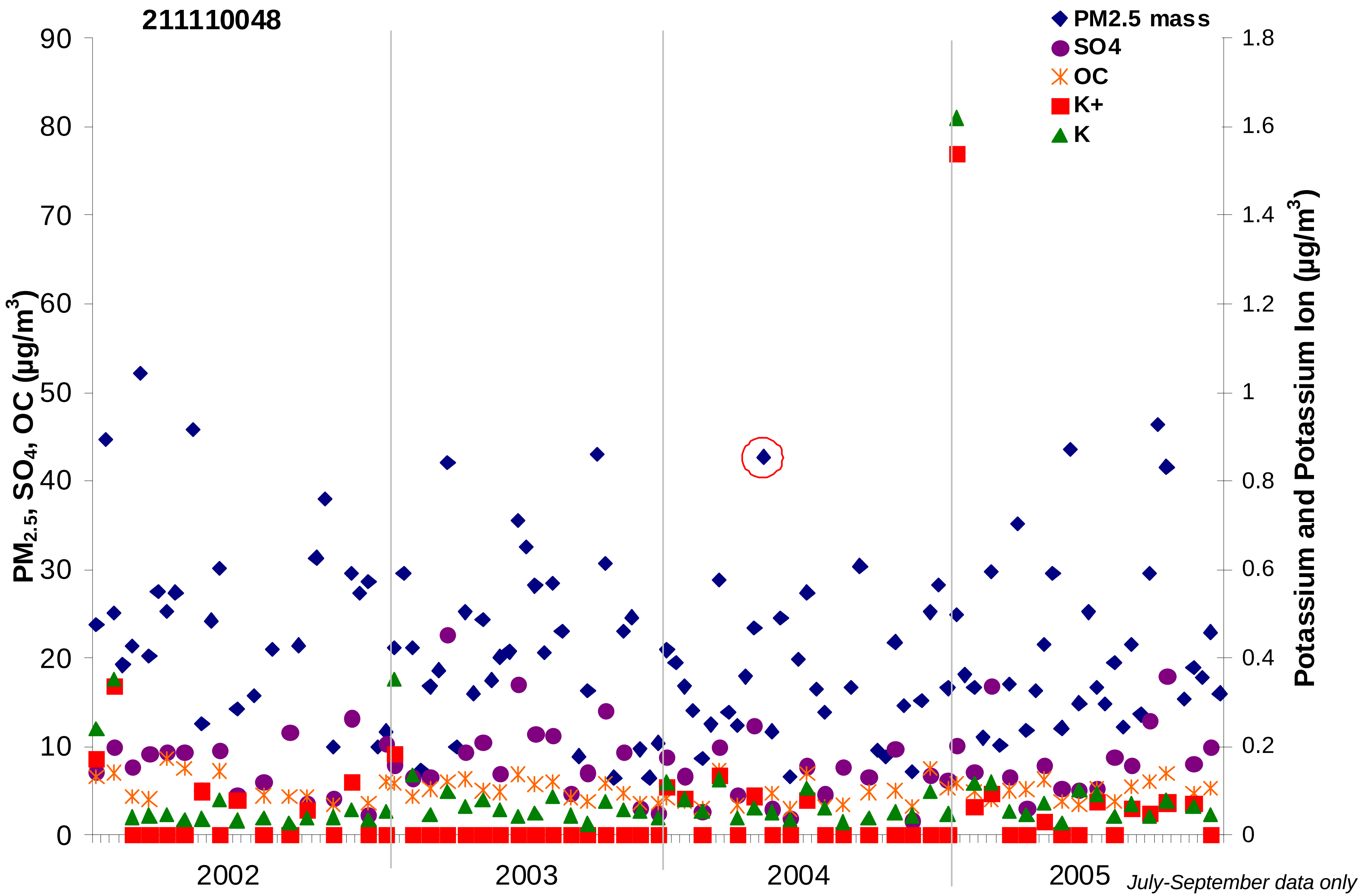
The purple lines show the difference between the given day and the historical 95th percentile concentration. On 8/3-8/4/04, concentrations were around 10-15 µg/m^3 higher than the historical values.



$PM_{2.5}$ concentrations are high, but within the range of historical concentrations. OC and potassium concentrations are not higher than normal, but sulfate is high on 8/1/04, which was the last reported sulfate measurement before the episode.



$PM_{2.5}$ concentrations are high, but within the range of historical concentrations. No speciated data are available for this site.



As at 21-111-0043, $PM_{2.5}$ concentrations are high, but within the range of historical concentrations. OC and potassium concentrations are not higher than normal, but sulfate is high on 8/1/04, which was the last reported sulfate measurement before the episode.

Summary

- Trajectory analysis does not indicate any impact from the area of the Kansas fires on 8/3/04 or 8/4/04.
- High sulfate concentrations indicate a regional sulfate episode throughout the southeast.
- Although $PM_{2.5}$ concentrations are high on 8/3/04 and 8/4/04, they are within the historical range of concentrations and were likely not impacted by forest fires.

Exceptional Events Analysis
Kentucky
9/8/05-9/13/05

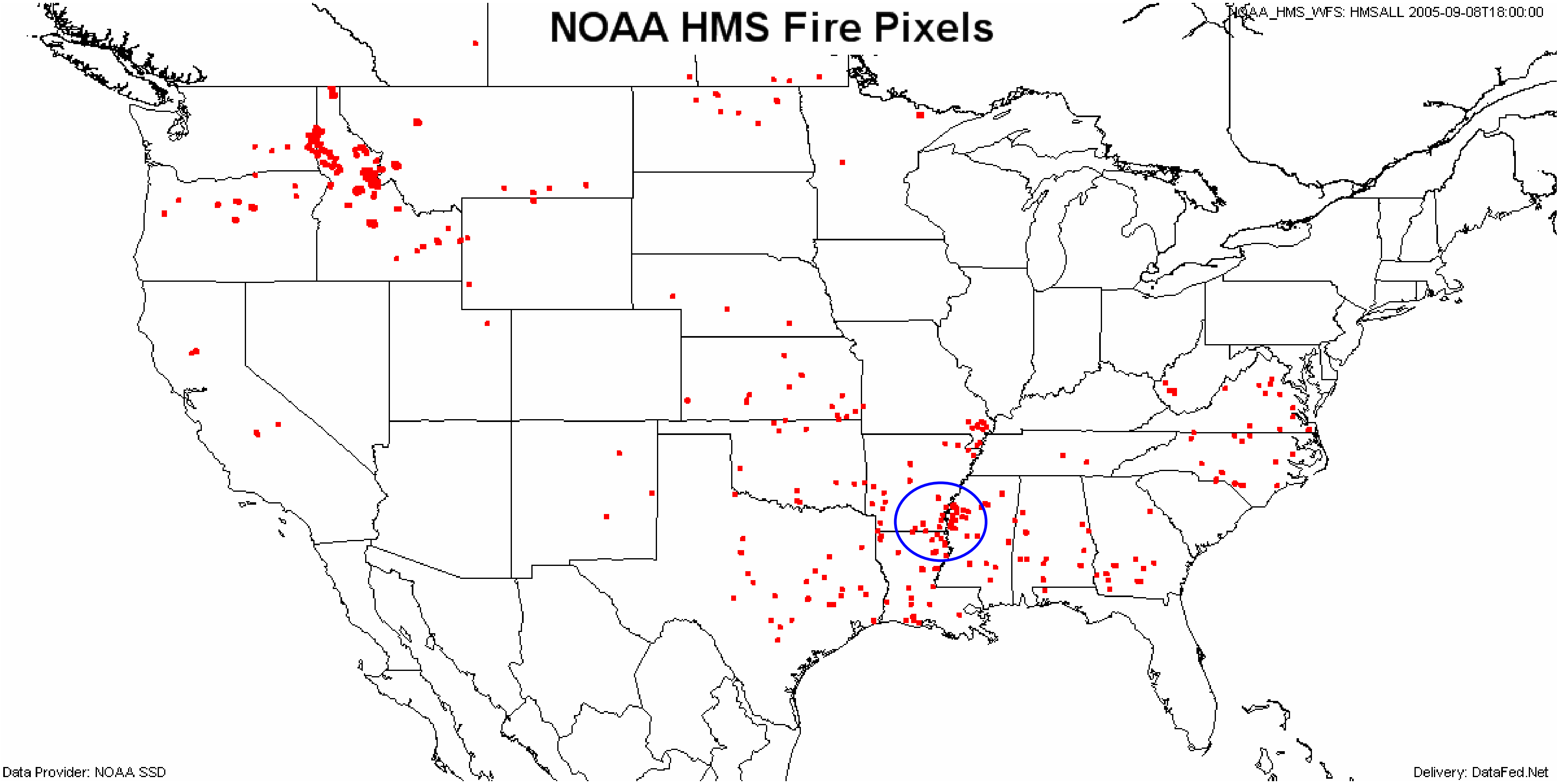
Four sites analyzed
(21-111-0043, 21-111-0044,
21-111-0048, 21-111-0051)
for possible fire impact from
Arkansas/Mississippi/Texas fires

Concentrations Under Consideration

$PM_{2.5}$ concentrations in µg/m^3

Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
September 8, 2005	43.5	42.2	41.1		
September 9, 2005	48.8	47.4	44.5		
September10, 2005	45.9		43.2	46.4	
September11, 2005	47.8	47.1	48.9		
September12, 2005	40.1	38.2	37.4		
September13, 2005	42.9	42.7	40.1	41.6	39.1

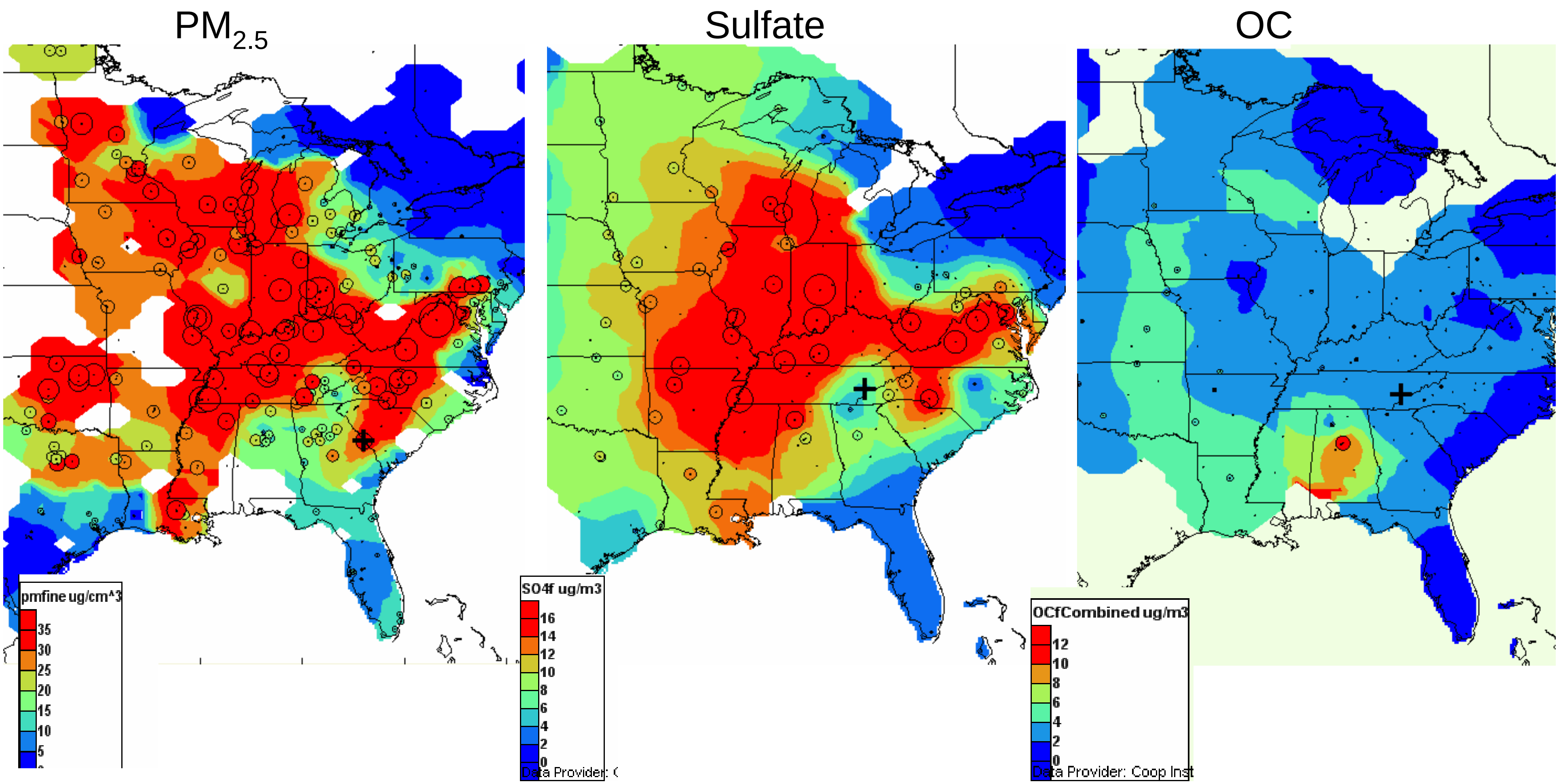
9/8/05



Fires in the Arkansas/Mississippi area are believed to be impacting the Louisville area for 9/8/05-9/13/05.

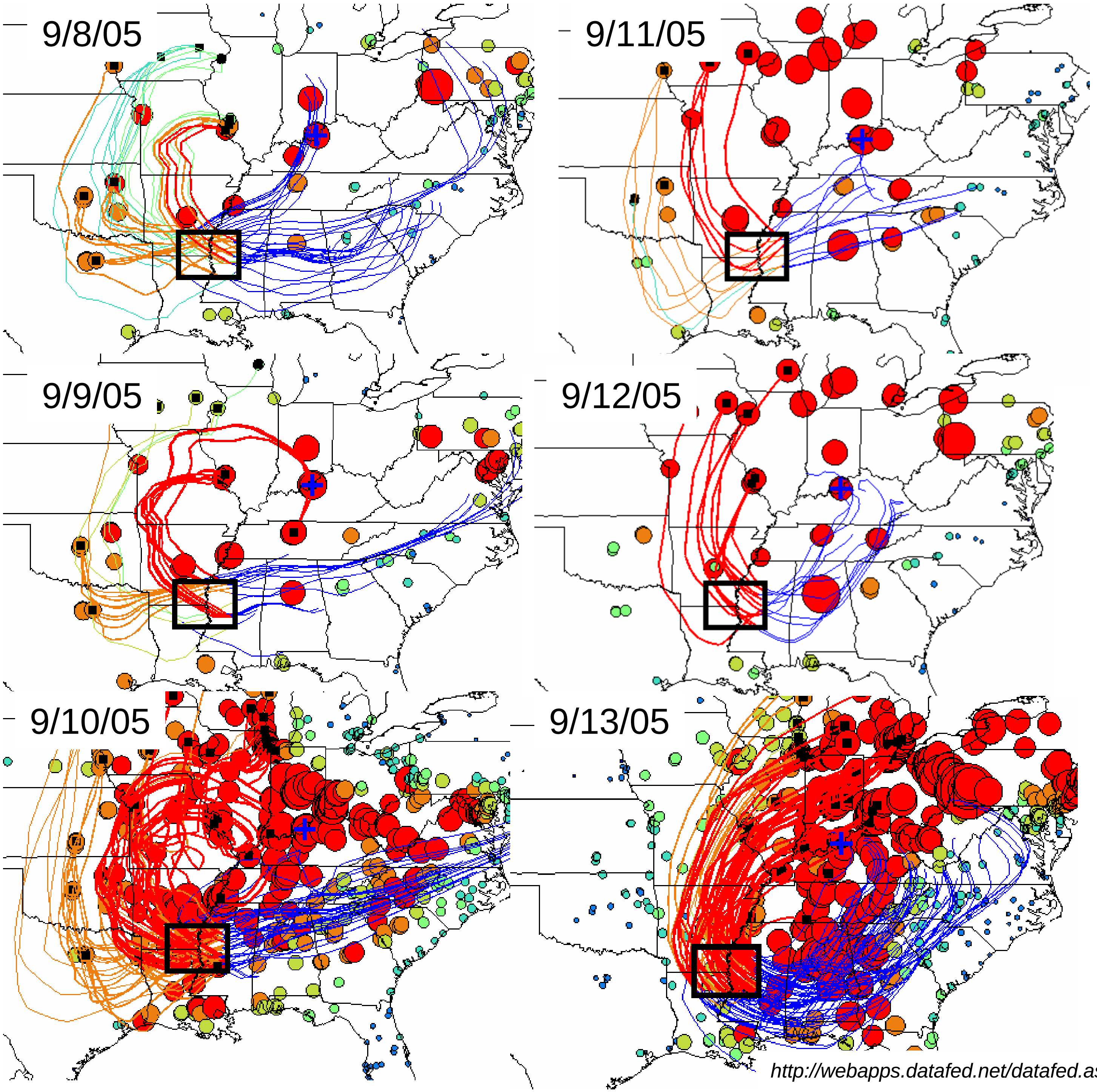
http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/NOAA_HMS_FirePix_map

9/10/05



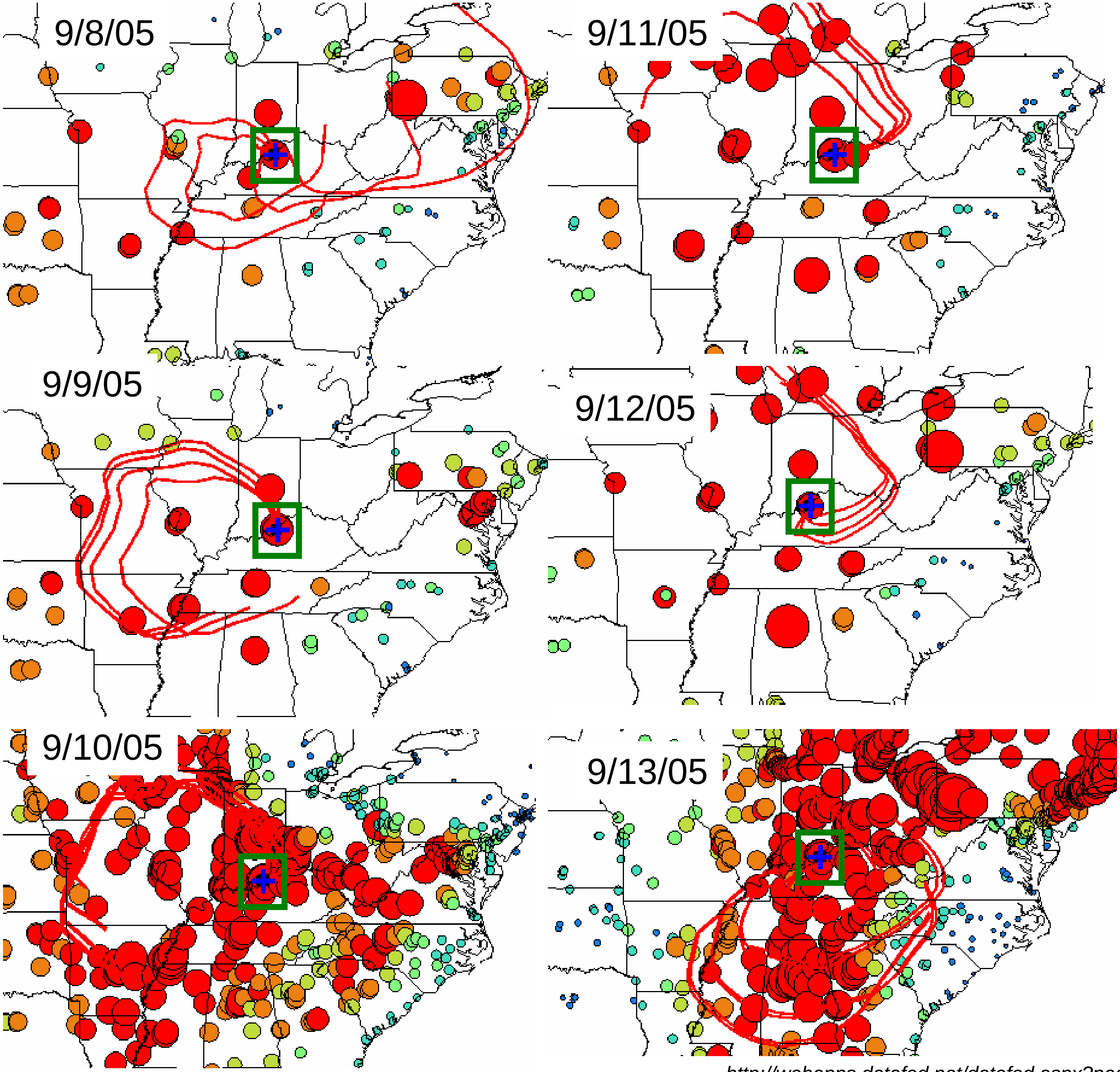
$PM_{2.5}$ and sulfate concentrations were high, and OC concentrations were low, throughout the region on 9/10/05, indicating a regional sulfate event. Data were not available for other study days.

http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/AIRNOW_PM25_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map



Source impact trajectories show that for most days, no trajectories from the fire location impacted the Louisville area. Although trajectories on 9/13/05 do pass through the fire area before impacting Louisville, this is caused by a surface high pressure centered over Kentucky that is conducive to a high regional sulfate event (likely caused by the transport of humid air into the region and limited dispersion).

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

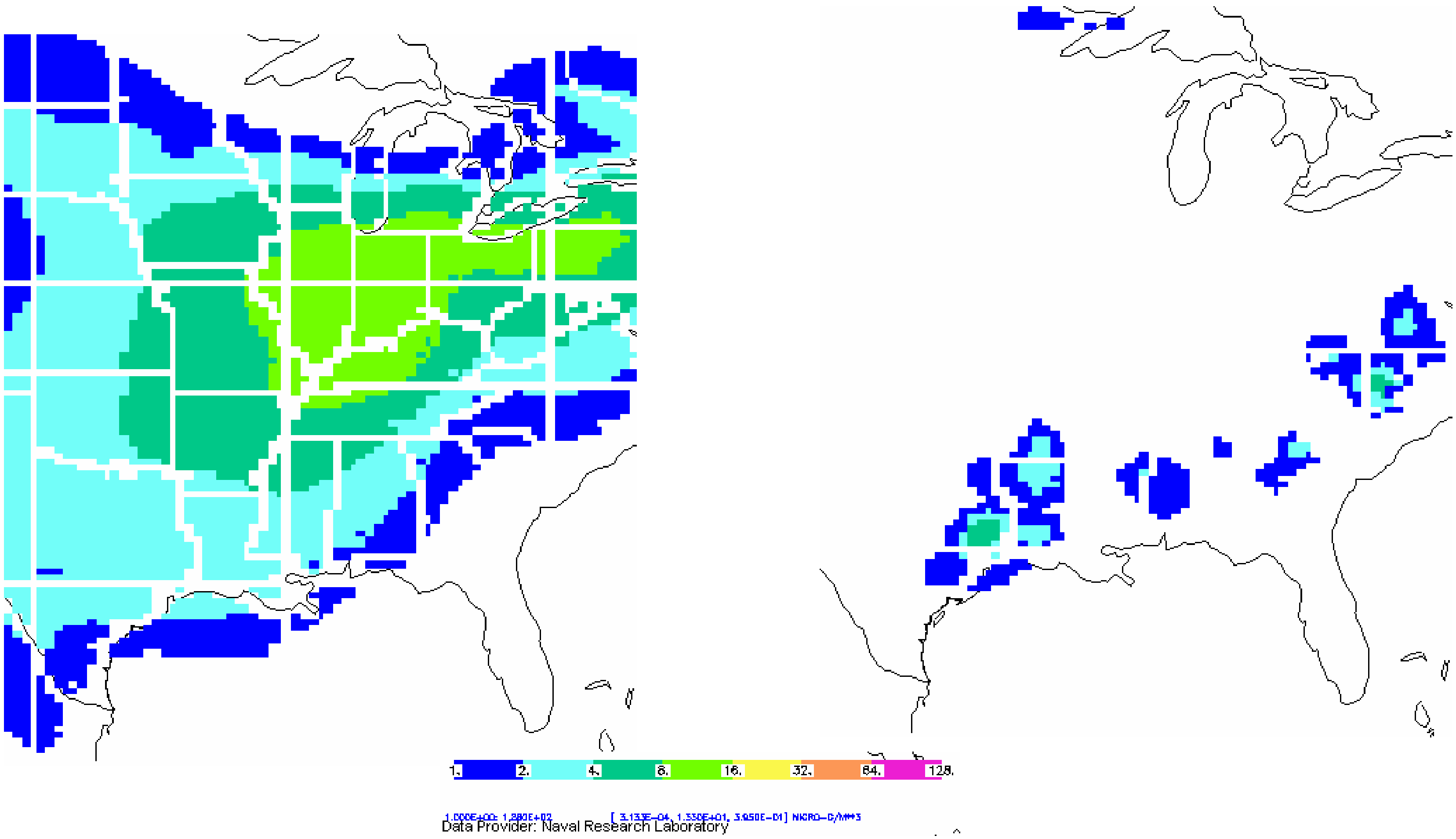


Back trajectories from the Louisville area do not show a distinct path from the fire area to the impacted sites and indicate light winds, which limit dispersion.

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

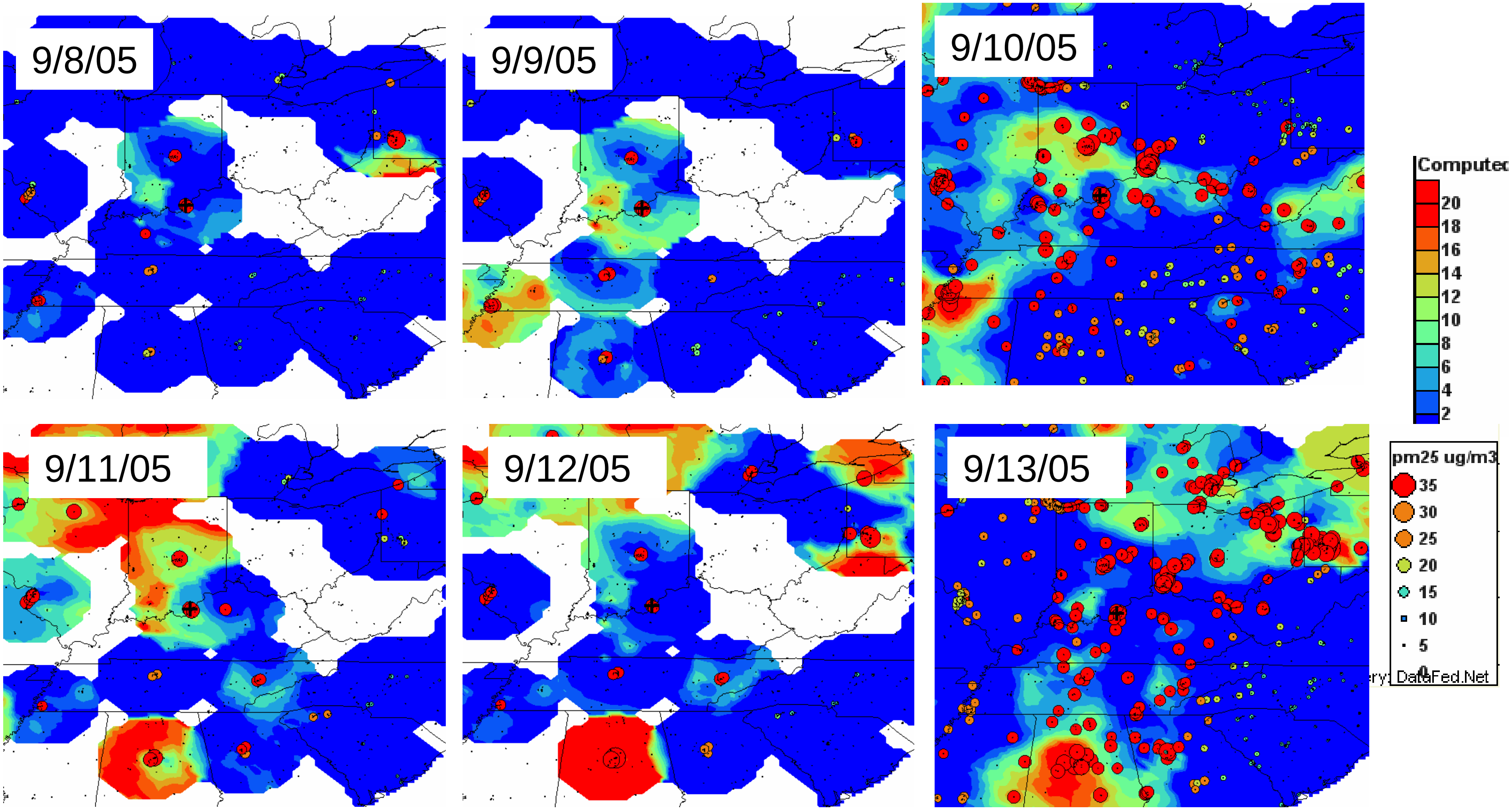
Modeled Sulfate

Modeled Smoke



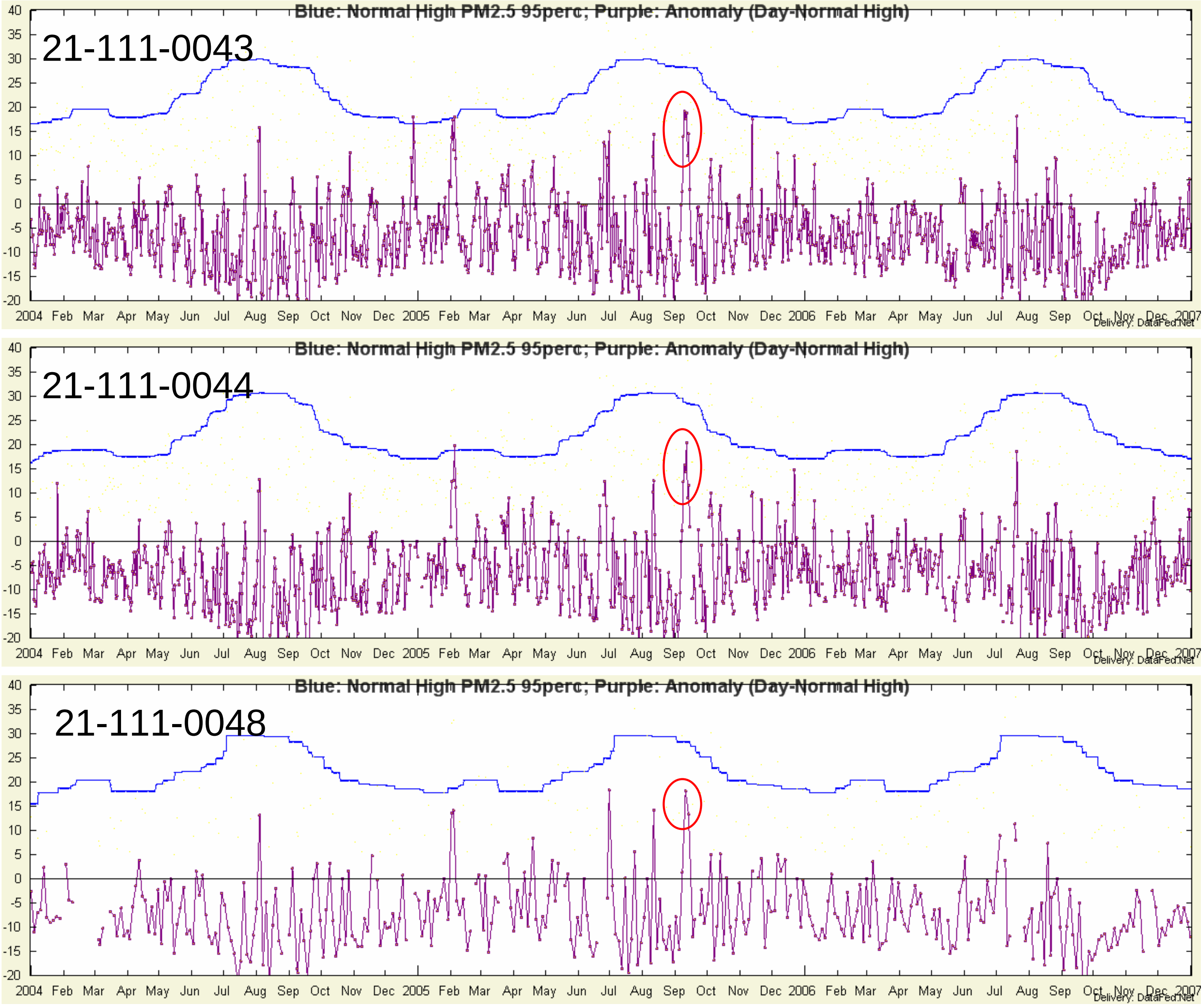
Modeled sulfate was moderate/high throughout the region and modeled smoke was low or zero throughout the region on all study days, again supporting a regional sulfate event. (9/8/05 shown)

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf



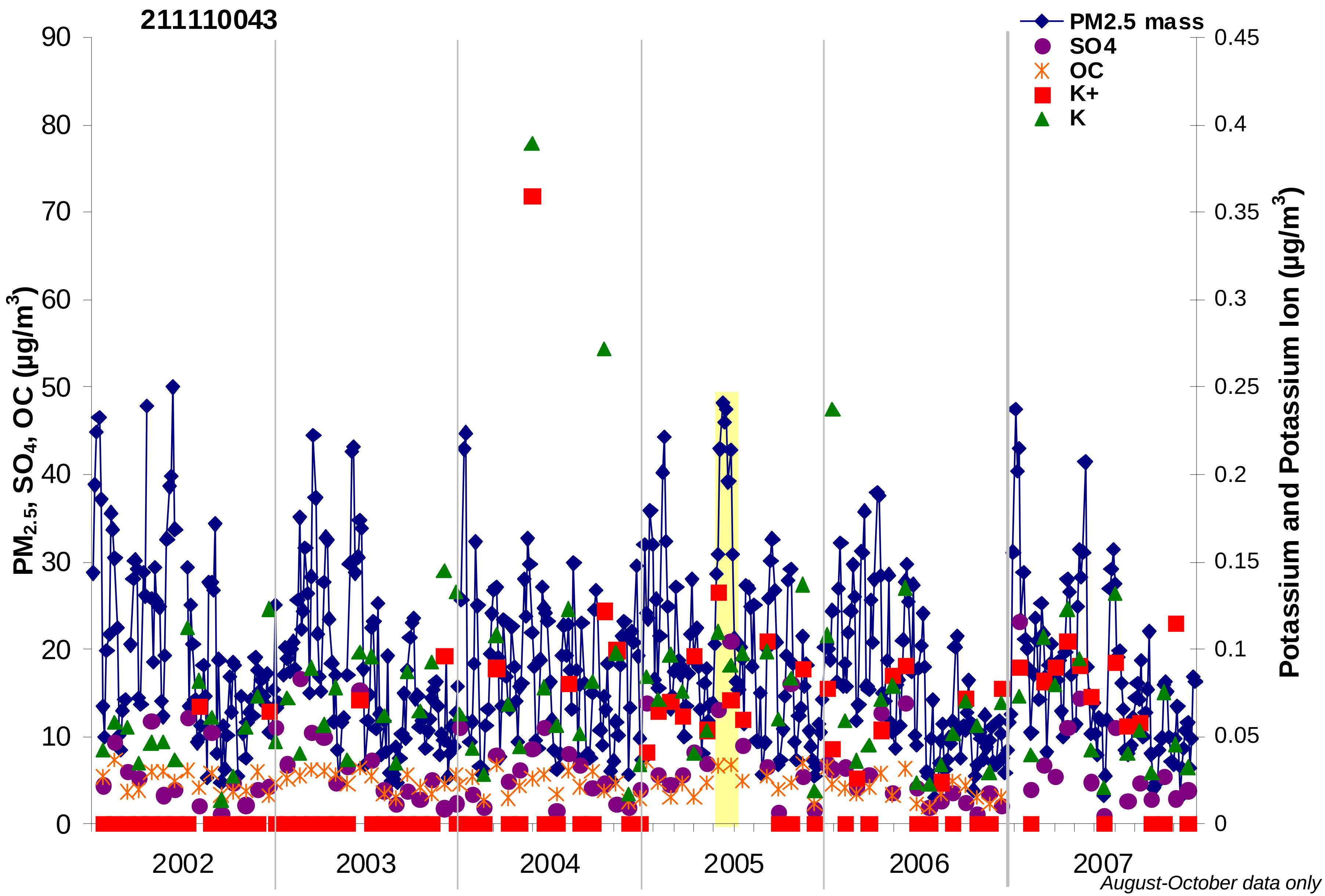
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 9/8/05, 9/9/05, and 9/13/05, concentrations were very close to the historical values. On 9/10/05, 9/11/05, and 9/12/05, concentrations were around 10-15µg/m^3 higher than historical values.

http://webapps.datafed.net/datafed.aspx?page=NHF/Gadsen_05-22-07R



The purple lines show the difference between the given day and the historical 95th percentile concentration. On 9/10-9/12/05, concentrations were around 10 to 15 μg/m^3 higher than the historical values.

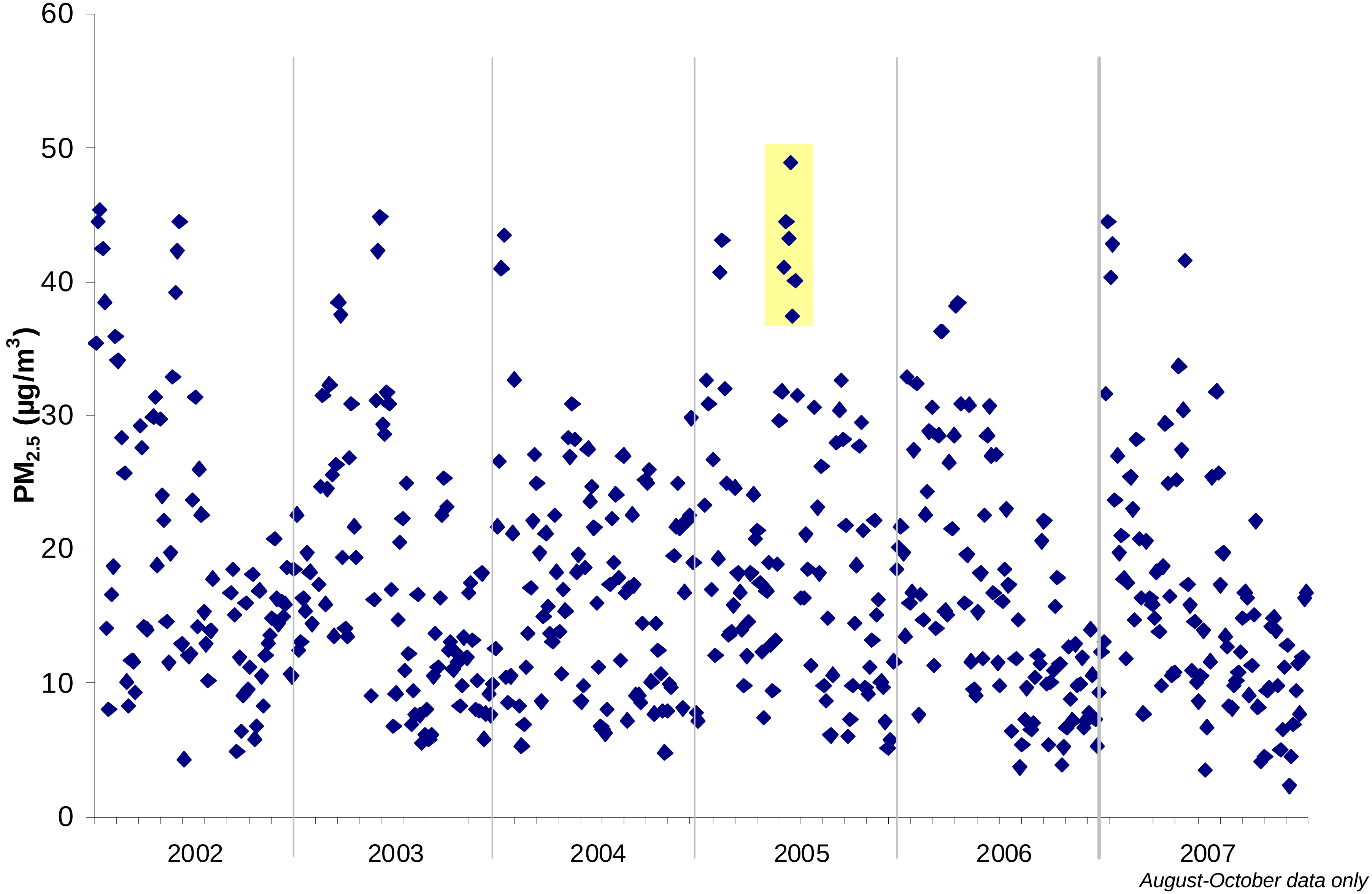
http://webapps.datafed.net/datafed.aspx?page=NHF/Gadsen_05-22-07R



$PM_{2.5}$ concentrations were high on 9/8-9/13/05 (highlighted in yellow). OC concentrations were average and sulfate concentrations were very high (9/13/05).

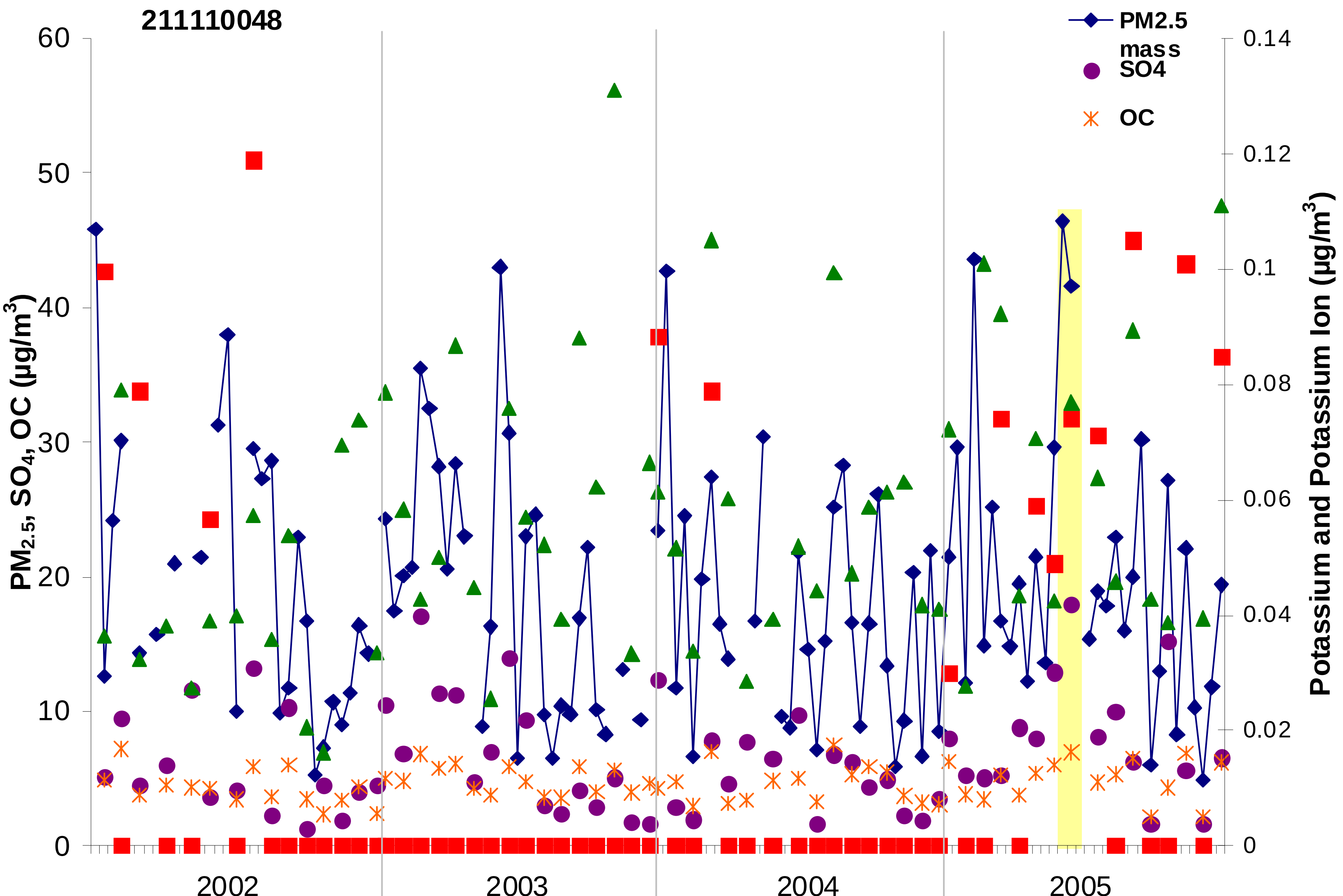
Data from AQS

211110044



All study days have high $PM_{2.5}$ concentrations; all except for 9/11/05 are within the historical range of concentrations. Speciated data are not available for this site.

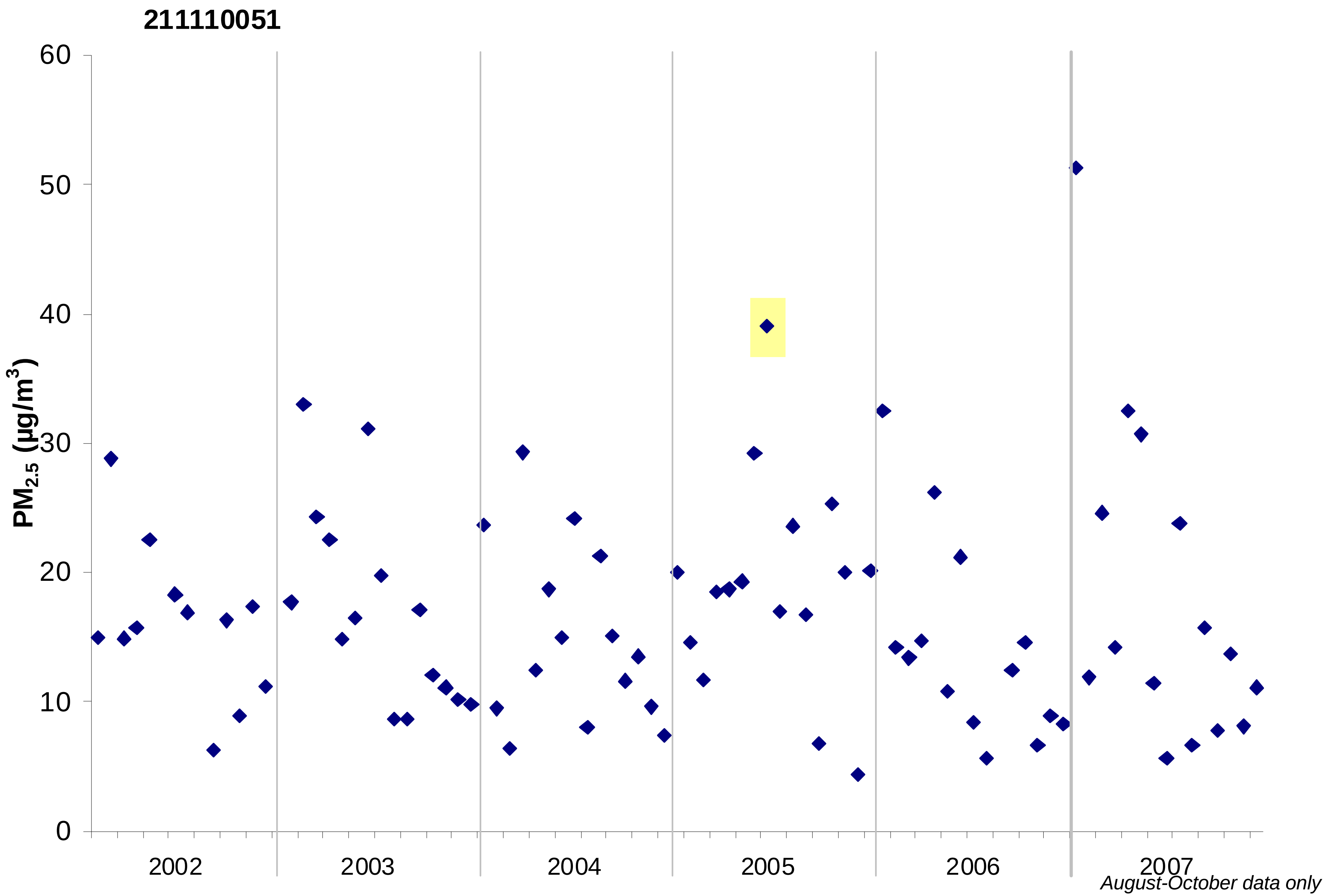
Data from AQS



August-October data only

$PM_{2.5}$ concentrations were high on 9/10/05 and 9/13/05 (highlighted in yellow). OC concentrations were average and sulfate concentrations were very high (9/13/05).

