

Regional Planning For Visibility

MANE-VU

Mid-Atlantic / Northeast Visibility Union



2002 Year in Review

Project Manager

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Modeling and Data Analysis/Monitoring Meeting

September 30, 2004

John Graham, NESCAUM

Overview

2002 represents middle of the baseline period for haze

Focus year for modeling and data analysis activities

This report provides overview of available data sets, with
initial assessment; data archive available & growing

State generated data primary focus of report

Approaches for data presentation and analysis provide basis
for future work by states/MANE-VU moves forward in
SIP process and development

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- VI. Conclusion

Appendices

Monitoring Networks in the MANE-VU Region

Routine PM Mass Measurements

Federal Reference Method (FRM)

24-hour integrated mass; daily, 1-in-3, 1-in-6 schedule

In 2002, MANE-VU had 31 daily, 171 1-in-3 with 133 having $\geq 75\%$ *annualized* data capture

Mixture of urban/rural; variety of land use categories

Continuous (hourly) methods

Converted to be “FRM-like” using Julian Day Approach

20 Sites had $\geq 75\%$ seasonal data capture

Routine PM Speciation

Interagency Monitoring of Protected Visual Environments

(IMPROVE): 18 sites in MANE-VU, 17 full year, 3 nearby

Speciation Trends Network (STN): 42 sites total, 26 full year

Monitoring Networks in the MANE-VU Region

Routine PM Mass Measurements (cont.)

Routine Visibility

CAMNET: 6 sites operating, 2 in Class 1 Areas (hazecam.net)

Automated Surface Observation System (ASOS)



Monitoring Networks in the MANE-VU Region

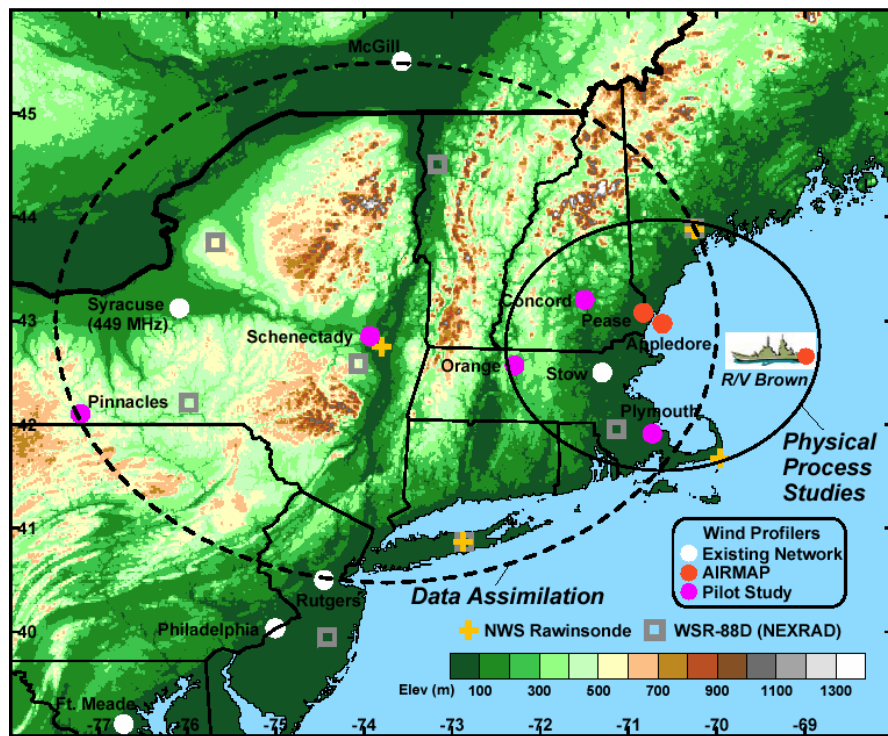
Special Studies

AIRMAP/NEAQS

Atmospheric Investigation, Regional Modeling, Analysis and Prediction (AIRMAP) run by UNH: Climate/AQ interaction

New England Air Quality Study (NEAQS) NOAA pilot in 2002

Enhanced surface obs, profilers, Ron Brown, Aircraft Flights



Radar Profiler Network

Radio Acoustic Sounding System (RAAS): Lower BL winds, Tv

Radar:

Winds at coarse res in upper BL

Monitoring Networks in the MANE-VU Region

Special Studies (cont.)

PM Supersites

3 MANE-VU sites: NYC, Baltimore, Pittsburg
Less data available than anticipated

PM Health Centers

3 MANE-VU sites: Boston, NYC, Rochester
Most 2002 measurements limited to Boston

Upper Air Measurements

UMD's Regional Atmospheric Measurement Modeling and
Prediction Program (RAMMPP): Aircraft Flights

2004 Millersville Balloon Study: Could improve general
understanding of atmospheric behavior of fine particles

HYSPLIT Back Trajectories

NESCAUM database for 17 sites (1997-2002)

Monitoring Networks in the MANE-VU Region

Data Availability

Appendix A lists data sets available through
NESCAUM repository
Supersite Integrated Relational Database (SIRD)

<http://www.supersitesdata.umd.edu>

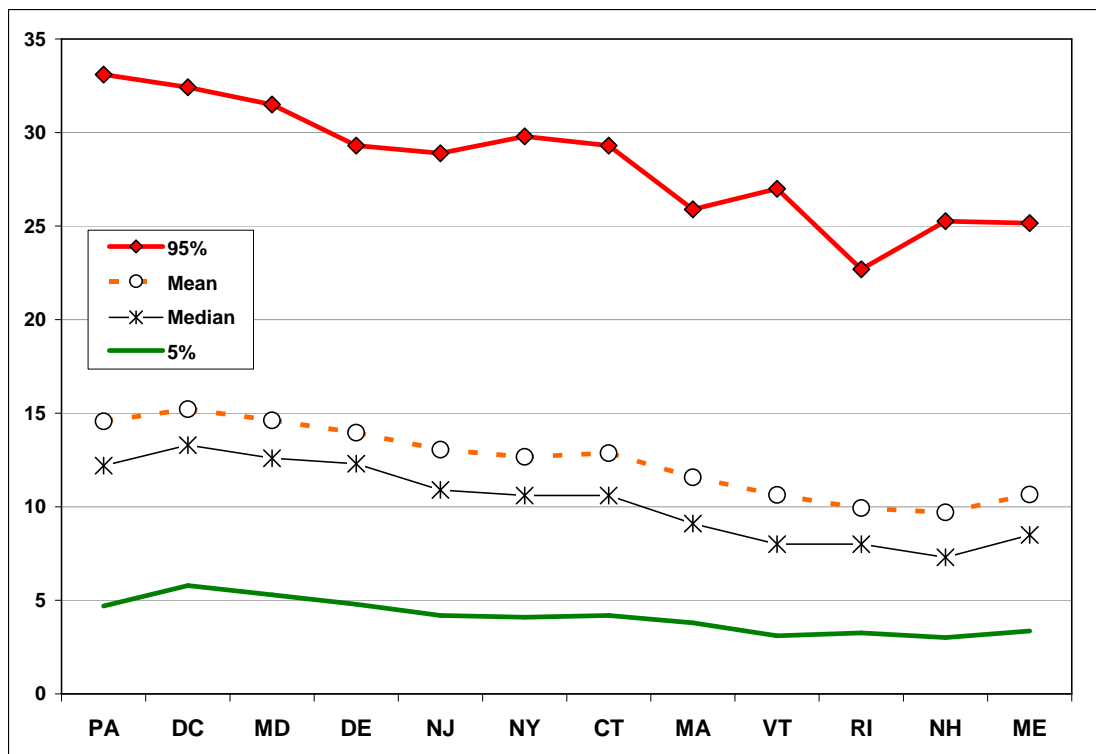
Directory	Sub-Directory/File Name	Notes	File Type	Parameter(s)	Site(s)	Start Date	End Date
2002-03 STI profiler data	Mane-Vu-STI 2002 profiler data -- Access database.zip	Contains file "NESCAUM.mdb" - includes data for both sites.	Zipped MS Access DB	All UA	Stow MA / East Brunswick NJ	6/13/2002	10/31/2002
2002 STN-Improve-FRM_JG	2002 data - JG.zip	5 Excel files with both raw and summarized data.	Zipped Excel	IMPROVE, STN, FRM mass	20 IMP (incl. 3 non-MANE-VU), 42 STN, 133 1-in-3 FRM, 31 "everyday" FRM	1/1/2002	12/31/2002
Airmap	Mount Washington AIRMAP bulk aerosol_GAllen.xls	Contains ~24hr data - Mt Wash only.	Excel sprdsht	SO ₄ , NO ₃ , NA, NH ₄ , K, Mg, Ca, Cl.	Mt. Washington	6/1/2001	12/31/2002