Data from AQS



$PM_{2.5}$ concentrations were very high on 9/13/05; speciated data are not available for this site.

Data from AQS

Summary

- Trajectories do not show a clear impact from the fire area on the Louisville area.
- Sulfate concentrations are very high throughout the region during 9/8-9/13/05, indicating a regional sulfate episode.
- Meteorological analysis shows a surface high centered over Kentucky that is likely causing the sulfate event (due to the transport of humid air into the region and limited dispersion).
- The high $PM_{2.5}$ concentrations in Louisville on 9/8-9/13/05 are likely not caused by impact from forest fires.

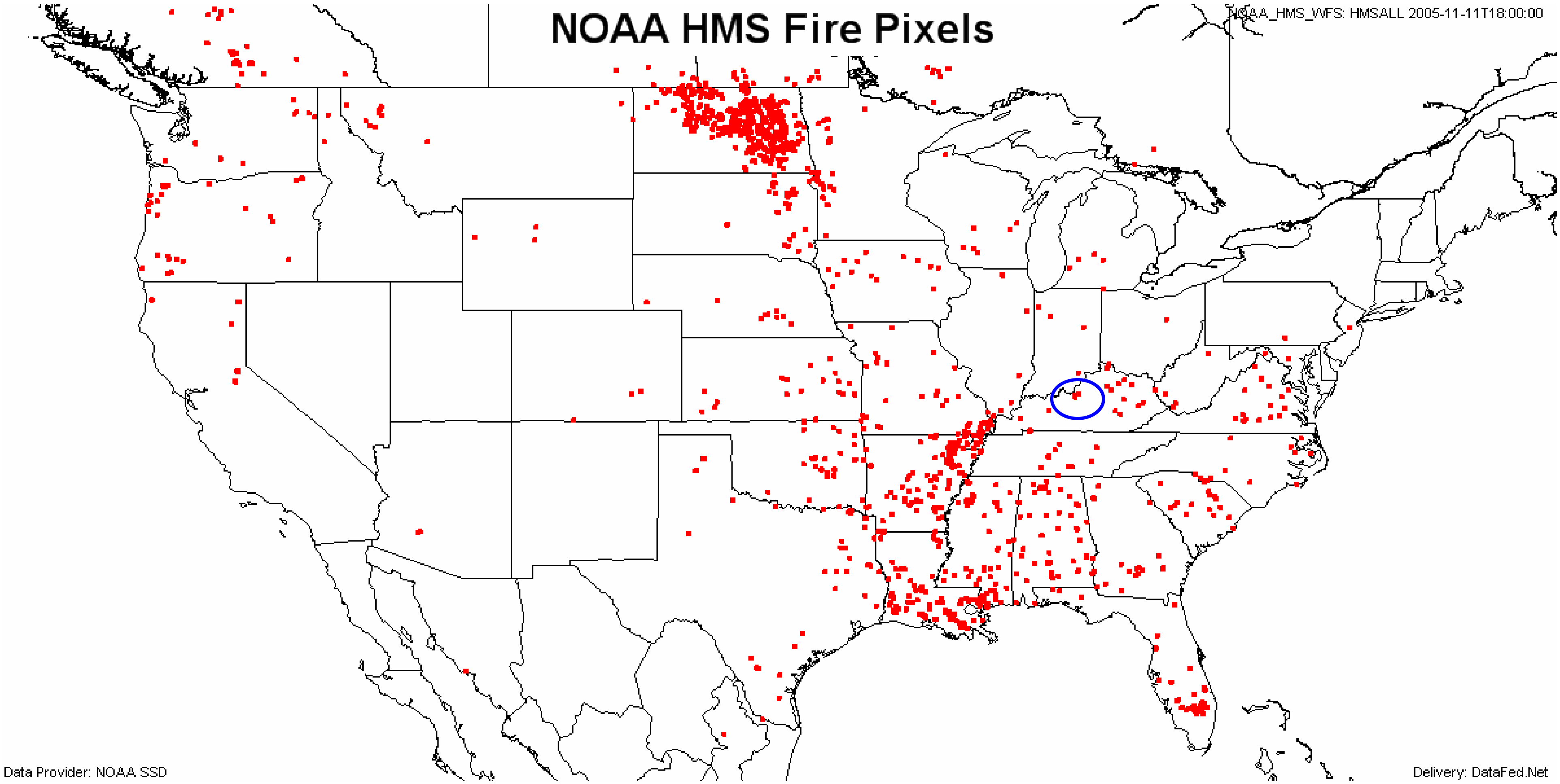
Exceptional Events Analysis
Kentucky
11/11/05-11/12/05

Three sites analyzed
(21-111-0043, 21-111-0044, 21-111-0048)
for possible fire impact
from Fort Knox fires

Days Under Consideration

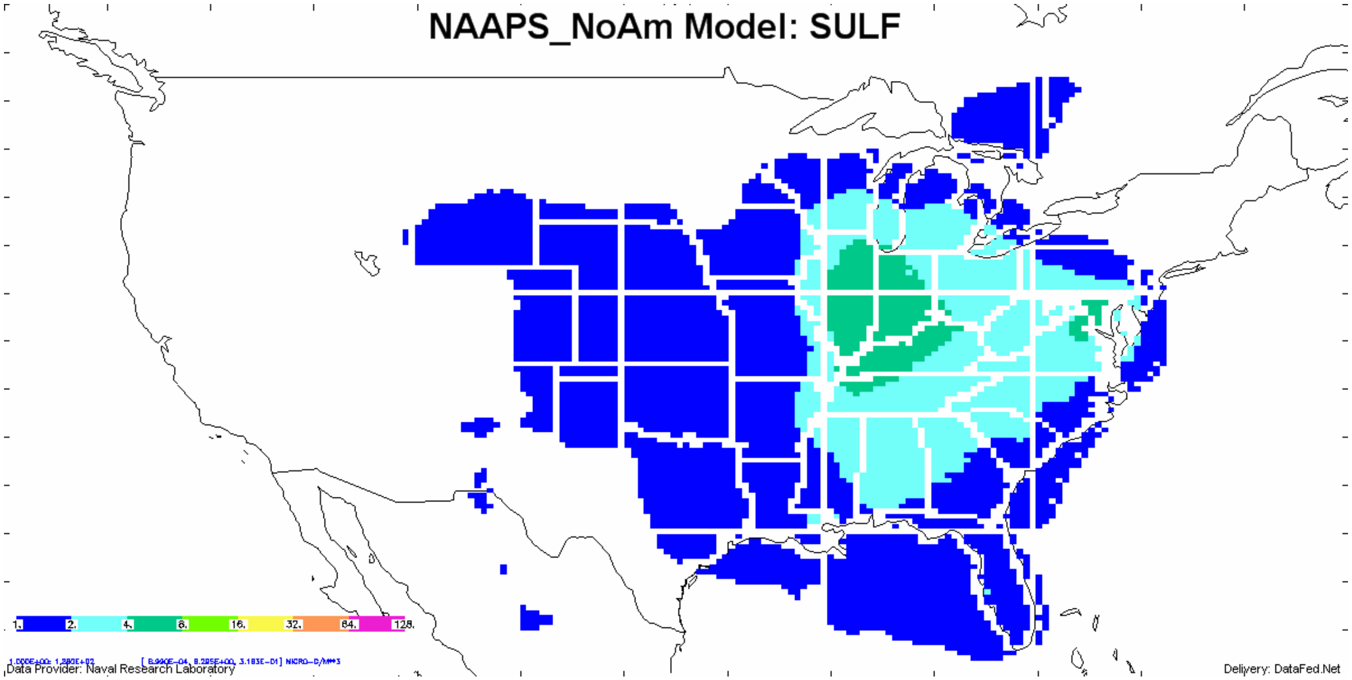
$PM_{2.5}$ in µg/m^3

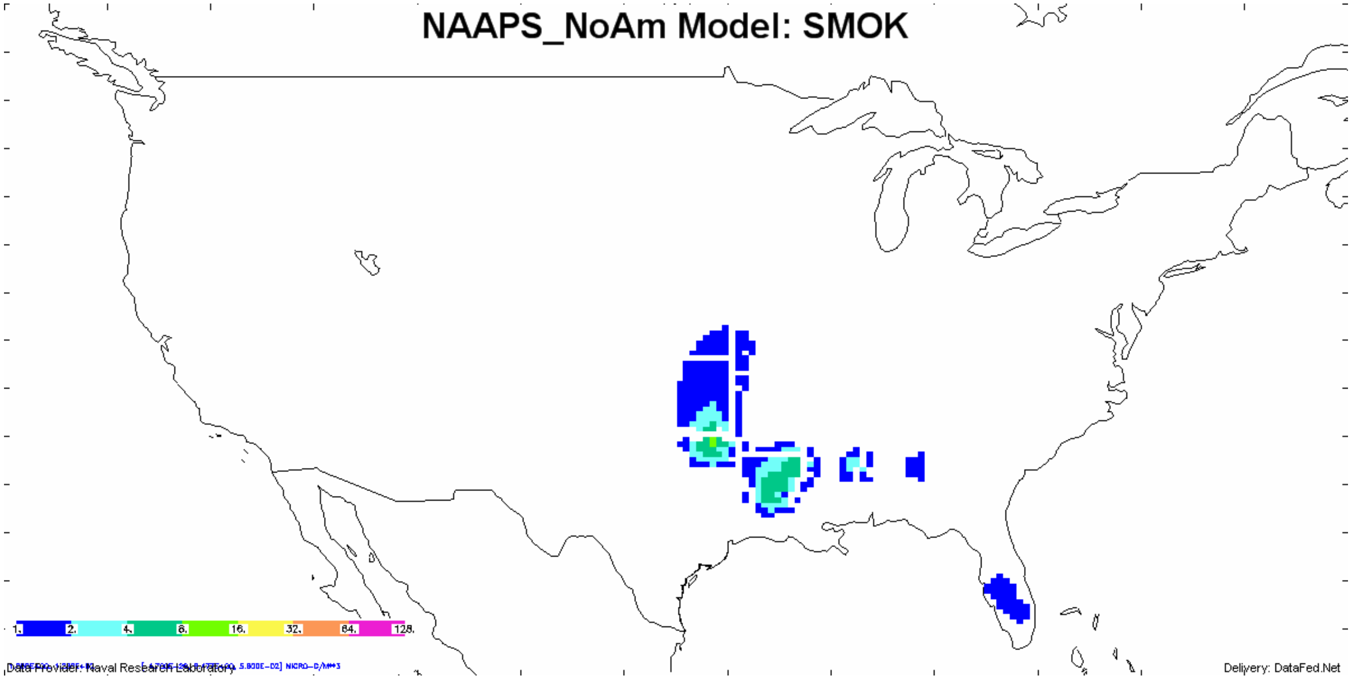
Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte	21-111-0048 Barret
November 11, 2005	21.3	28.8	Not Reported
November 12, 2005	36.0	29.6	21.2



Local fires are believed to be impacting concentrations at three sites on 11/11/05 and 11/12/05.

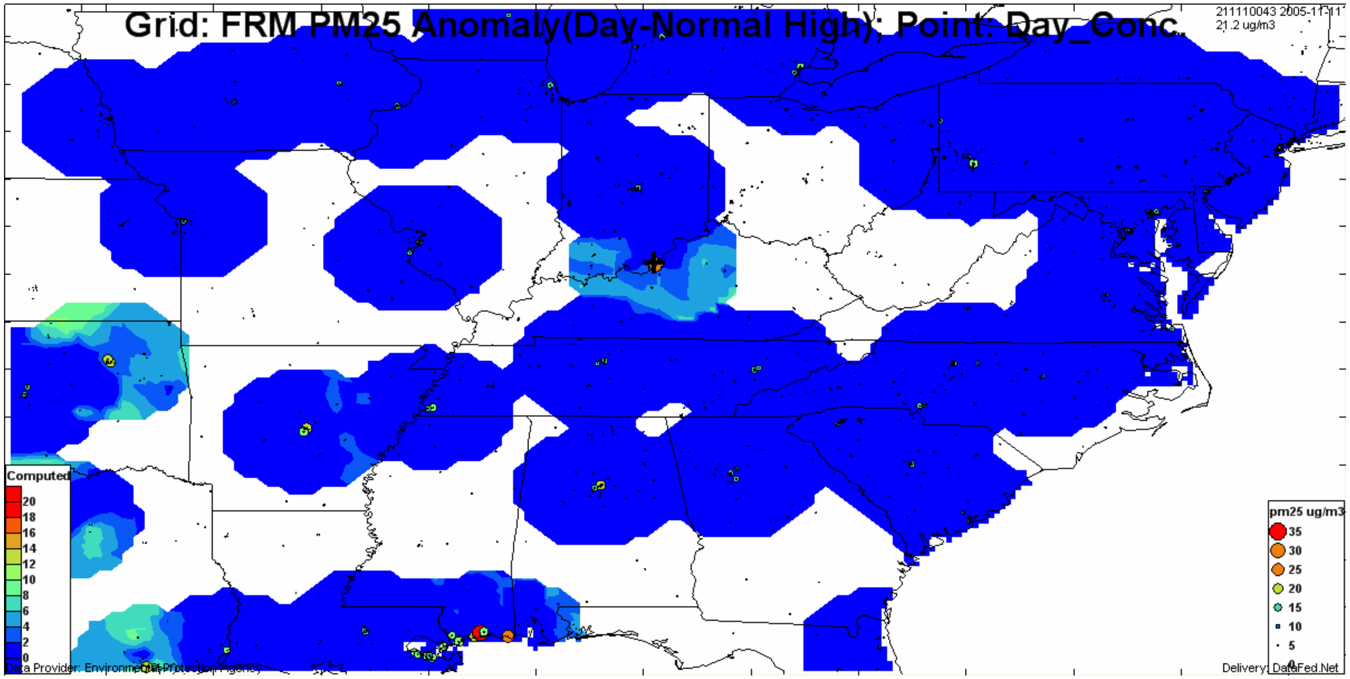
http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/NOAA_HMS_FirePix_map



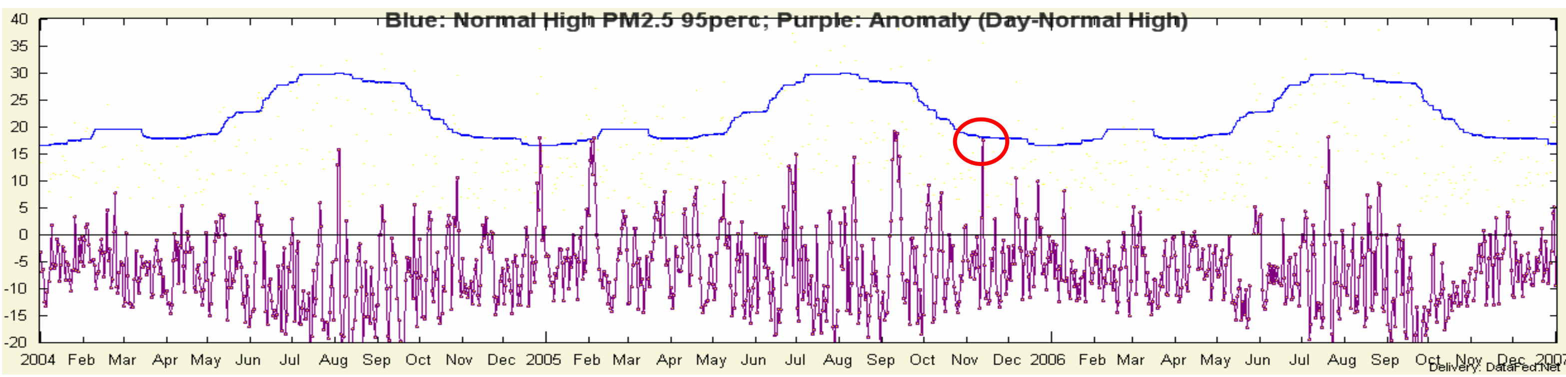


Modeled sulfate in Kentucky was low/moderate on 11/11/05. The absence of a contribution from smoke may be misleading as the fire under consideration is very small and believed to only have very local impacts.

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf

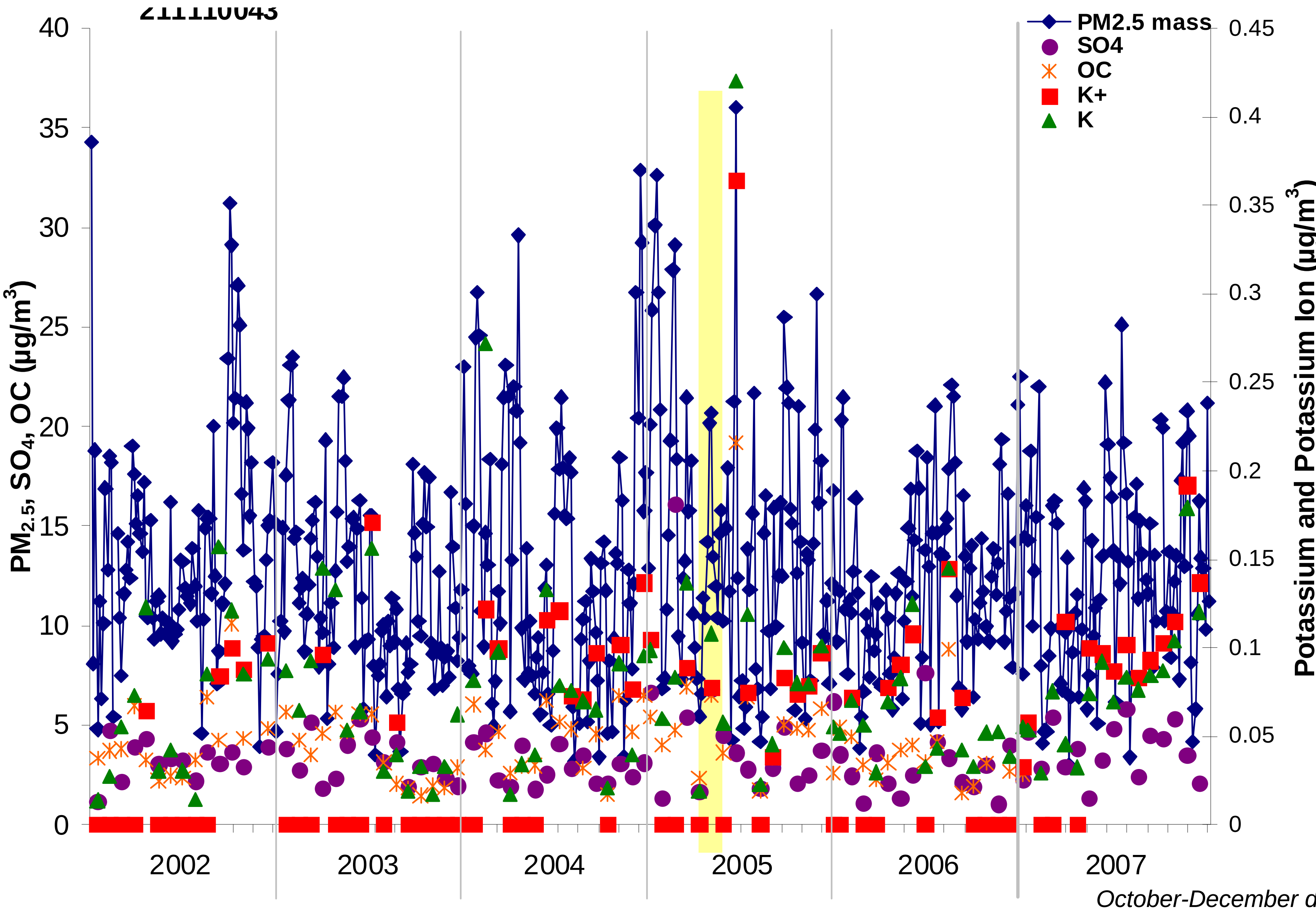


The map above shows the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (shaded background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 11/11/07, differences in excess of 5 µg/m^3 are seen throughout Kentucky.



The purple lines show the difference between the given day and the historical 95th percentile concentration at site 21-111-0043. On 11/11/07, concentrations were about 15µg/m^3 higher than normal. Other sites and days under consideration were similar.

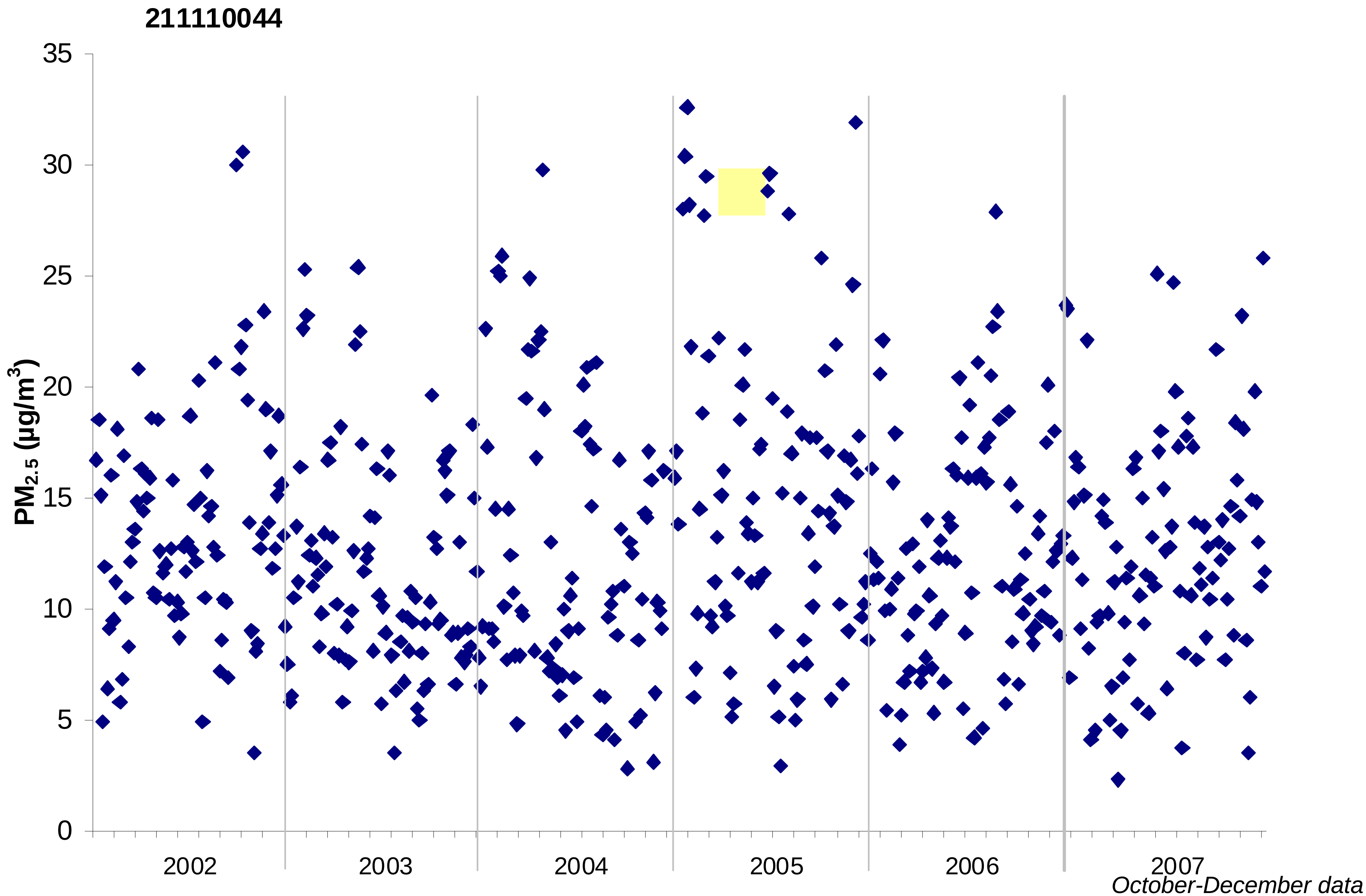
http://webapps.datafed.net/datafed.aspx?page=NHF/Gadsen_05-22-07R



October-December data

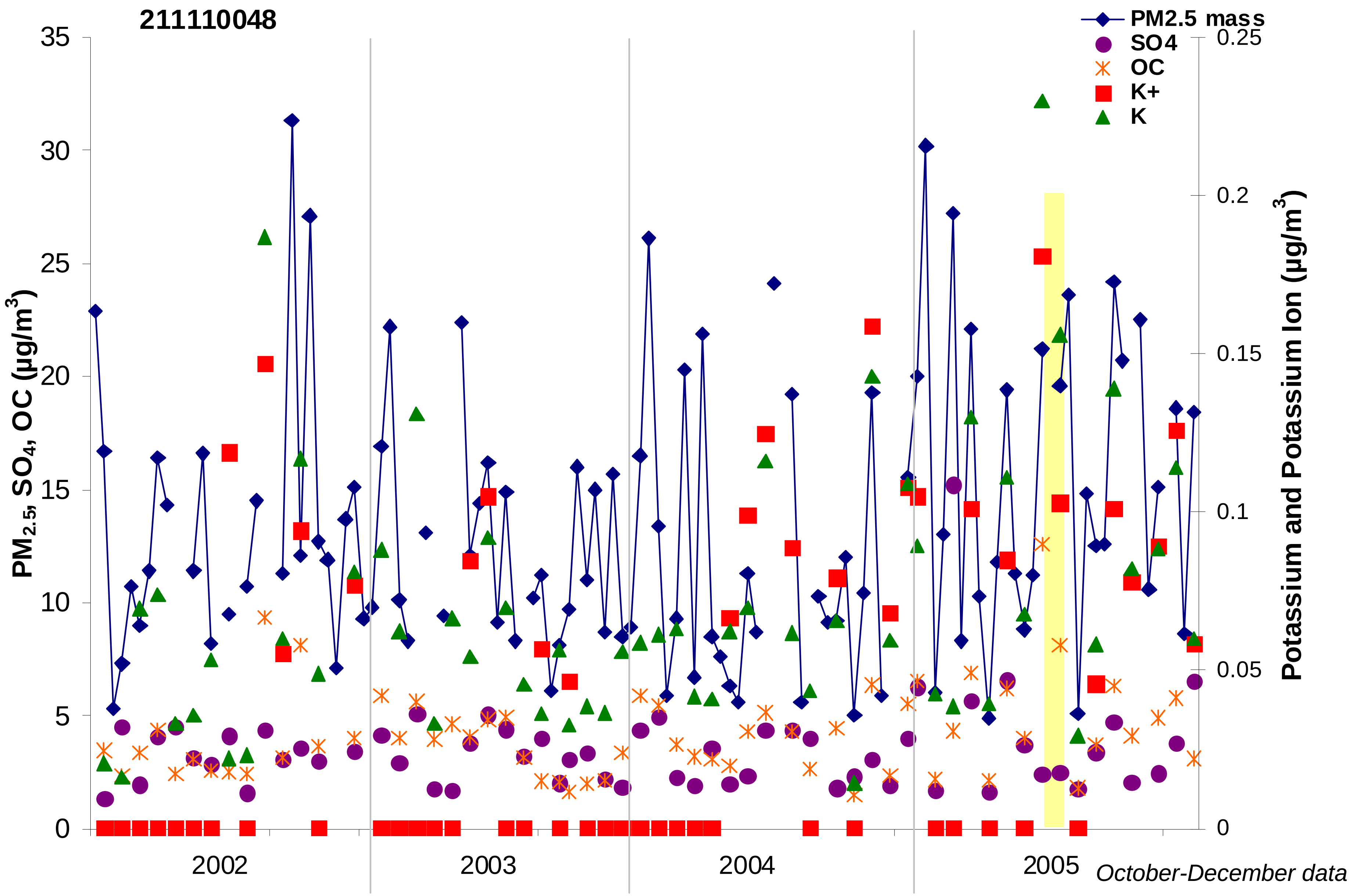
At 21-111-0043 $PM_{2.5}$ concentrations on 11/11/05 were within the historical range of concentrations. However, concentrations of PM2.5 and fire tracers (not measured on 11/11/05), were very high on 11/12/05. 11/11/05 and 11/12/05 are highlighted in yellow.

Data from AQS



$PM_{2.5}$ concentrations at 21-111-0044 were high but within with the historical range of concentrations on 11/11/05 and 11/12/05 (highlighted in yellow).

Data from AQS



Concentrations of PM2.5 and fire tracers at 21-111-0048 were high but within the historical range of concentrations on 11/12/05.

$PM_{2.5}$ in µg/m^3

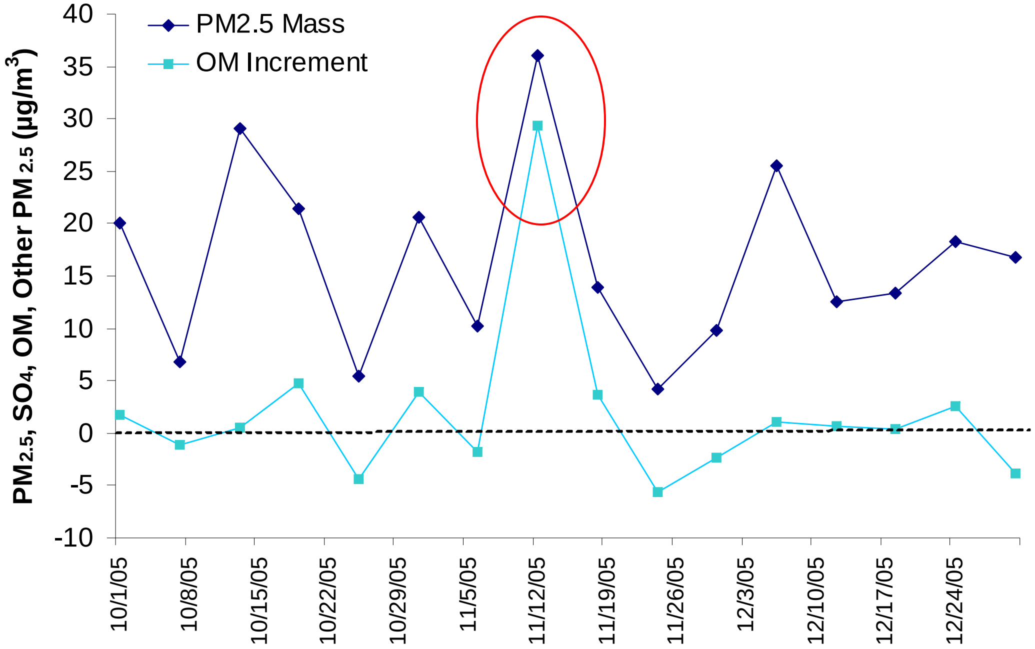
		Mean	Median	95th Percentile	11/11/05	11/12/05
21-111-0043	2005	14.2	13.3	27.2	21.3	36.0
	2002-2007	12.9	12.0	22.5		
21-111-0044	2005	15.2	14.4	29.3	28.8	29.6
	2002-2007	13.0	12.1	23.4		
21-111-0048	2005	15.6	14.8	26.0	Not Reported	21.2
	2002-2007	12.6	11.3	22.8		

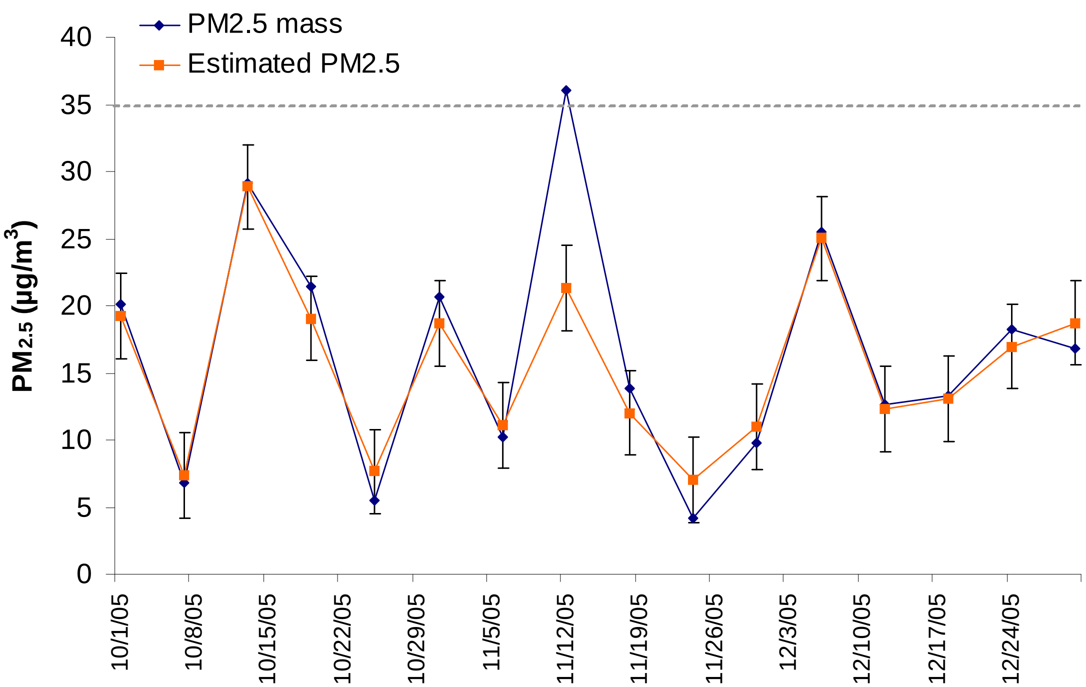
October-December data

Concentrations on 11/11/05 were well above median concentrations but within the 95th percentile of concentrations for all cases except comparing site 21-111-0044 to 2002-2007 data (highlighted in green). 21-111-0043 was well above the 95th percentile of concentrations on 11/12/05 (highlighted in yellow), but the other sites were near or below the 95th percentiles.

Data from AQS

21-111-0043





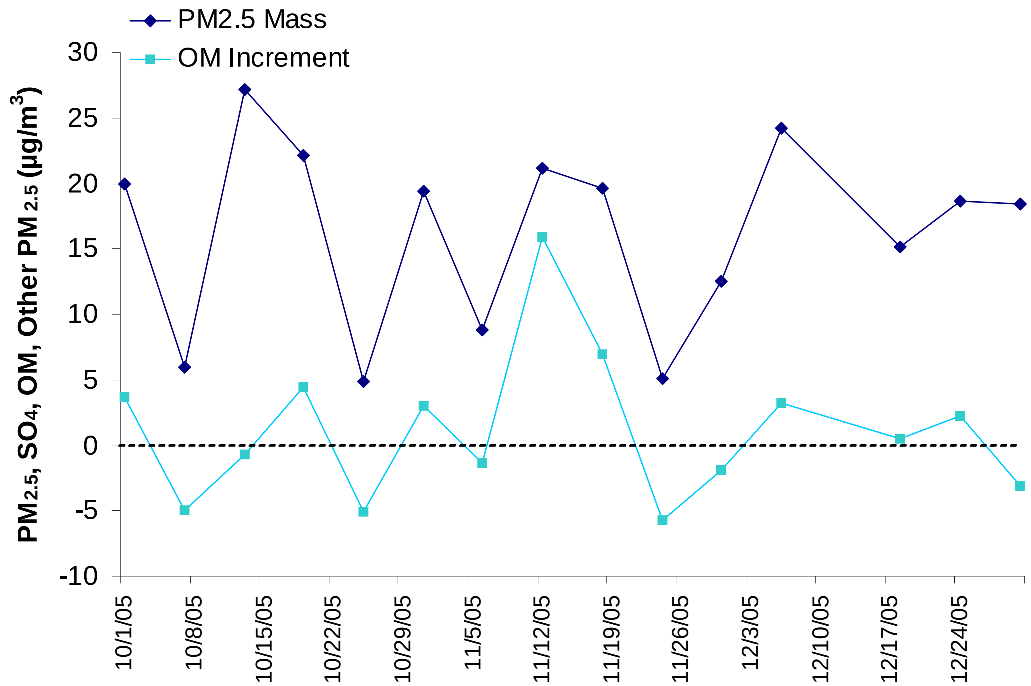
The OM Increment was calculated to represent fire-related mass:

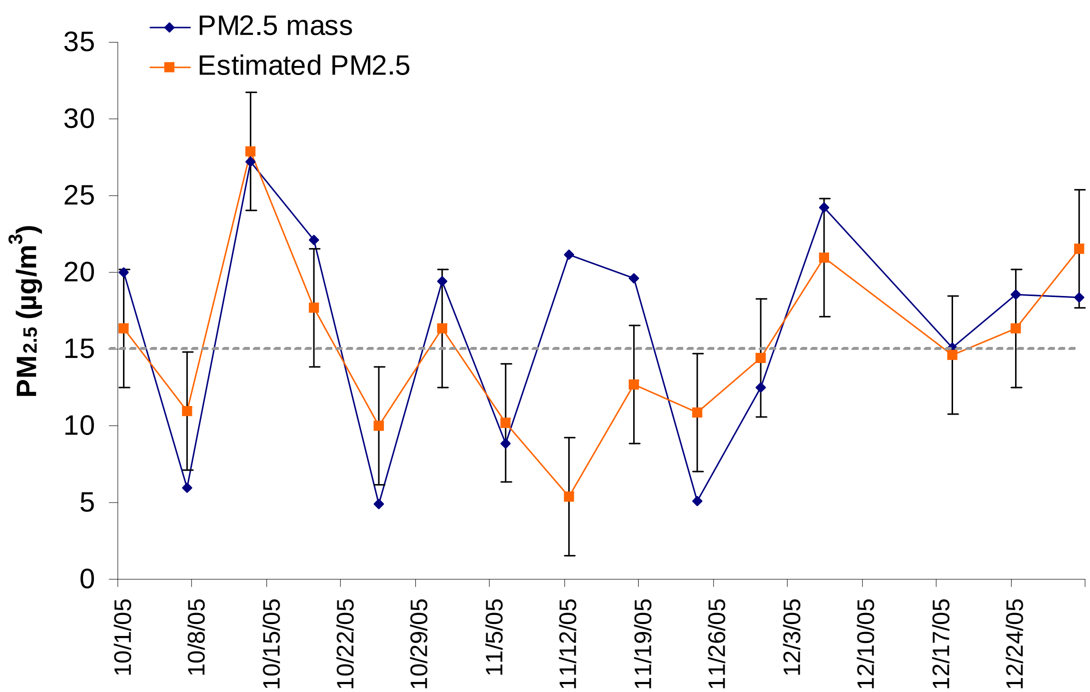
OM Increment = 2(OCd – OCavg),
where OCd and OCavg are daily and typical (average over the quarter) measured OC.
2 was chosen as a reasonable multiplier of OM to estimate fire-related mass and is likely a conservative estimate.

Estimated PM2.5 is the measured PM2.5 – OM Increment. Error bars of +/- 2 standard deviations of the OC concentrations are used to include day-to-day variability in OC concentrations.

The large OM increment on 11/12/05 (red circle) is driving $PM_{2.5}$ concentrations on this day. Without the fire contribution, the $PM_{2.5}$ on 11/12/05 would be well below the 24-hour standard (35µg/m^3), but still above the annual standard (15µg/m^3).
OC measurements were not available for 11/11/05.

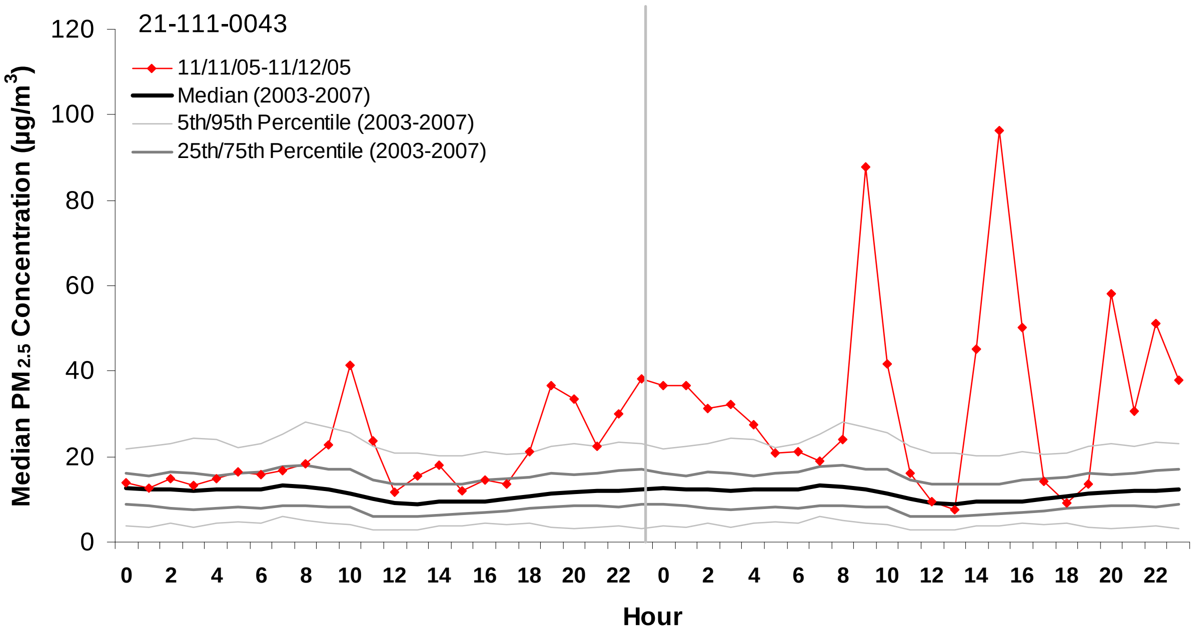
Data from AQS

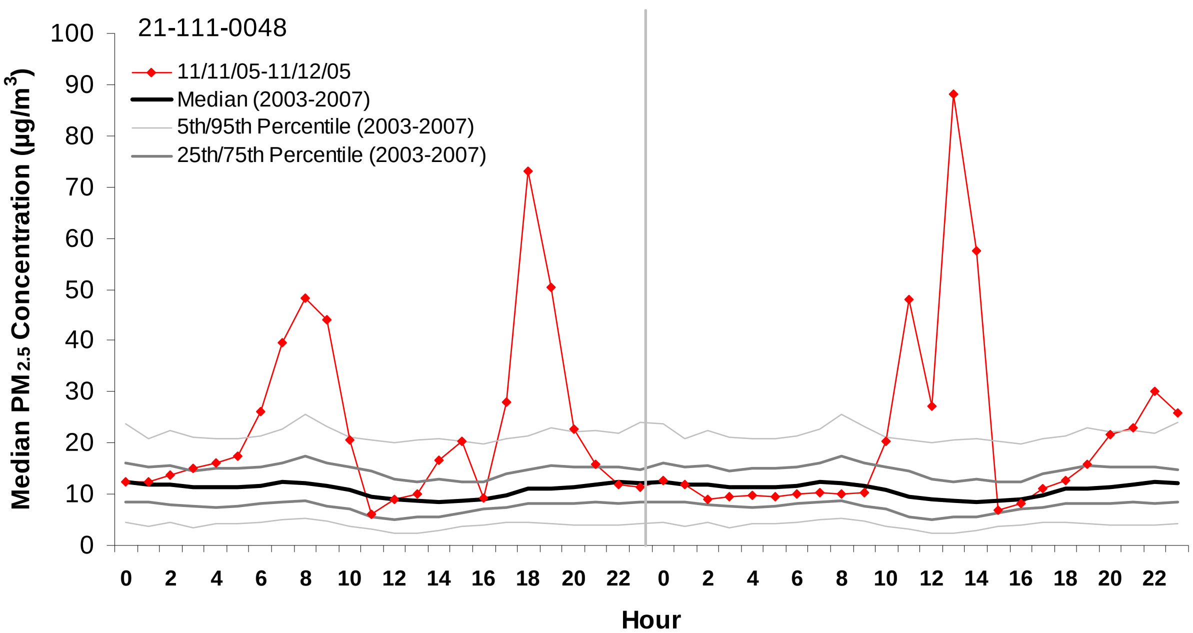




The large OM increment on 11/12/05 is likely driving $PM_{2.5}$ concentrations. Without the forest fire impact, the $PM_{2.5}$ would have been well below the annual standard (15µg/m^3). However, the quarterly and annual average for 2005 would likely remain above 15µg/m^3.
OC measurements were not available for 11/11/05.

Data from AQS





Hourly concentrations well above the 95th percentile of concentrations were assumed to be due to smoke influence. To calculate the contribution of smoke to total PM2.5, any concentrations above the 95th percentile were replaced by the median concentration for that hour. The 24-hour average of the hourly measurements then decreases by 30% (11/11) and 62% (11/12) at 21-111-0043 and 54% (11/11) and 56% (11/12) at 21-111-0048.

If the 24-hour filter measurements are decreased by the same percentages, the 11/12/05 concentration at 21-111-0043 is well below the 24-hour standard (17.5µg/m^3). However, the decreases had little impact on the quarterly and annual averages and would not affect the design value for either site.

Data from AQS

Summary

- High forest fire tracers and meteorological conditions favoring accumulation of pollution near the surface indicate impact from a local forest fire.
- $PM_{2.5}$ at 21-111-0043 on 11/12/05 would likely have been well below the 24-hour standard without the impact from the fire.
- Annual average values would likely not have changed significantly without the impact from the fire.