Overview of 2002 State by State Summaries

Statistics on MANE-VU FRM sites

Table detailing Urban/Rural Sites (#, obs, ranges)

142 urban and 22 rural sites, over 25,000 data points



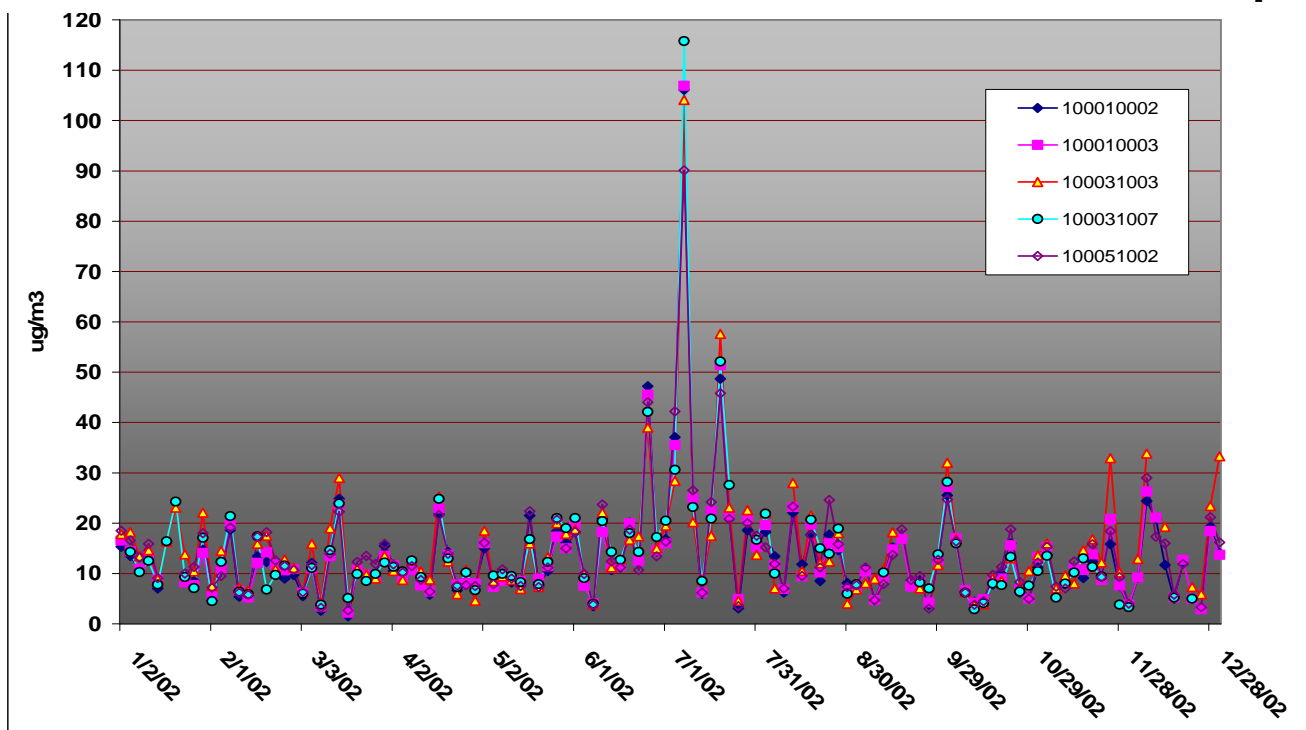
Regional Urban PM2.5 mass
distribution statistics from
Southwest to Northeast

Overview of 2002

Time Series of 1-in-3 Day Samples

State by State Graphical summary

2002 PM_{2.5} from 1-in-3 sites in Delaware with > 75% data capture



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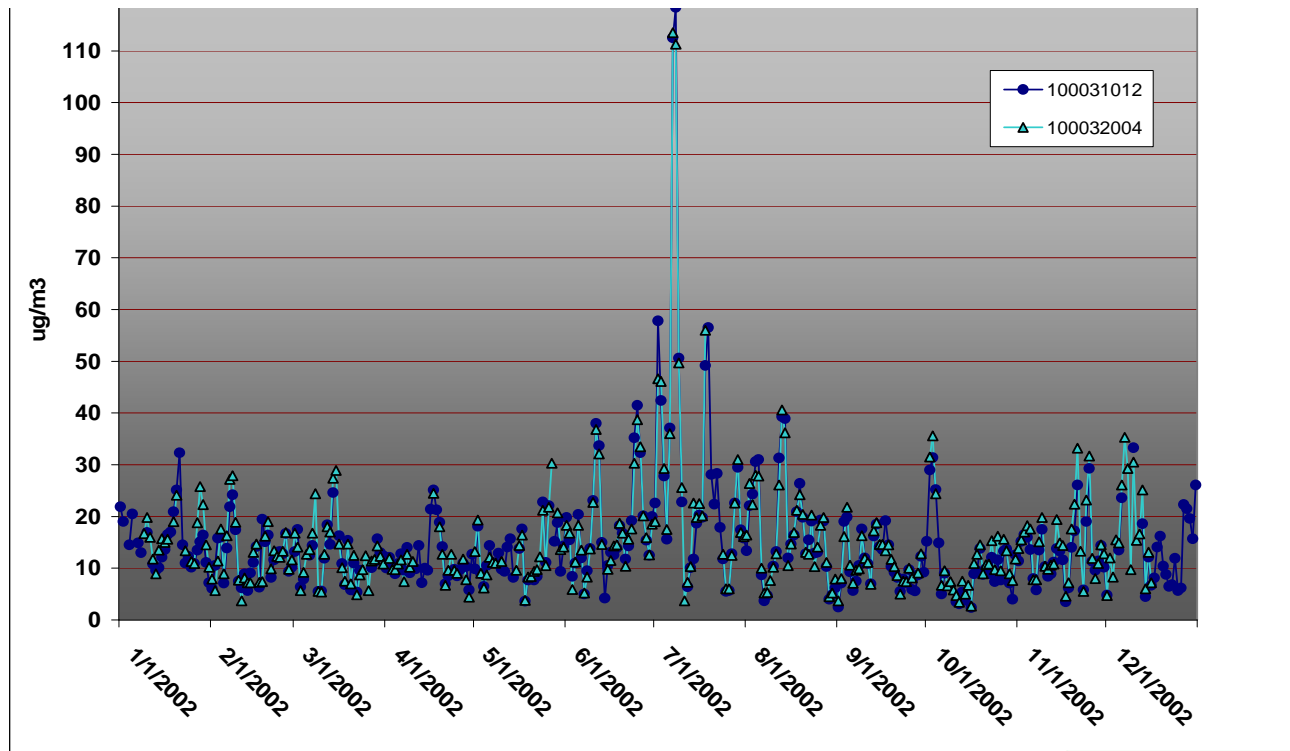


Overview of 2002

Time Series of Everyday Samples

State by State Graphical summary

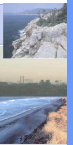
2002 PM2.5 from everyday sites in Delaware with > 75% data capture



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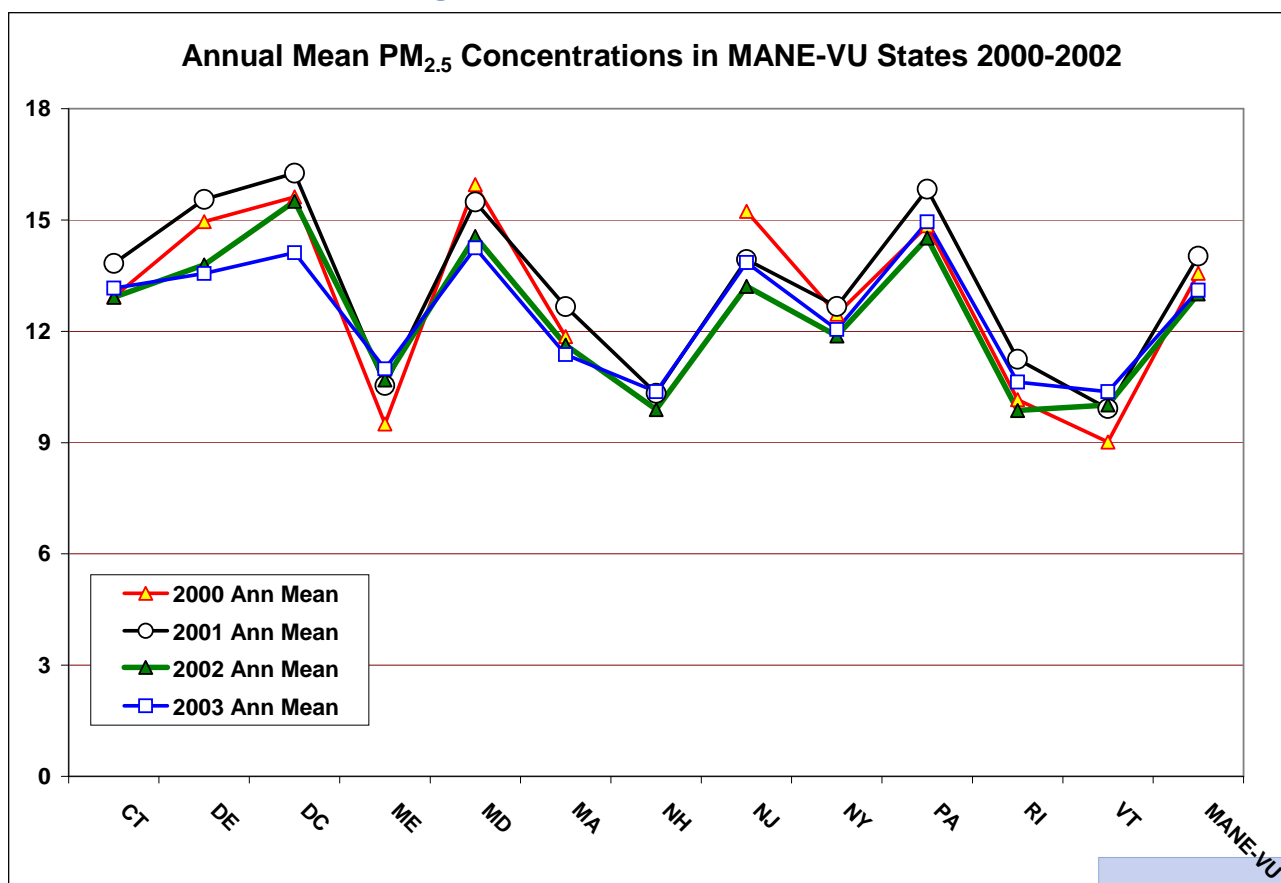
Mid-Atlantic / Northeast Visibility Union



Overview of 2002

Temporal Patterns of PM Mass Distribution

Statewide Average Interannual Variability



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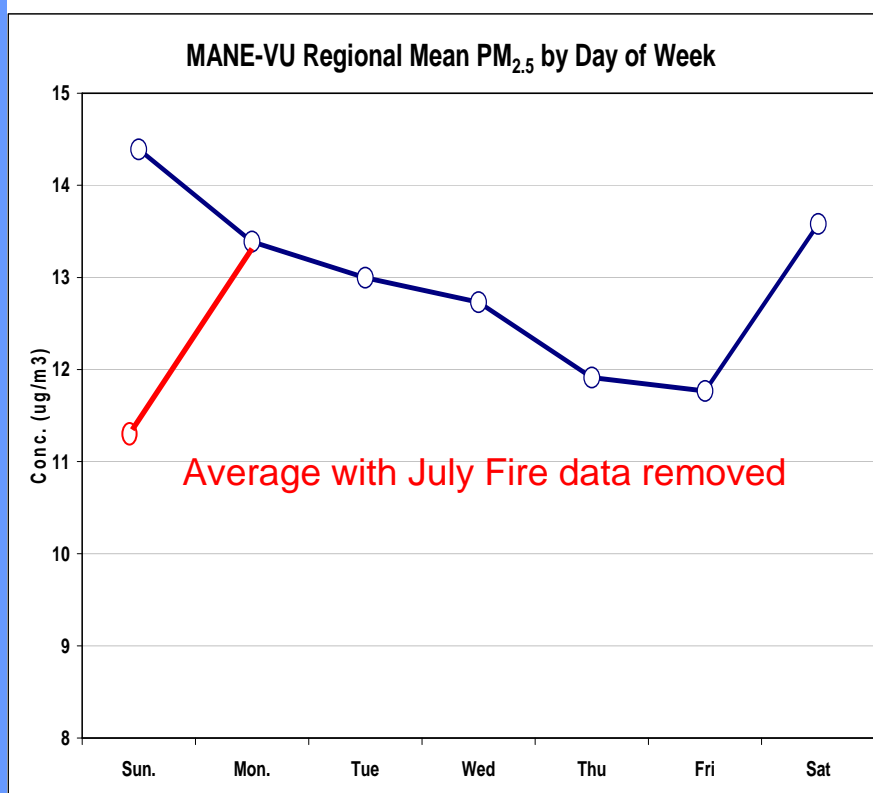
Mid-Atlantic / Northeast Visibility Union