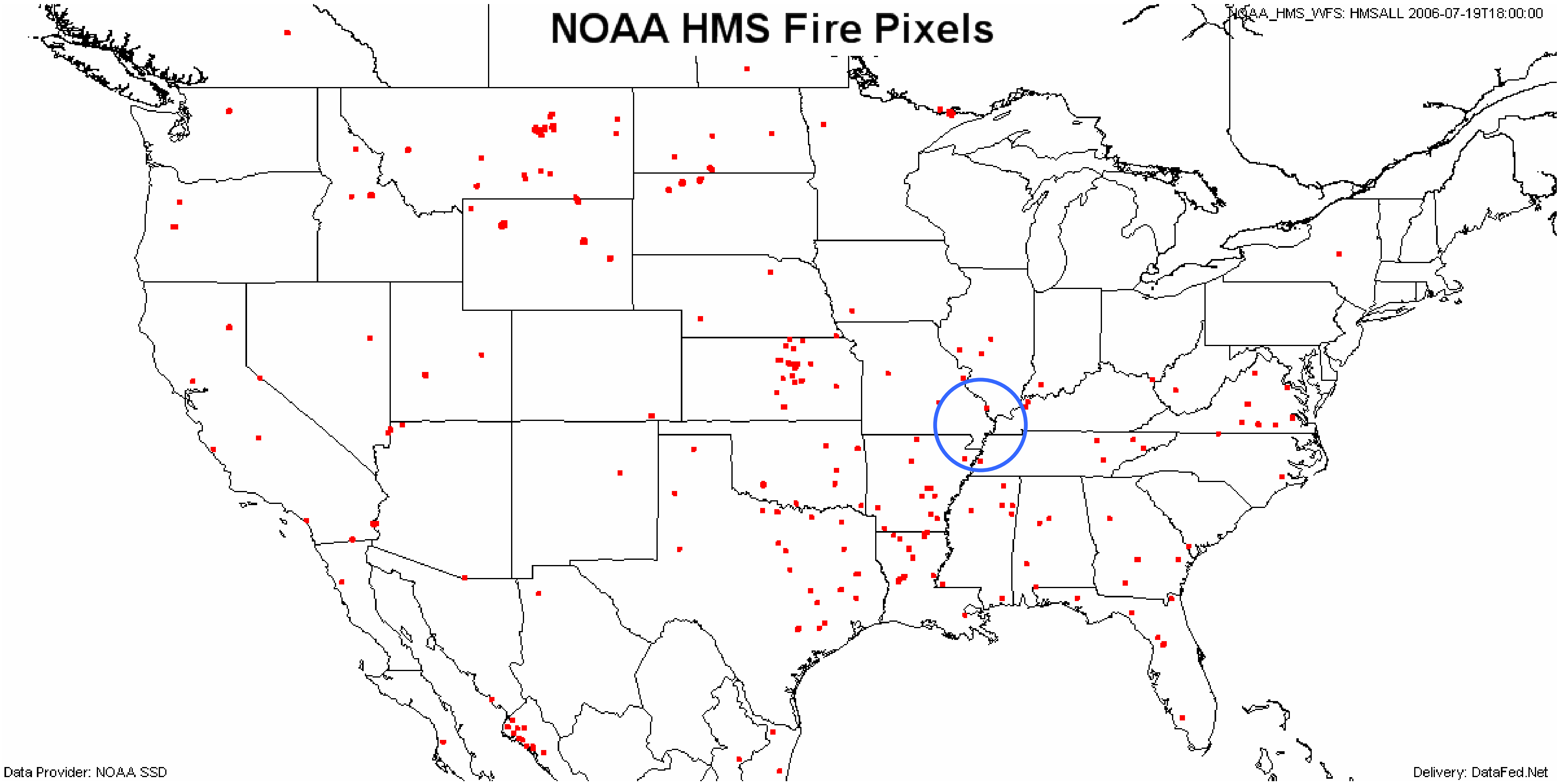
Exceptional Events Analysis
Kentucky
7/18/06 -7/20/06

Three sites analyzed
(21-111-0043, 21-111-0044, 21-111-0048)
for possible fire impact
from Arkansas/local fires

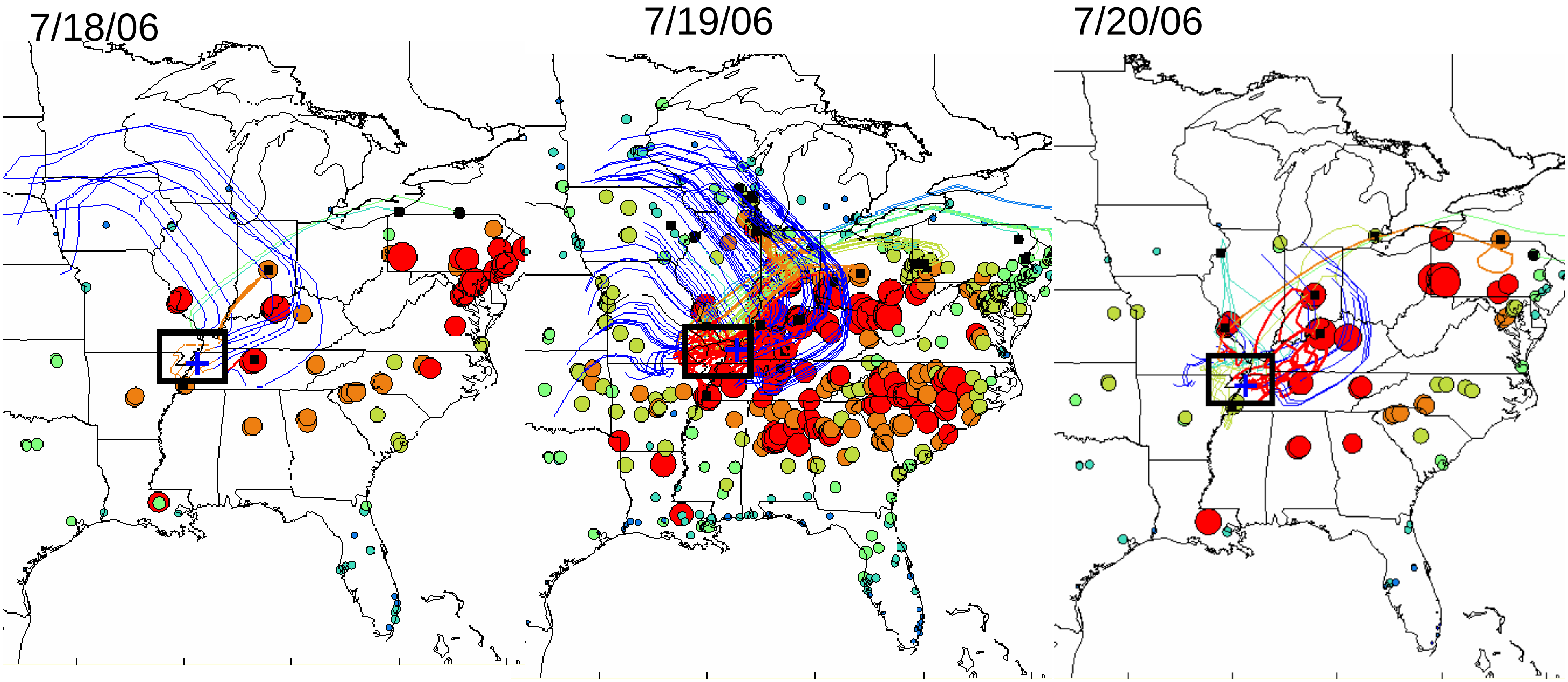
Concentrations Under Consideration

$PM_{2.5}$ concentrations in $\mu g/m^3$

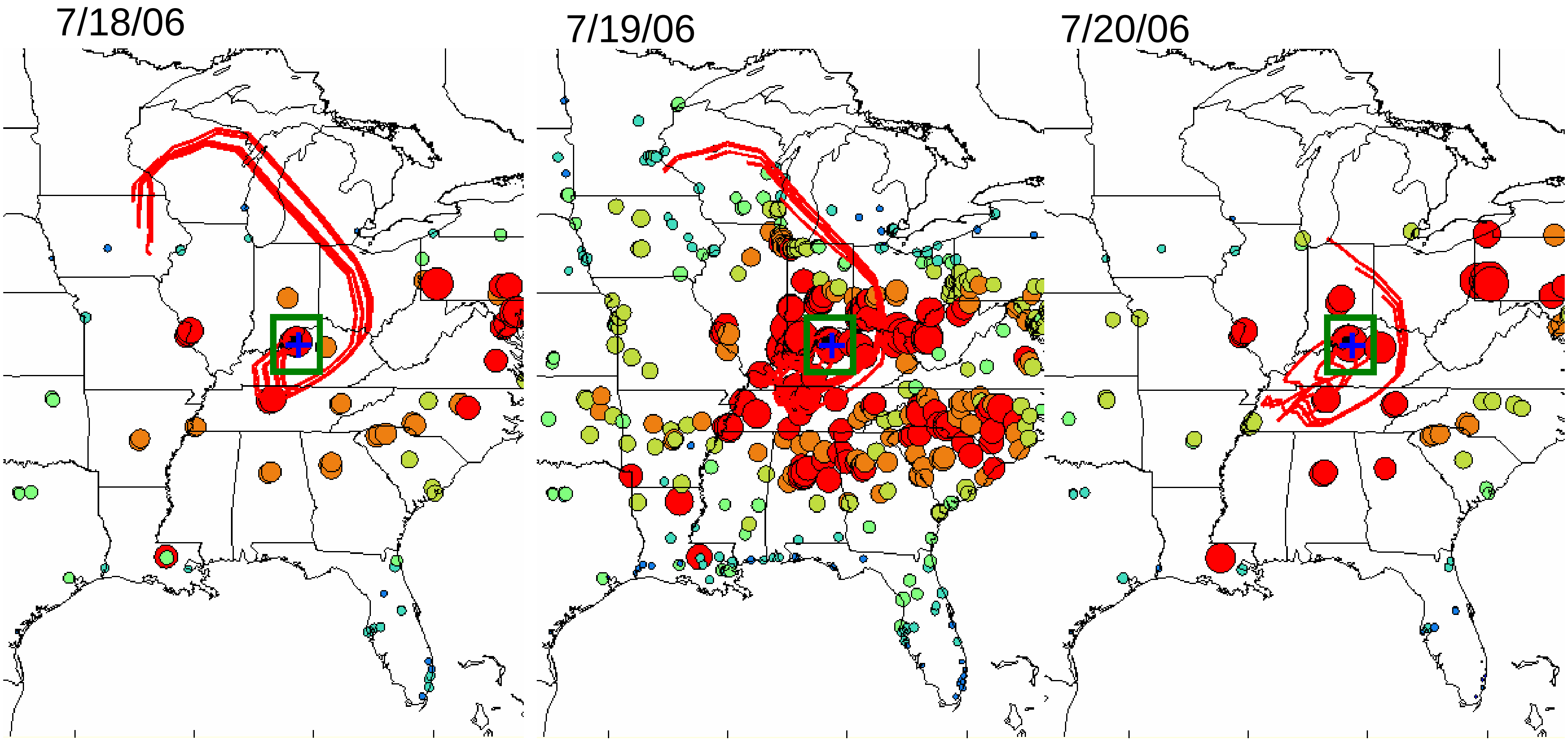
Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret
July 18, 2006		39.6	37.9	40.9
July 19, 2006	39.3	38.6	38.3	37.6
July 20, 2006	48.2	47.9	48.9	



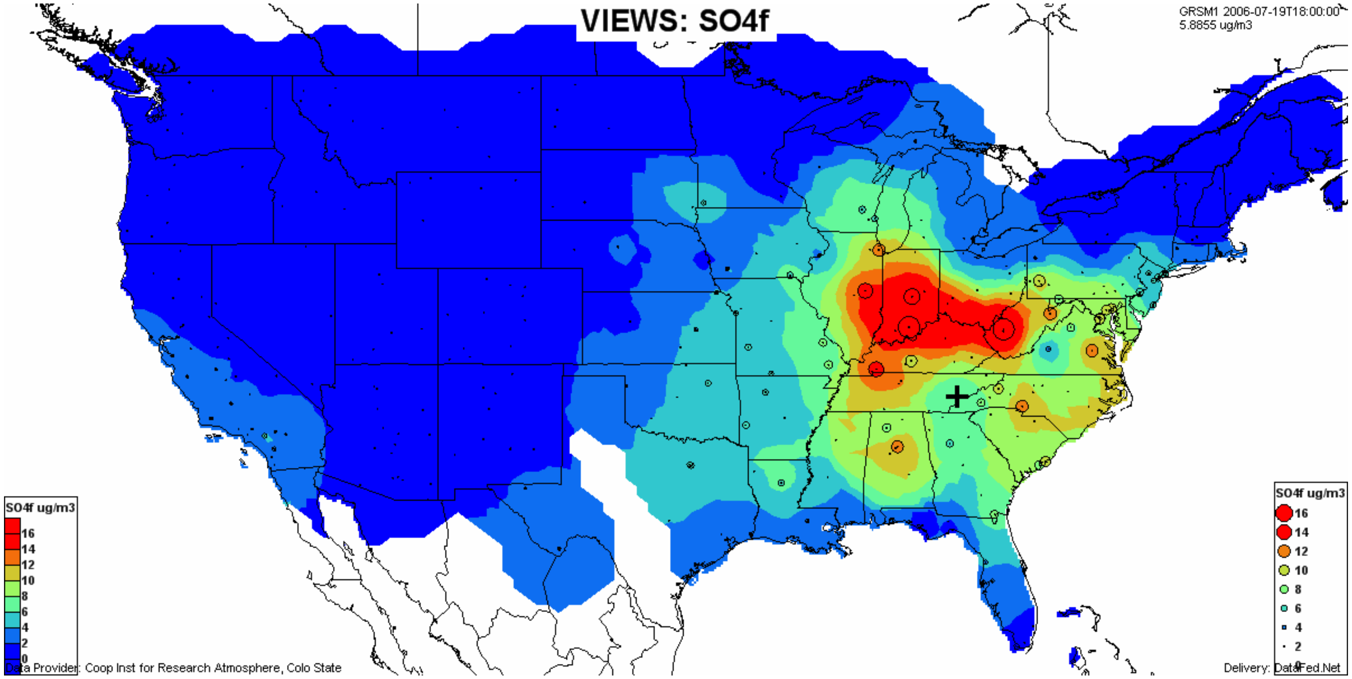
Some fires were observed in the area; however, the magnitude is unknown and none appears to be very large (none had multiple pixels). All three study days had similar fire detections.

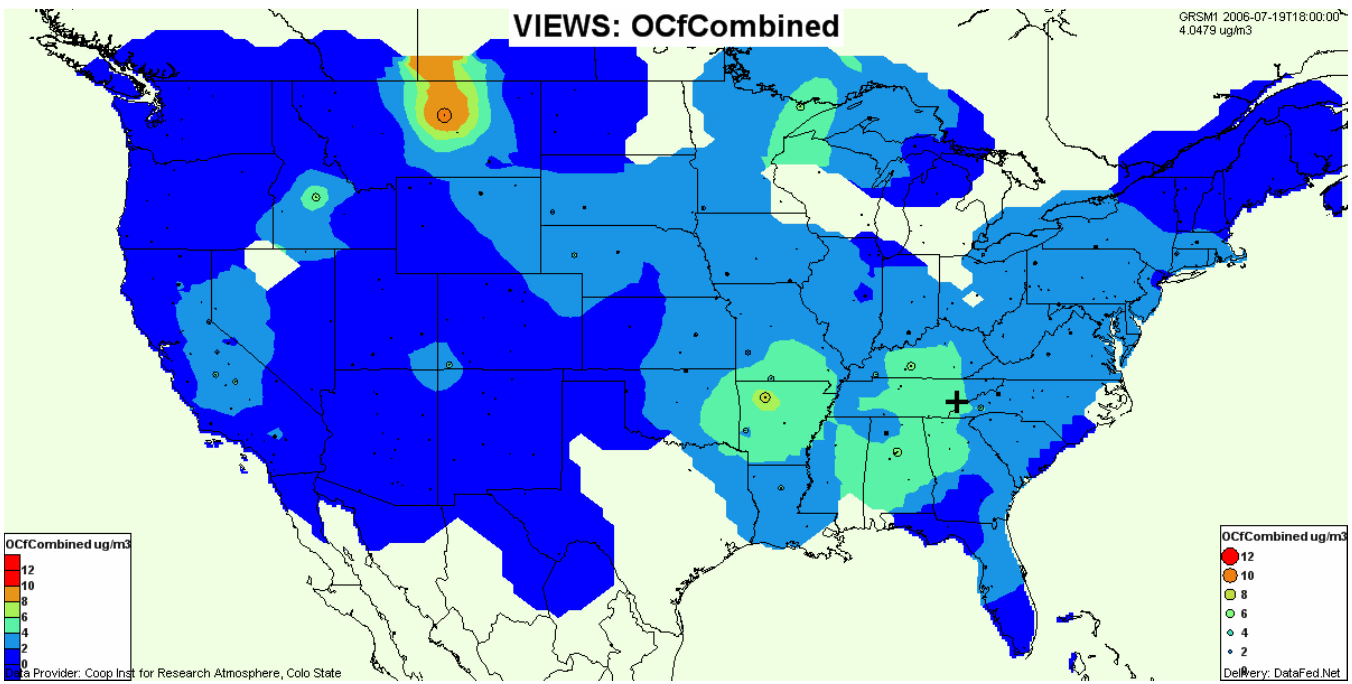


Source impact trajectories do not show a clear impact from the fire area on the sites.

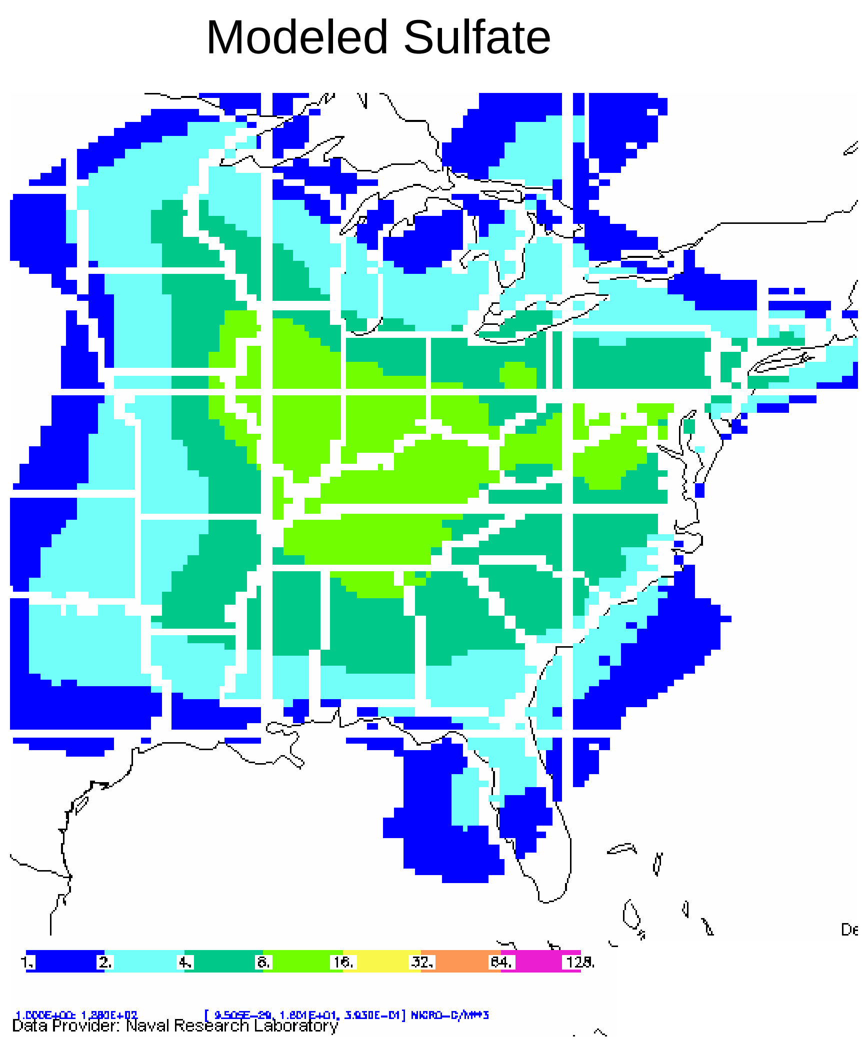


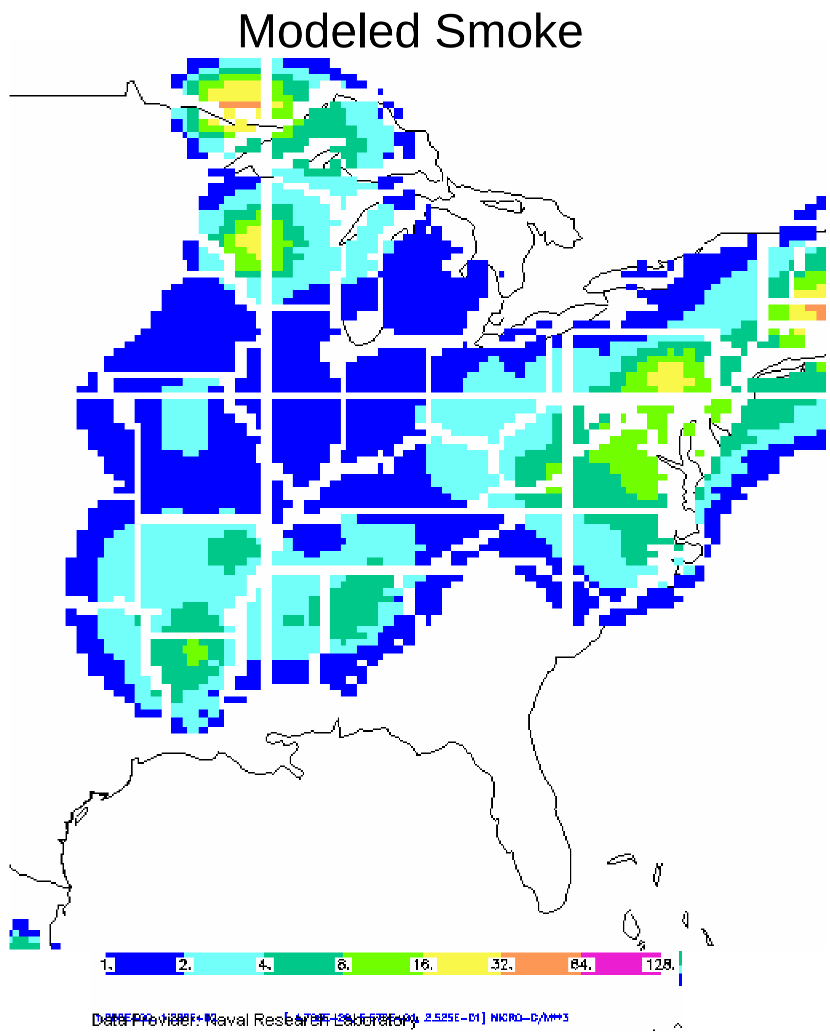
Back trajectories indicate stagnant conditions, particularly on 7/20/06, with some influence from the north early in the episode.





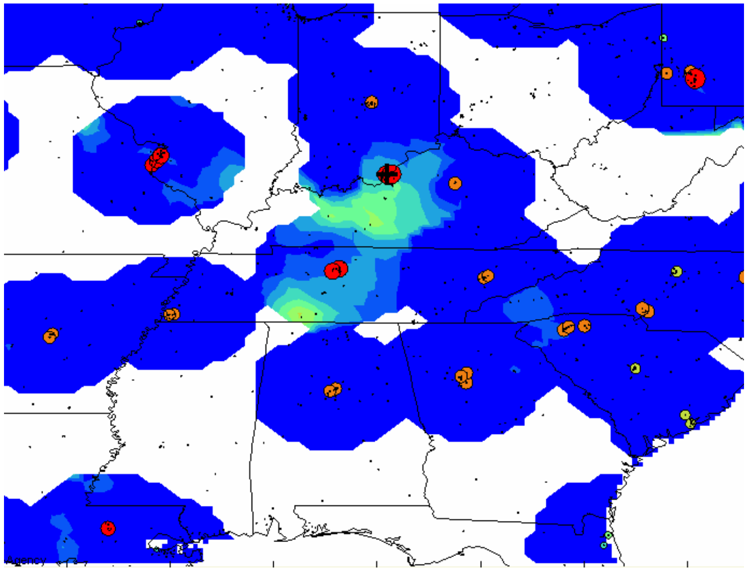
Regional sulfate concentrations were very high and regional OC was low/moderate on 7/19/06. (Data not available for other study days.)



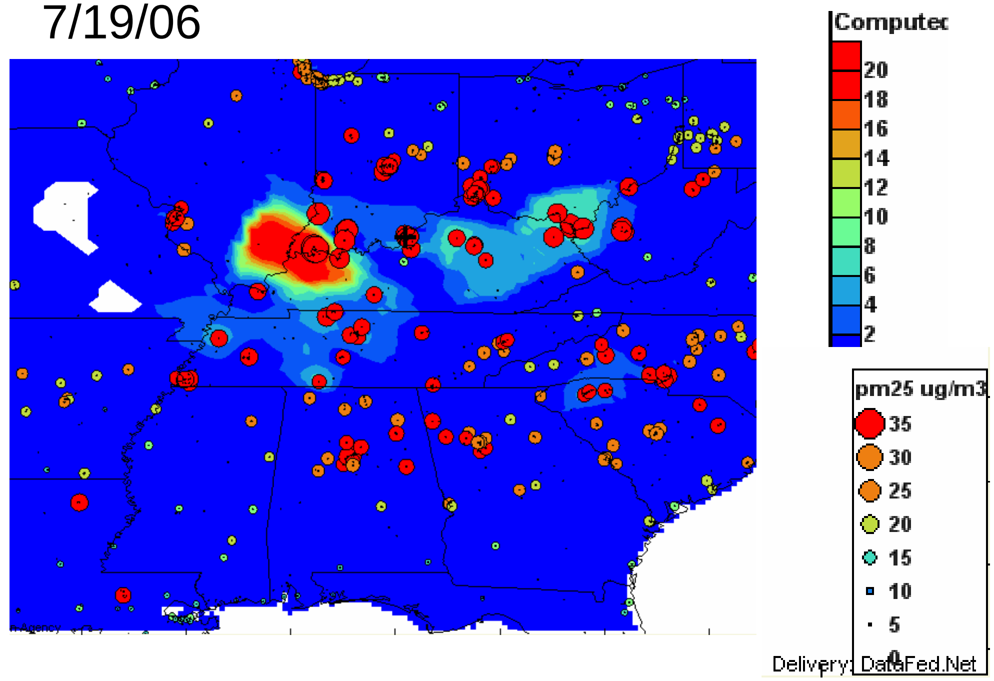


Model output indicated moderate/high sulfate concentrations and low/moderate smoke concentrations on all study days.

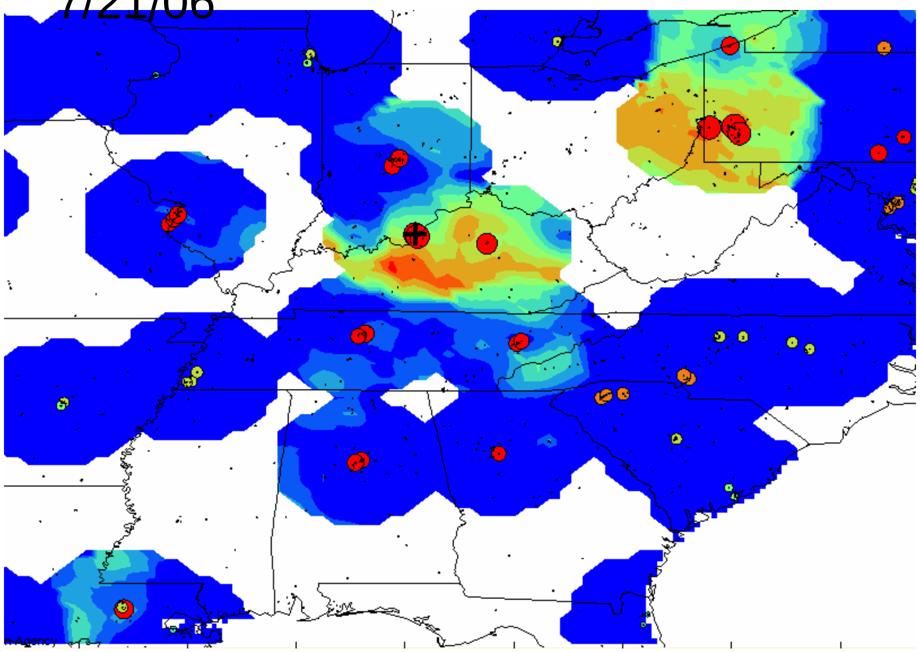
7/18/06



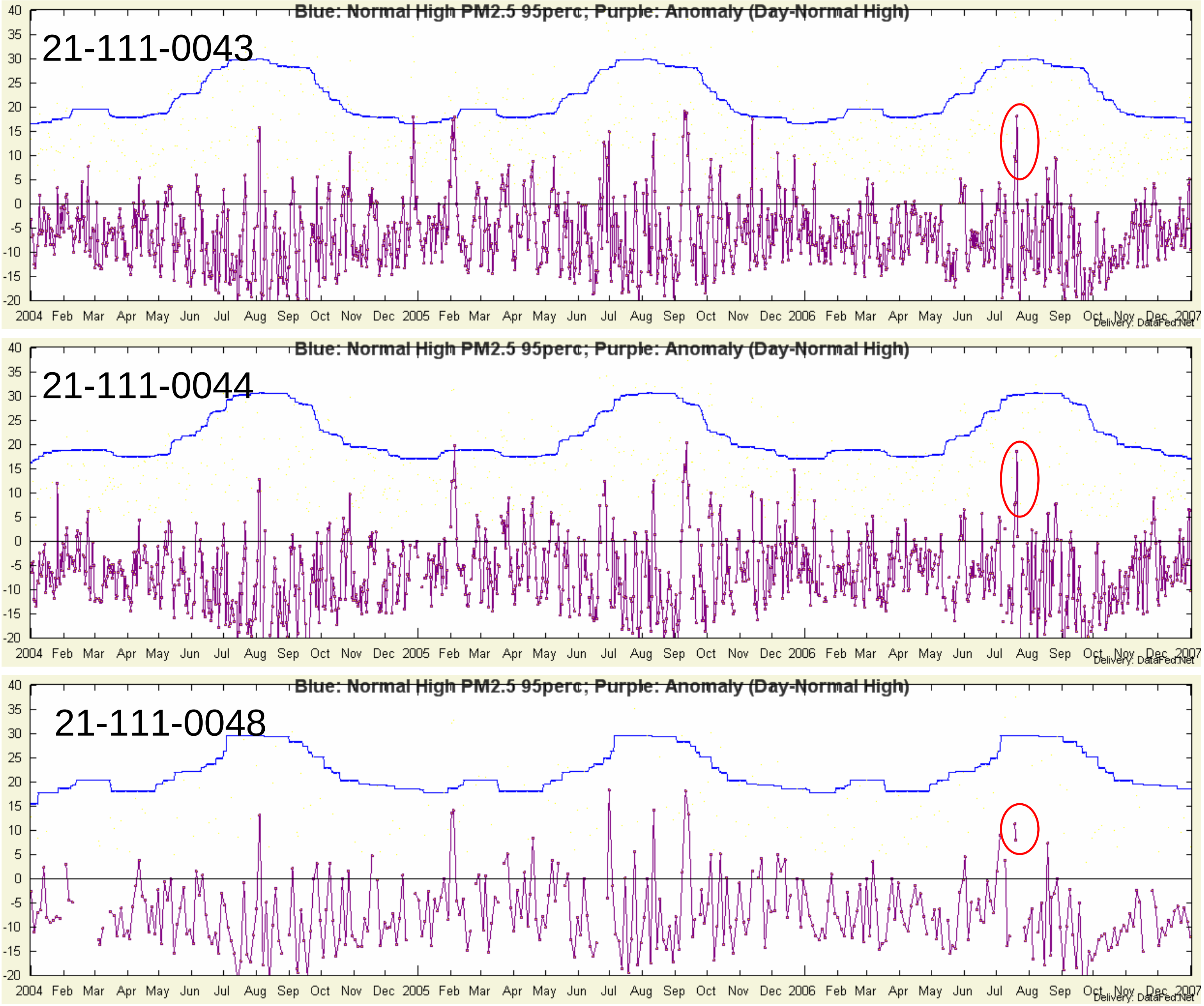
7/19/06



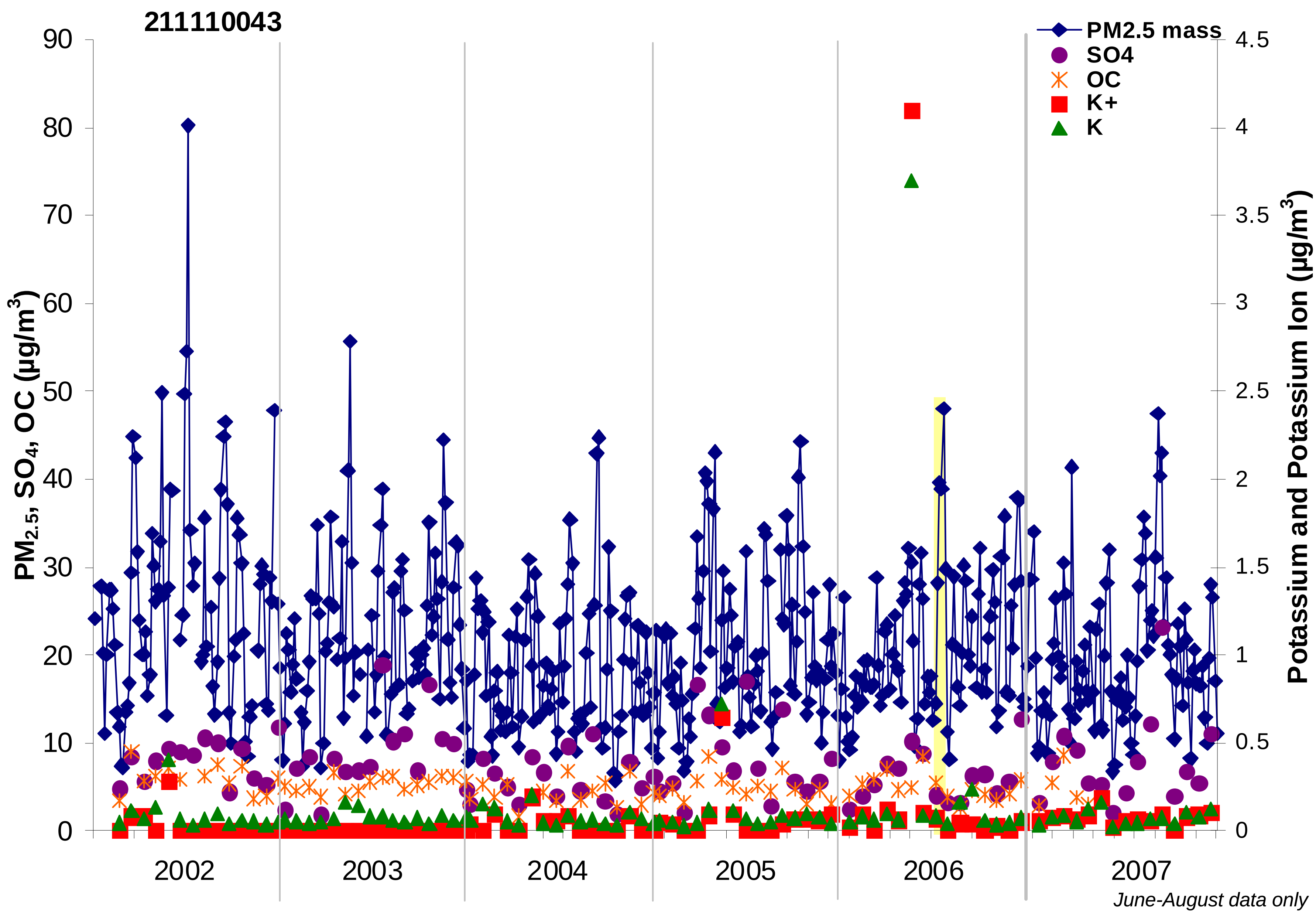
7/21/06



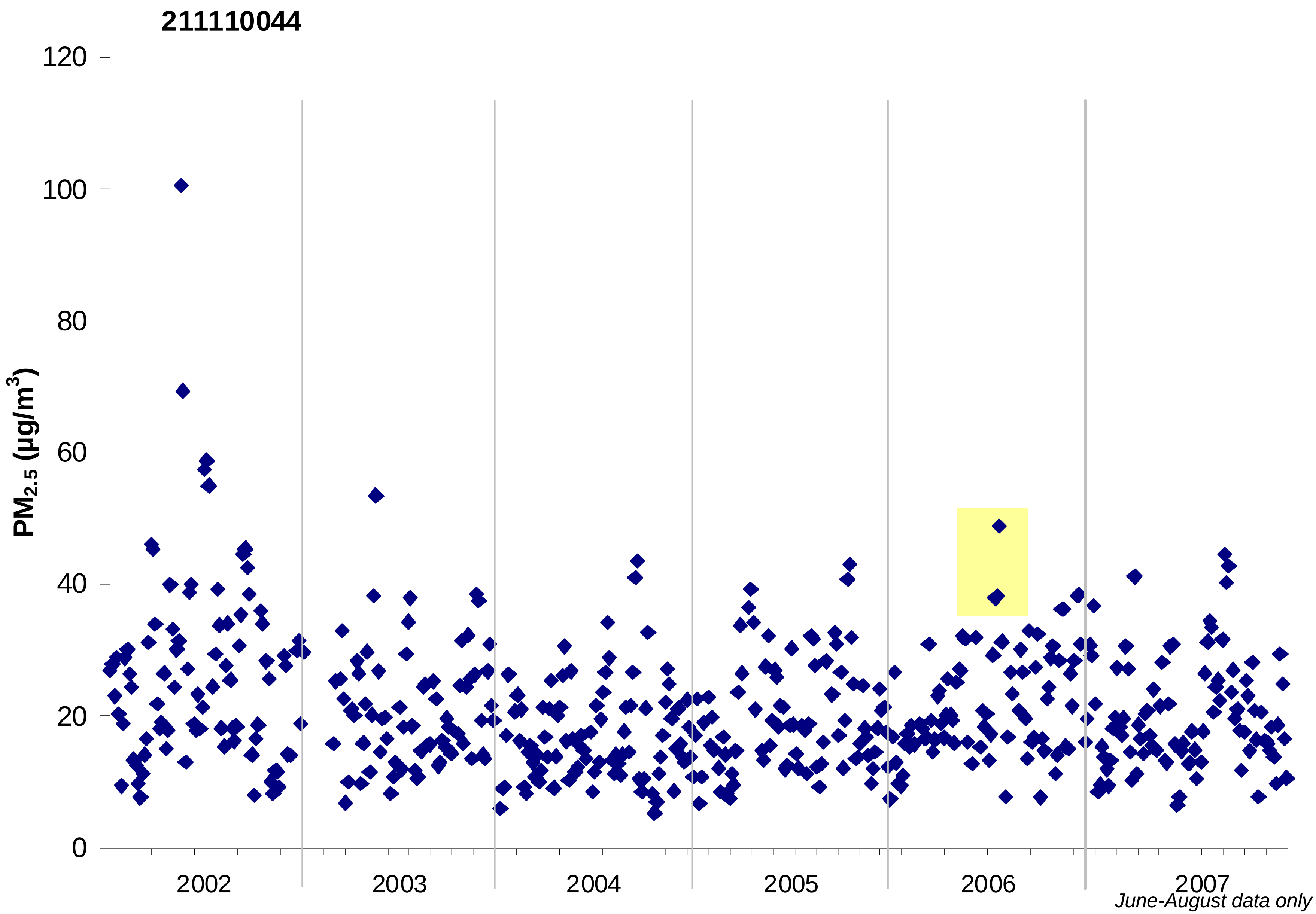
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 7/18/06 and 7/19/06, concentrations were very close to the historical values. On 7/21/06, concentrations were around 10 μg/m^3 higher than normal concentrations throughout Kentucky.



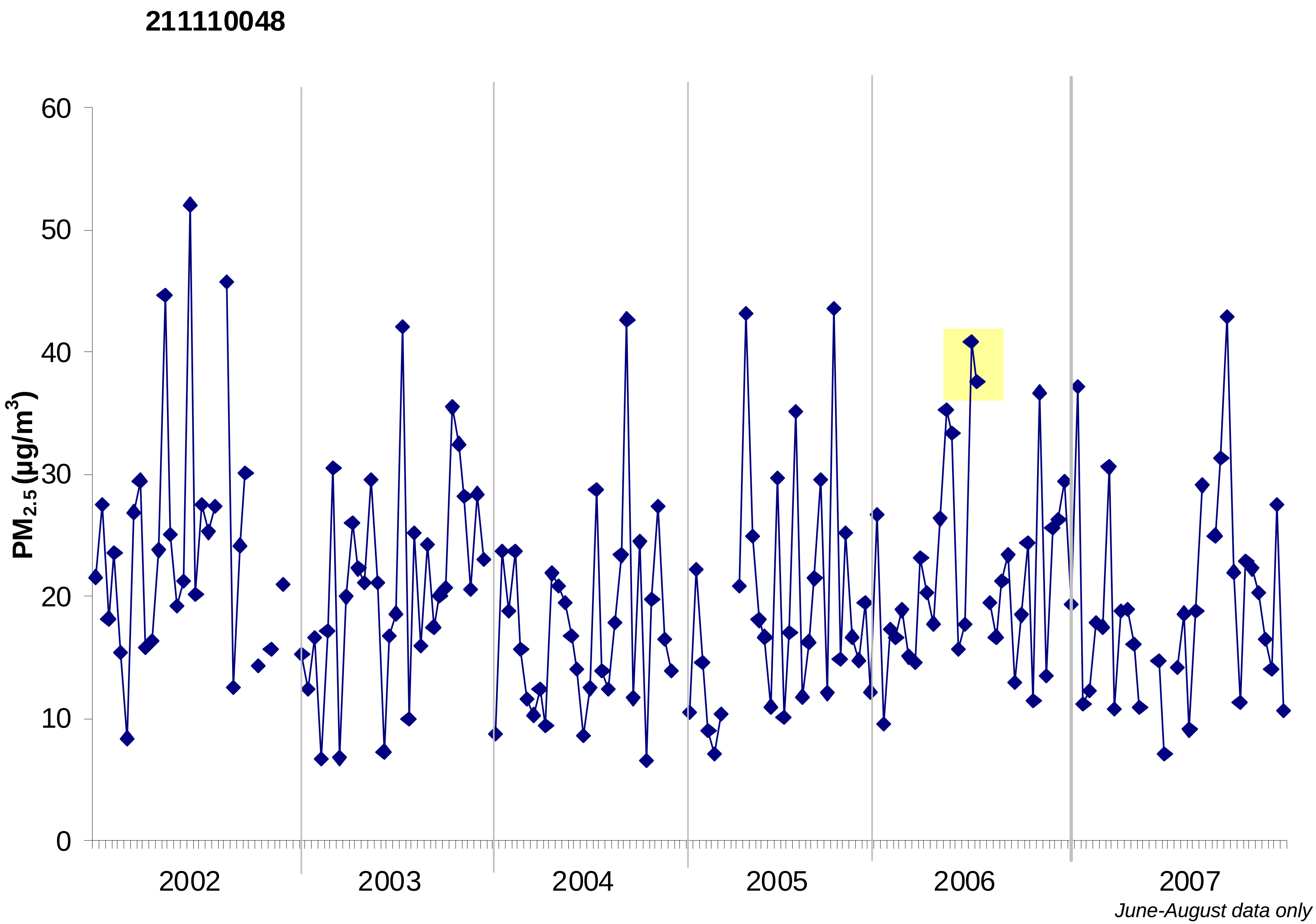
The purple lines show the difference between the given day and the historical 95th percentile concentration. On 7/18-7/20/06, concentrations were around 10-15 µg/m^3 higher than the historical values.



At site 21-111-0043, OC and potassium (indicators of fire impact) are within the normal range of values on 7/19/06 (highlighted in yellow). $PM_{2.5}$ is high on all study days, but not outside the historical range of concentrations.



At site 21-111-0044, $PM_{2.5}$ is high on the study days, but not outside the historical range of concentrations.



As at the other sites, $PM_{2.5}$ is high on the study days at site 21-111-0044, but not outside the historical range of concentrations.

Comparison to Historical Values

		Mean	Median	95th Percentile	7/18/2006	7/19/2006	7/20/2006
21-111-0043	2006	21.5	19.3	36.6	39.6	39.0	48.1
	2002-2007	21.3	19.5	38.9			
21-111-0044	2006	22.2	20.2	37.7	37.9	38.3	48.9
	2002-2007	21.2	18.9	38.5			
21-111-0048	2006	22.1	19.5	37.2	40.9	37.6	Not Reported
	2002-2007	20.6	19.0	38.6			

Summer data only (June-August) used in these statistics.

The concentrations on 7/18/06 and 7/19/06 are near the historical 95th percentiles of concentrations. Concentrations on 7/20/06 are 10 µg/m^3 higher than historical percentiles, but concentrations of $PM_{2.5}$ were high throughout the region.

Meteorological Conditions

Met conditions in the area were conducive to high PM (regardless of whether nearby fires were impacting the site):

- Persistent surface high pressure over the previous three days led to calm-to-light surface winds, limiting pollutant dispersion.
- Weak upper-level ridge of high pressure led to warm temperatures aloft, limiting vertical mixing.
- Persistent high dew point temperatures (frequently above 70°F) over the previous three days enhanced secondary particle production.

Summary

Although there could be some impact from forest fires in the Louisville area on 7/18/06-7/20/06, stagnant winds, temperature inversion, and high humidity all led to increased secondary PM formation. This supports the hypothesis that there was a regional sulfate episode on this day that was likely a more important contributor than forest fires to high $PM_{2.5}$ concentrations. Without any impact from fires, the $PM_{2.5}$ concentrations would still have been higher than normal.