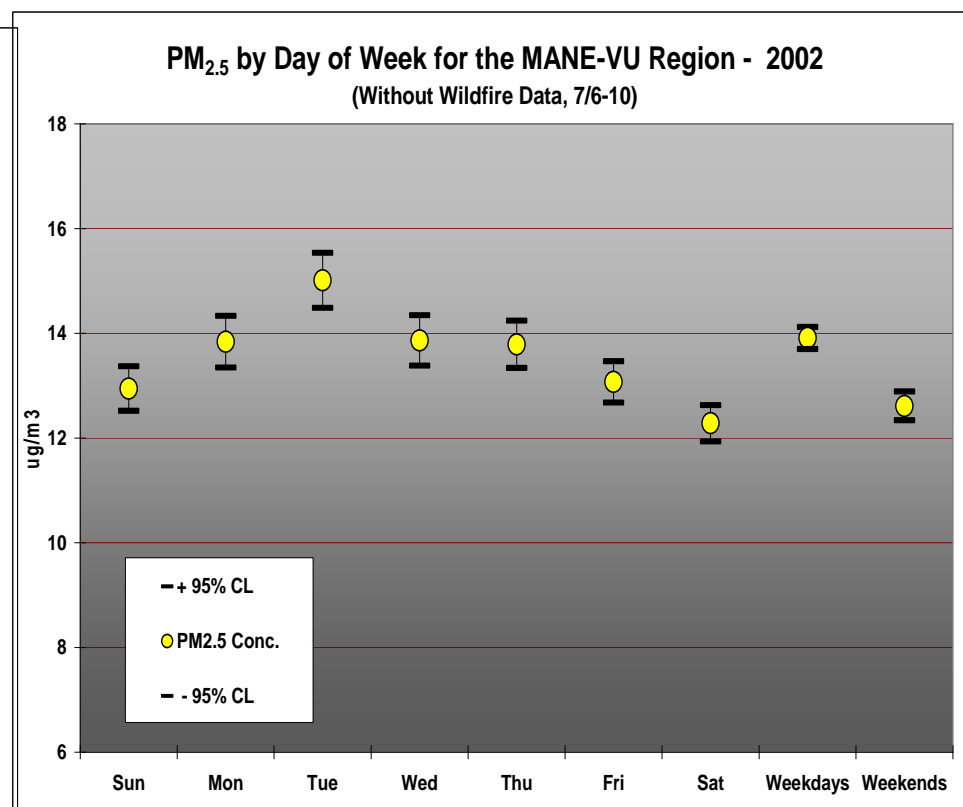
Overview of 2002

Temporal Patterns of PM Mass Distribution

Weekday versus Weekend variations



1-in-3 day plot



daily samplers

Overview of 2002

Temporal Patterns of PM Mass Distribution

Creating “FRM-like” Hourly Data: Julian Day Algorithm

Summary Statistics Table

Summary of FRM-like continuous fine particle measurements for 2002.

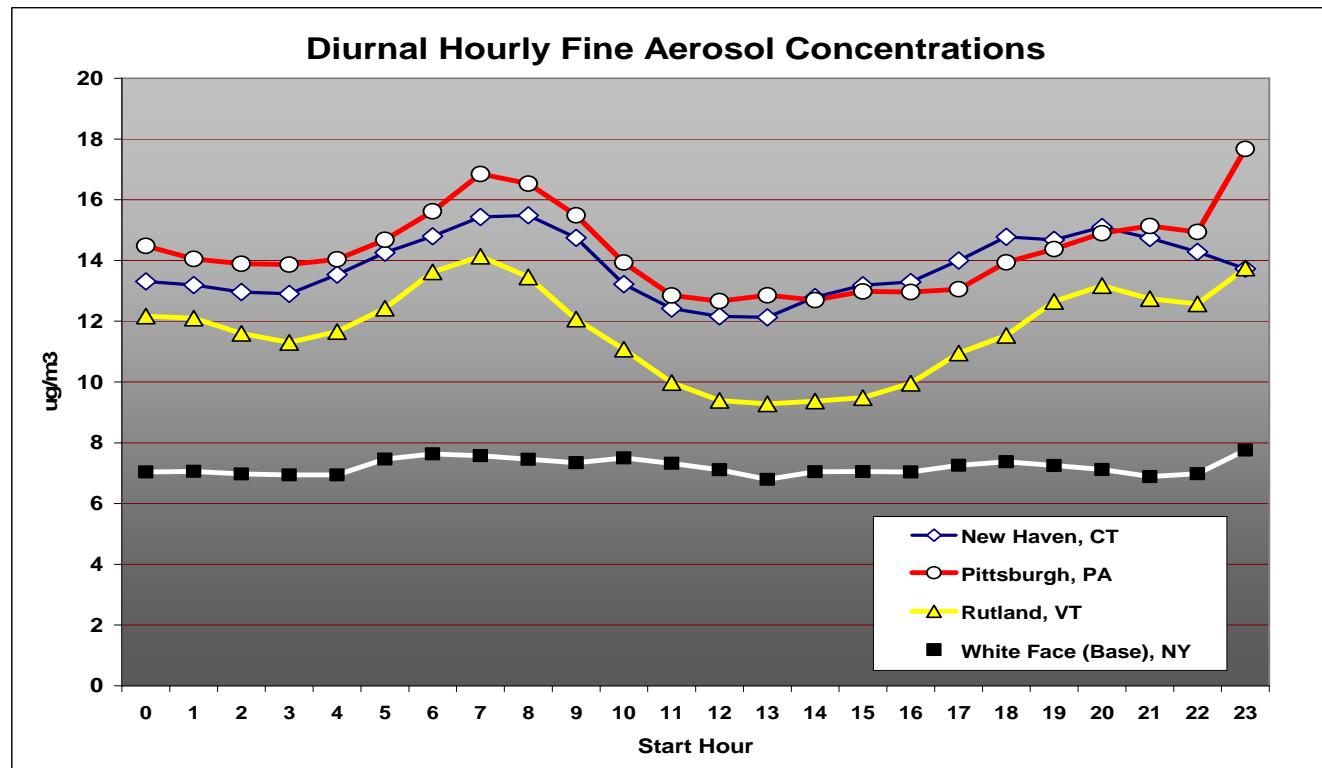
<i>FRM-like Hourly Data (ug/m³) - 2002</i>								
	CT	DE	ME	NJ	NY	PA	VT	MANE-VU
# Sites	3	1	3	4	4	3	2	20
# Obs.	25,991	8,300	25,656	33,637	34,080	25,650	17,436	170,750
Max	146	237	119	165	211	198	117	237
0.95%	33.8	40.8	27.9	35.2	33.2	44.6	30.4	34.7
0.90%	26.3	30.6	21.7	26.8	24.8	33.2	23.7	26.3
75%	17.3	20.3	14.3	17.2	15.1	19.7	15.0	16.7
Median	10.5	13.0	8.7	11.0	9.1	11.9	8.1	10.1
Mean	13.2	15.9	10.9	13.9	12.0	16.2	10.8	13.1
25%	5.8	7.2	4.9	6.9	5.1	7.2	3.9	5.7
10%	2.6	3.1	2.1	4.0	2.5	3.9	1.5	2.7
5%	1.1	0.8	0.9	2.6	1.4	2.2	-0.9	1.3
Min	-1.7	-6.1	-7.0	-4.3	-12.4	-2.1	-6.6	-12.4