Exceptional Events Analysis
Kentucky
8/25/06-8/26/06

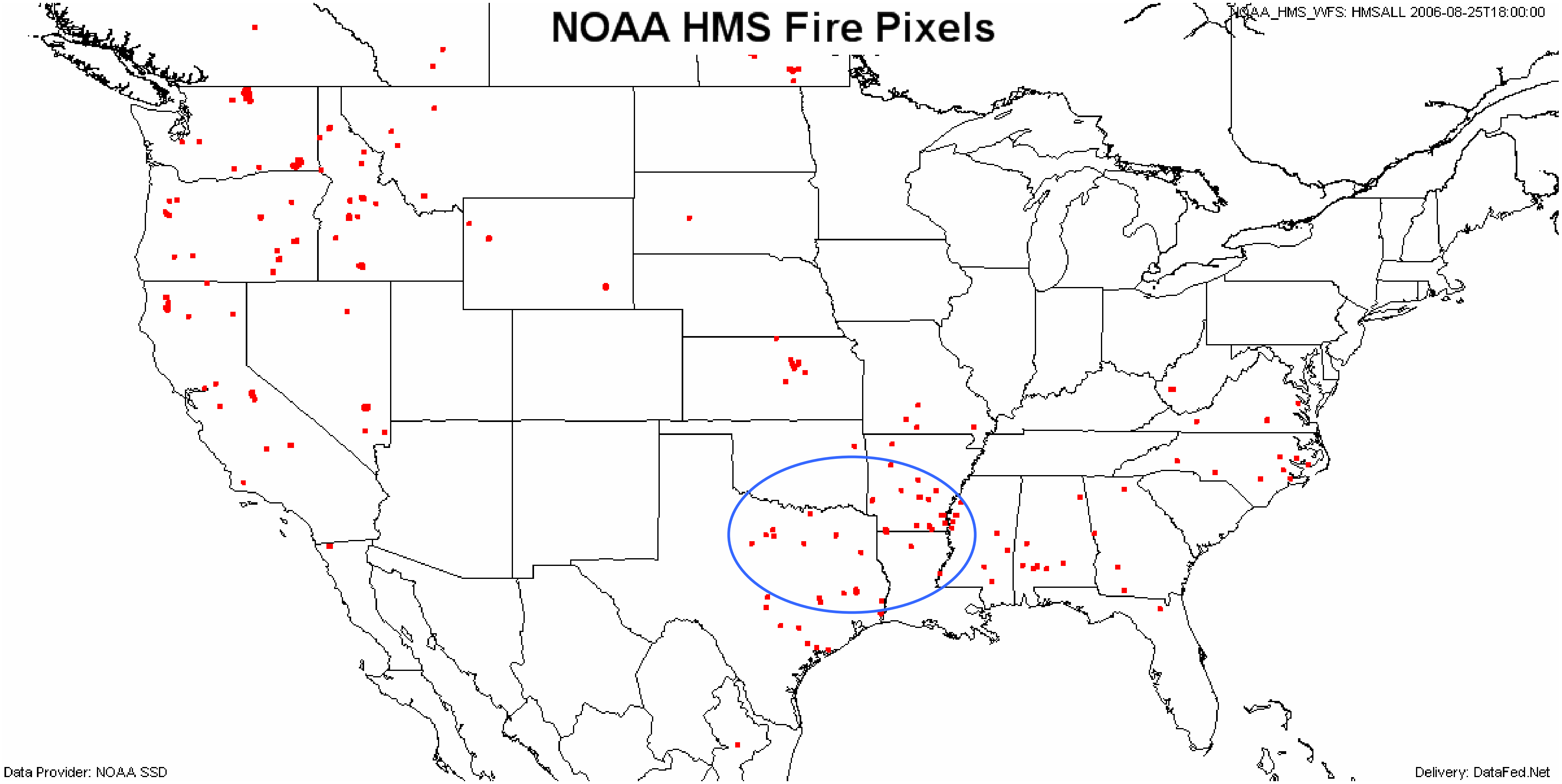
Two sites analyzed
(21-111-0043, 21-111-0044)
for possible fire impact
from Arkansas/Texas fires

Concentrations Under Consideration

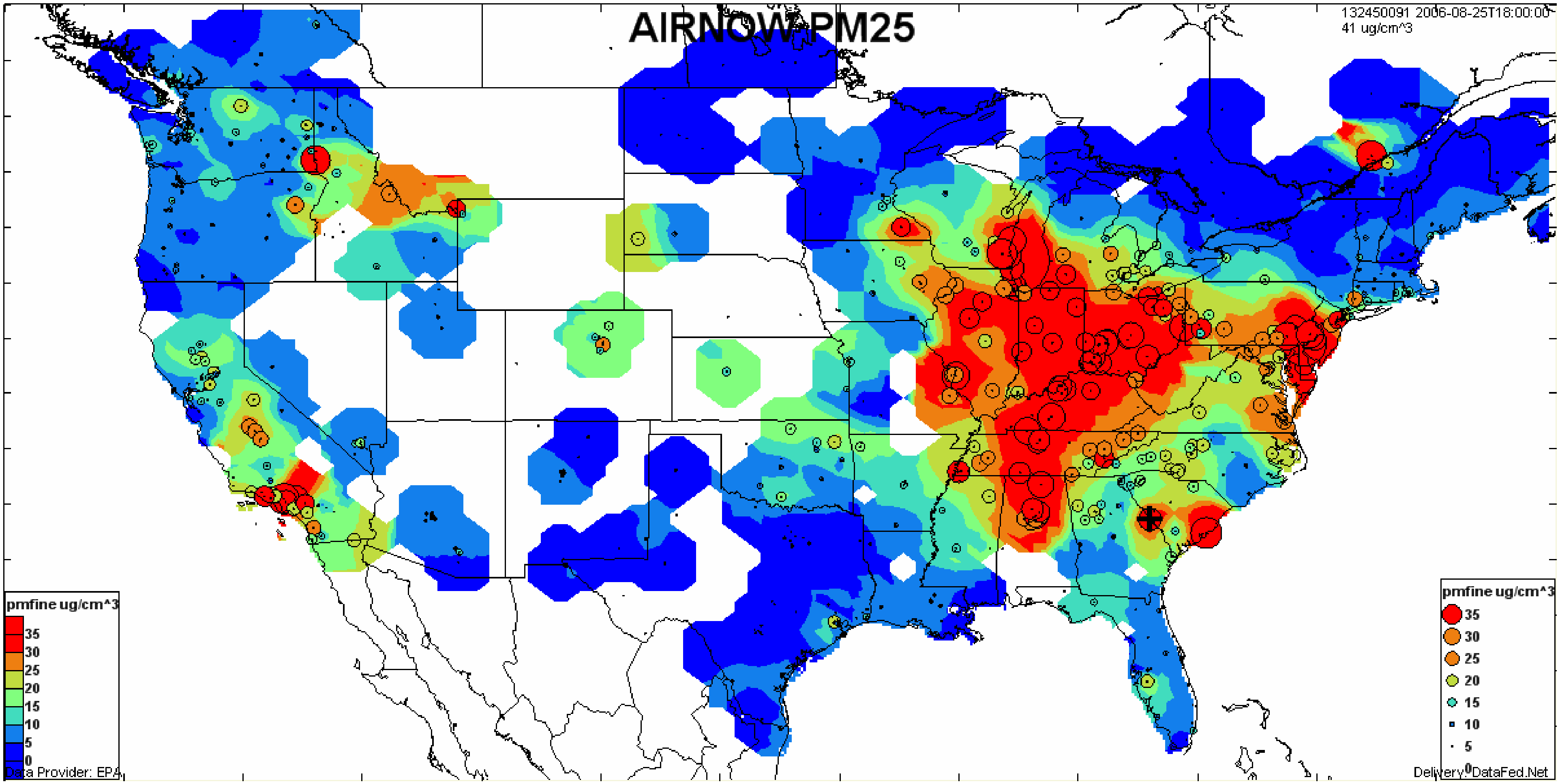
$PM_{2.5}$ concentrations in $\mu g/m^3$

Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte
August 25, 2006	38	38	38.2
August 26, 2006	37.3	37.7	38.4

8/25/06



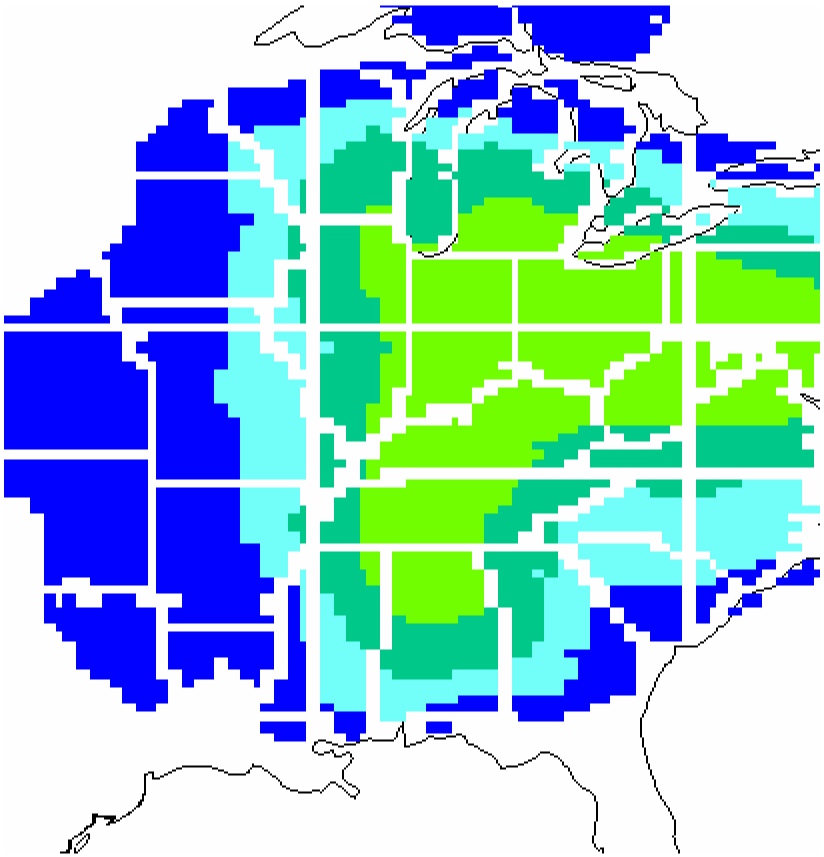
Several small fires throughout Arkansas and Texas are believed to have impacted $PM_{2.5}$ concentrations in Kentucky. Fewer fires were detected on 8/26/06.



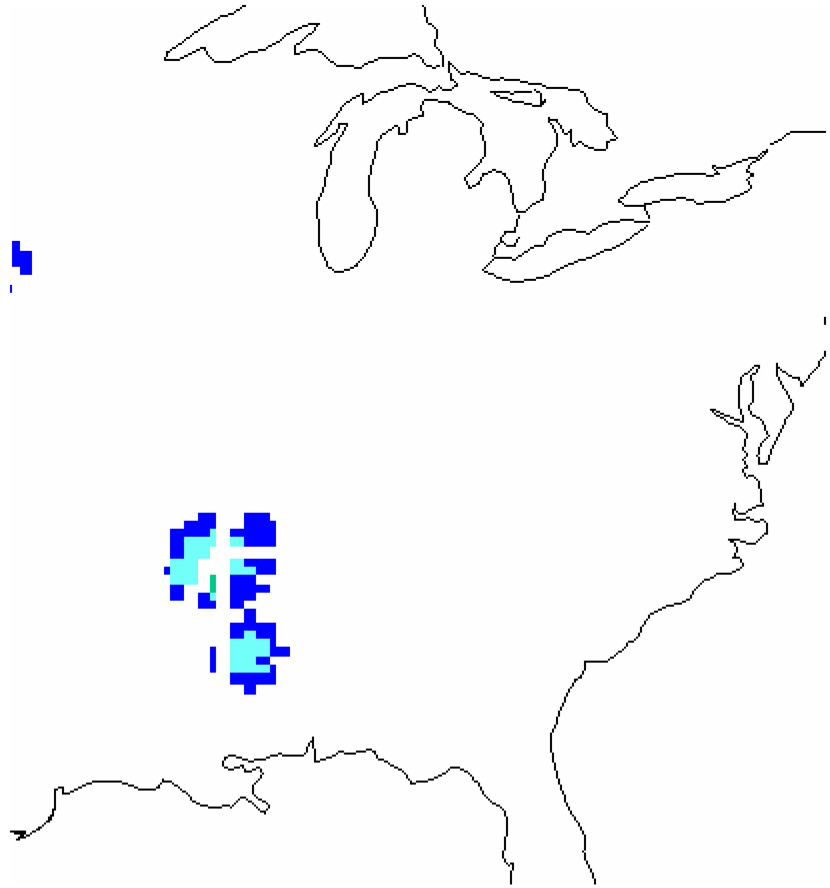
$PM_{2.5}$ concentrations are high throughout the region.

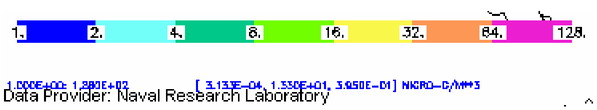
8/25/06

Modeled Sulfate



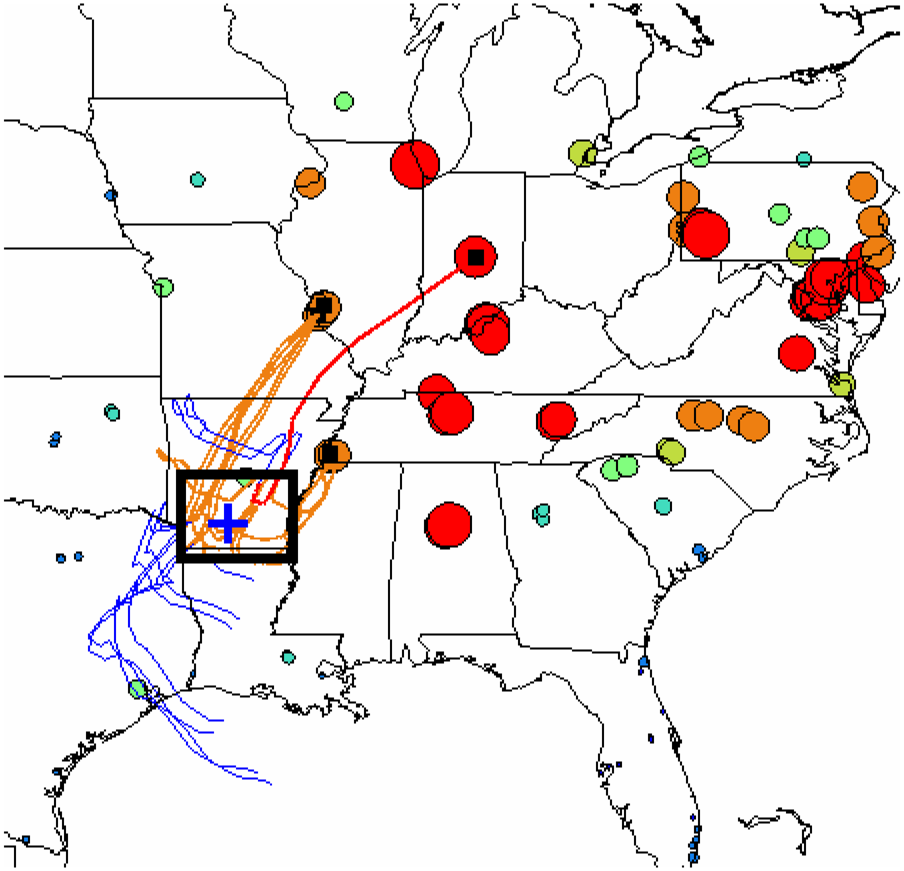
Modeled SMOKE



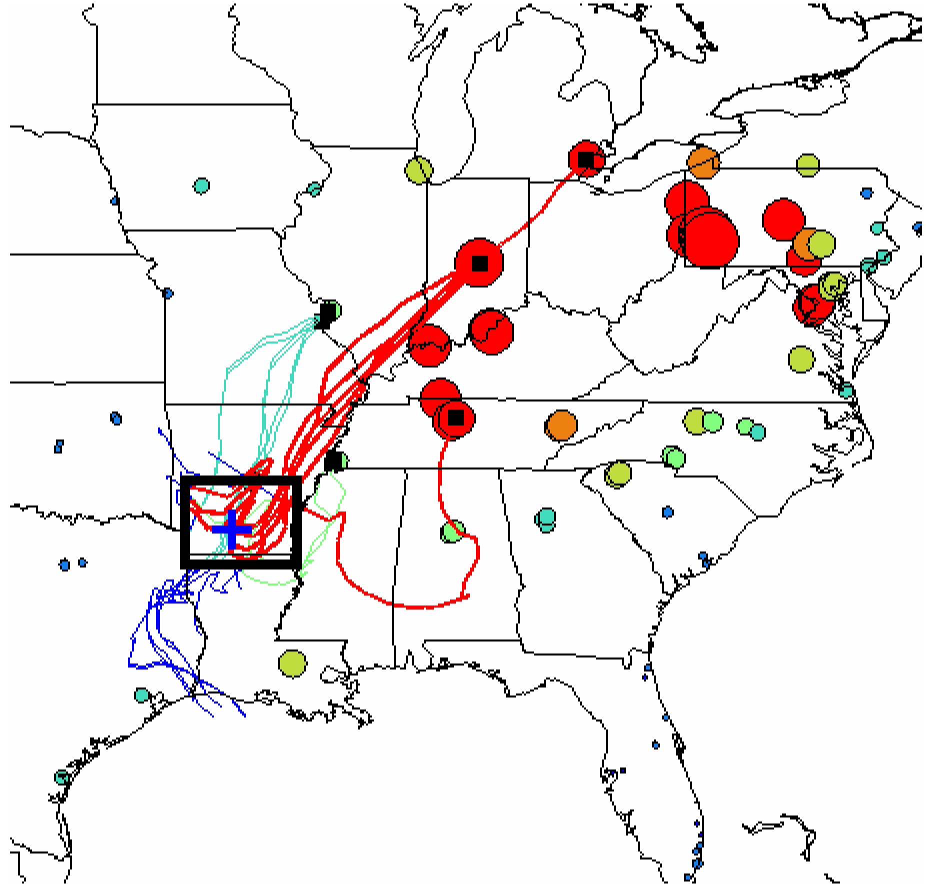


Modeled sulfate was moderate/high and modeled smoke was not present in Kentucky on 8/25/06. (Same results on 8/26/06.)

8/25/06

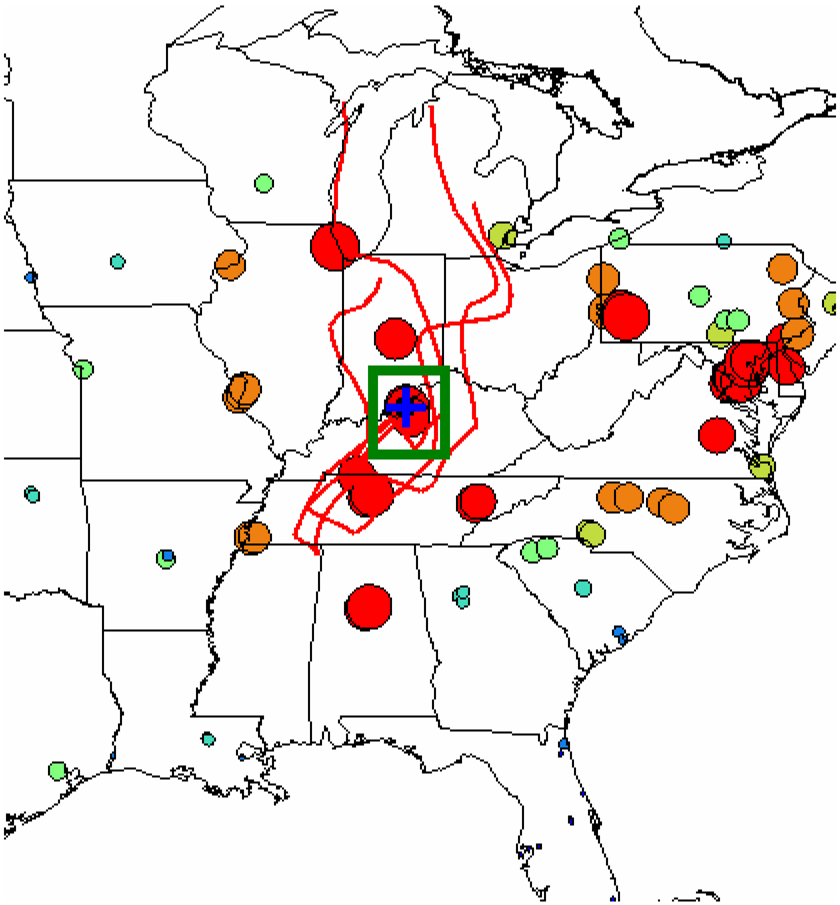


8/26/04

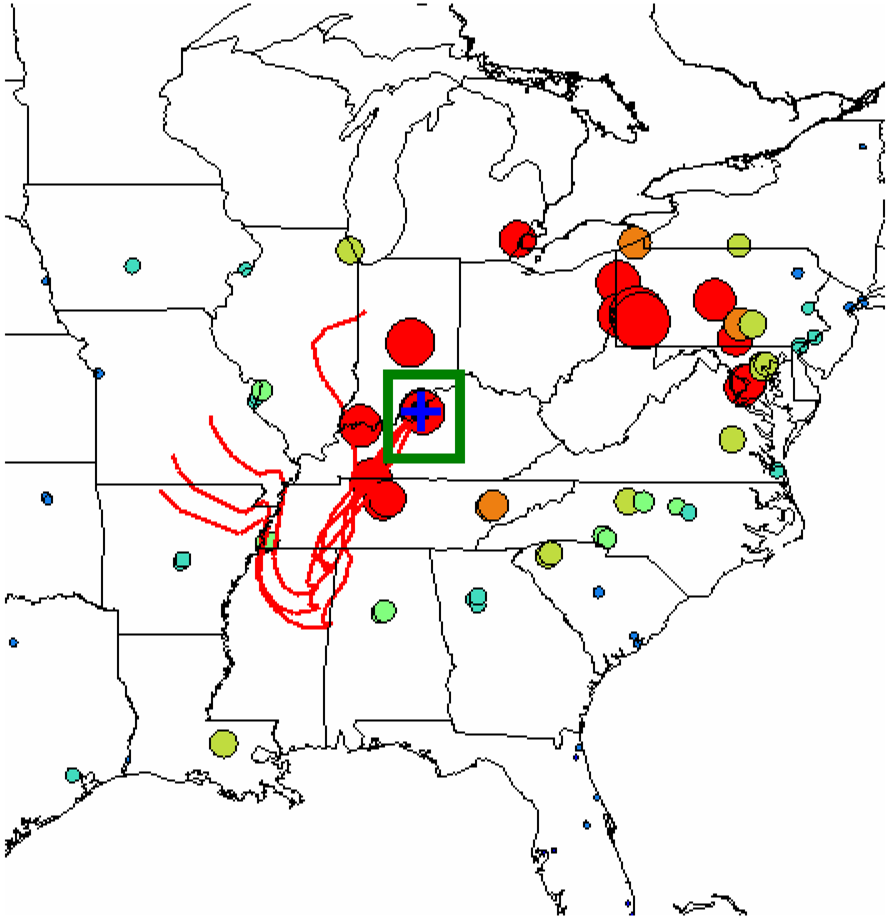


Source impact trajectories show that fires in the Arkansas area were unlikely to have impacted the Louisville area.

8/25/06

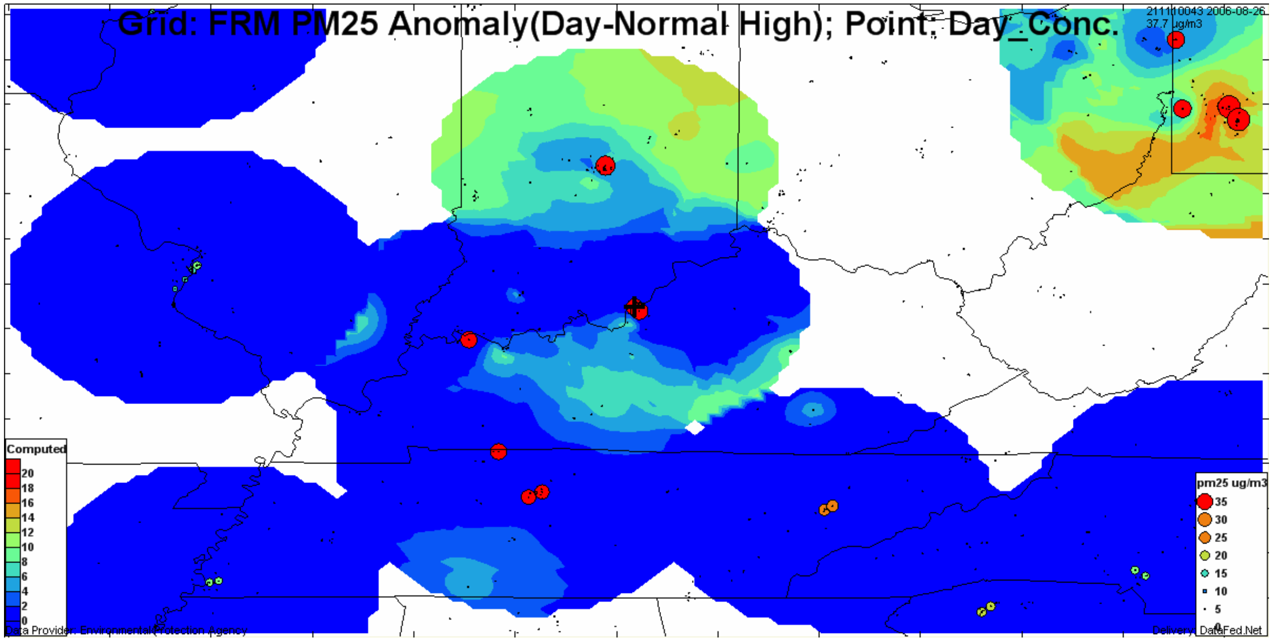


8/26/06

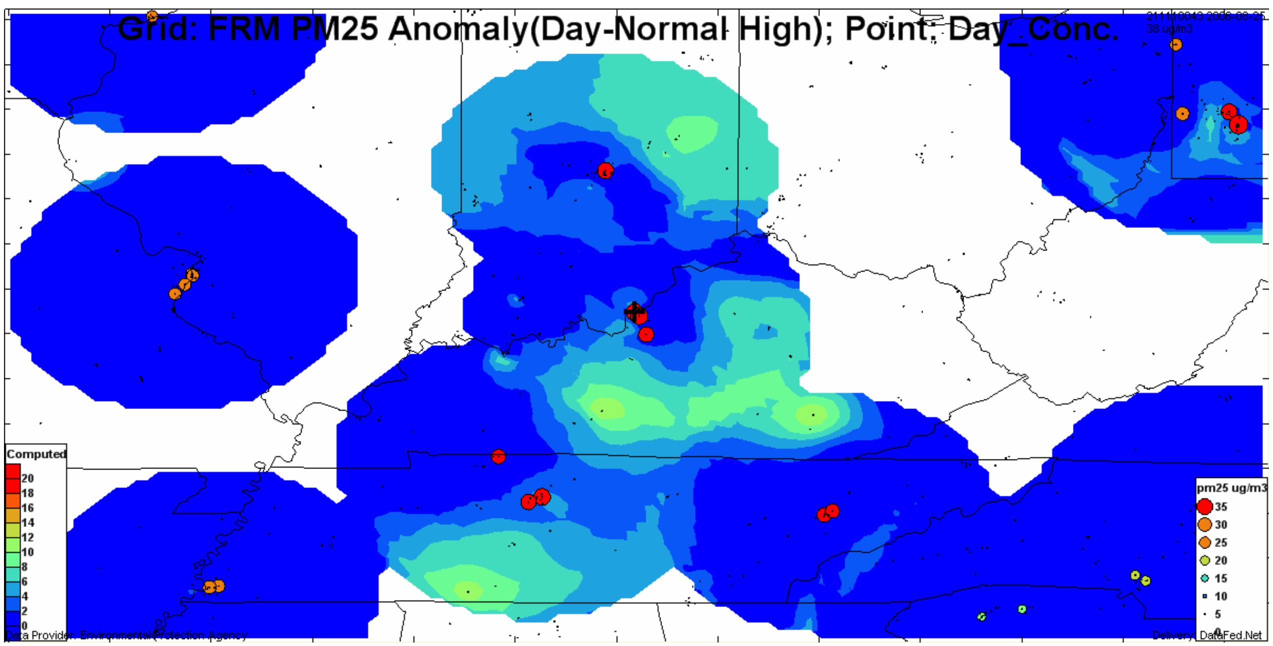


Back trajectories also show the Louisville site had no impact from the Arkansas/Texas area. Winds were light on these days, limiting transport.

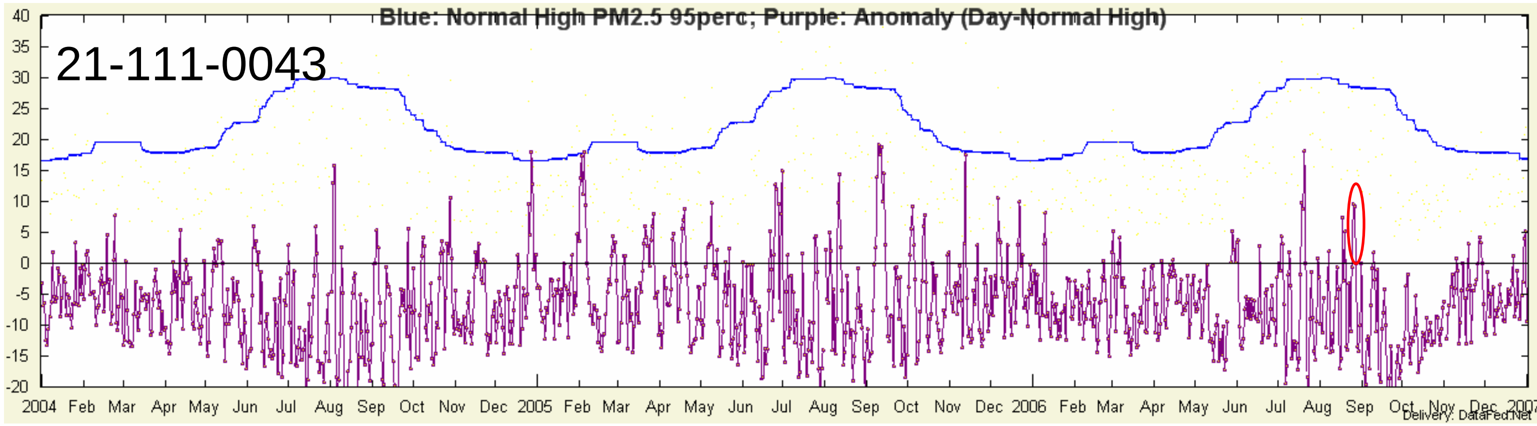
8/25/06

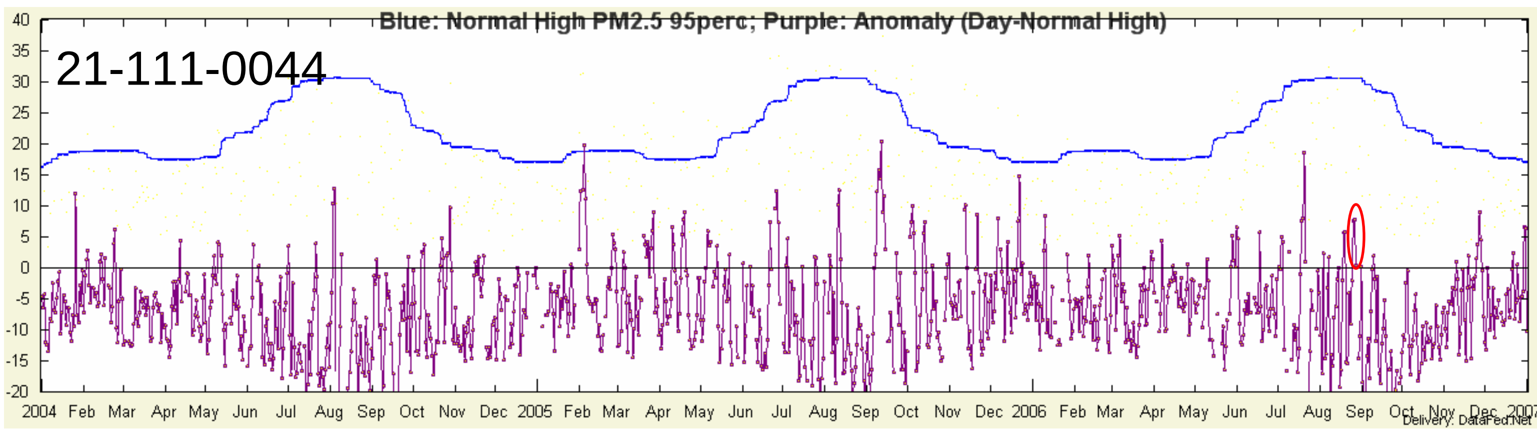


8/26/06

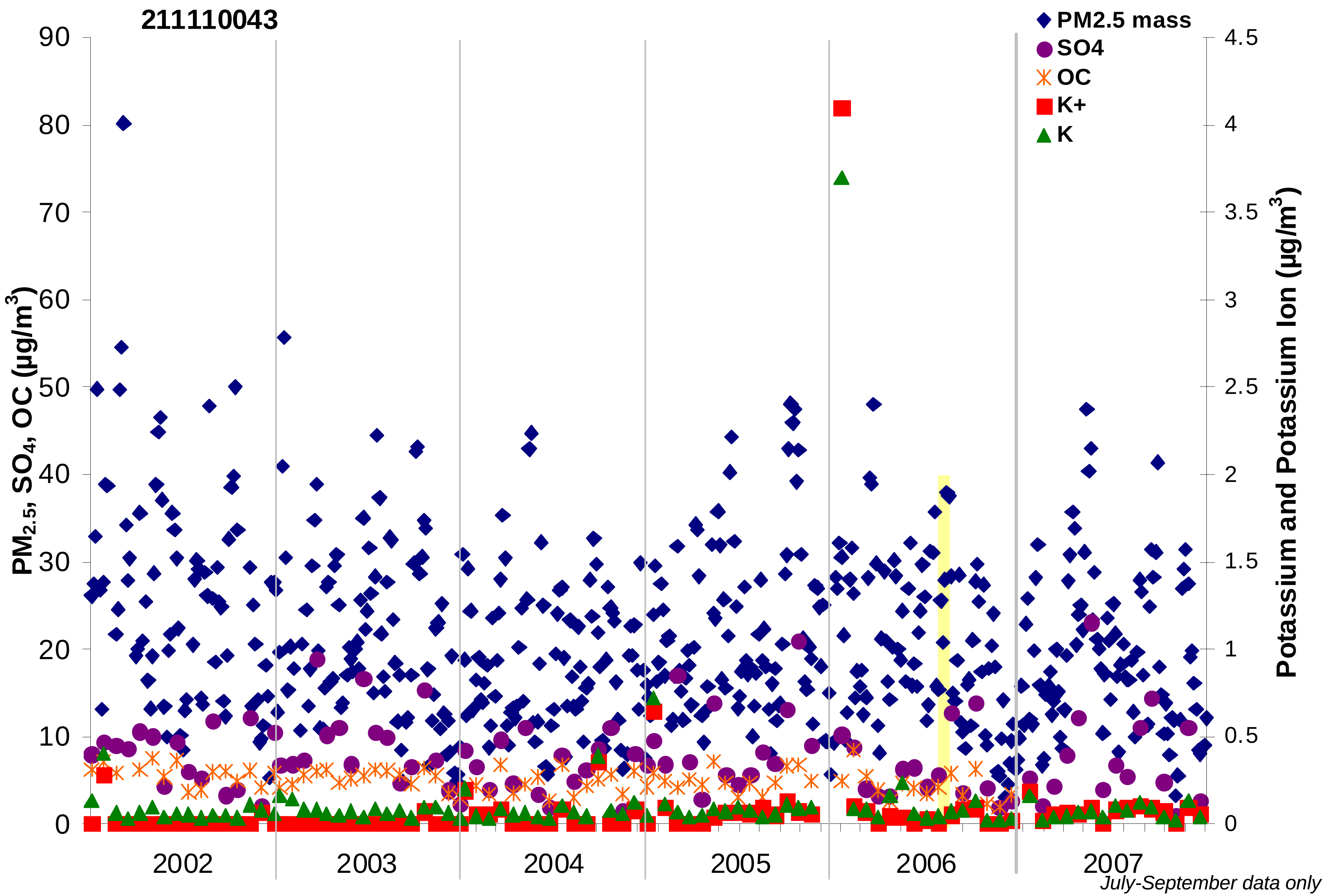


These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 8/25/06 and 8/26/06, concentrations were very close to the historical values.

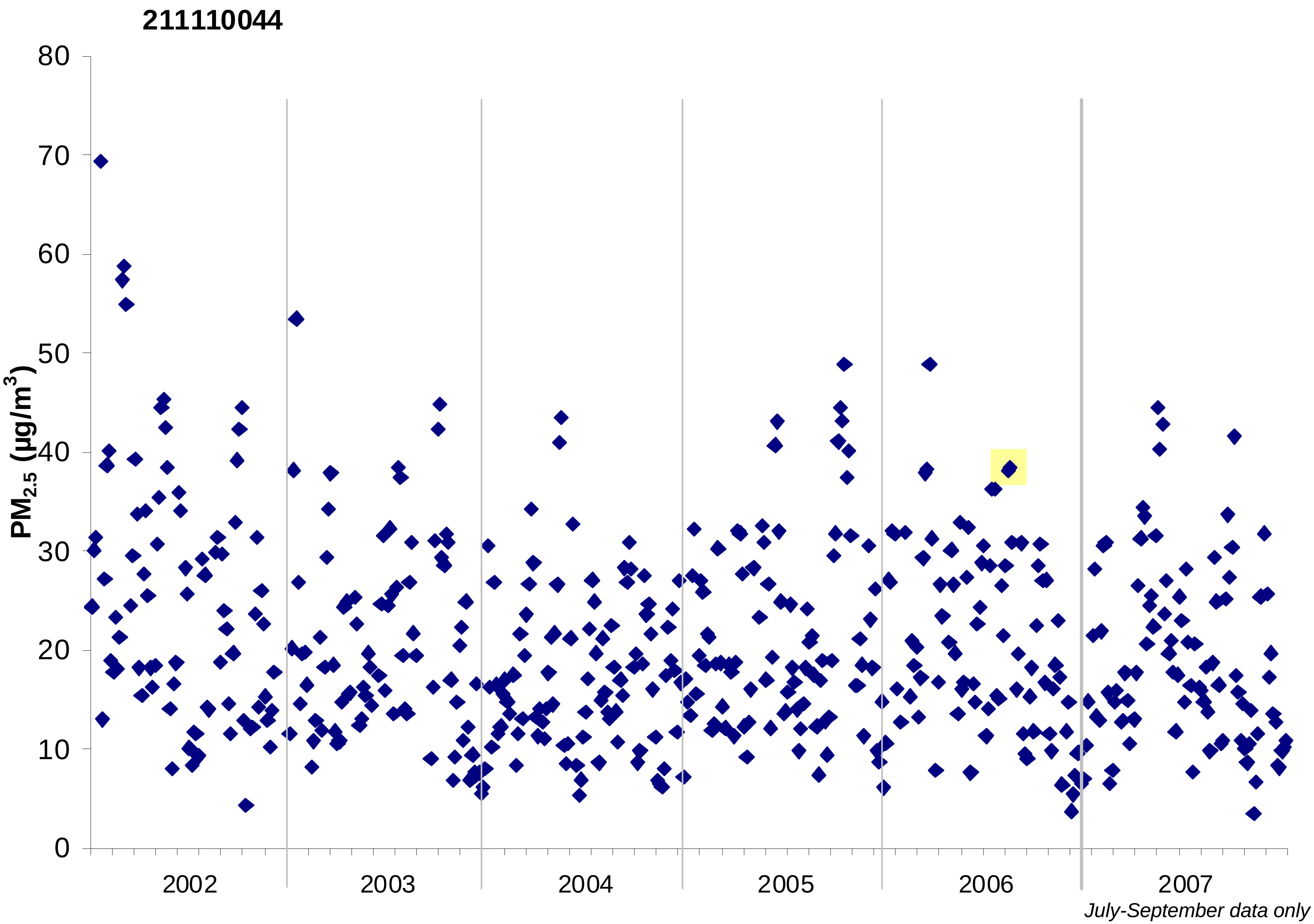




The purple lines show the difference between the given day and the historical 95th percentile concentration. On 8/25-8/26/06, concentrations were around 5 to 10 µg/m^3 higher than the historical values.



$PM_{2.5}$ concentrations were within the range of historical concentrations on 8/25-8/26/06 (highlighted in yellow). OC and potassium concentrations are not higher than normal, but sulfate is high on 8/26/04, which was the closest reported sulfate measurement to the episode.



$PM_{2.5}$ concentrations are within the range of historical concentrations. No speciated data are available for this site.

Summary

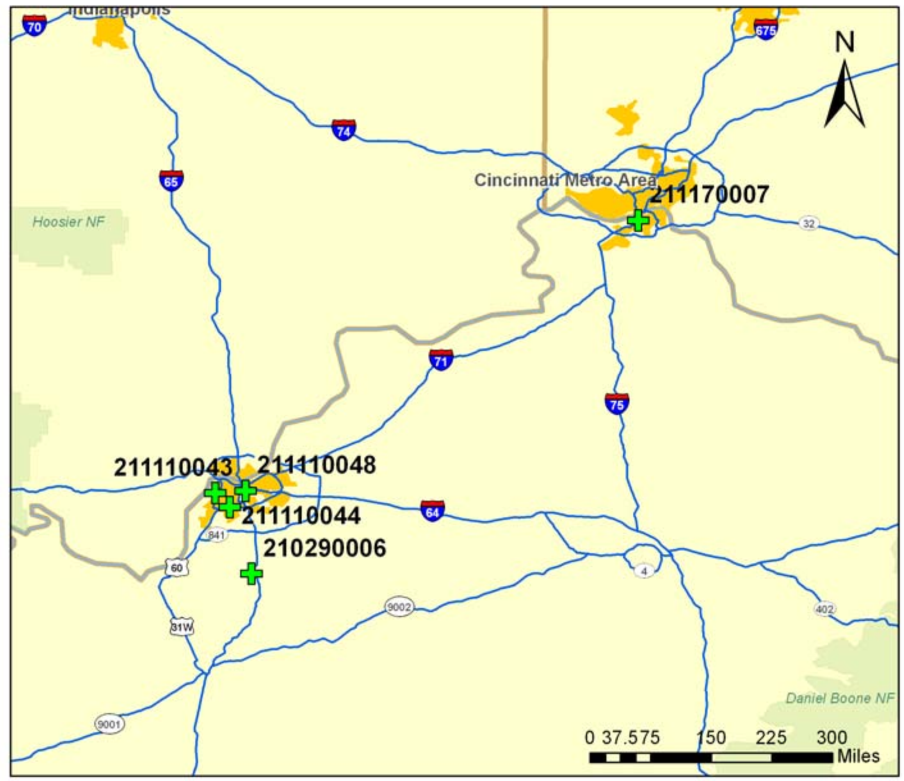
- Trajectory analysis does not indicate any impact from the area of the fires on 8/25/06 or 8/26/06.
- High modeled sulfate concentrations indicate a regional sulfate episode throughout the southeast.
- $PM_{2.5}$ concentrations are within the historical range of concentrations and were likely not impacted by forest fires.

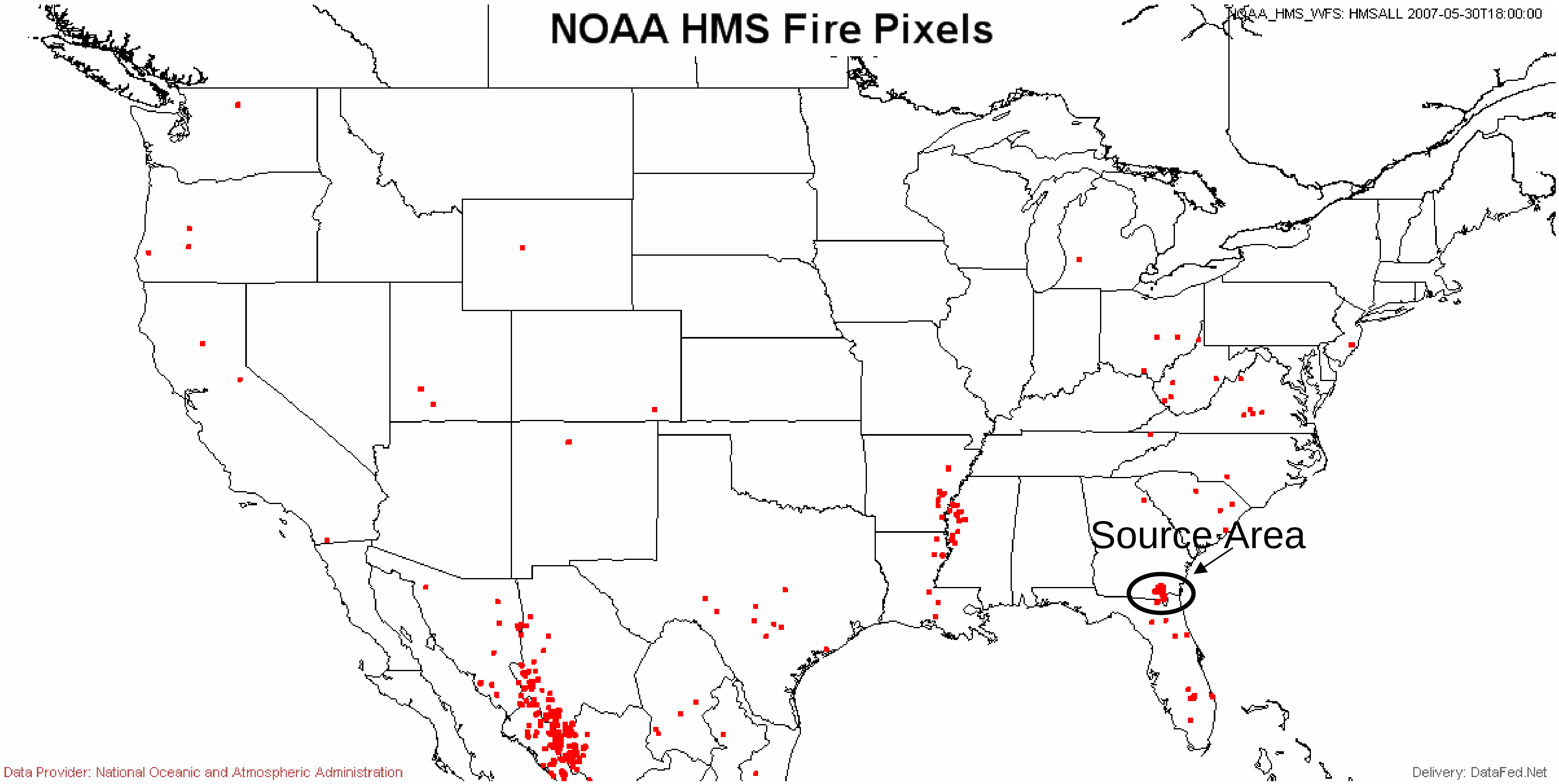
Exceptional Events Analysis Kentucky 6/2/07

Multiple sites flagged for fire impact from S. Georgia/N. Florida Fires

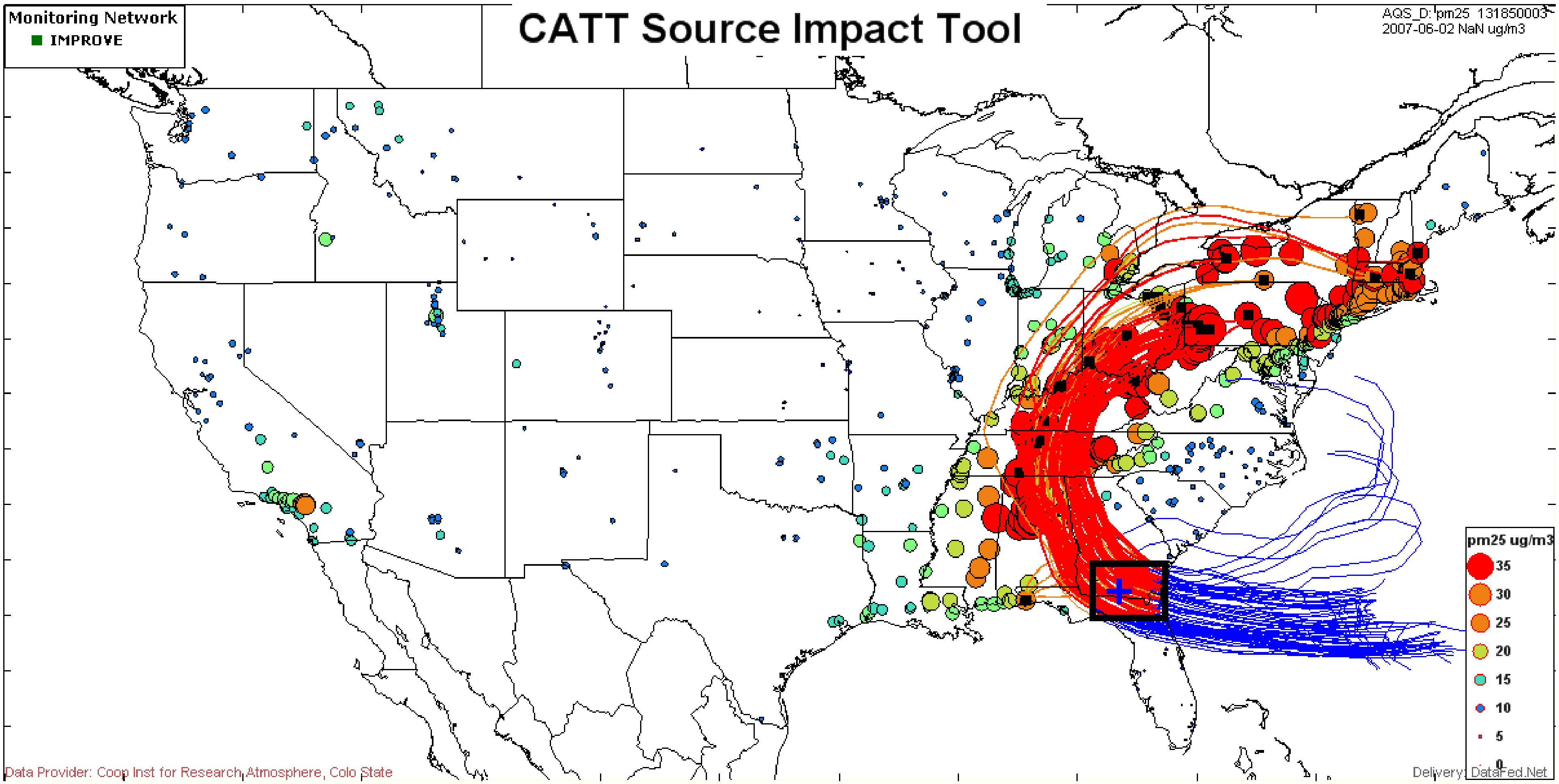
Sites Submitted for Exceptional Event Status (6/2/07)

Site ID	$PM_{2.5}$ (µg/m³)
210290006	36.2
211110043	34
211110044	36.8
211110048	37.2
211170007	40.1