Overview of 2002

Temporal Patterns of PM Mass Distribution

Diurnal Mass Distribution

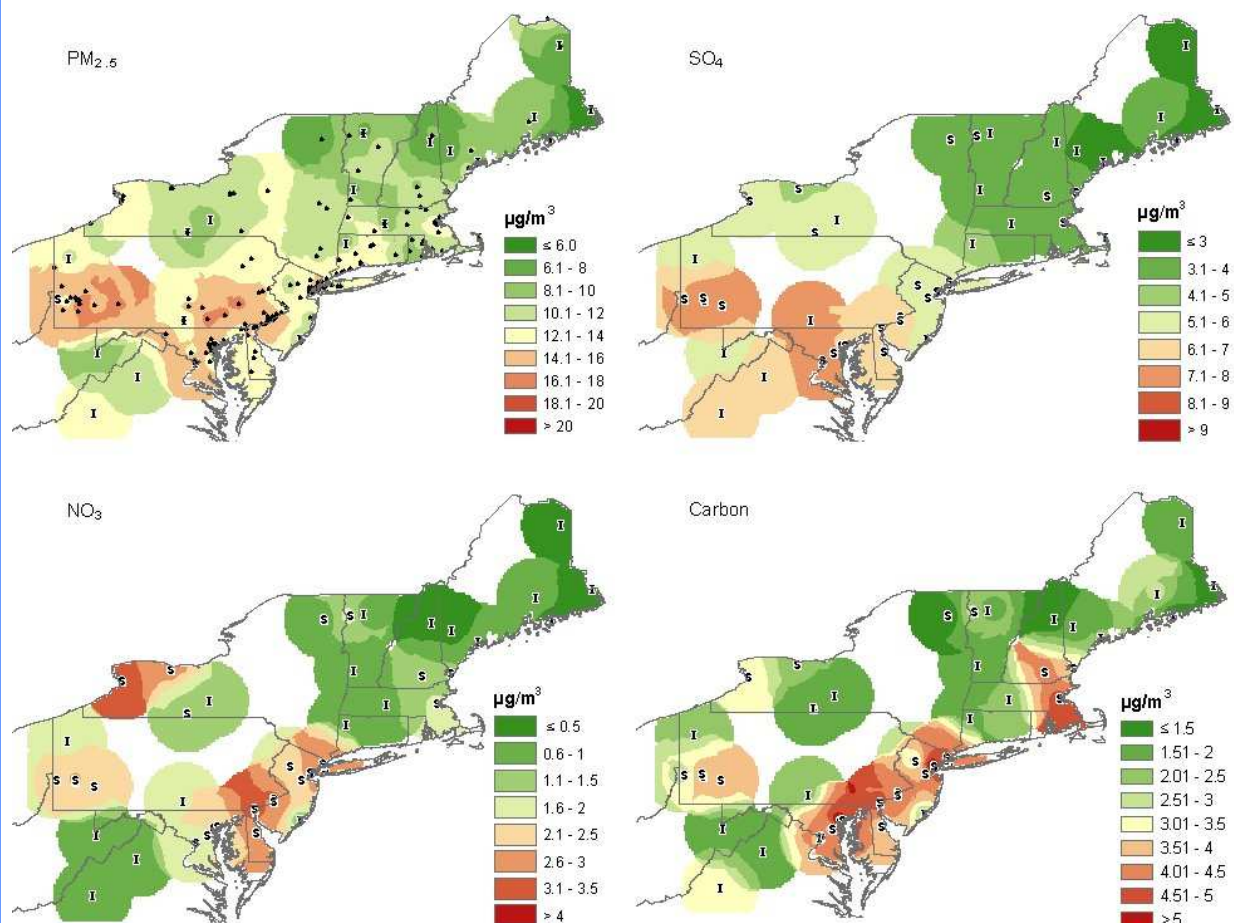
Annual, Seasonal, Urban, Rural differences



**Differences in annual diurnal patterns
between urban and rural sites.**

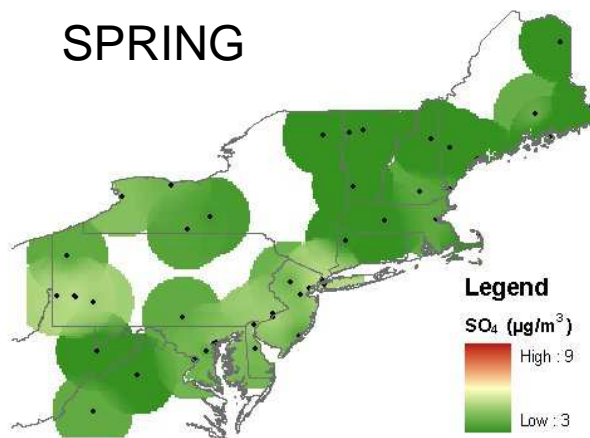
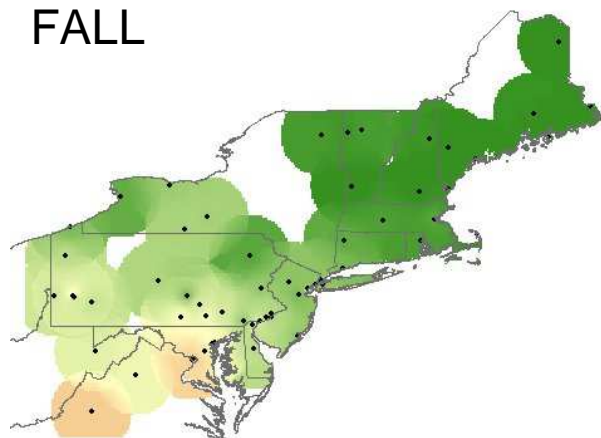
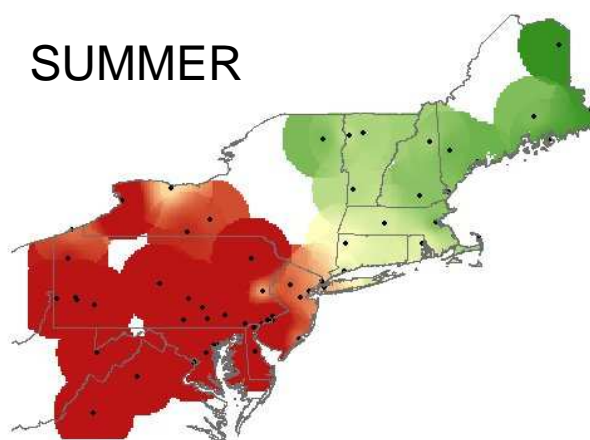
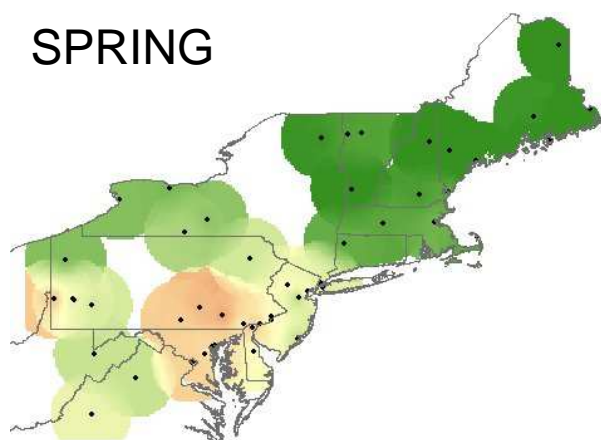
Overview of 2002 Speciated Data