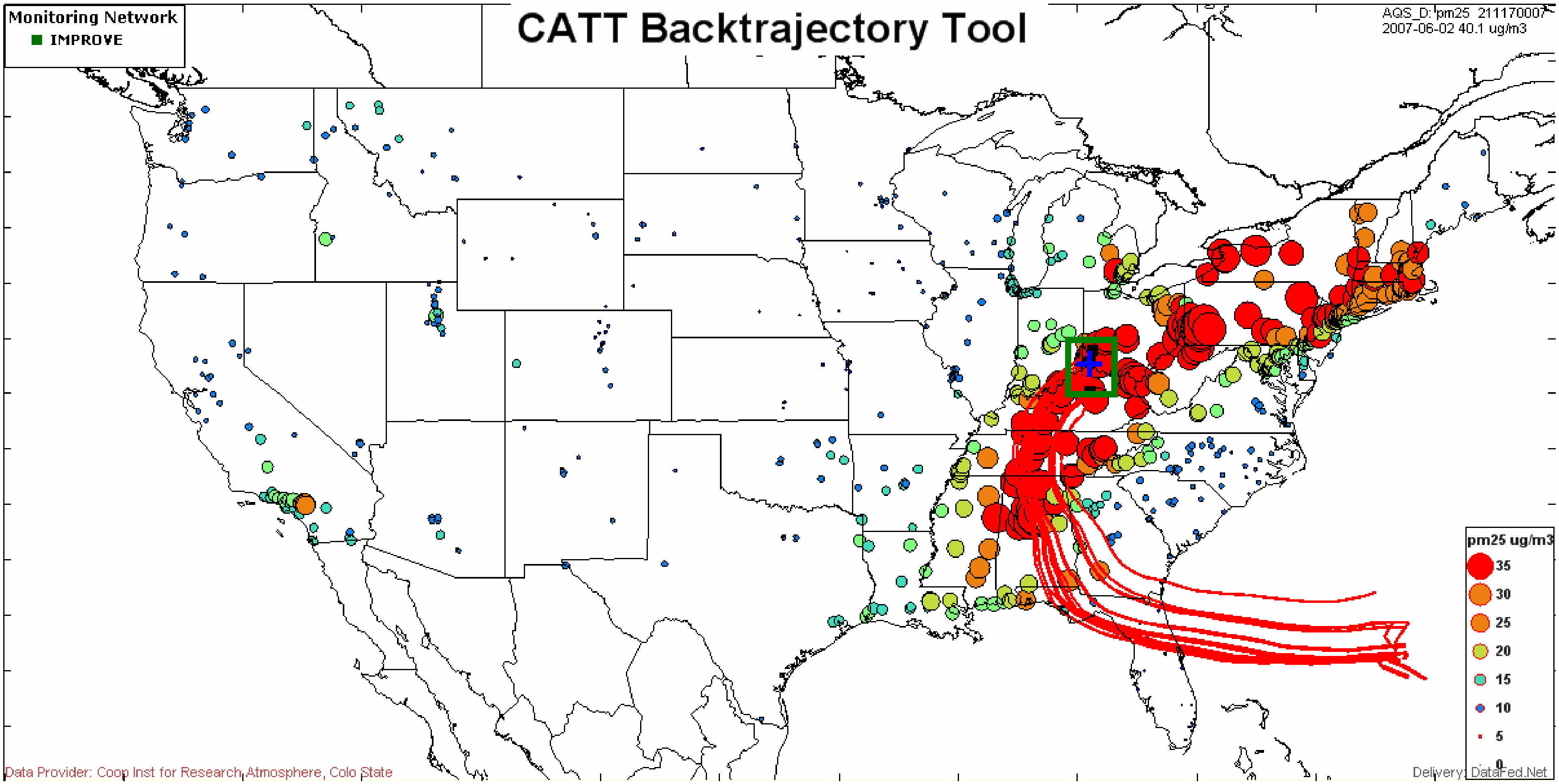




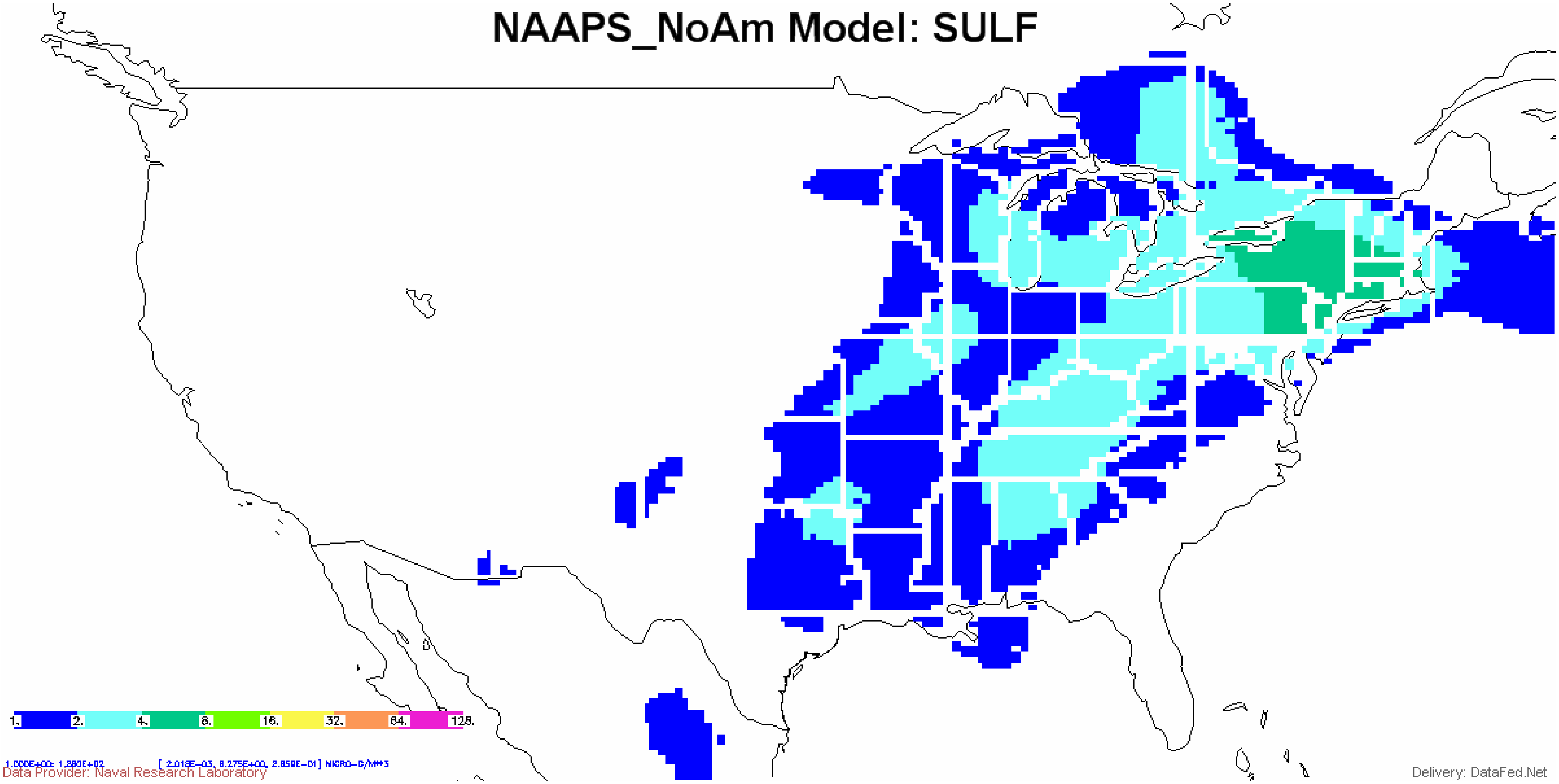
No fire pixels were evident in the area on 6/2/07, possible due to heavy cloud cover; this image is from 5/30/07



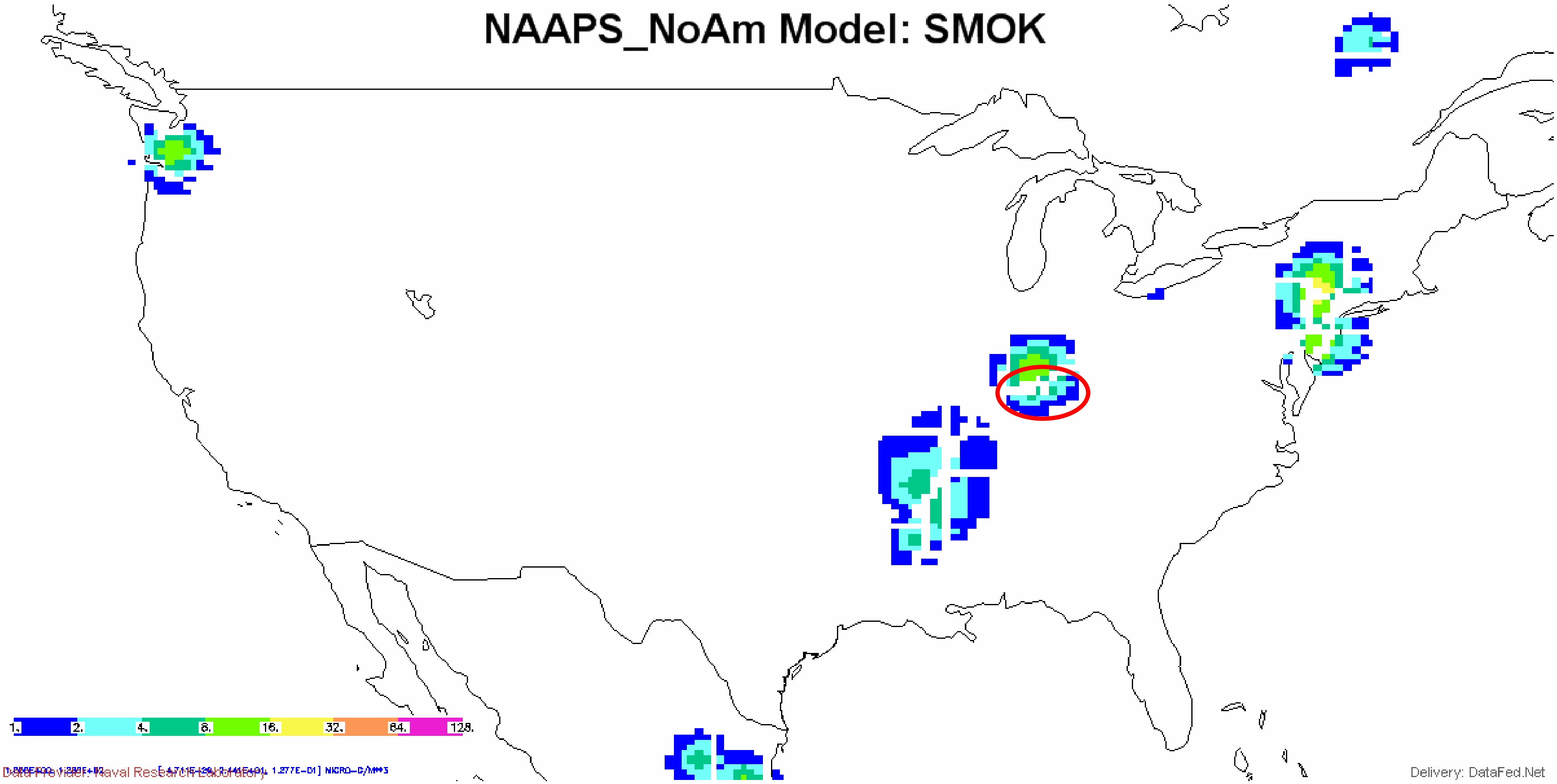
Source impact tool shows many trajectories passing through the fire region later passed through Kentucky



Back trajectory analysis highlights the trajectories that passed directly over the 211170007 site (blue cross), which were from the S. Georgia/N. Florida area



Modeled sulfate contributions are low-moderate

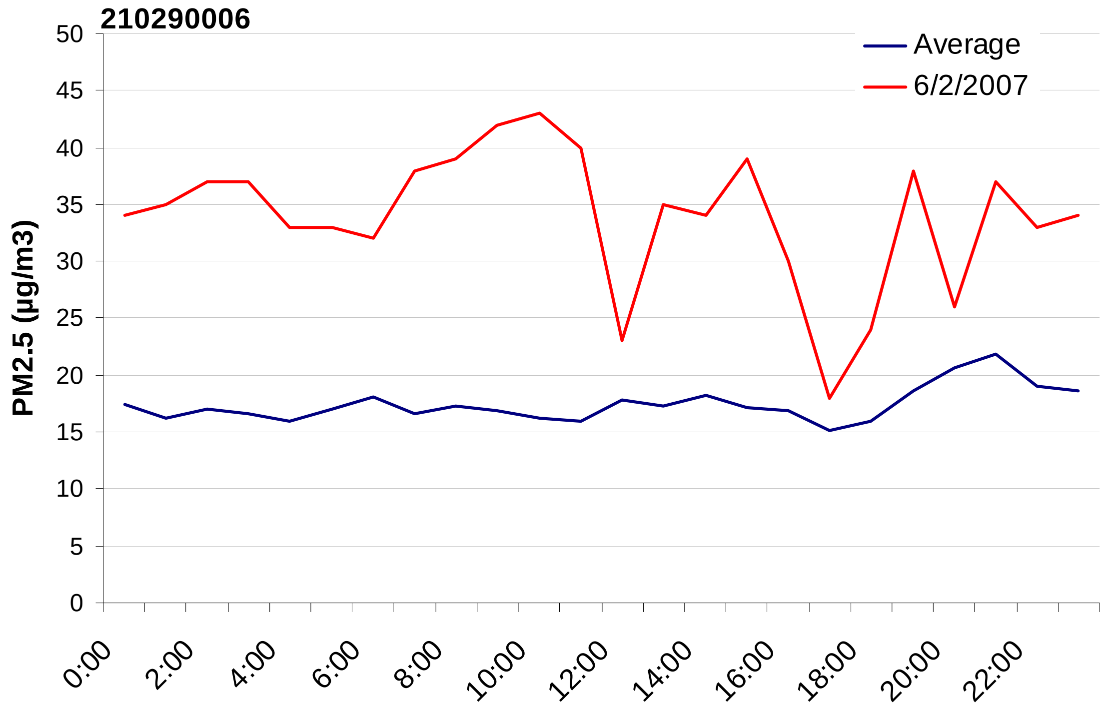


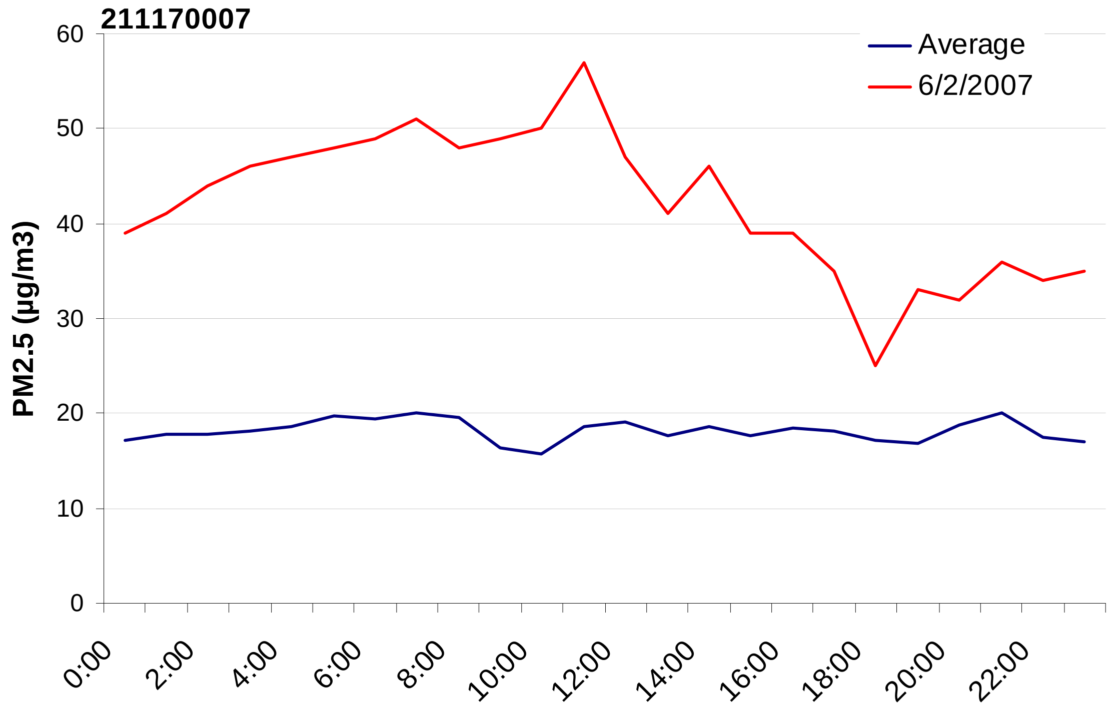
Some modeled smoke impact in KY indicated with red circle

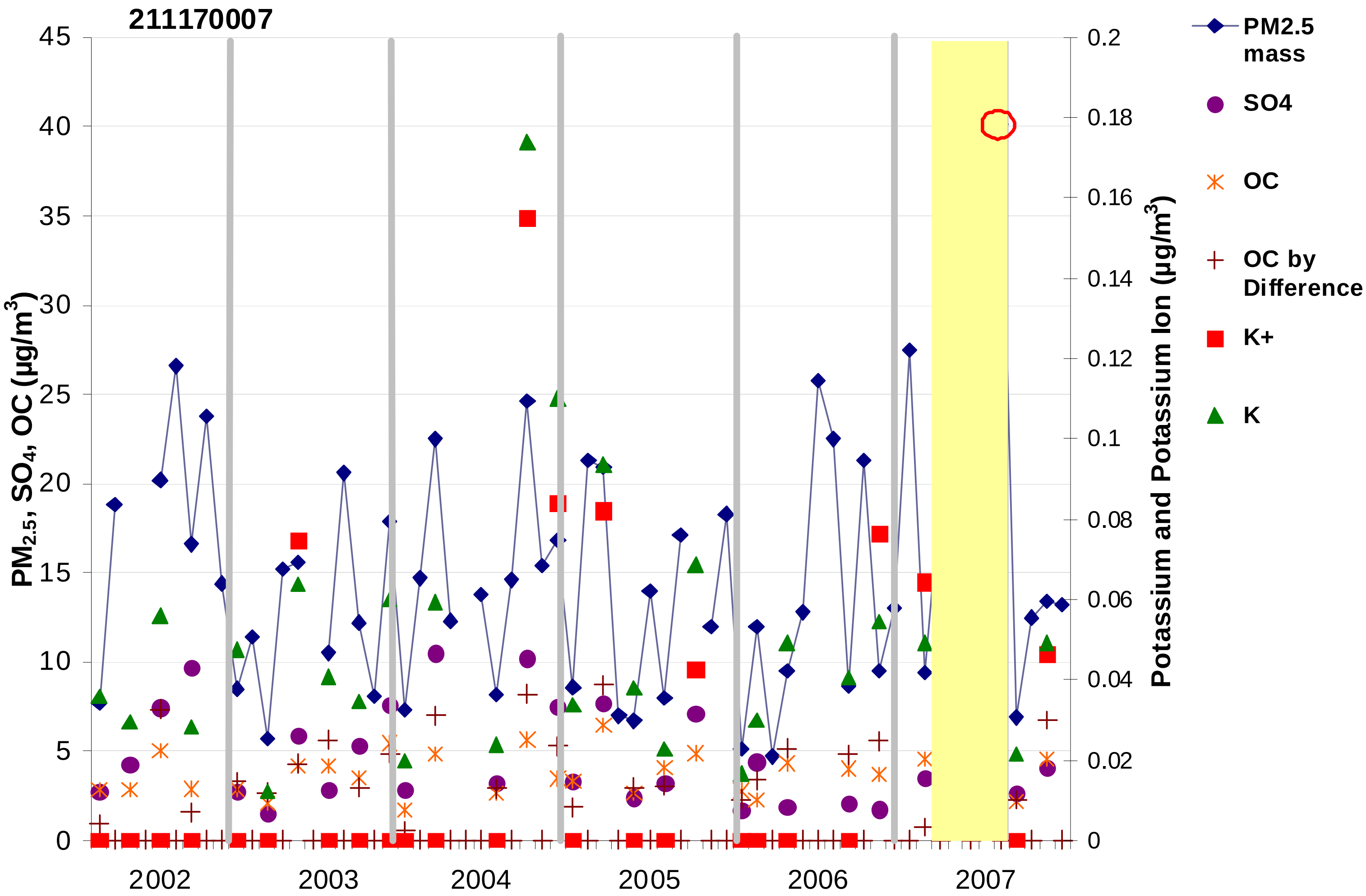
Diurnal profiles show much more variation than usual, as well concentrations more than 2x higher than average for June.

The average range of values over a day at each site was around 21 µg/m³. On 6/2/07, the range was slightly higher at 210290006 (25 µg/m³) and much higher at 211170007 (35 µg/m3). On high sulfate days (defined as days with a sulfate contribution >10 µg/m³), the range at 211170007 was only 16 µg/m³. No days had sulfate >10 µg/m³ at 210290006.

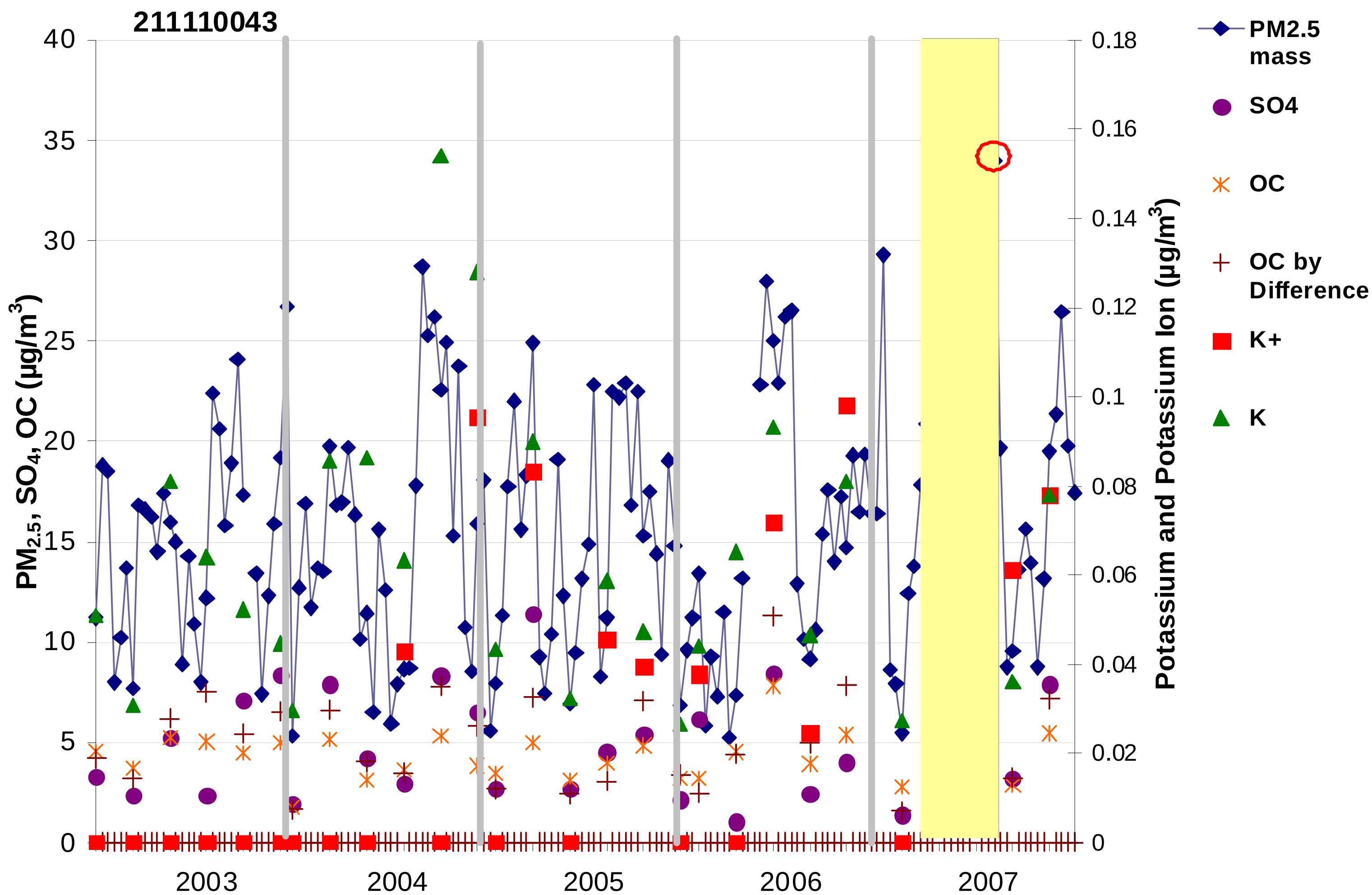
(‘average’ presented here is the average per hour over all June data, 2000-2007)







Time series for multiple years (May 15-June 15) shows 6/2/07 is well above the normal range at 211170007. Individual years are delineated by a grey line. While there were no speciated measurements on 6/2/07, the two samples prior (highlighted in yellow) show high OC and potassium concentrations (indicative of smoke impact). However, SO_4 is also high, suggesting the fire impact may not be the only cause of high $PM_{2.5}$ concentrations.



At site 211110043, PM concentrations are high, but not extremely so. However, potassium concentrations are high for much of the month and, like at 211170007, OC concentrations are high in the samples preceding 6/2/07. SO4 is also slightly high.

Comparison to Historical Values

		mean	median	95th	6/2/2007
211110043	2007	19.8	18.5	34.8	34.0
	2000-2007	21.3	19.7	38.9	
211170007	2007	17.6	16.3	30.5	40.1
	2000-2007	19.1	17.1	36.5	

Summer data only (June-August) used in these statistics.

The 6/2/07 value at 211110043 was well above the mean/median concentrations for both summer 2007 and all summers 2000-2007, but was lower than the 95th percentile for all summers 2000-2007. This does not support the “but-for” clause.

The 6/2/07 value at 211170007 is well above mean, median, and 95th percentiles for summer 2007 and all summers 2000-2007. Without the event, the value on this day could have been below 35µg/m^3.

No speciated data was available on this day, OC/OM concentrations could not be compared to historical values.

Conclusions

- Trajectory analysis indicates smoke emissions from the S. Georgia/N. Florida area could be impacting Kentucky
- Likely not a sulfate event based on low(ish) sulfate
- Diurnal patterns are much more varied on 6/2/07, showing a buildup in concentrations over the morning- possibly due to a fire plume
- At the 211170007 site, the PM2.5 concentration on 6/2/07 was well above normal and obviously a unique event
- At the 211110043 site, the PM2.5 concentration was high on 6/2/07 compared to the rest of 6/07, but not compared to previous years
- There is likely impact from the Georgia/Florida fires throughout Kentucky on 6/2/07 (and nearby dates). The highest impact is evident at the 211170007 site, where concentrations would likely be much lower without the smoke contribution.

Exceptional Events Analysis
Kentucky
8/2/07-8/4/07

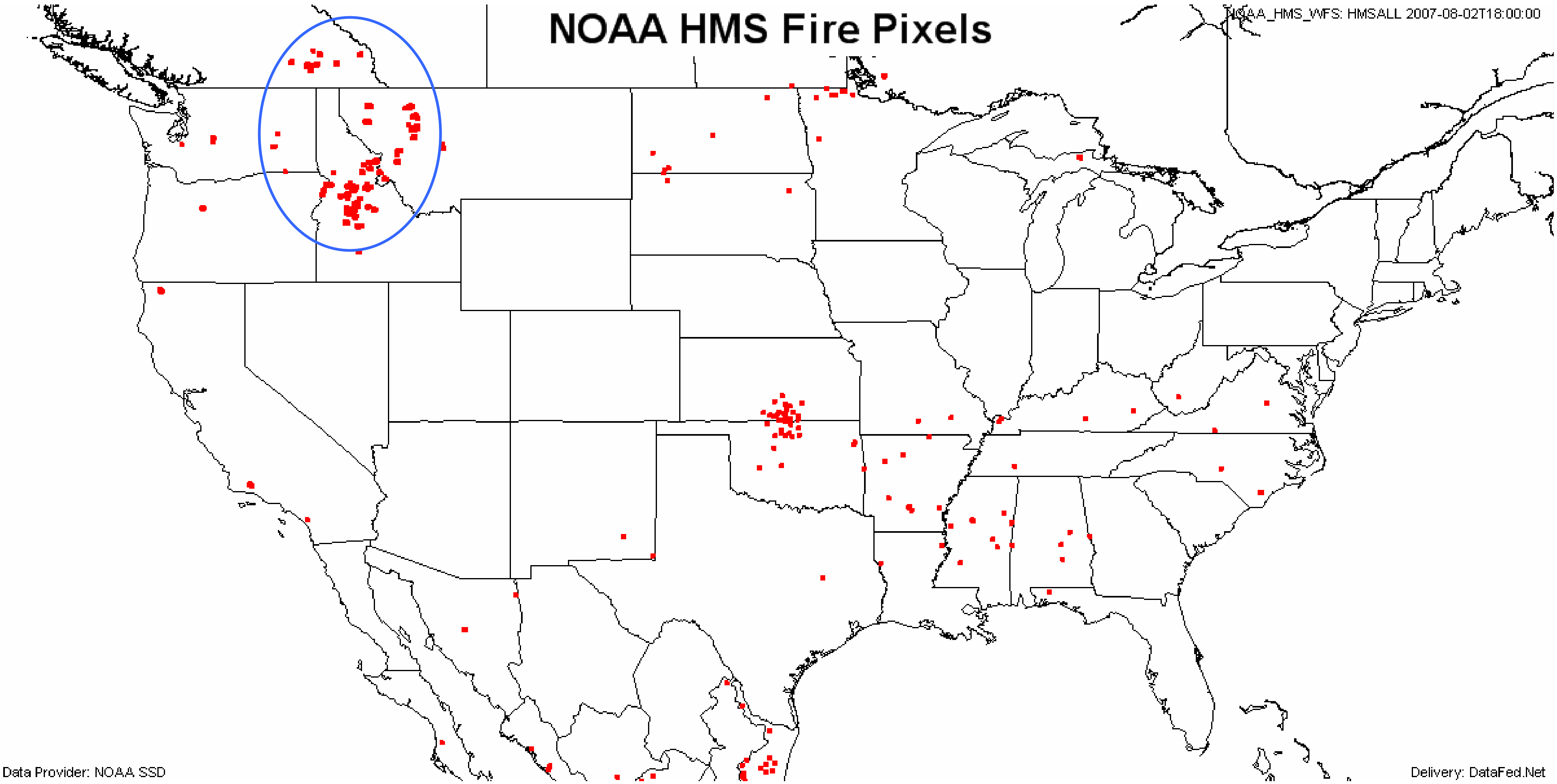
Four sites analyzed
(21-111-0043, 21-111-0044,
21-111-0048, 21-111-0051)
for possible fire impact
from western U.S. fires

Concentrations Under Consideration

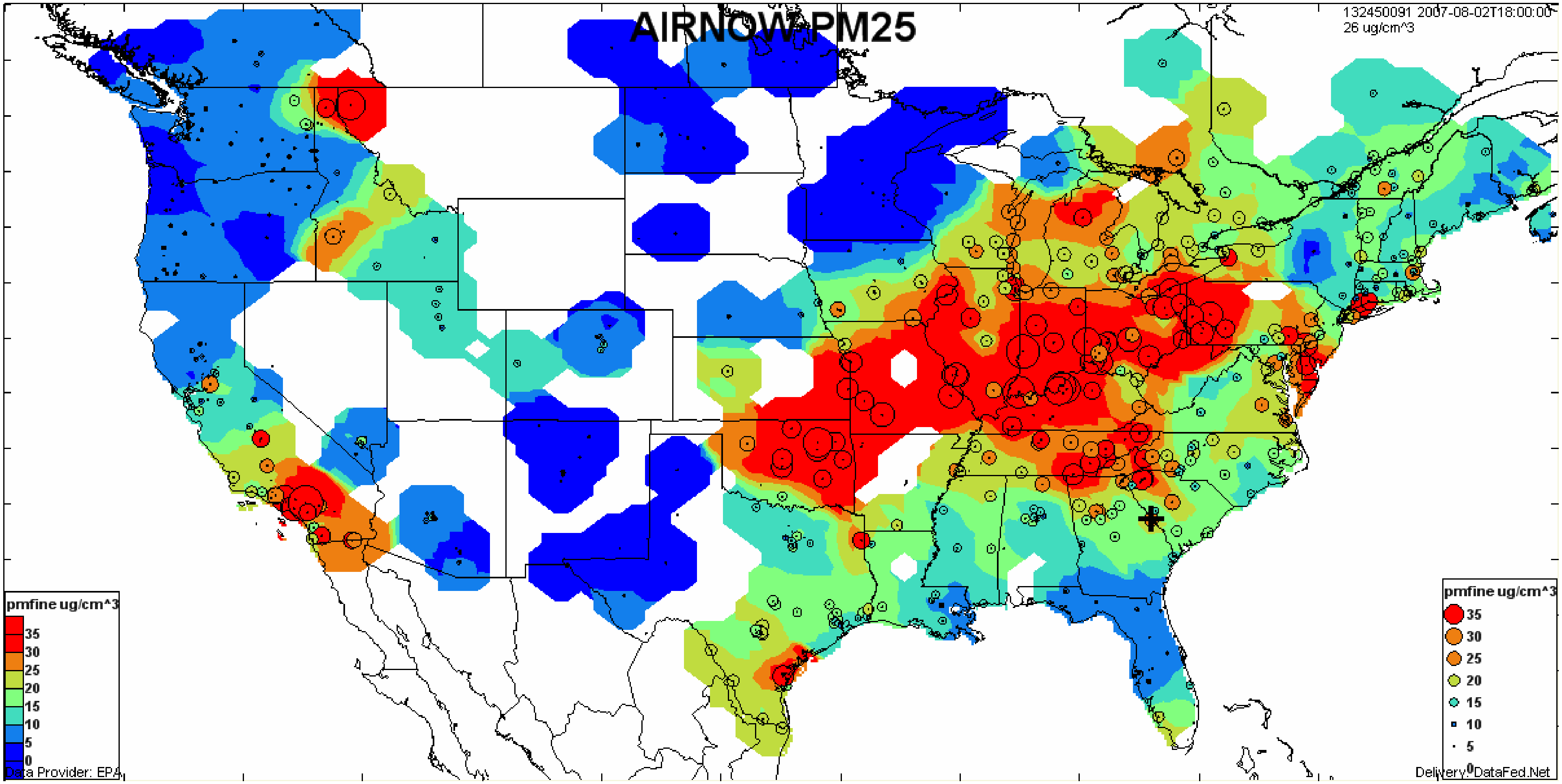
$PM_{2.5}$ concentrations in $\mu g/m^3$

Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
August 2, 2007	47.4		44.5		
August 3, 2007	40.4	47.2	40.3		
August 4, 2007	43.0		42.8	42.9	51.3

8/2/07



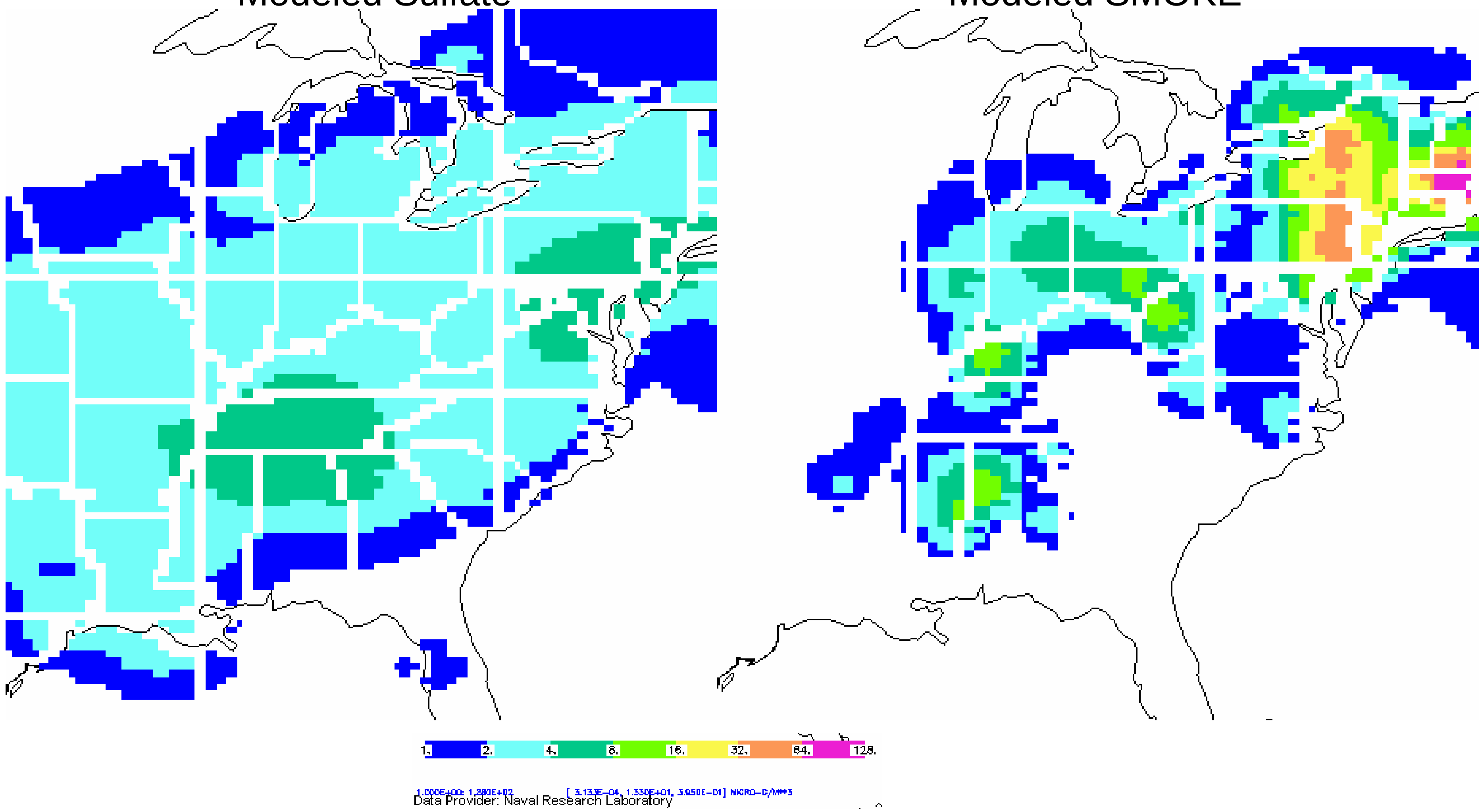
Several large fires in Montana/Idaho are believed to have impacted $PM_{2.5}$ concentrations in Kentucky. Similar fire detections were seen on 8/3/07 and 8/4/07.



$PM_{2.5}$ concentrations are high throughout the region on 8/2/07. Similar concentrations were seen on 8/3/07 and 8/4/07.

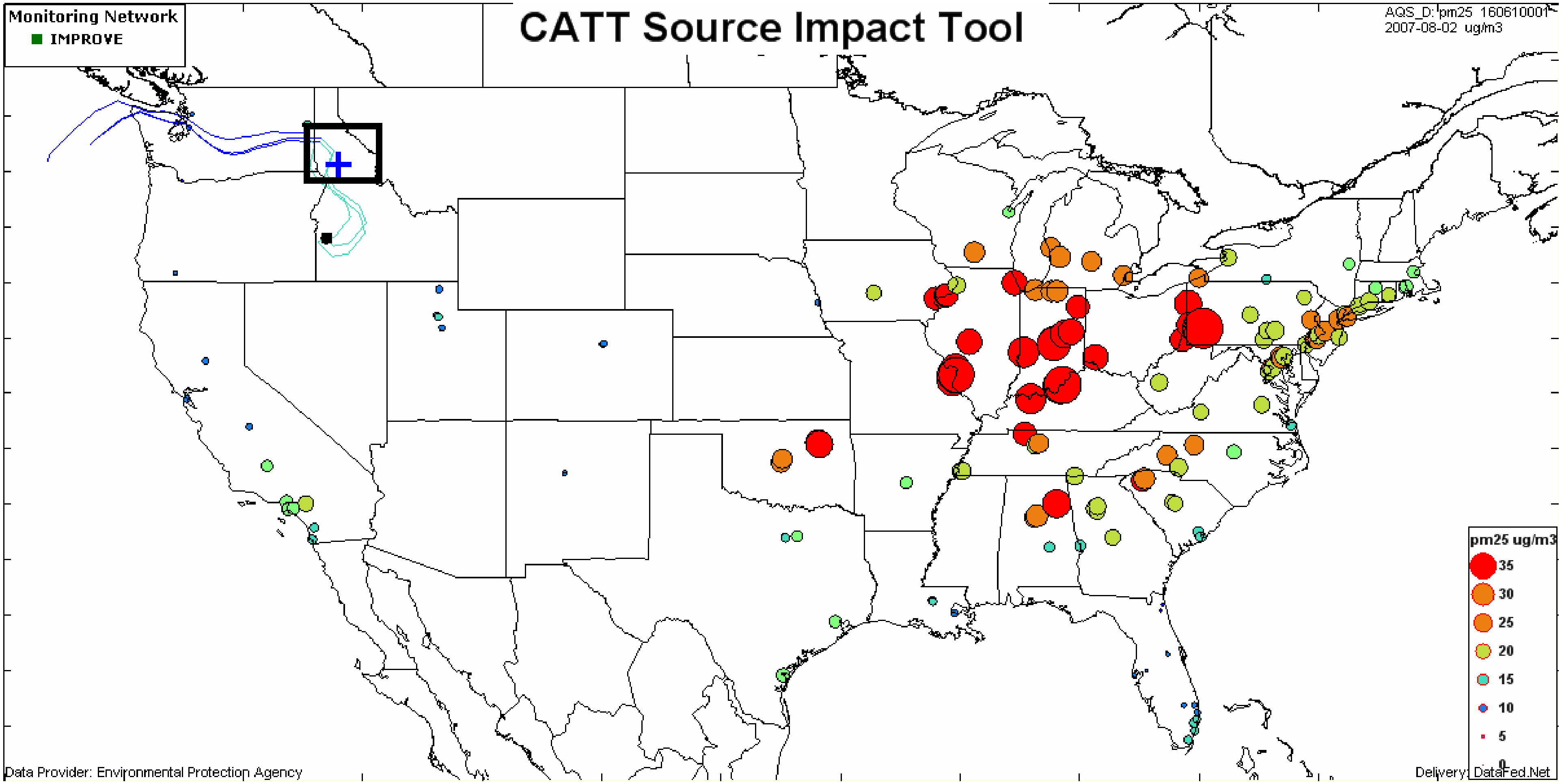
8/2/07

Modeled Sulfate Modeled SMOKE



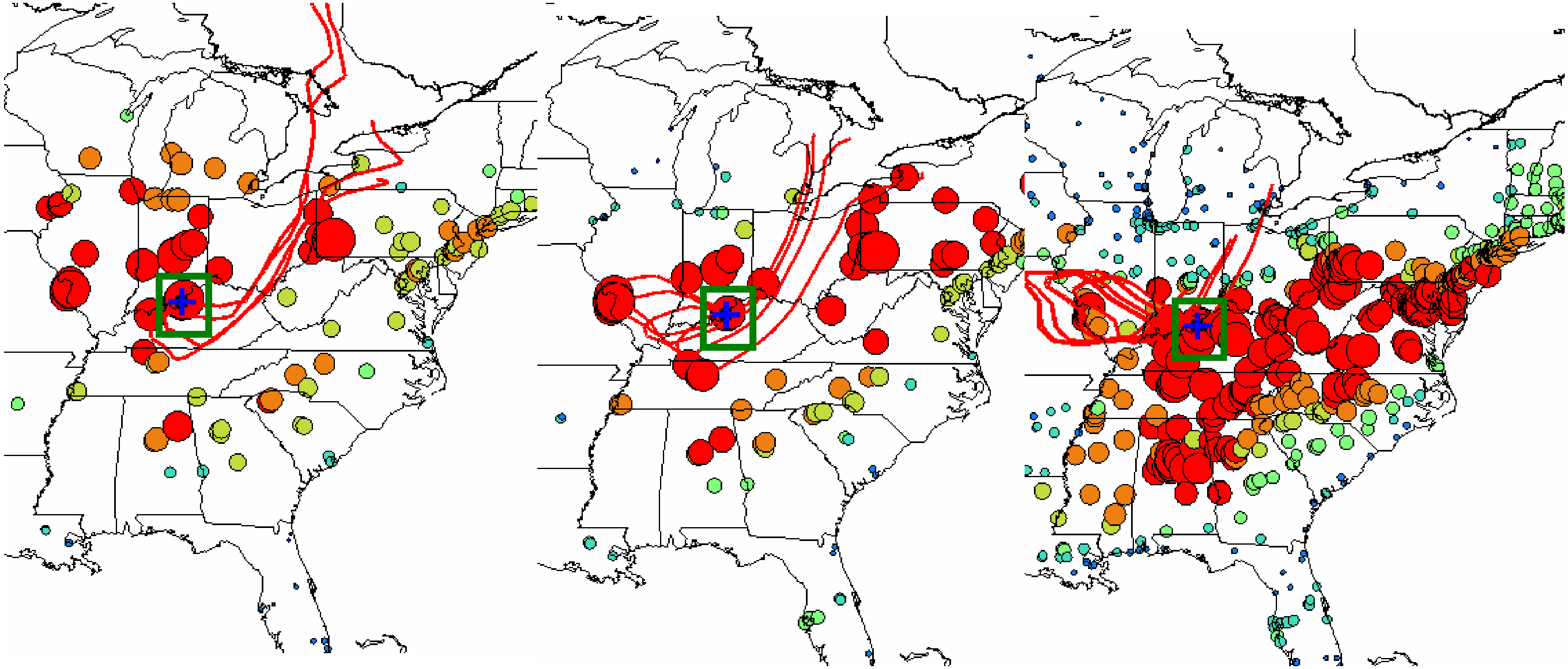
Modeled sulfate and modeled smoke were low/moderate in Kentucky on 8/2/07. (Same results on 8/3/07 and 8/4/07.)

8/2/07



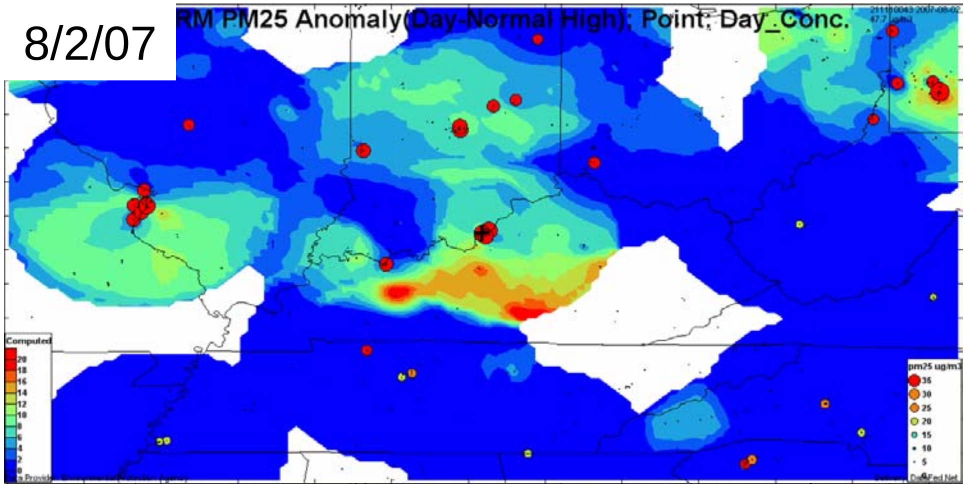
Source impact trajectories show no transport from fires in the Idaho/Montana area to Louisville. All three days were similar.

8/2/07 8/3/06 8/4/06

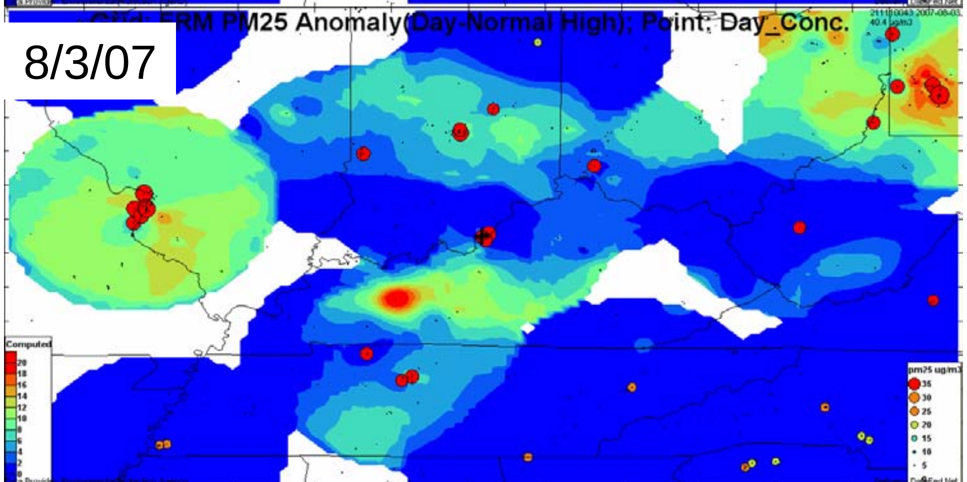


Back trajectories also show the Louisville site had no impact from the Idaho/Montana area.