2002 Annual and Seasonal Maps for PM_{2.5} Mass and Major Constituents



Overview of 2002 Speciated Data

2002 Seasonal Maps Ammonium Sulfate

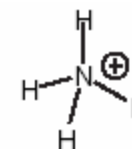
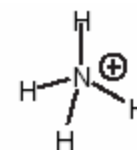


Legend

SO₄ (µg/m³)

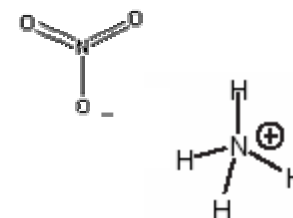
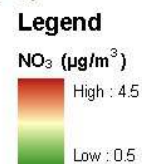
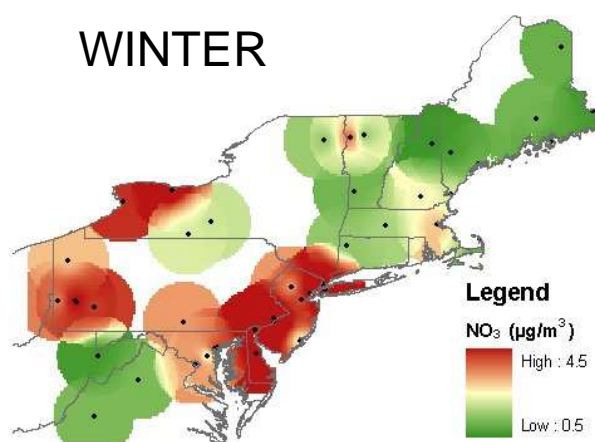
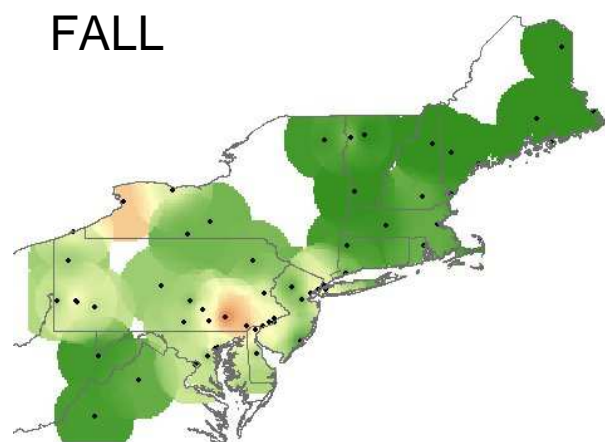
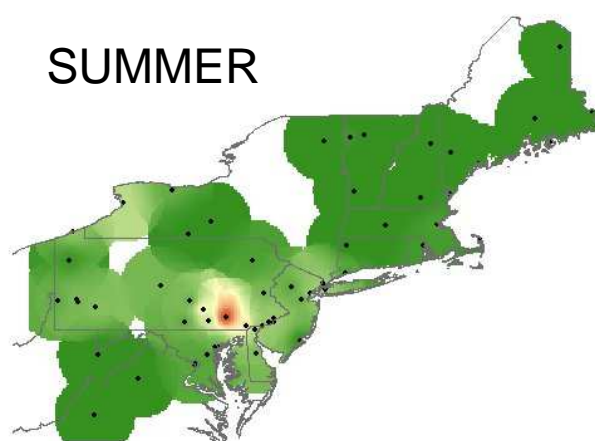
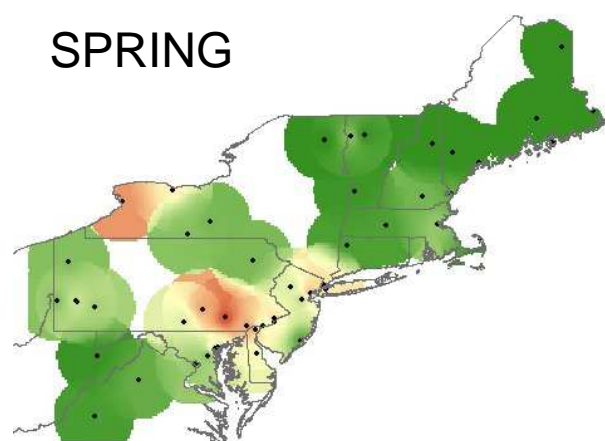
High : 9