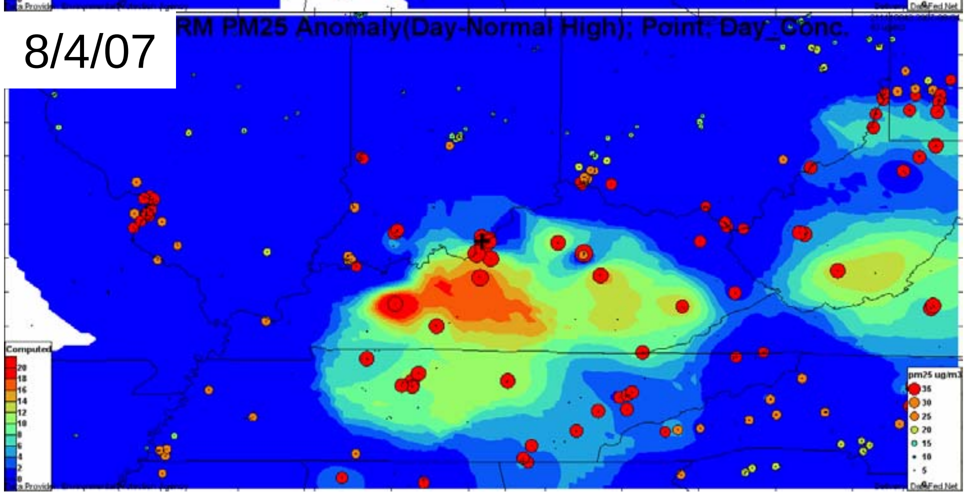
8/2/07



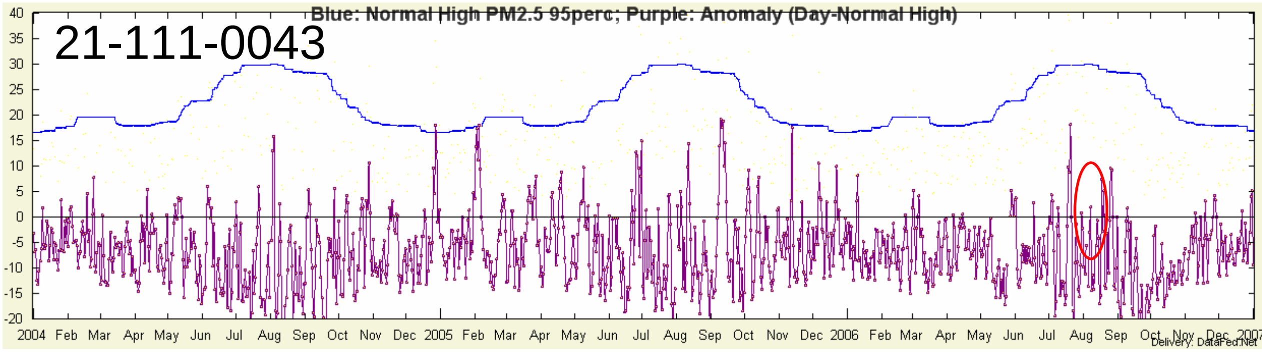
8/3/07

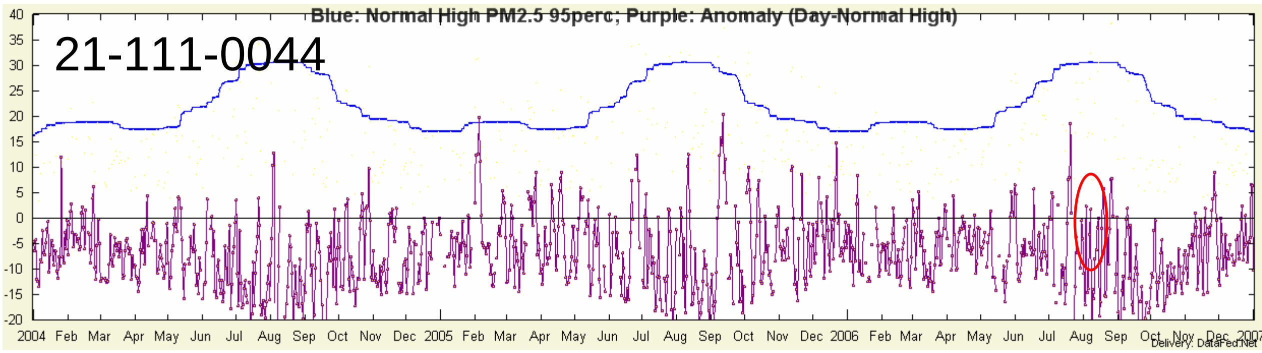


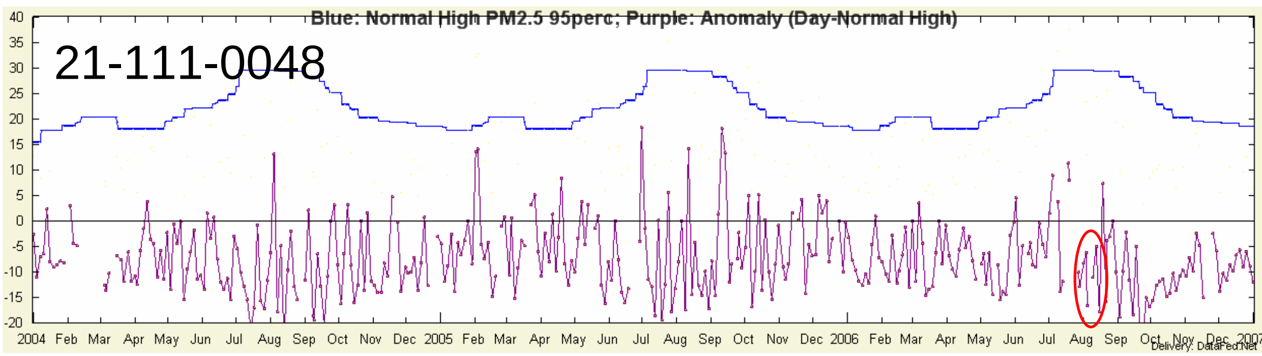
8/4/07

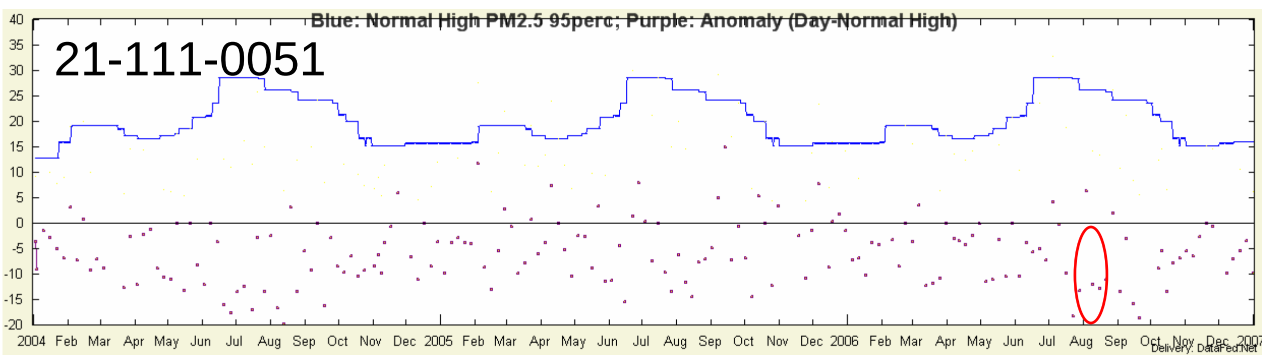


These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 8/2/07, 8/3/07, and 8/4/07, concentrations were close to the historical values, but throughout the rest of Kentucky, many high concentrations were seen.

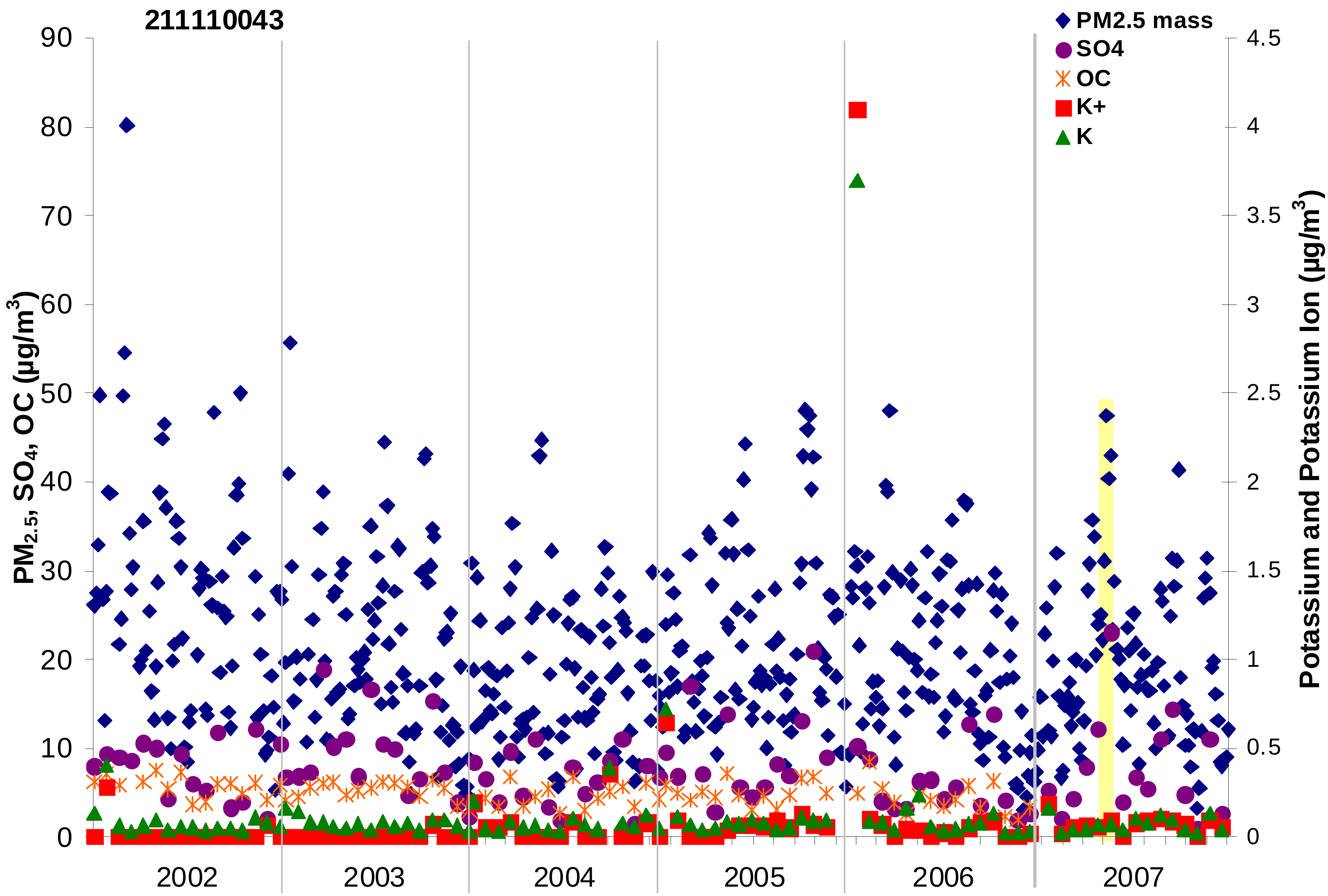




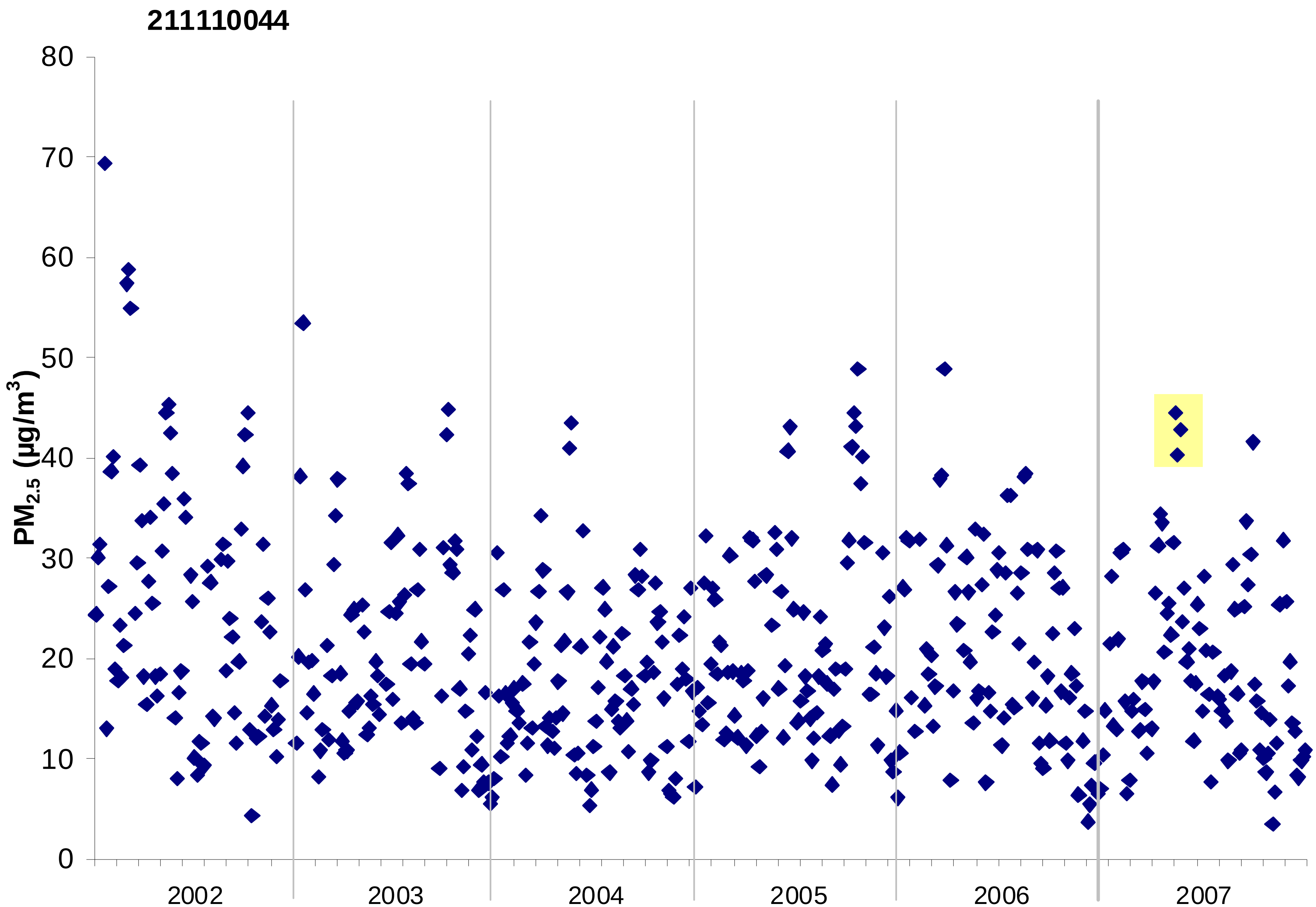




The purple lines show the difference between the given day and the historical 95th percentile concentration. On 8/2-8/4/07, concentrations were near or below the historical values.

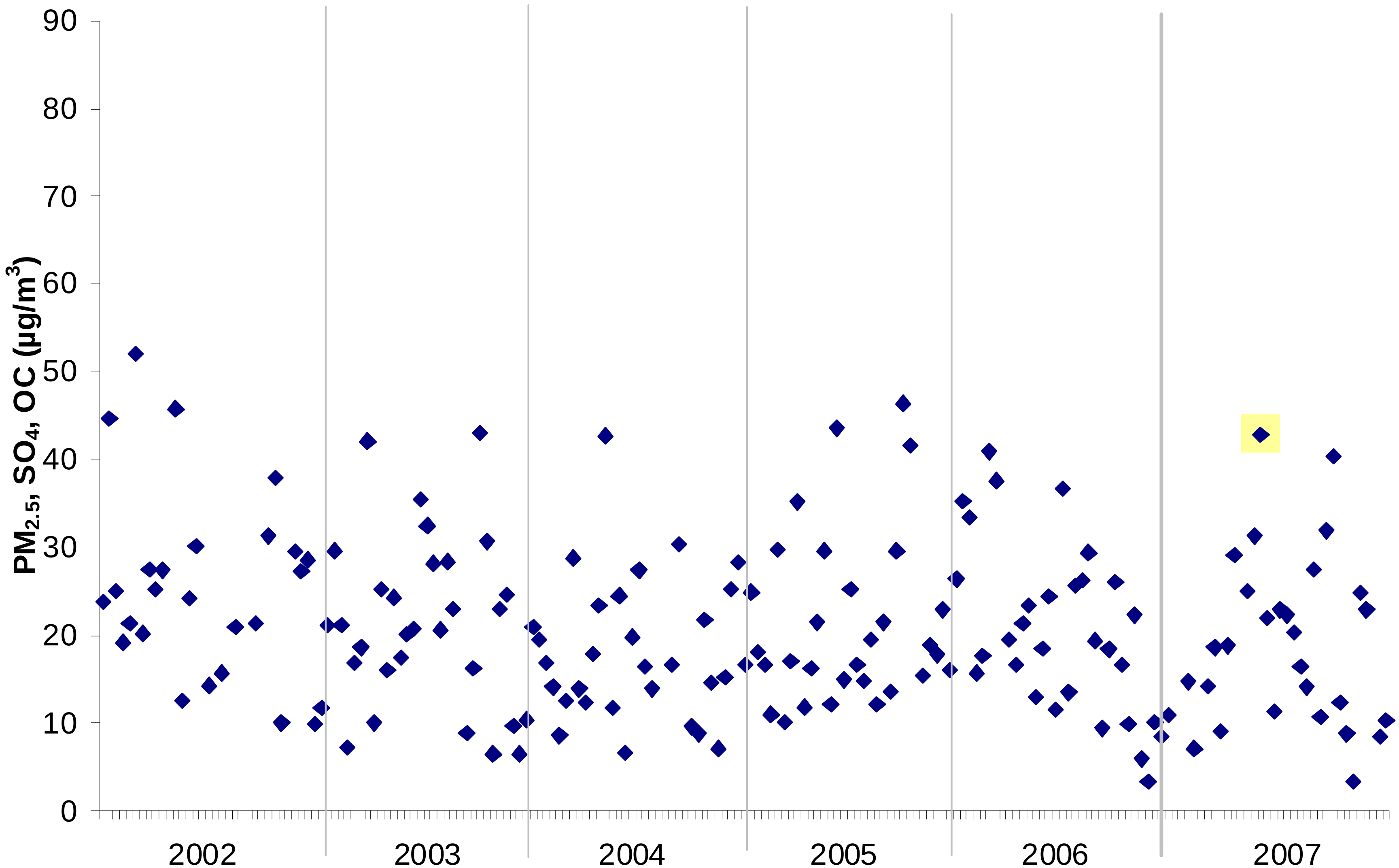


$PM_{2.5}$ concentrations were within the range of historical concentrations on 8/2-8/4/07 (highlighted in yellow). OC and potassium concentrations are not higher than normal, but sulfate is very high on 8/4/07.



PM$_{2.5}$ concentrations are high, but within the range of historical concentrations. No speciated data are available for this site.

211110048



As at the other sites, $PM_{2.5}$ concentrations at 21-111-0048 are within the range of historical concentrations.

Summary

- Trajectory analysis does not indicate any impact from the area of the fires on 8/2/07-8/4/07.
- $PM_{2.5}$ concentrations are within the historical range of concentrations.
- High sulfate concentrations at 21-111-0043 indicate a sulfate event.

Exceptional Events Analysis
Kentucky
9/6/07

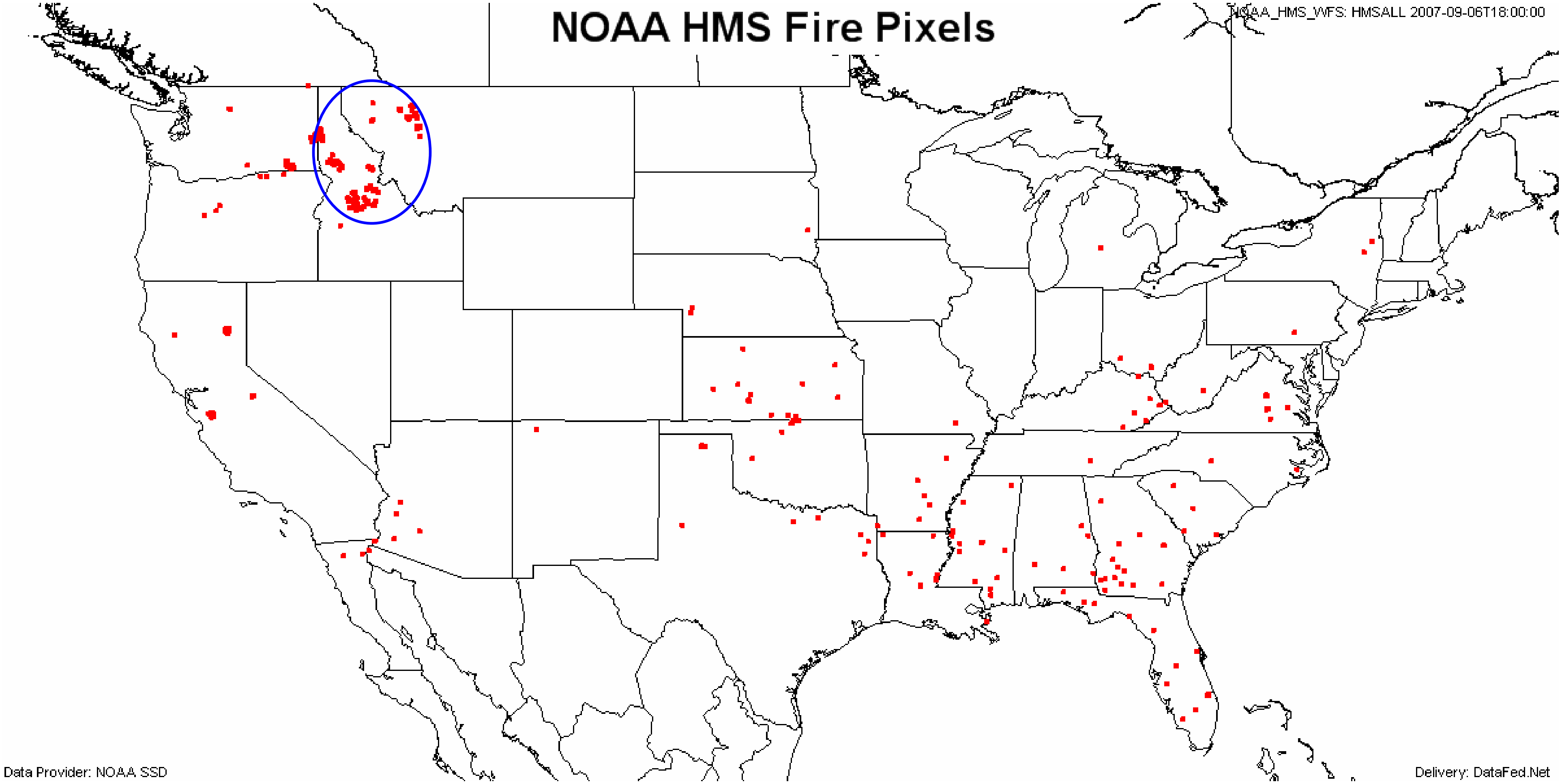
Three sites analyzed
(21-111-0043, 21-111-0044, 21-111-0048)
for possible fire impact
from Idaho/Montana fires

Concentrations Under Consideration

$PM_{2.5}$ concentrations in $\mu g/m^3$

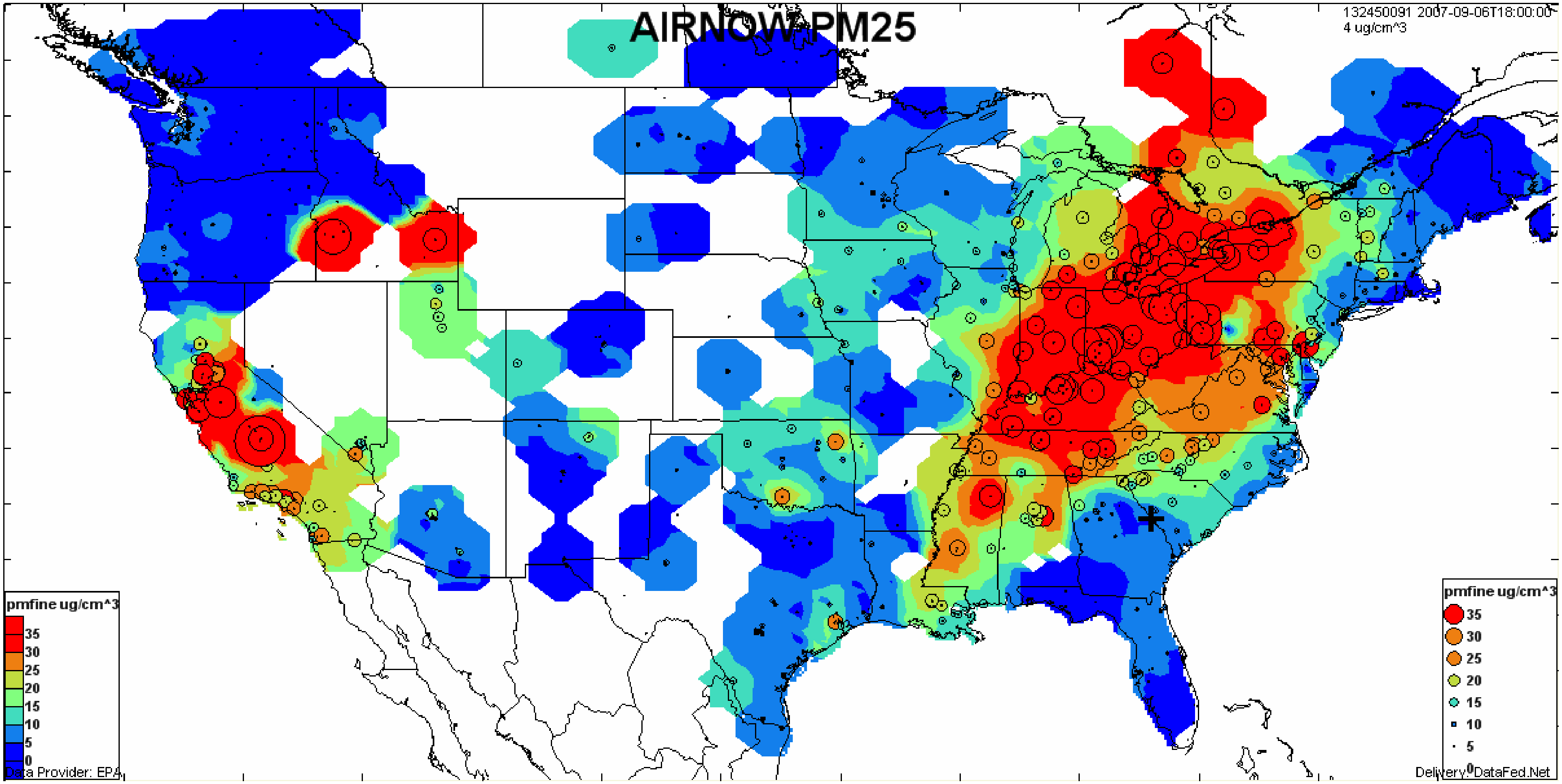
Date	21-111-0043-1 Southwick	21-111-0043-2 Southwick (QA)	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
September6, 2007	41.4		41.6	40.4	

9/6/07

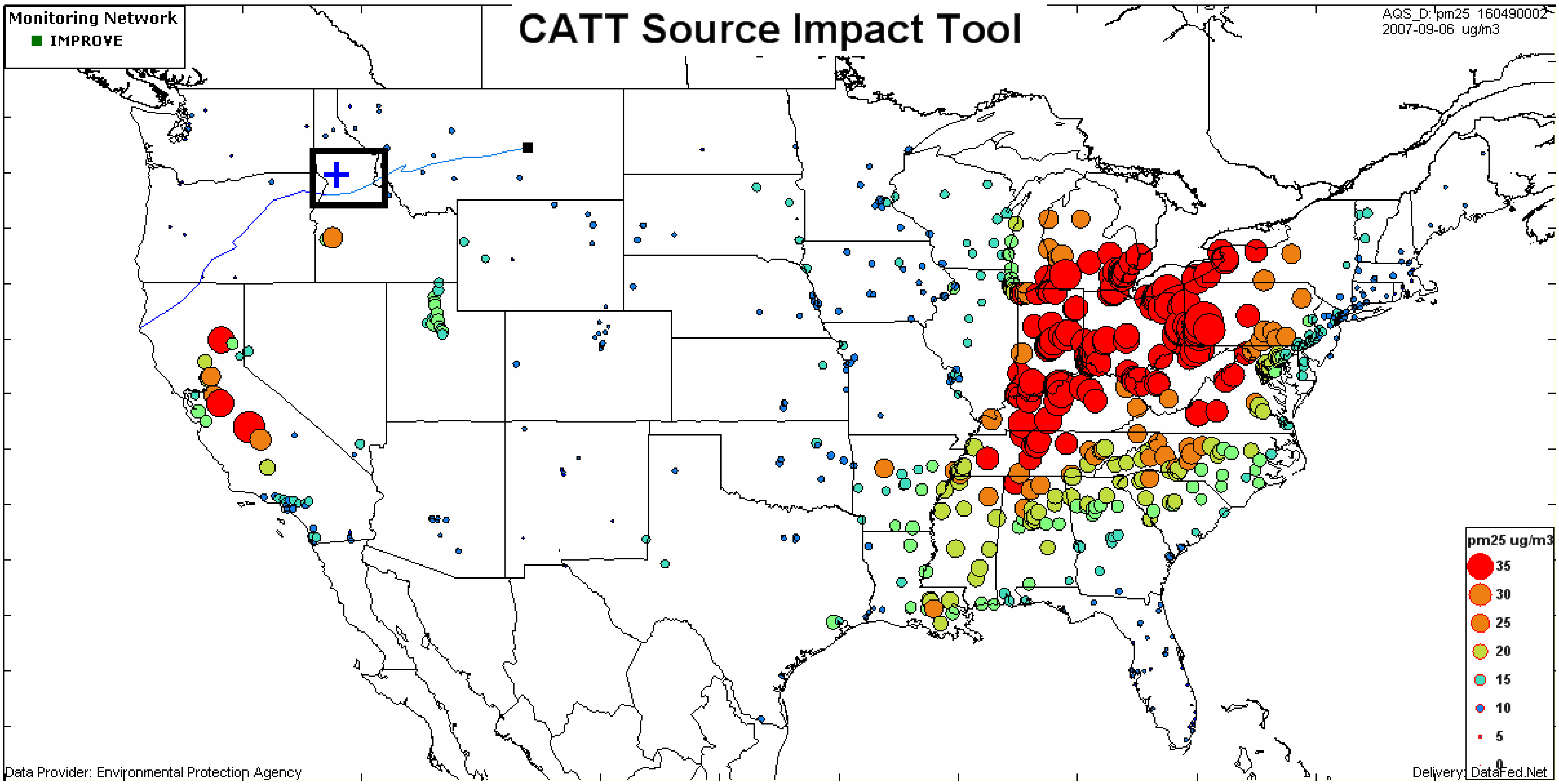


Fires in the Idaho/Montana area are believed to be impacting the Louisville area for 9/6/07.

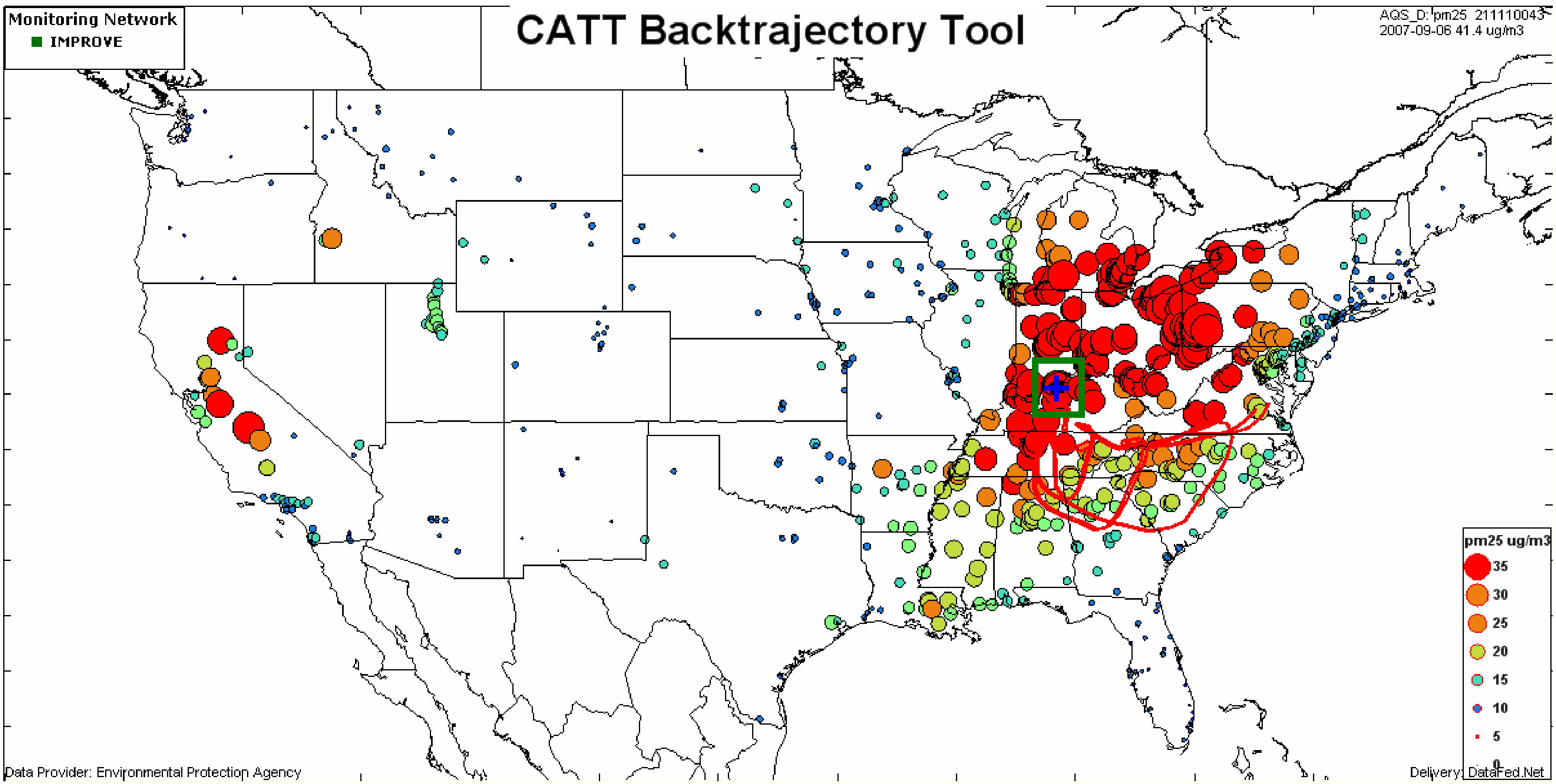
9/6/07



$PM_{2.5}$ concentrations were high throughout the region on 9/6/07. Sulfate and OC data were not available.



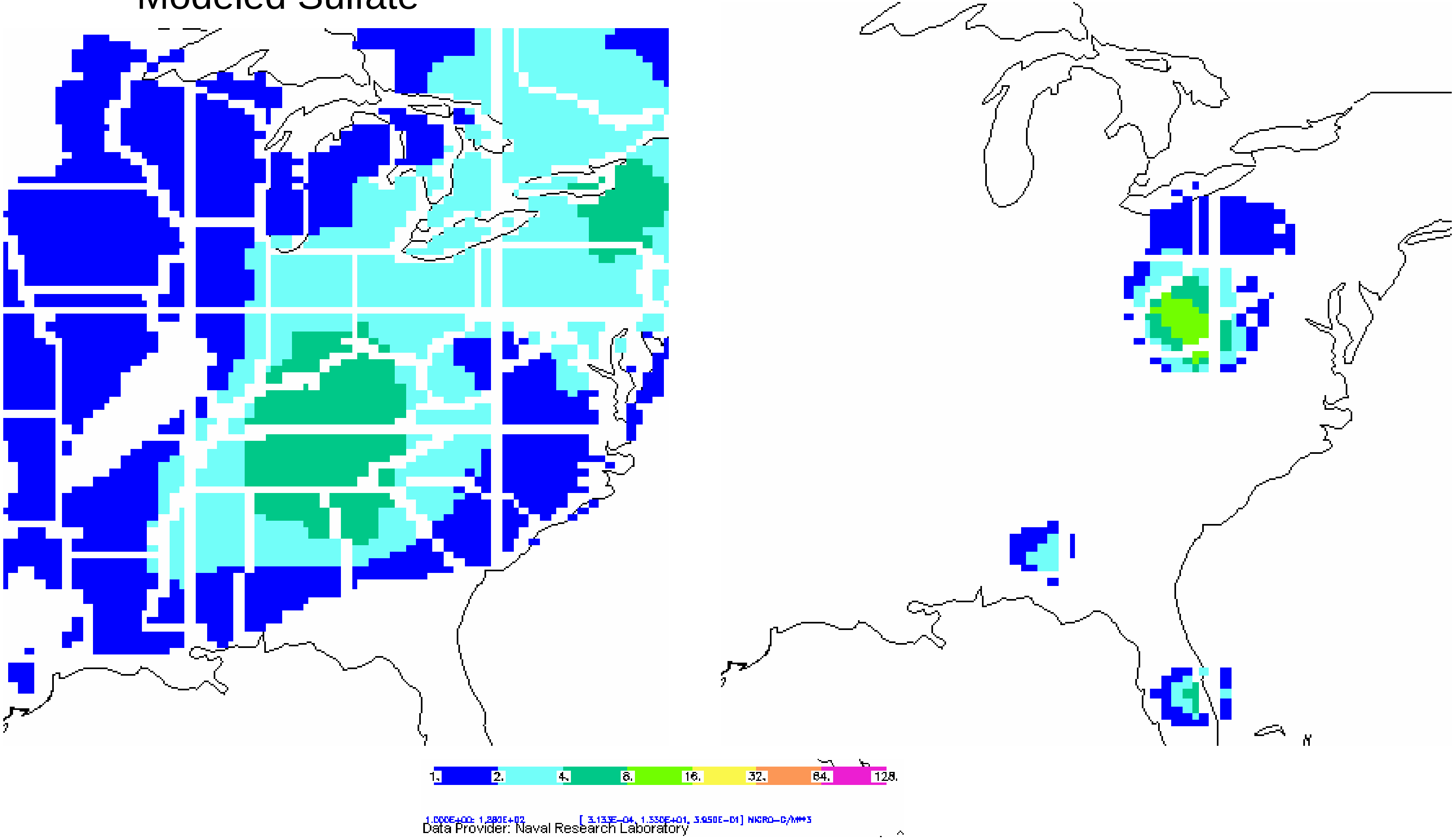
Source impact trajectories show no trajectories from the fire location impacting the Louisville area.



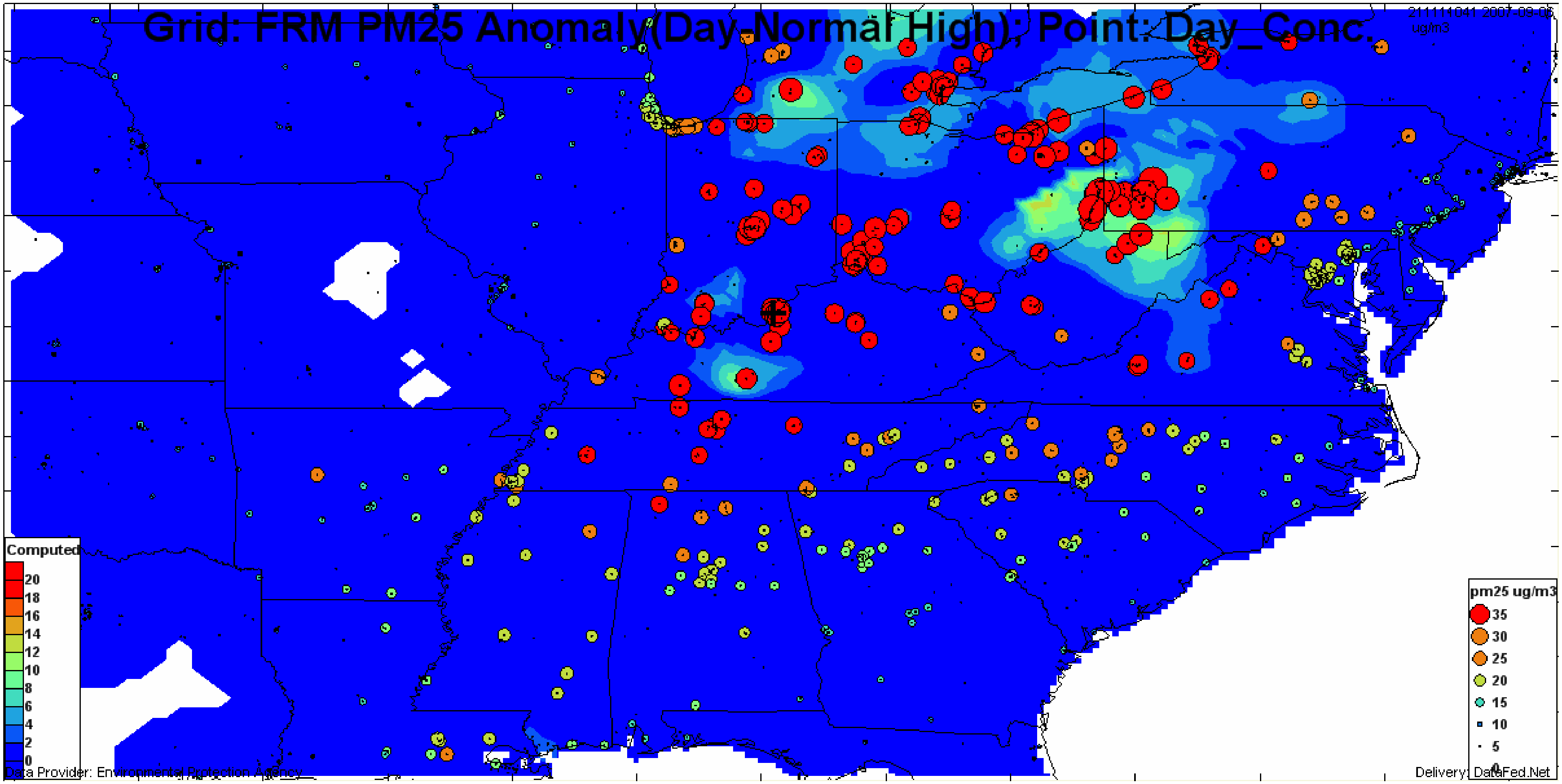
Back trajectories from the Louisville area agree with source impact trajectories: no impact from the fire area is seen.

Modeled Sulfate

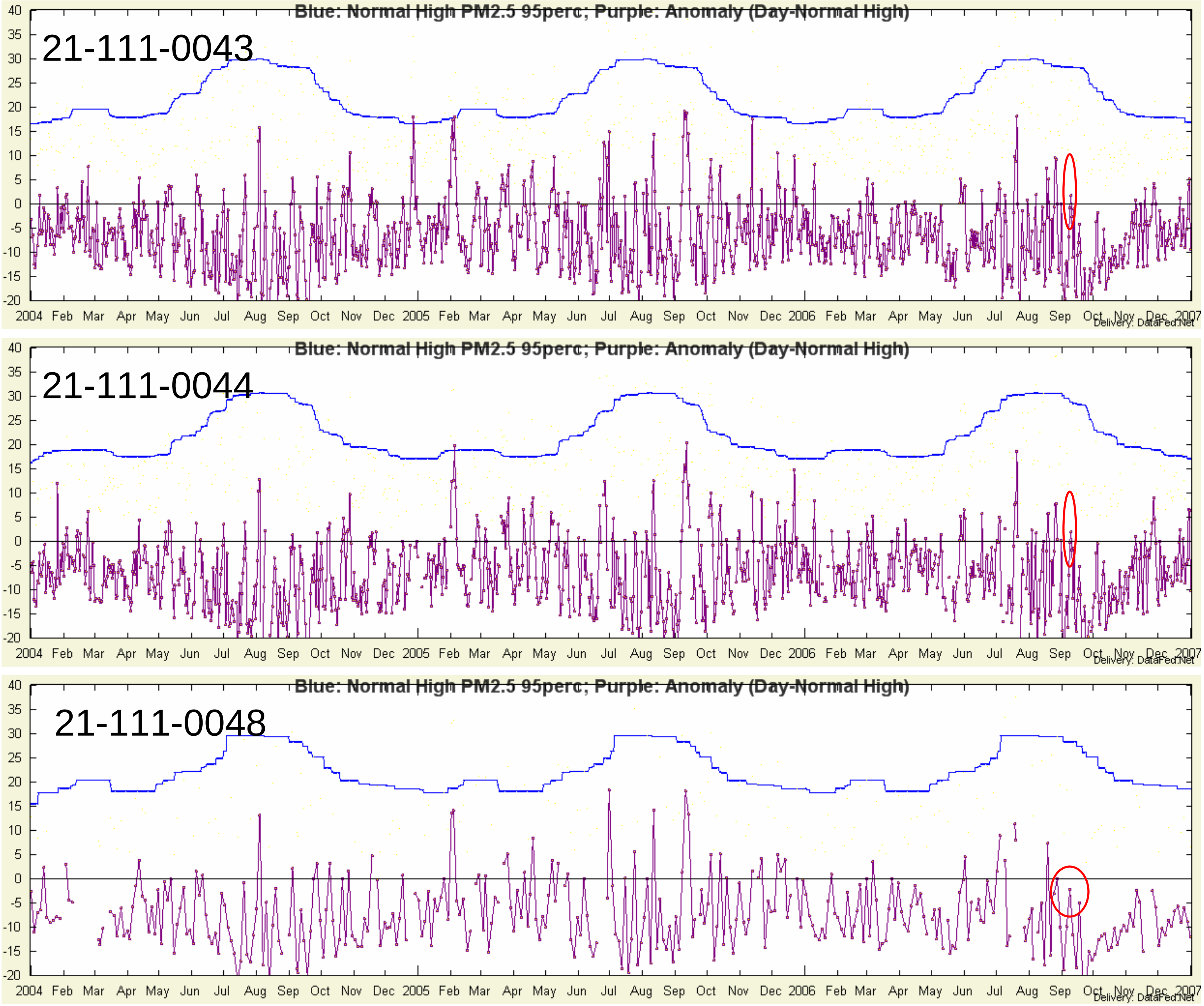
Modeled Smoke



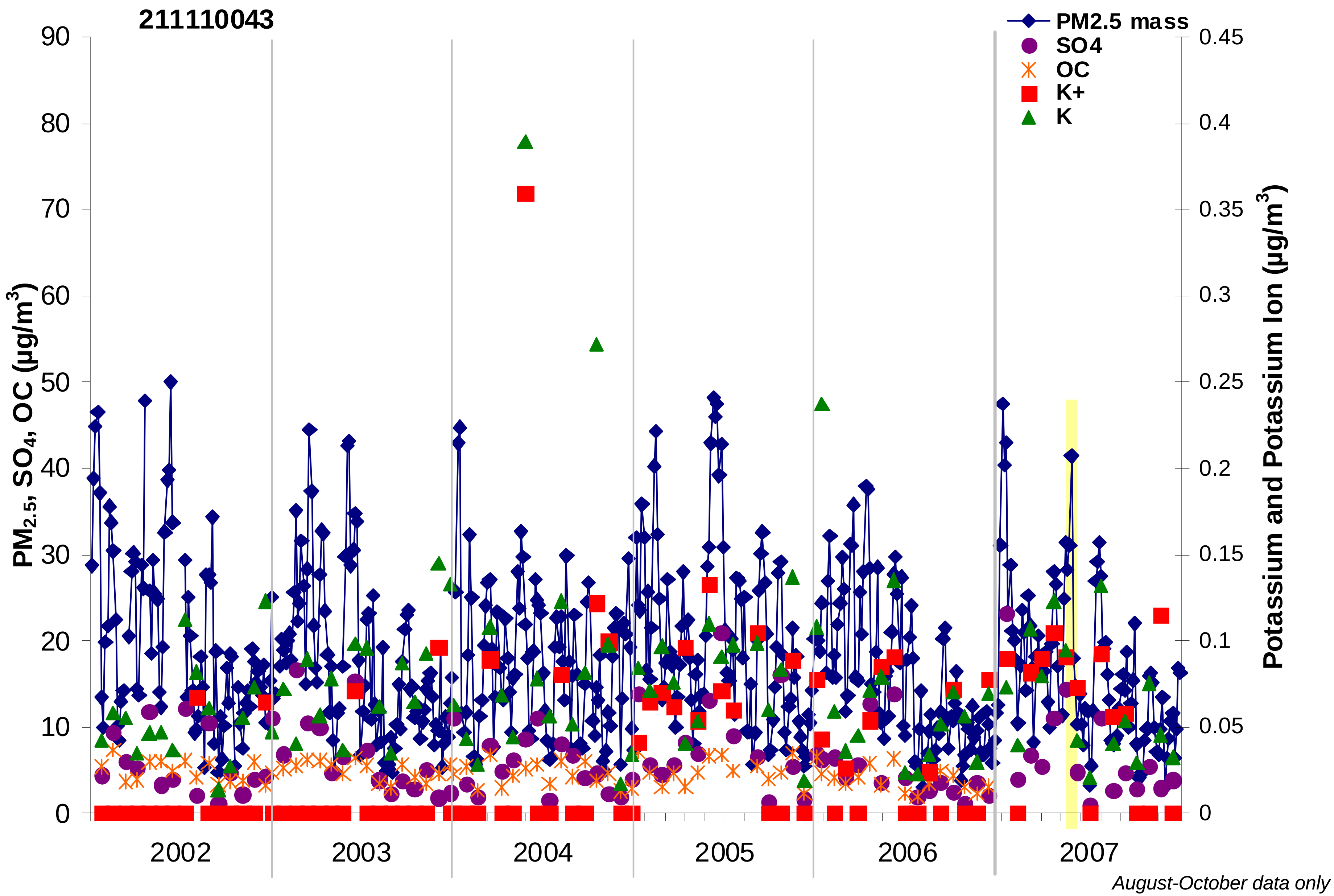
Modeled sulfate was low/moderate throughout the region and modeled smoke was low or zero throughout the region on 9/6/07.