Low : 3



Overview of 2002 Speciated Data

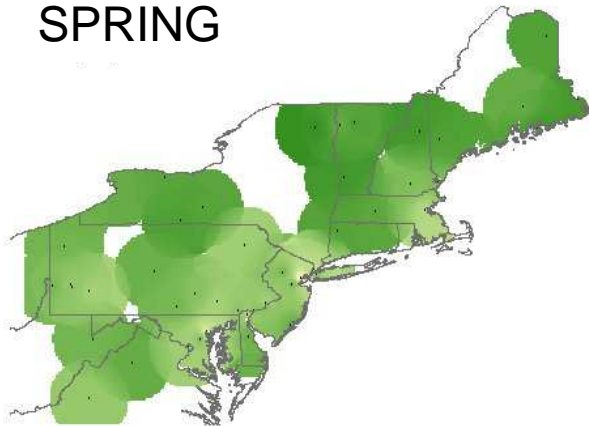
2002 Seasonal Maps Ammonium Nitrate



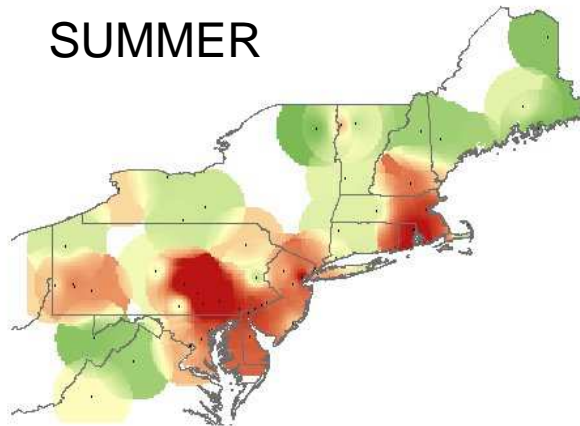
Overview of 2002 Speciated Data

2002 Seasonal Maps Carbon

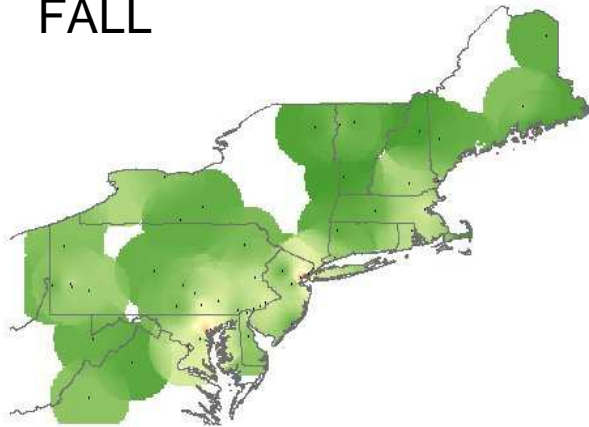
SPRING



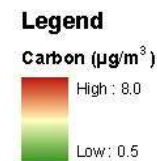
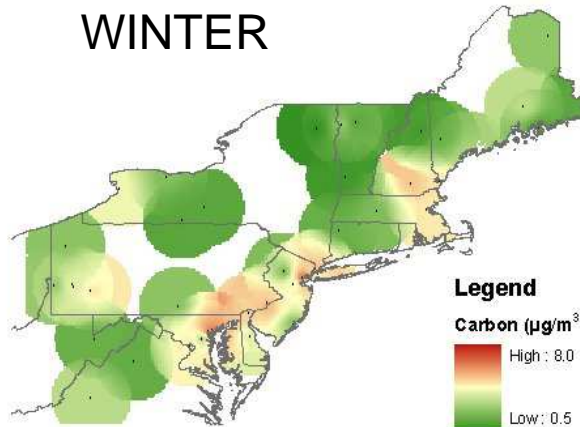
SUMMER



FALL



WINTER



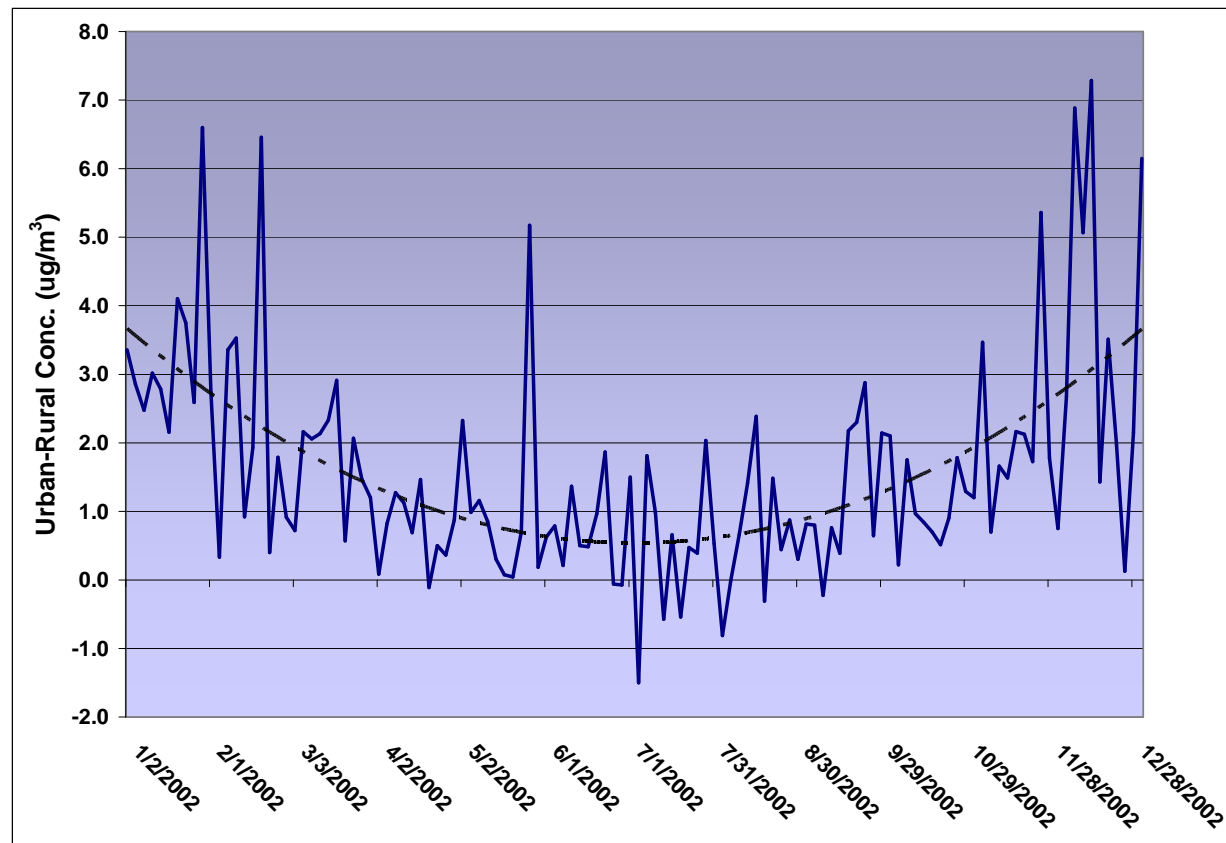
For the purposes of this map, C is the sum of EC and OC, where OC is the mass of C only (i.e. no multiplicative factor)

Given the different operational definitions of OC/EC by IMPROVE and STN, this is the simplest approach to map the carbon measurements of both networks.