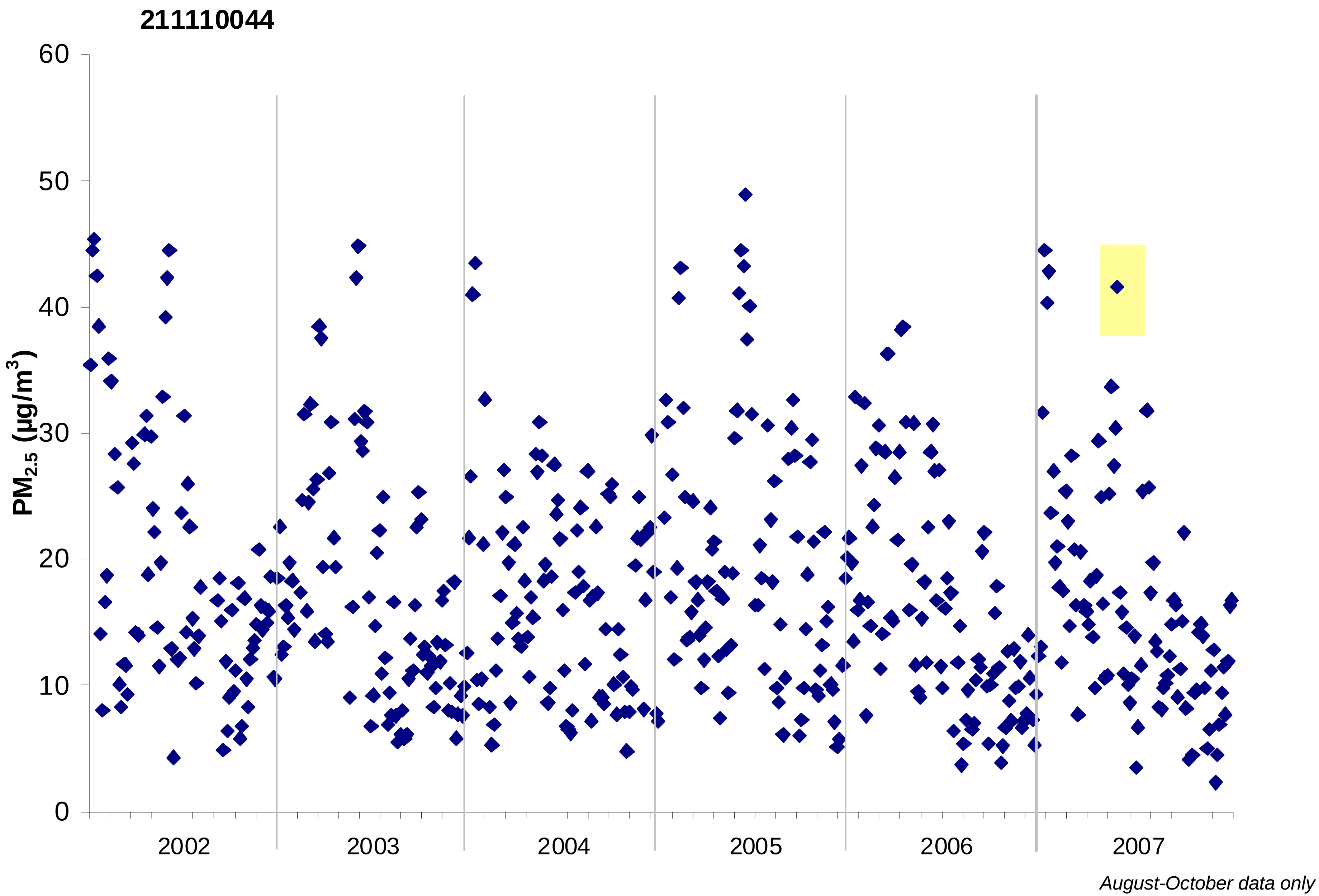
These maps show the computed difference between the $PM_{2.5}$ concentration on the given day and the historical 95th percentile of concentrations on all days (colored background), overlaid with the actual $PM_{2.5}$ concentration on the given day. On 9/6/07, concentrations were very close to the historical values.



The purple lines show the difference between the given day and the historical 95th percentile concentration. On 9/6/07, concentrations were very close to historical values.

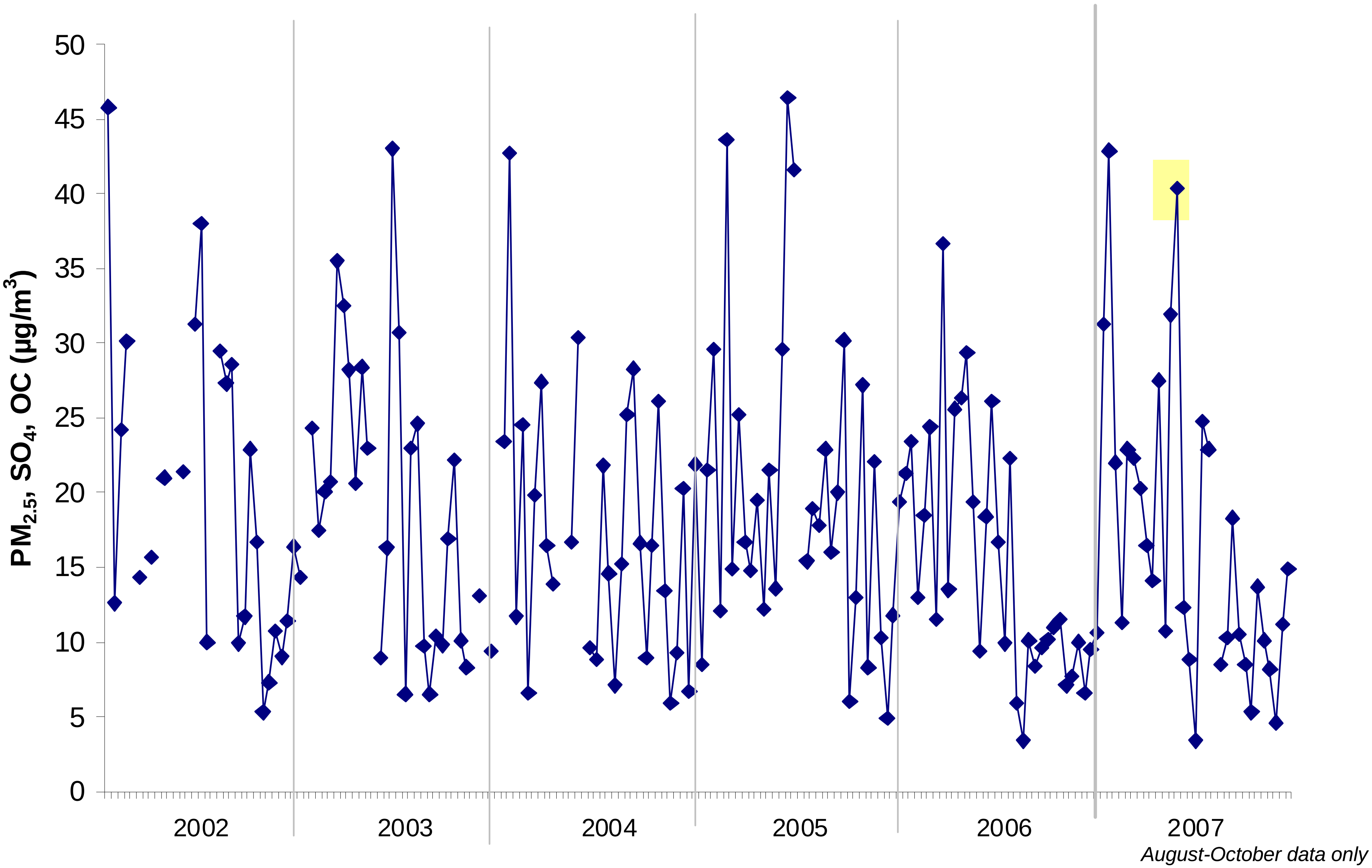


$PM_{2.5}$ concentrations were high on 9/6/07 (highlighted in yellow), but within the historical range of concentrations. OC concentrations were not available in 2007. Sulfate concentrations were high on the two samples prior to 9/6/07.



The $PM_{2.5}$ concentration is high but within the historical range of concentrations on 9/6/07 (highlighted in yellow).

211110048



The $PM_{2.5}$ concentration is high but within the historical range of concentrations on 9/6/07 (highlighted in yellow).

Summary

- Trajectories do not show a clear impact from the fire area on the Louisville area.
- Modeled sulfate concentrations were only moderate in the region on 9/6/07, but there was no modeled smoke impact.
- Meteorological conditions are conducive to a high $PM_{2.5}$ event (winds from the south likely transporting a humid air mass that would increase secondary particle formation and a strong upper level ridge limiting mixing).
- Concentrations at all sites are within the historical range and likely not impacted by forest fires.

Exceptional Events Analysis Louisville, KY

Multiple sites (21-111-0043, 21-111-0044,2 21-111-0048, 21-111-0051) evaluated for impact from fireworks

Years examined: 2004, 2005, 2006

Days Under Consideration

$PM_{2.5}$ concentrations in $\mu g/m^3$

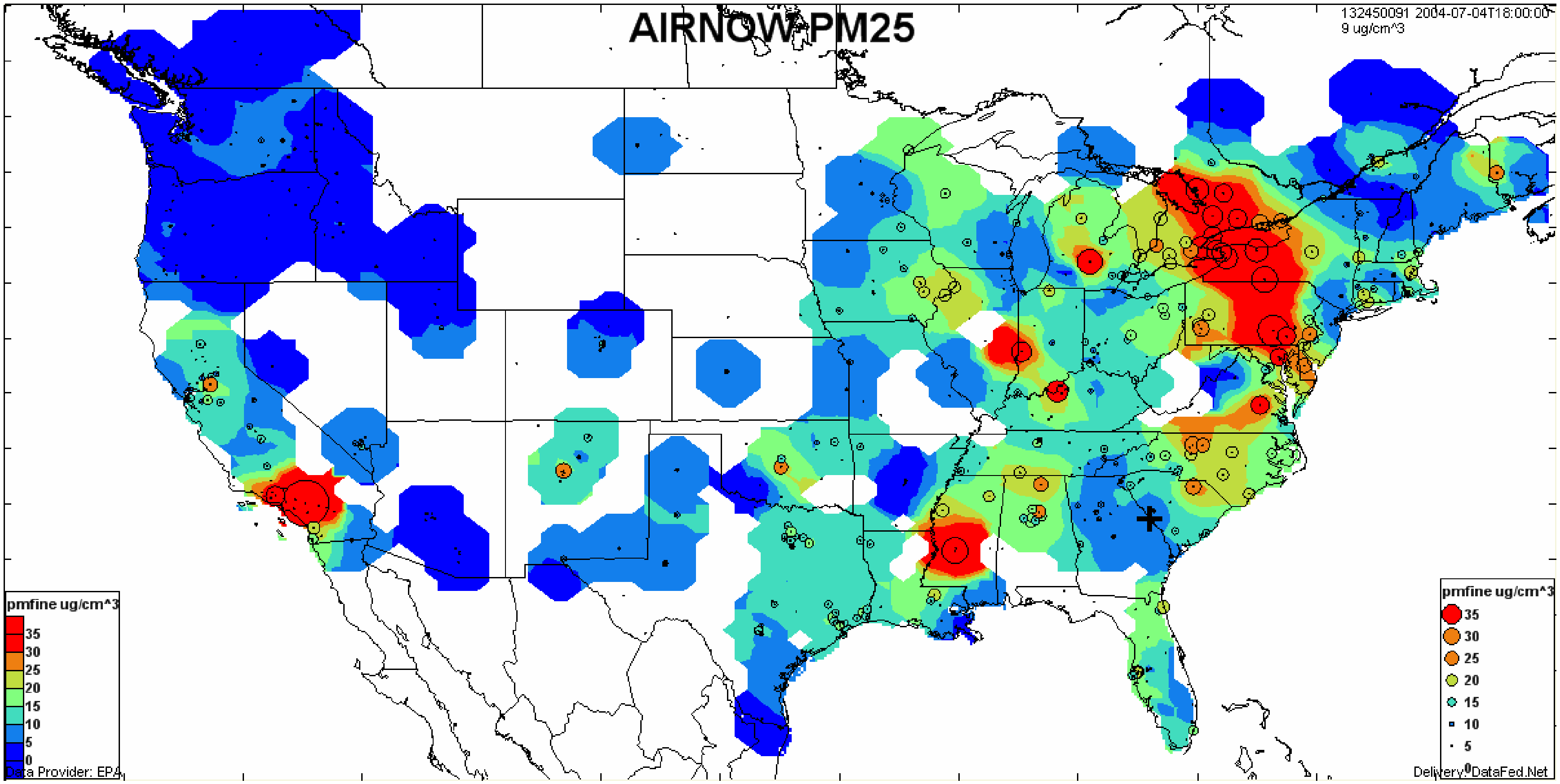
Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
July 4, 2004	33.1	26.4		
July 3, 2005	24.1	27.5	24.9	28.9
July 4, 2005	29.5	32.2		
July 3, 2006	31.7	32.1		
July 4, 2006	29.6	32.7	35.3	

2004

$PM_{2.5}$ concentrations in $\mu g/m^3$

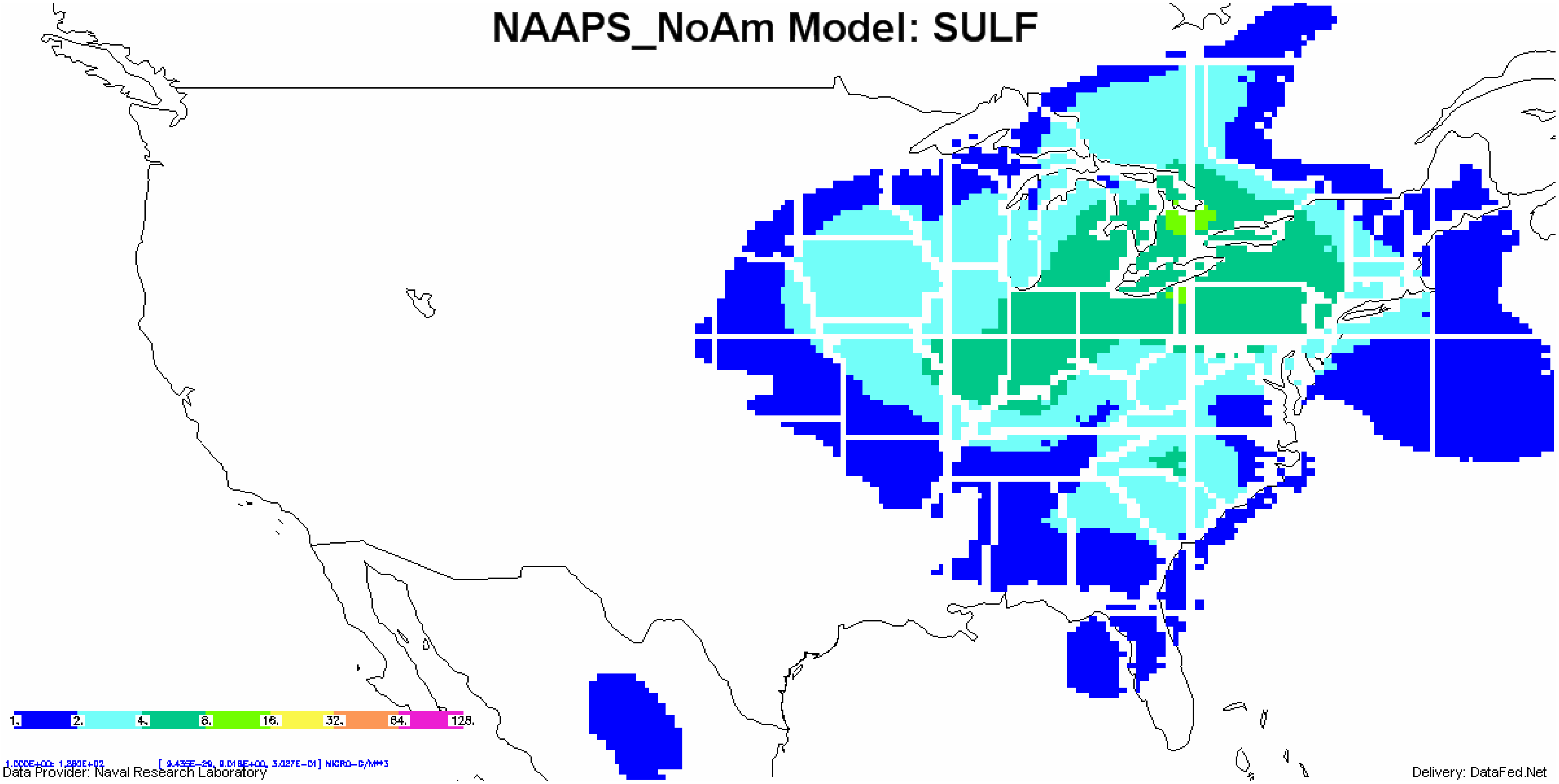
Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte
July 4, 2004	33.1	26.4

July 4, 2004 was flagged as exceptional at two sites. These values will be evaluated against the annual average $PM_{2.5}$ standard (15$\mu g/m^3$).



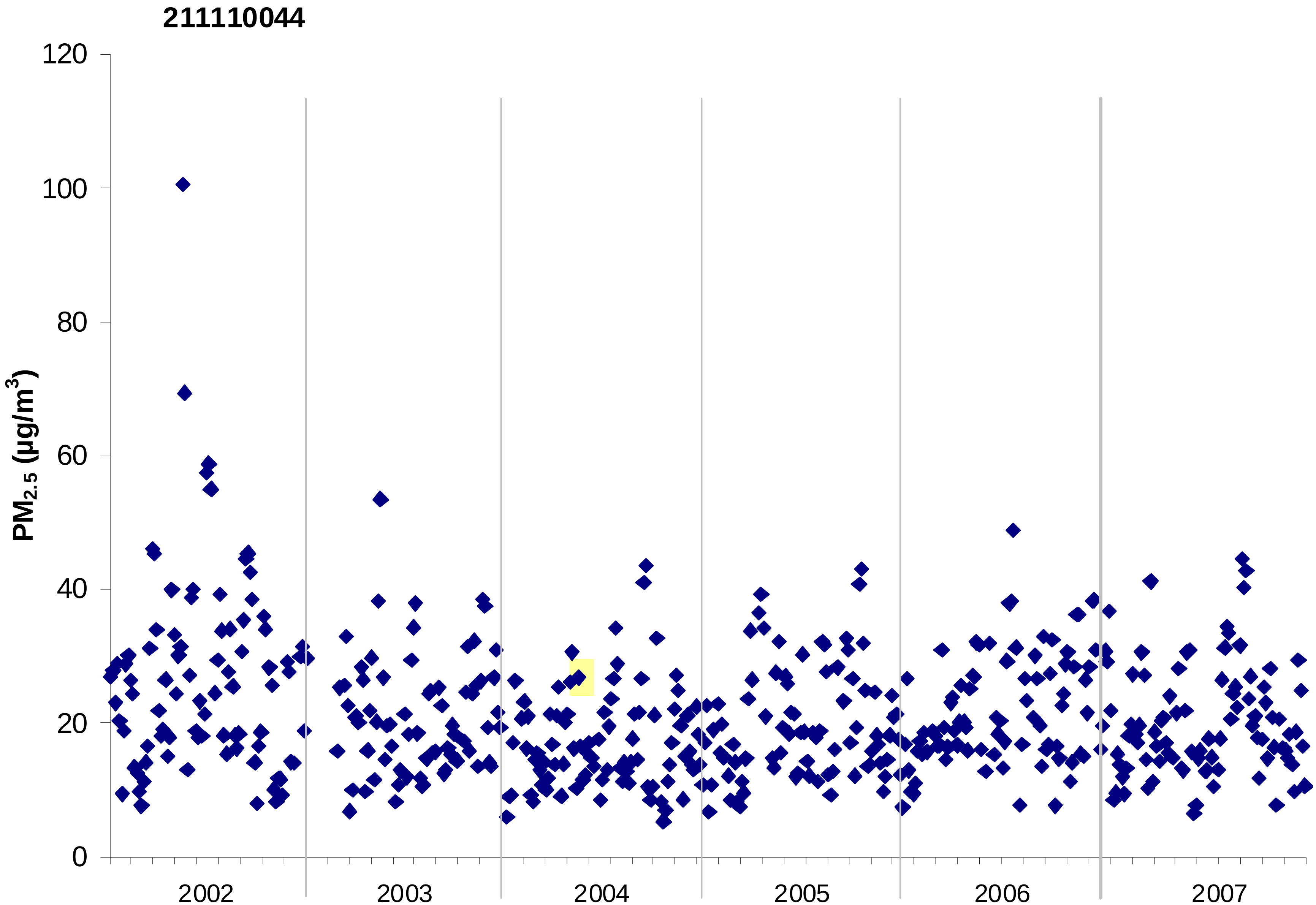
Relatively isolated areas of high PM2.5 are seen, indicating there was no regional event (i.e., from sulfate) causing high $PM_{2.5}$ concentrations.

http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/AIRNOW_PM25_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map



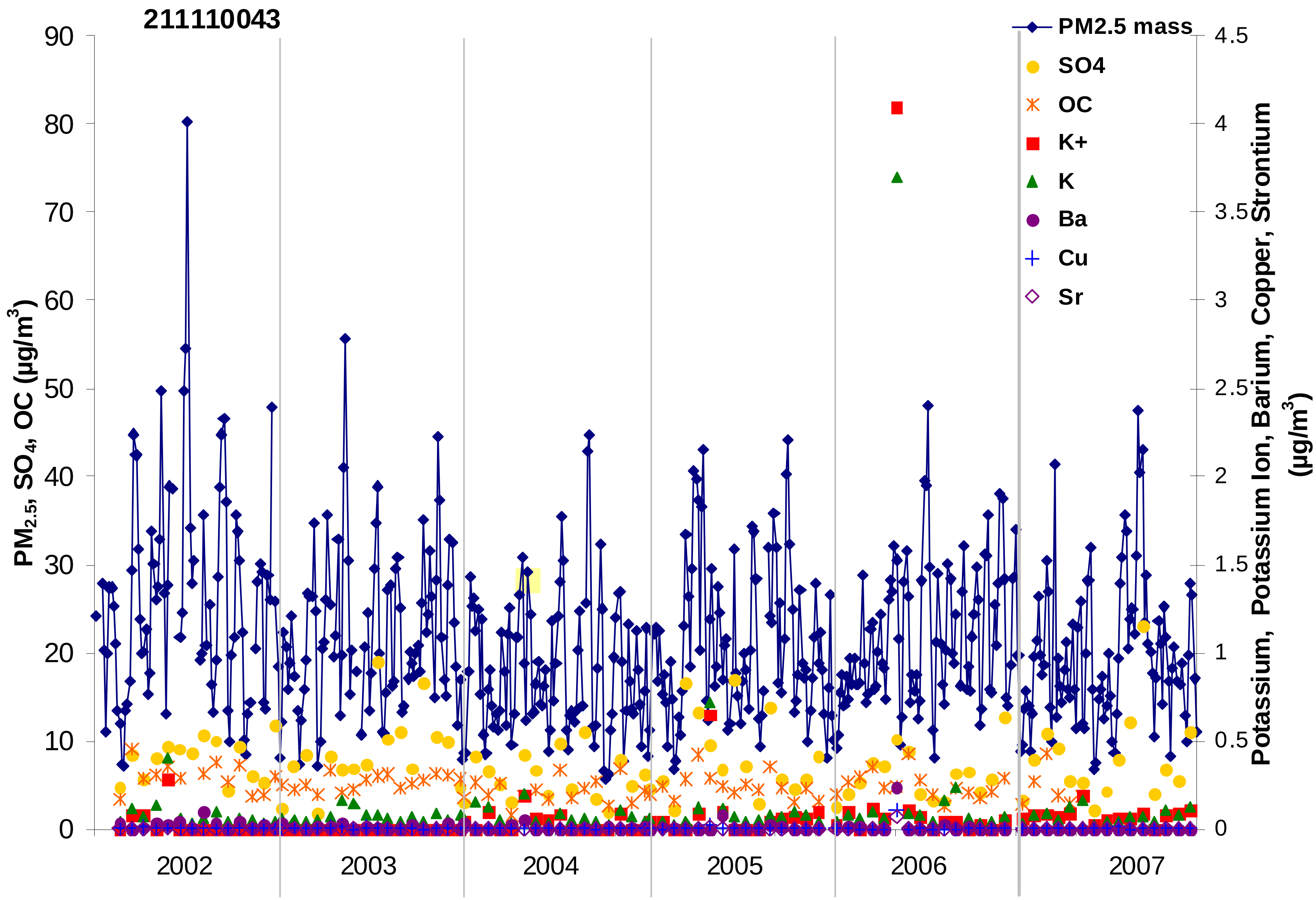
Modeled sulfate is low/moderate in Louisville on 7/4/04.

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf



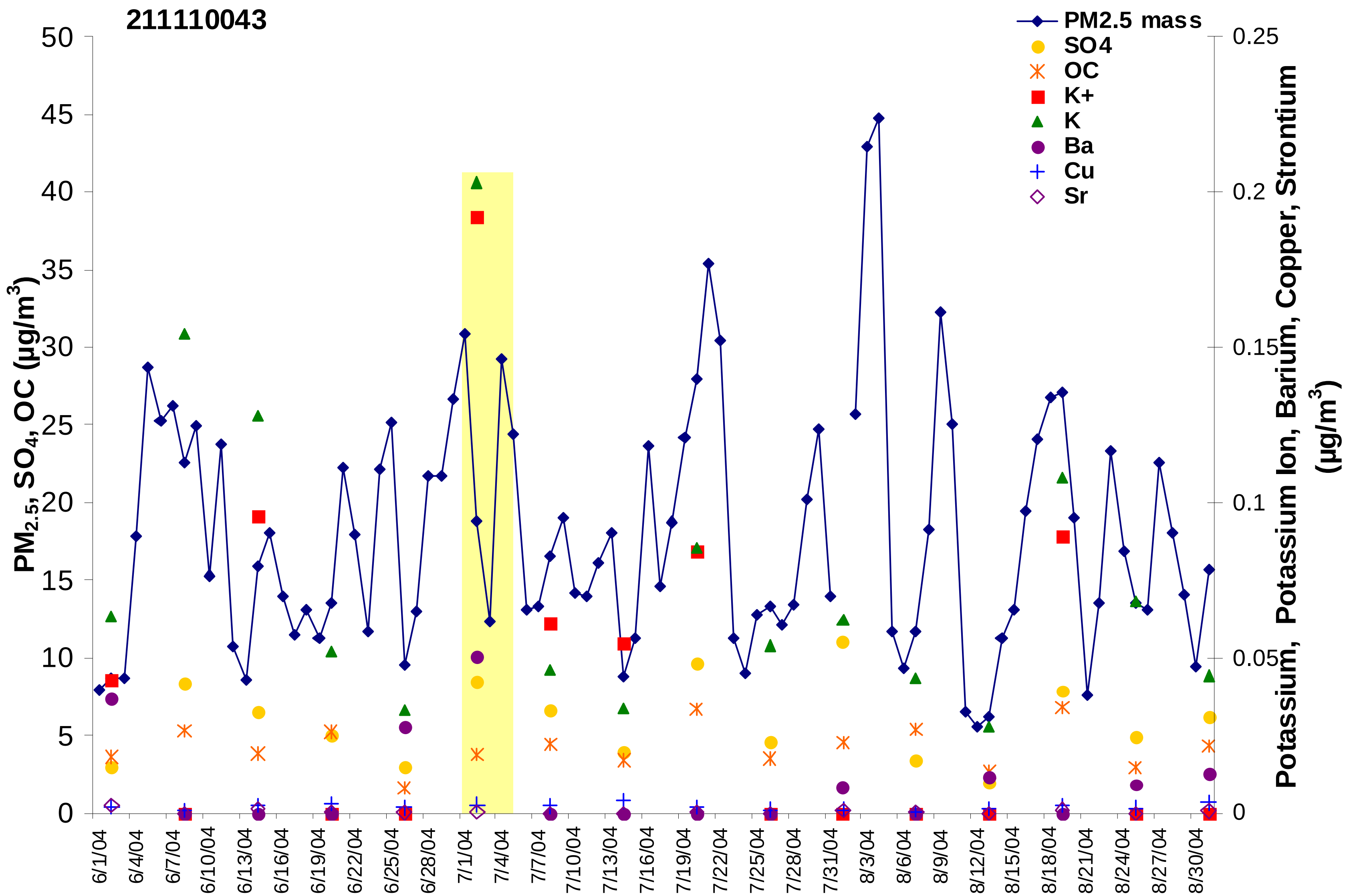
$PM_{2.5}$ concentrations at 21-111-0044 on 7/4/04 (highlighted in yellow) were well within the normal range of concentrations.

Data from AQS



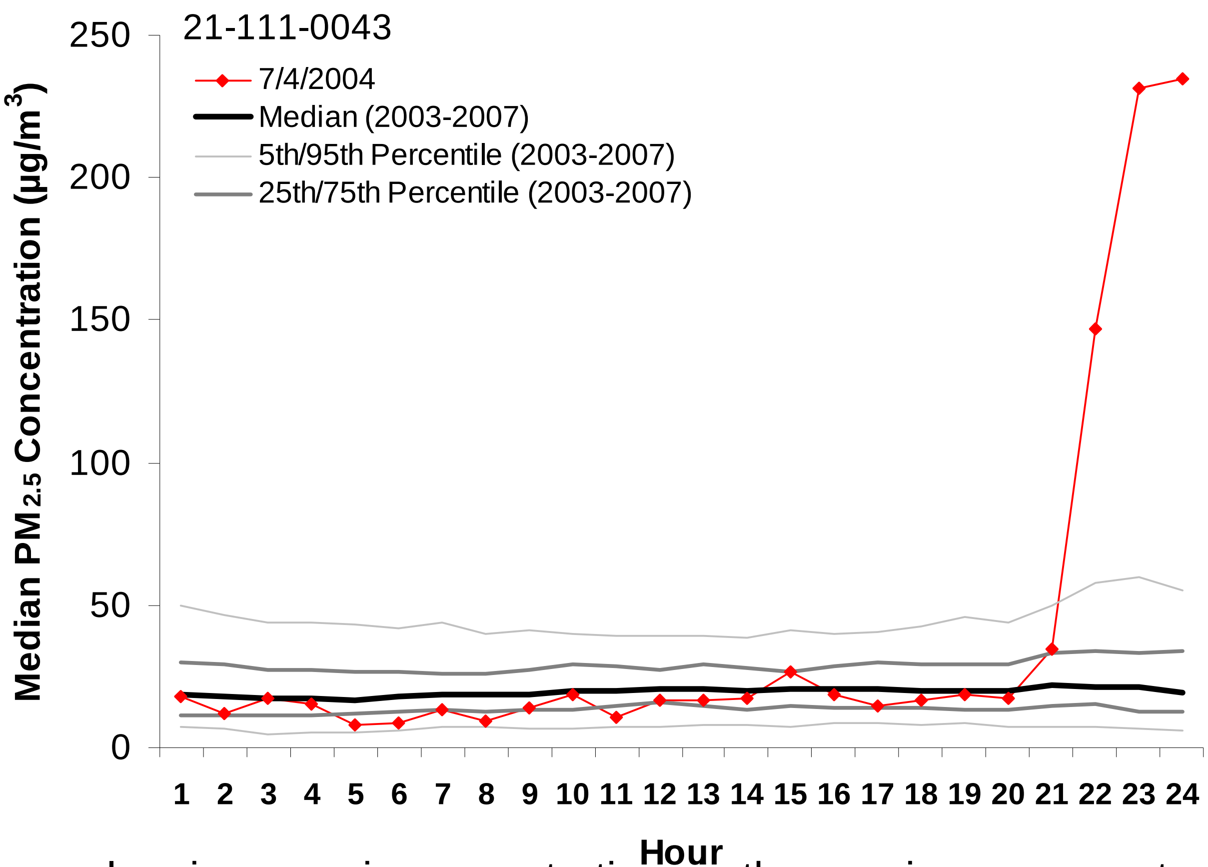
$PM_{2.5}$ concentrations at 21-111-0043 on 7/4/04 (highlighted in yellow) were well within the normal range of concentrations.

Data from AQS



Concentrations of various fireworks tracers are high on 7/2/04 (no measurements were available on 7/4/04).

Data from AQS



Hourly data show a clear increase in concentrations in the evening, as expected from fireworks. An upper-level trough of low pressure passing over the region led to enhanced vertical mixing in the atmosphere, limiting the impact of the fireworks. Concentrations returned to normal values within a few hours (not shown).

If the three highest hours (22-24) are replaced with the median or excluded, the 24-hour average decreases by about 60%.

The 24-hour filter measurement was also decreased by 60%, which decreased the quarterly average by 0.2µg/m^3 and the annual average by 0.05µg/m^3. This is not enough to bring the 3-year average below 15µg/m^3.

Hourly data is not available for site 21-111-0044, but it likely had a similar level of impact from fireworks.

Data from AQS

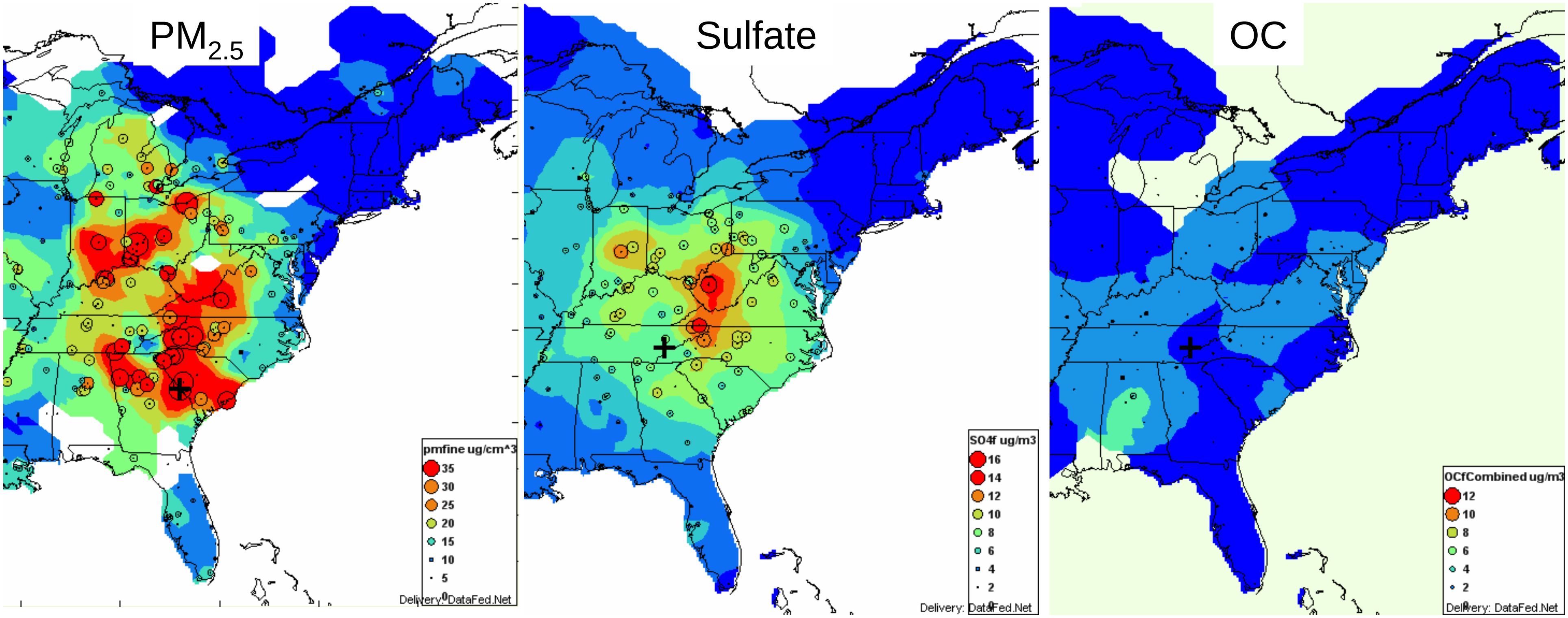
Summary: 2004

- A clear impact from fireworks was observed using hourly data and speciated data.
- Using the hourly data to estimate what the 24-hour average would be without the fireworks impact shows that the annual average and, therefore, 3-year average would not have been significantly impacted without the fireworks event.

2005

Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte	21-111-0048 Barret	21-111-0051 Watson
July 3, 2005	24.1	27.5	24.9	28.9
July 4, 2005	29.5	32.2		

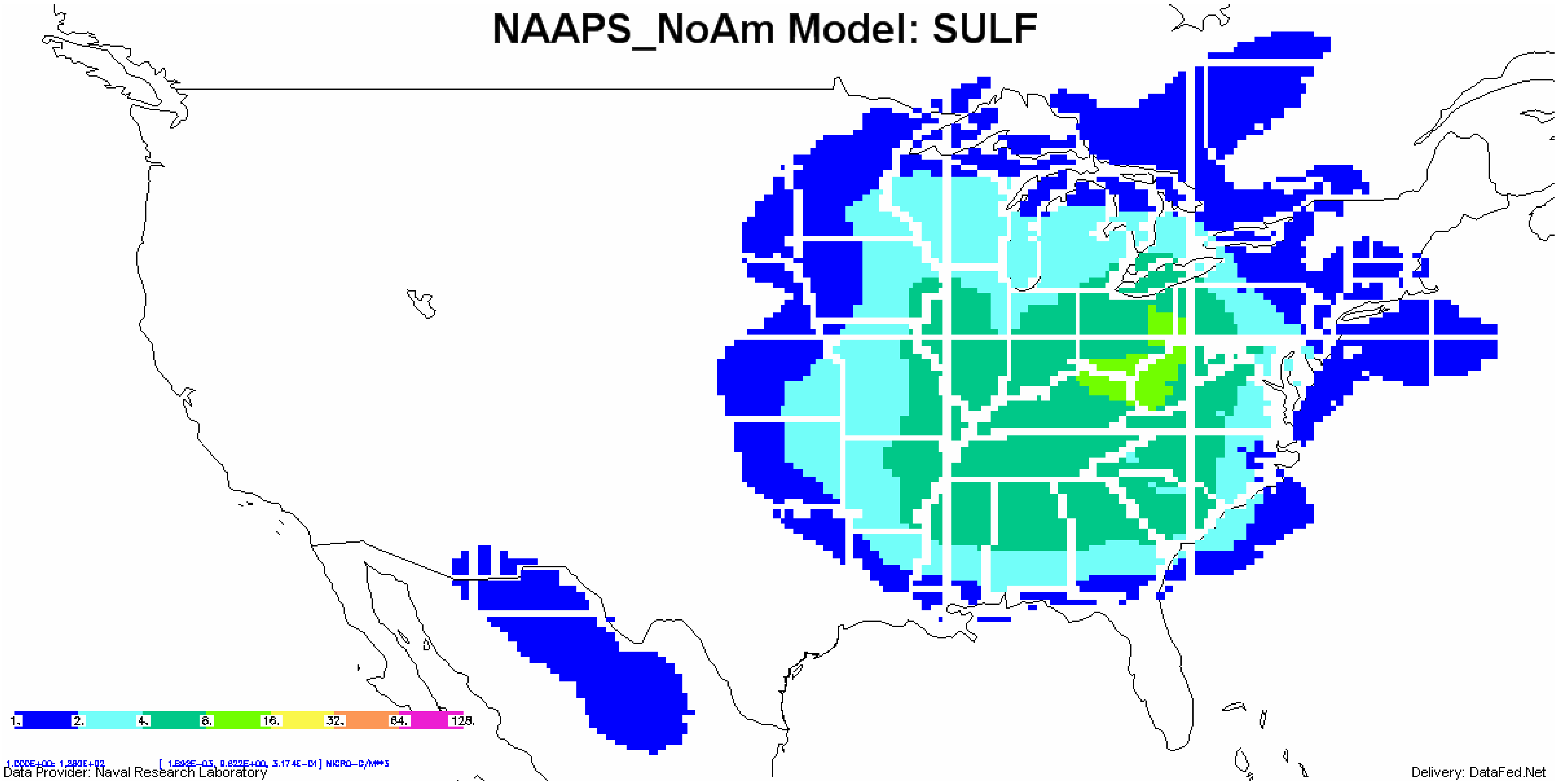
July 3, 2005 was flagged as exceptional at four sites and July 4, 2005 was flagged as exceptional at two sites. These values will be evaluated against the annual average $PM_{2.5}$ standard (15µg/m^3).



On 7/3/05, $PM_{2.5}$ concentrations were high in several areas throughout the region. Some high sulfate areas area also observed, but OC is low throughout the region.

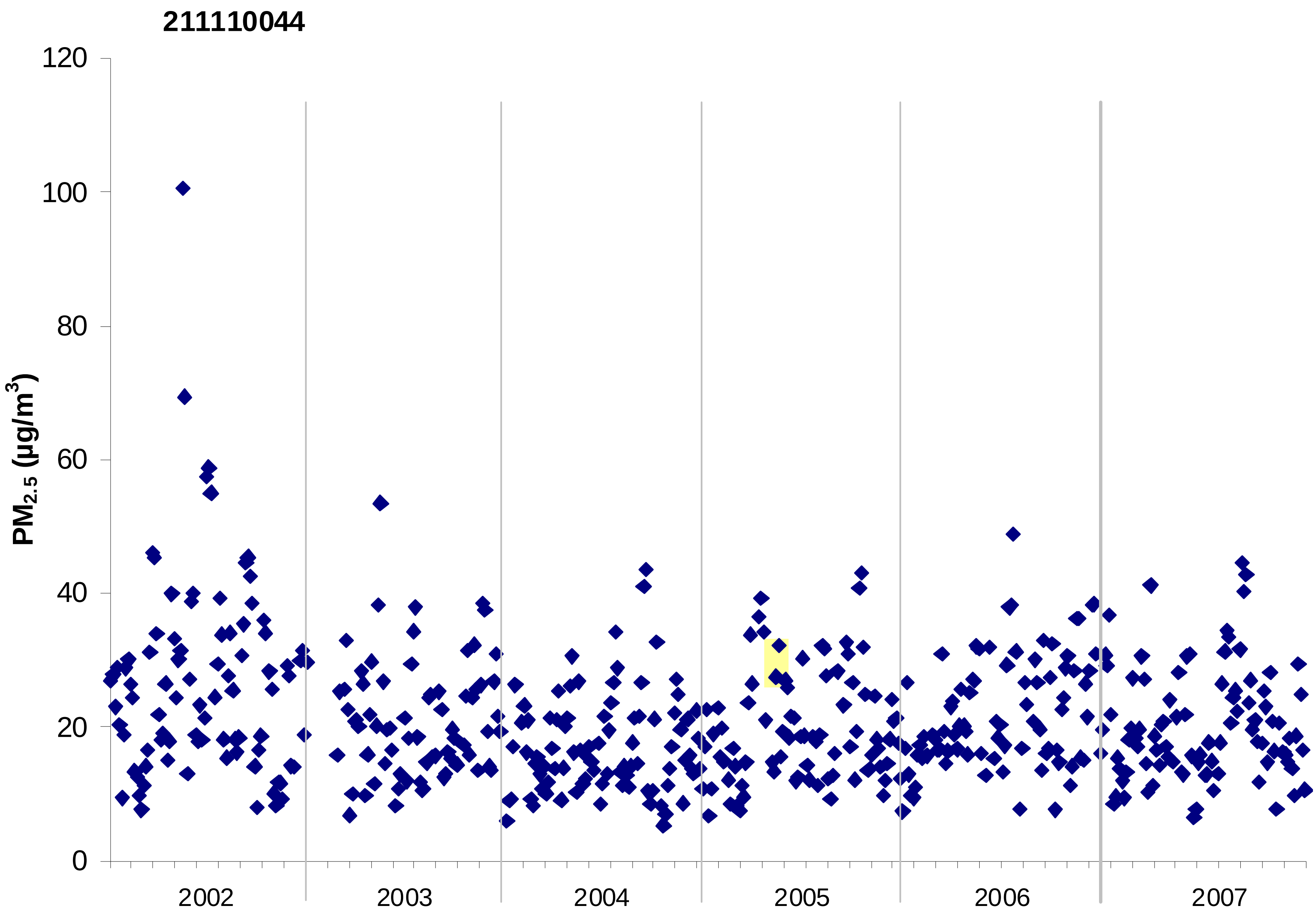
Sulfate and OC are not available on 7/4/05, but $PM_{2.5}$ showed similar areas of high concentrations.

http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/AIRNOW_PM25_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map



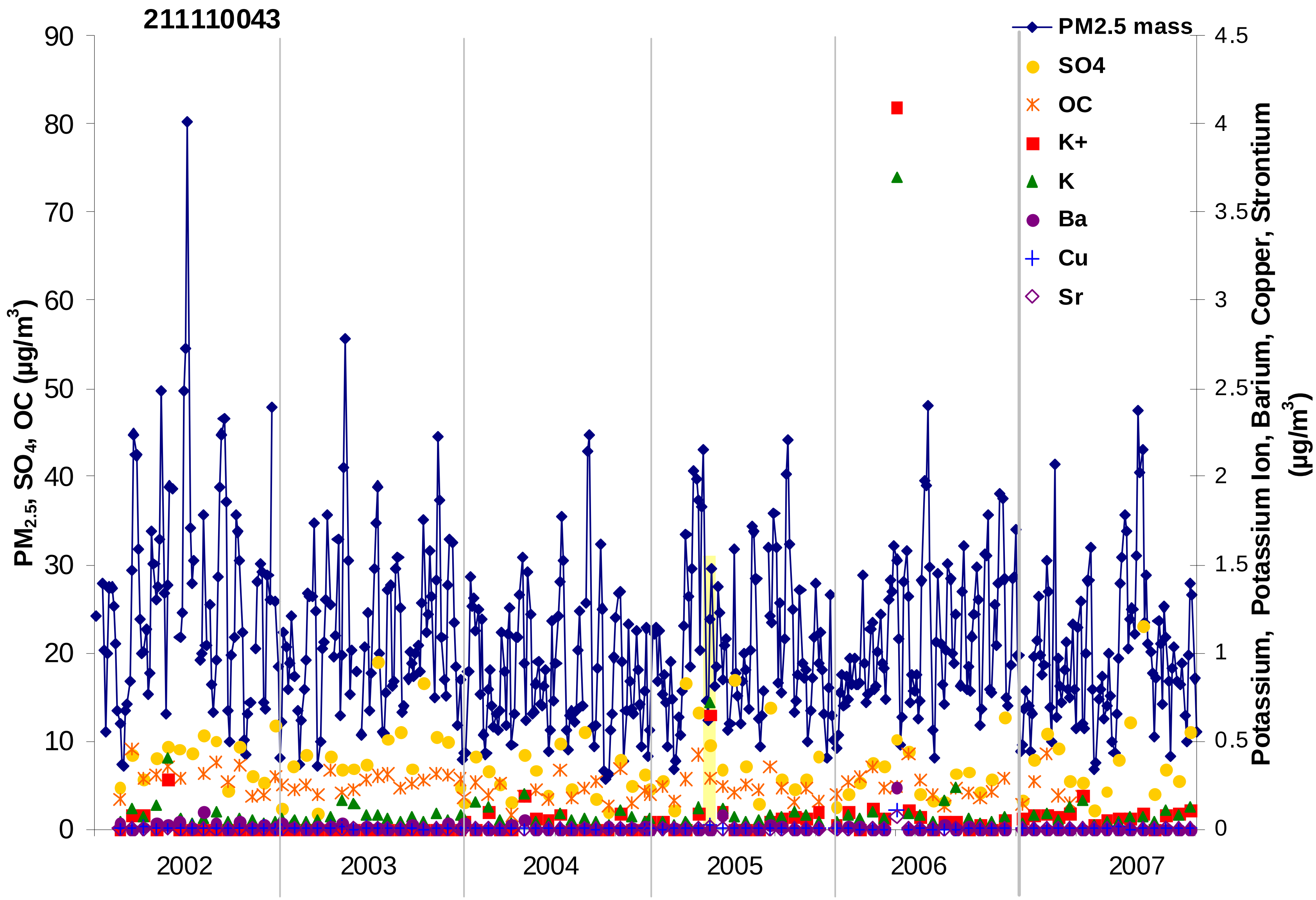
Modeled sulfate was moderate throughout Kentucky on 7/3/05. (Similar on 7/4/05)

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf



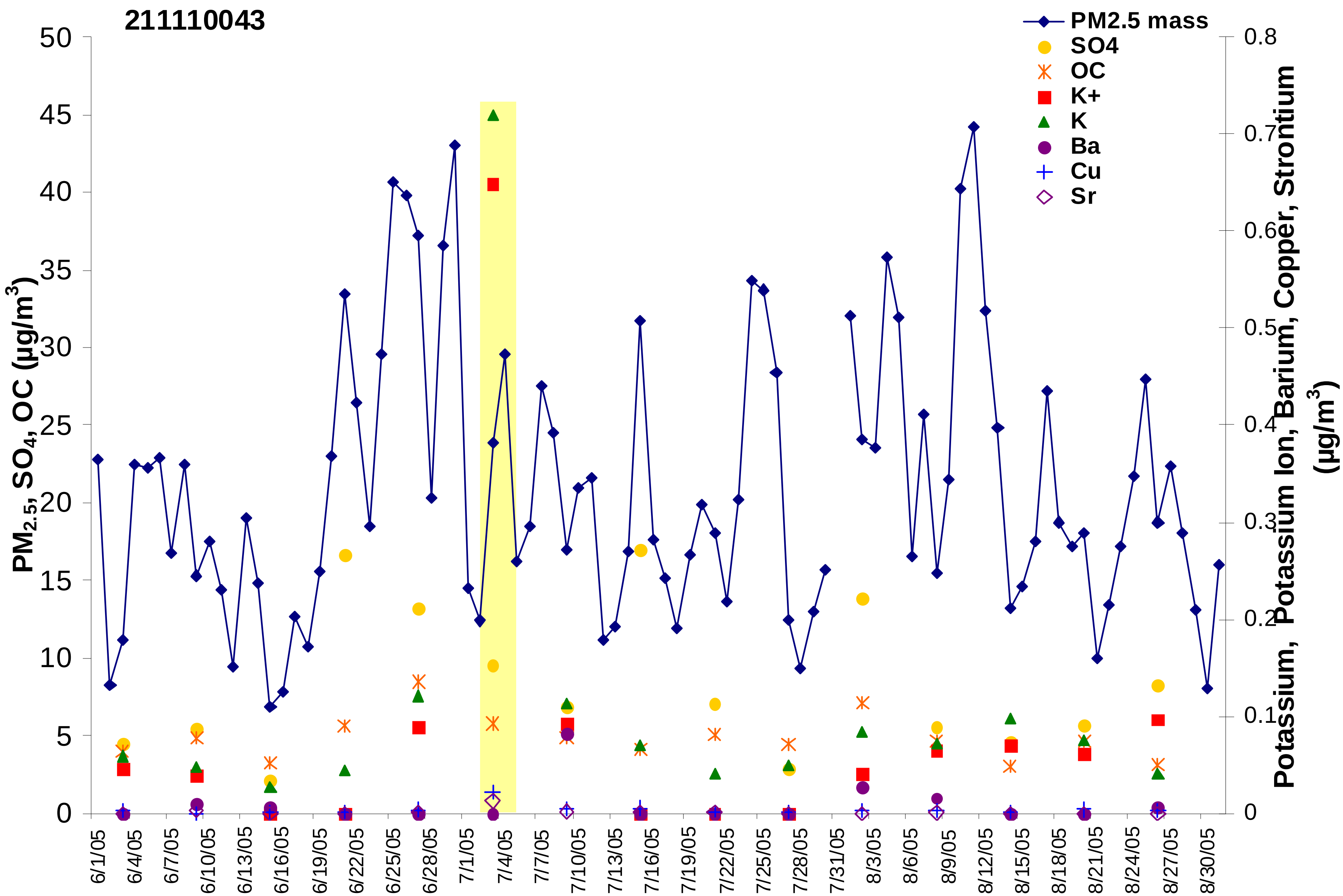
PM$_{2.5}$ concentrations at 21-111-0044 on 7/3/05-7/4/05 (highlighted in yellow) were well within the normal range of concentrations.

Data from AQS



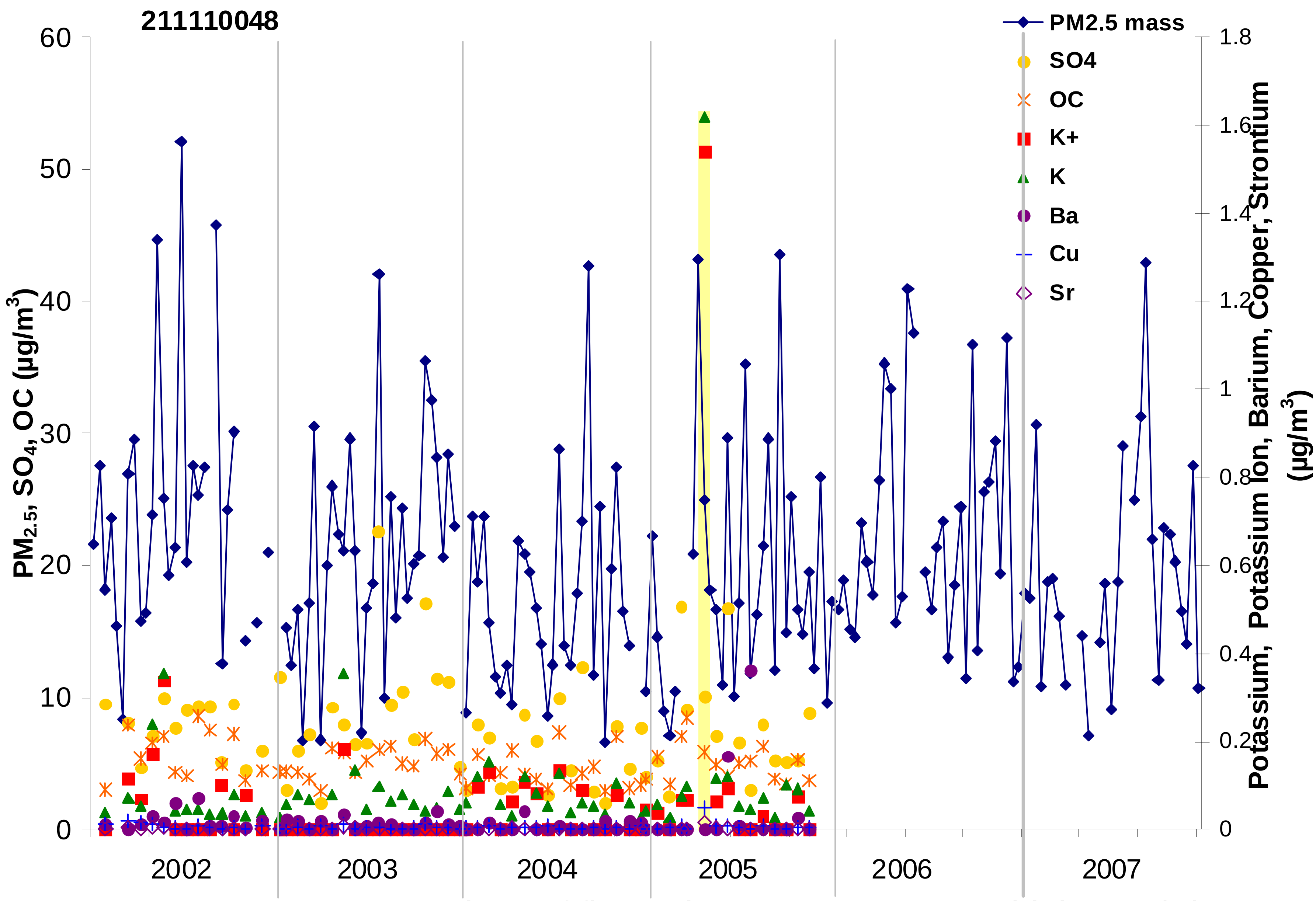
$PM_{2.5}$ concentrations at 21-111-0043 on 7/3/05-7/4/05 (highlighted in yellow) were well within the normal range of concentrations.

Data from AQS



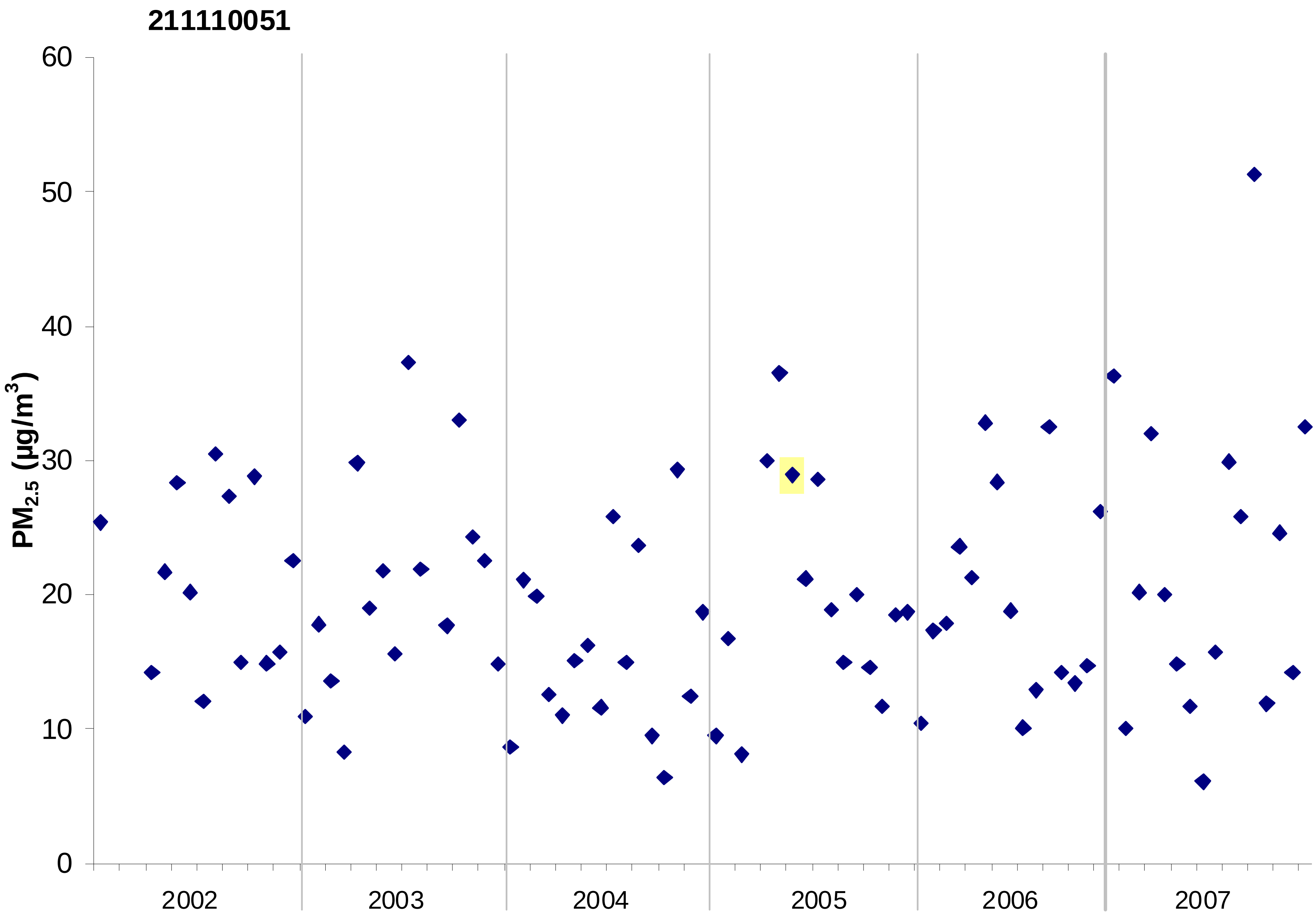
Concentrations of fireworks tracers at 21-111-0043 were high on 7/3/05 (measurements not available on 7/4/05).

Data from AQS



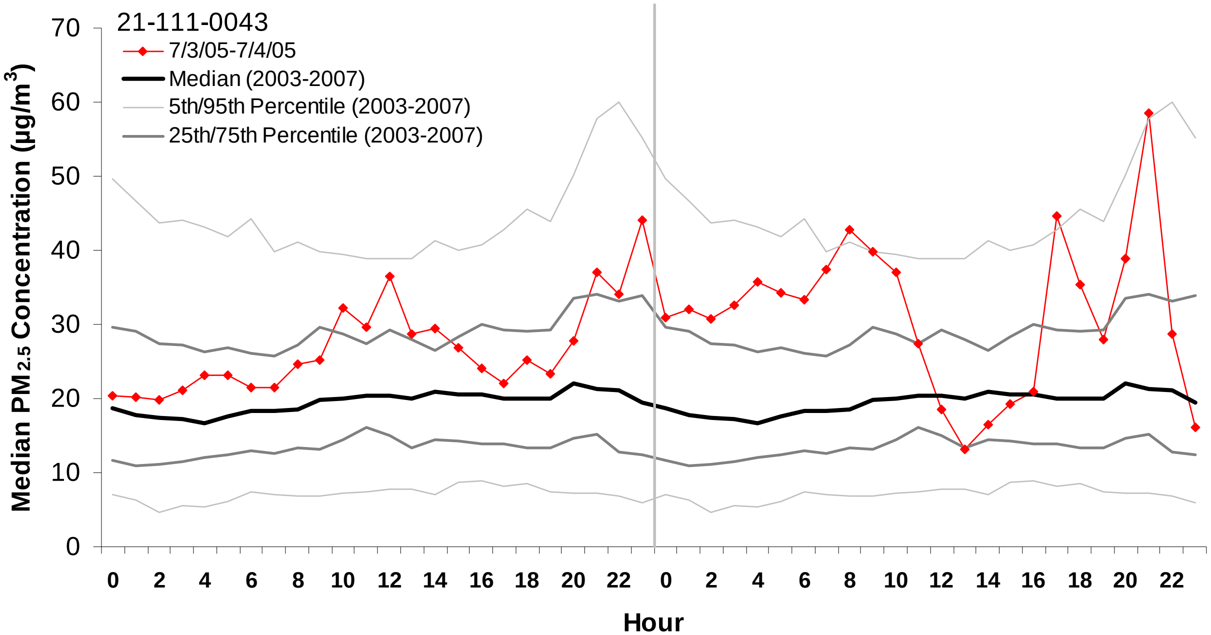
At 21-111-0048, concentrations of fireworks tracers were very high on 7/3/05; concentrations of $PM_{2.5}$ were within the typical range of concentrations.

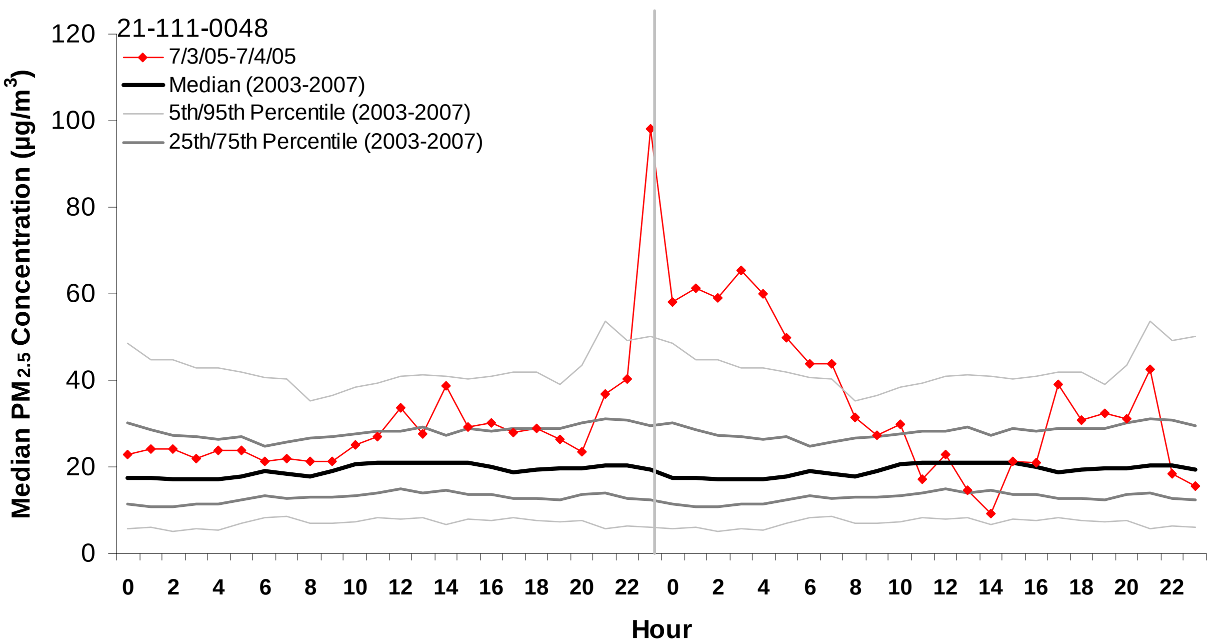
Data from AQS



Concentrations of PM2.5 at 21-111-0051 were within the historical range of concentrations on 7/3/05.

Data from AQS





No large increase in hourly concentrations, as expected from a single fireworks event, is seen at 21-111-0043. However, concentrations at several hours are near the 95th percentile of concentrations.
A large spike in concentration is seen at midnight on July 3rd. It's possible that because the 4th of July was on a Monday, large firework displays were set off the day before. Additionally, there was limited dispersion due to calm winds, an overnight surface inversion, and an strong subsidence inversion at 800 mb, which likely caused concentrations at 21-111-0048 to remain elevated for several hours.

Similar to the analysis for 7/4/04, the percent increase due to the fireworks was calculated and applied to the 24-hour filter measurement. The annual average decreased by less than 0.01µg/m^3 at 21-111-0043 and 0.02µg/m^3 at 21-111-0048, not enough to be below the standard or to affect the 3-year average.

Data from AQS

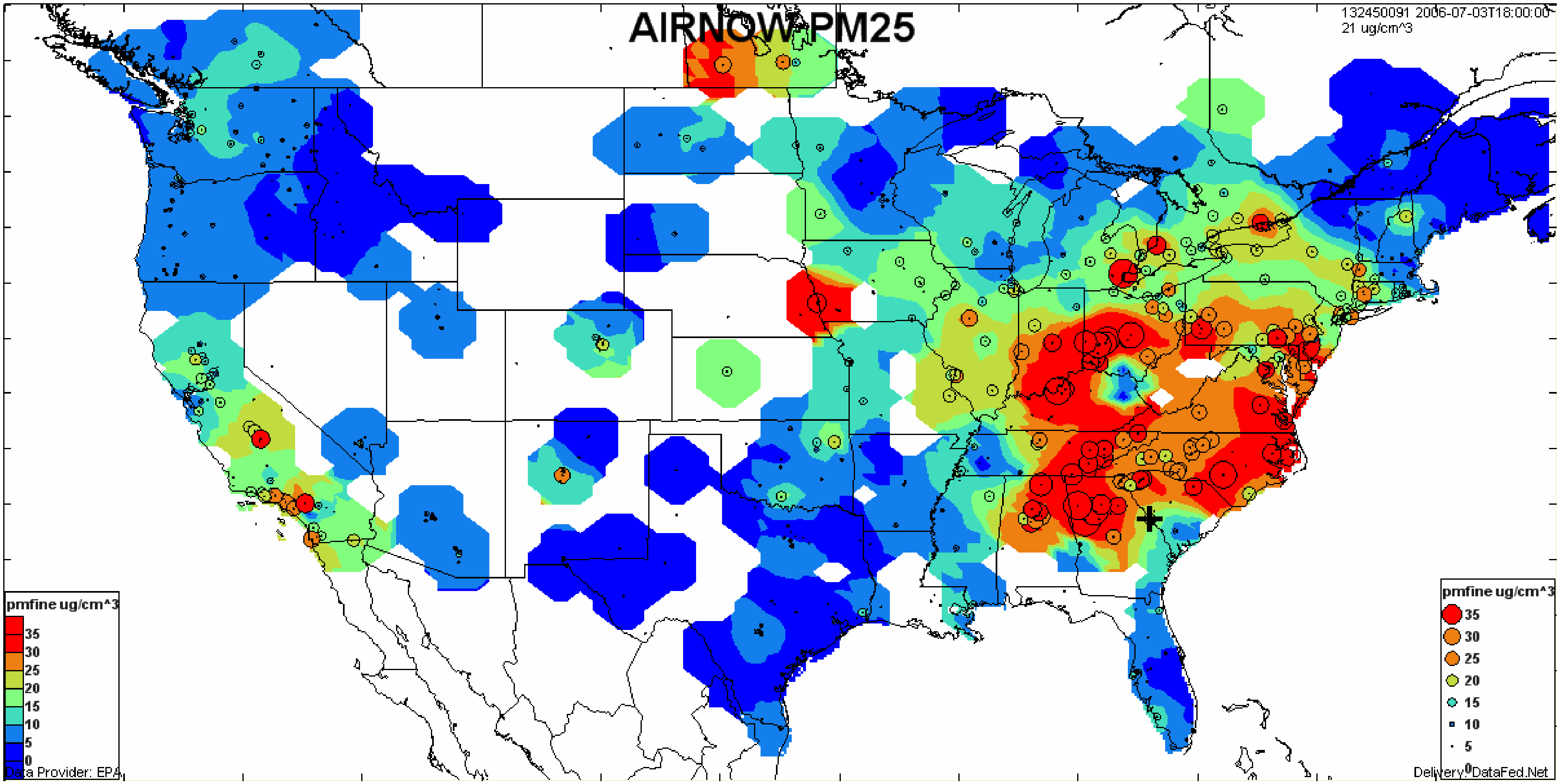
Summary: 2005

- Based on high concentrations of fireworks tracers and short (hourly) increases in PM2.5 concentrations on 7/3/05 and 7/4/05, it is likely that fireworks were impacting $PM_{2.5}$ concentrations.
- However, 24-hour concentrations were not exceptionally high and would likely not have been low enough without the influence of fireworks to impact the annual average.

2006

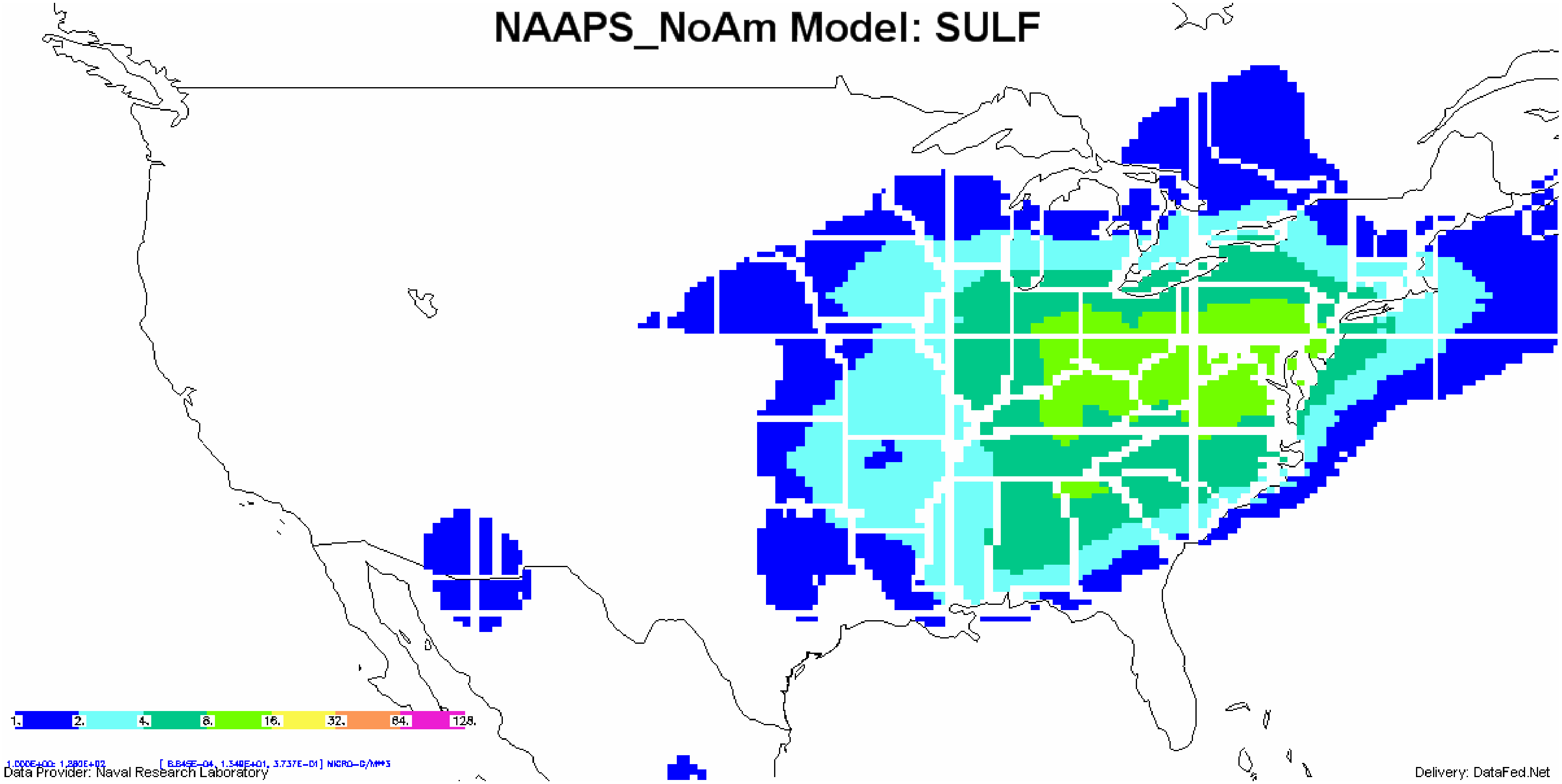
Date	21-111-0043-1 Southwick	21-111-0044 Wyandotte	21-111-0048 Barret
July 3, 2006	31.7	32.1	
July 4, 2006	29.6	32.7	35.3

July 3, 2006 was flagged as exceptional at two sites and July 4, 2006 was flagged as exceptional at three sites. These values will be evaluated against the annual average $PM_{2.5}$ standard (15µg/m^3). The July 4, 2006 value at 21-111-0048 will also be evaluated against the 24-hour standard (35µg/m^3).



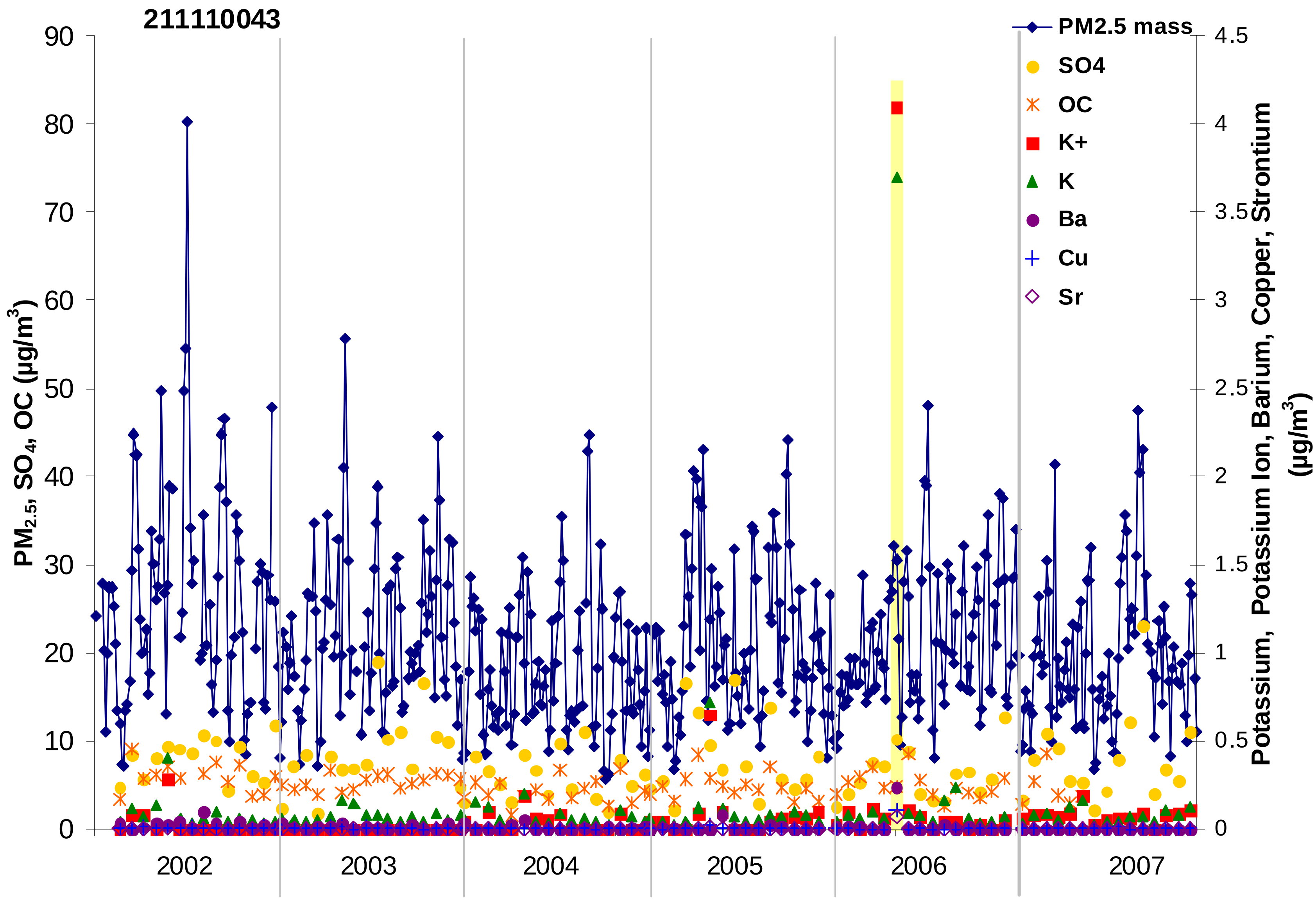
PM2.5 concentrations were high throughout the southeast on 7/3/06 (similar on 7/4/06).

http://www.datafed.net/consoles/user_consoles.asp?view_states=ARC/AIRNOW_PM25_map,ARC/VIEWS_SO4_map,ARC/VIEWS_OCfCombined_map



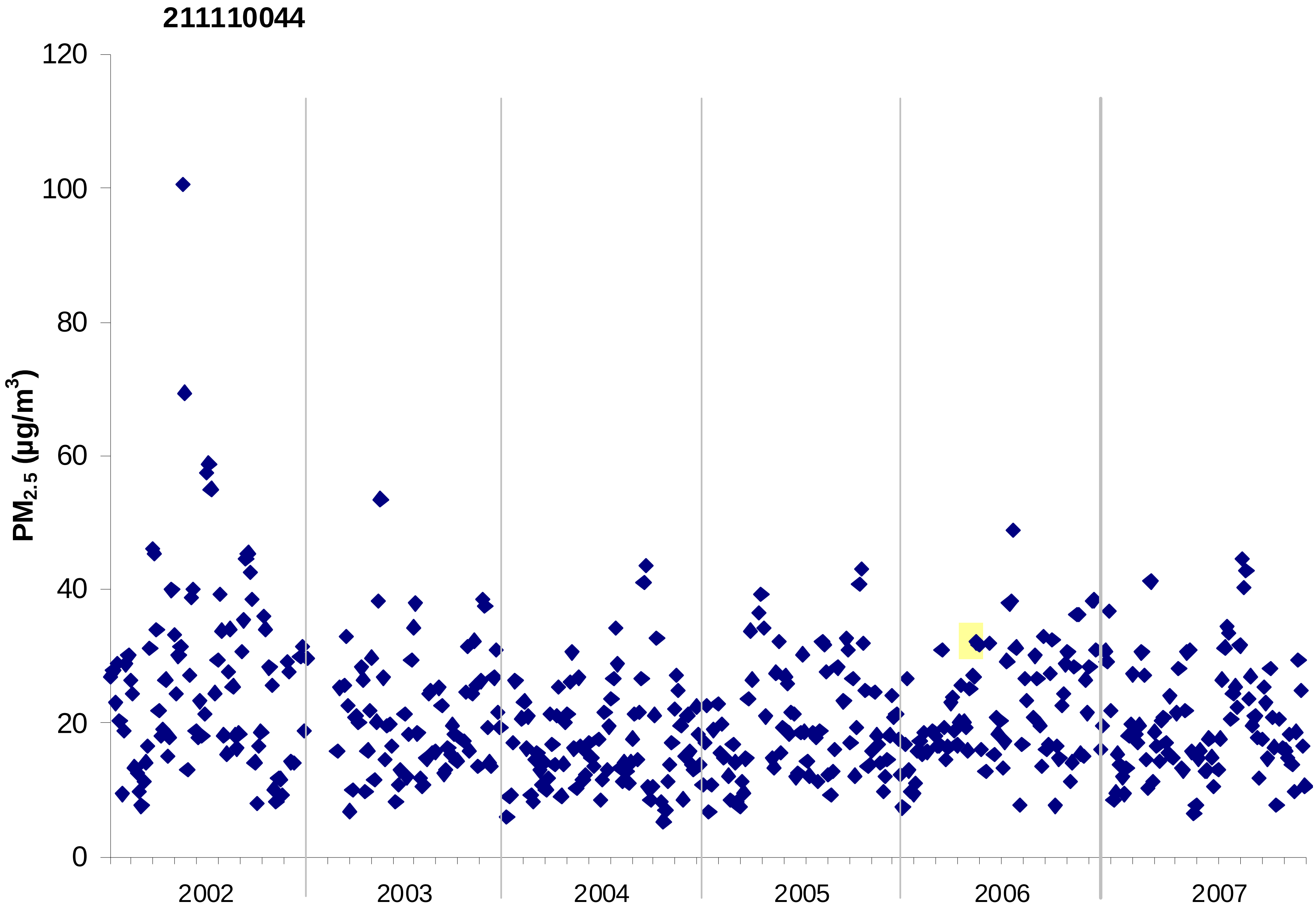
Modeled sulfate was moderate throughout the region on 7/3/06 (7/4/06 was similar).

http://webapps.datafed.net/datafed.aspx?page=ARC/NAAPS_NoAm_Sulf



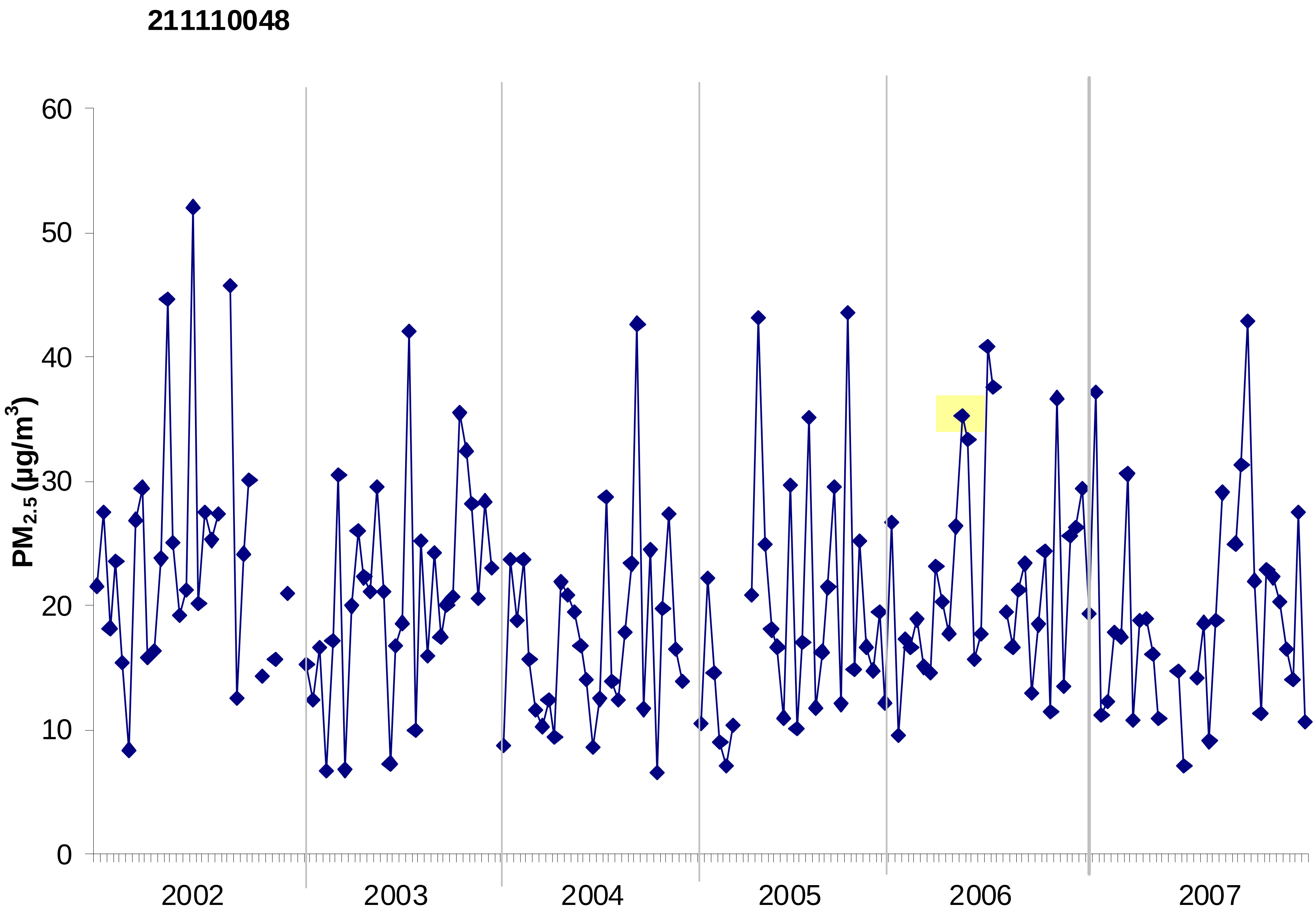
$PM_{2.5}$ concentrations at 21-111-0043 on 7/3/06-7/4/06 (highlighted in yellow) were well within the normal range of concentrations. Fireworks tracer species were high on 7/4/06.

Data from AQS



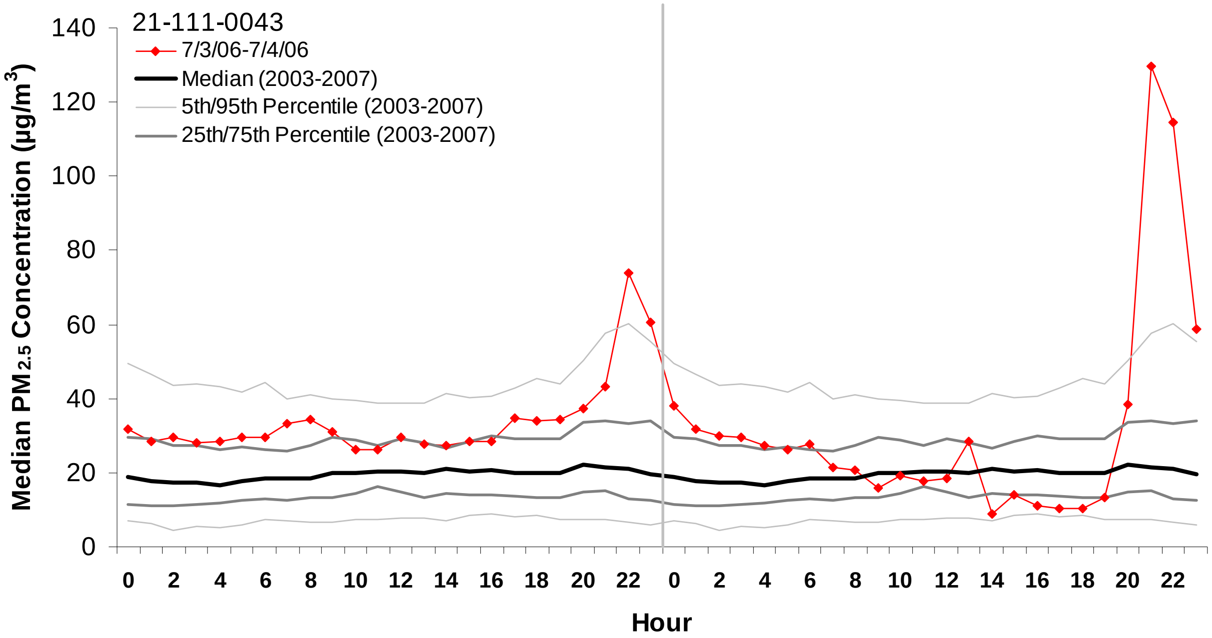
$PM_{2.5}$ concentrations at 21-111-0044 on 7/3/06-7/4/06 (highlighted in yellow) were well within the normal range of concentrations.

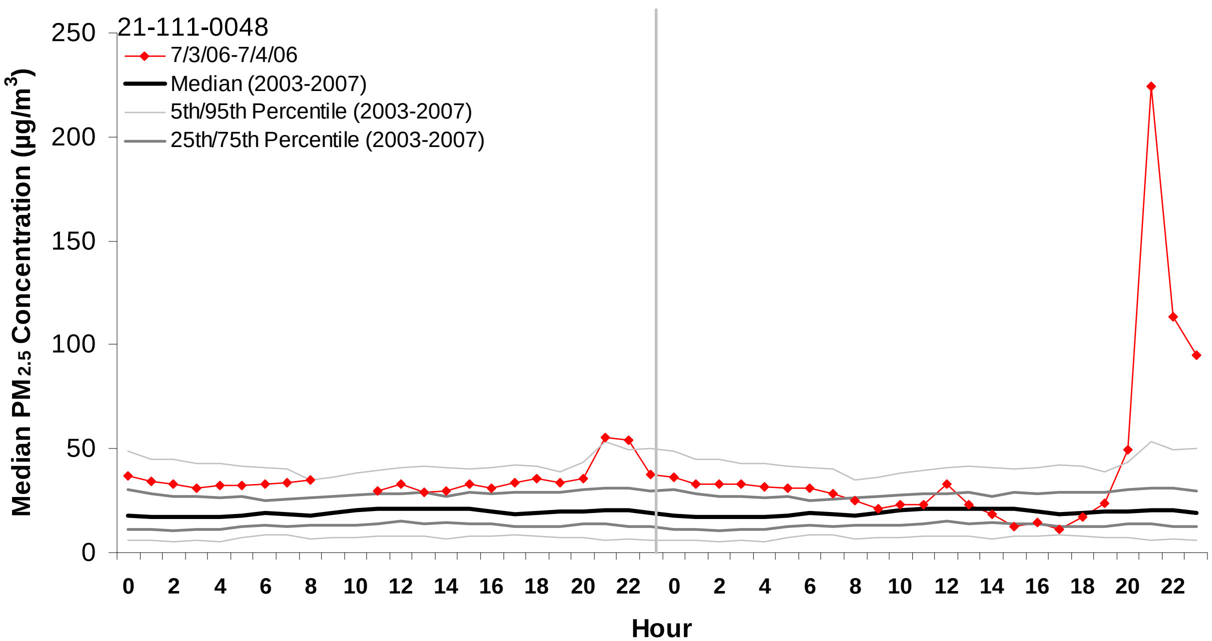
Data from AQS



At 21-111-0048, concentrations of $PM_{2.5}$ were within the typical range of concentrations. Speciated data was not available for 2006 at this site.

Data from AQS





Large spikes in concentration were seen on 7/4/04 at hours 22-24. Smaller spikes were seen the previous night. The impact from the fireworks was limited to a few hours due to light/moderate winds throughout the night, a weak upper-level trough, and the lack of a surface inversion, all of which enhanced mixing.

As for other years, the percent increase due to the fireworks was calculated and applied to the 24-hour filter measurement. The annual average decreased 0.02µg/m^3 at both sites, not enough to be below the standard or to affect the 3-year average. At 21-111-0048, it is estimated that the 24-hr filter measurement (35.3µg/m^3) would be 38% lower (21.9µg/m^3) without the impact from fireworks. This would be well below the standard.

Data from AQS

Summary: 2006

- As in the previous years, high concentrations of fireworks tracers and short (hourly) increases in $PM_{2.5}$ concentrations on 7/3/05 and 7/4/05 indicate that fireworks were impacting $PM_{2.5}$ concentrations.
- 24-hour concentrations were not exceptionally high and would likely not have been low enough without the influence of fireworks to impact the annual average.
- July 4, 2006 was also evaluated against the 24-hour standard; it is likely this date would have been well below the standard without impact from fireworks.

Summary: 2004-2006

- There is evidence of impact from fireworks on/around July 4 for all years examined (2004-2006).
- Using hourly data, it is estimated that the impact of the fireworks on the annual average for each year is 0.01-0.02 $\mu g/m^3$, not enough to impact the design value at each site.
- One sample, July 4, 2006, 21-111-0048, was also above the 24-hour standard. This sample would likely have been well below the standard without the impact from fireworks.