Detailed Spatial Analysis

Rural vs. Urban PM_{2.5} Mass

FRM Urban-Rural Pairs

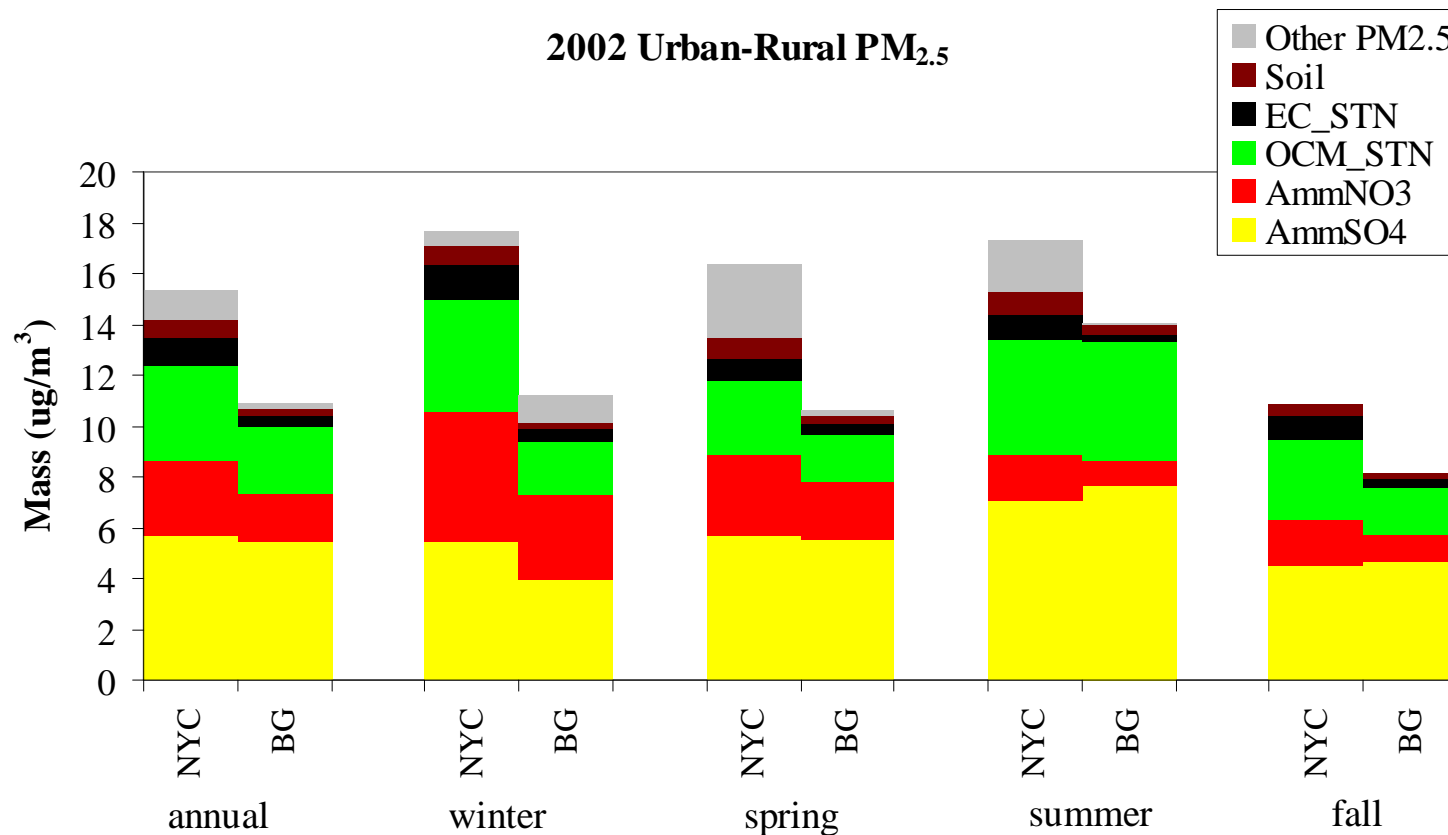


Difference in FRM data
between 10 urban/rural site pairs for 2002

Detailed Spatial Analysis

Rural vs. Urban Chemistry

NYC Urban area compared to an upwind Background Site

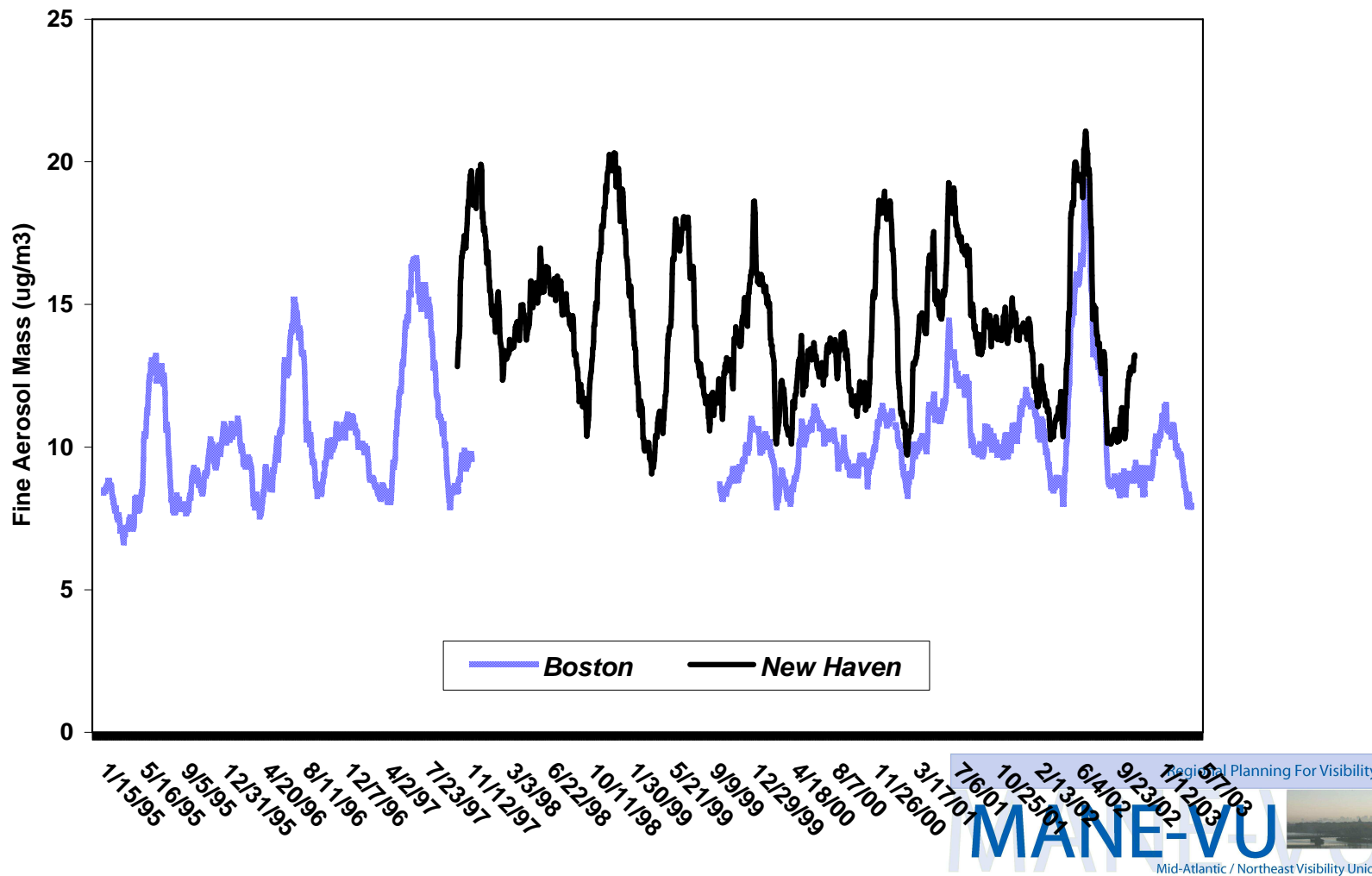


20-24 measurement values per season, same day data

Detailed Spatial Analysis

Regional Scales of Influence

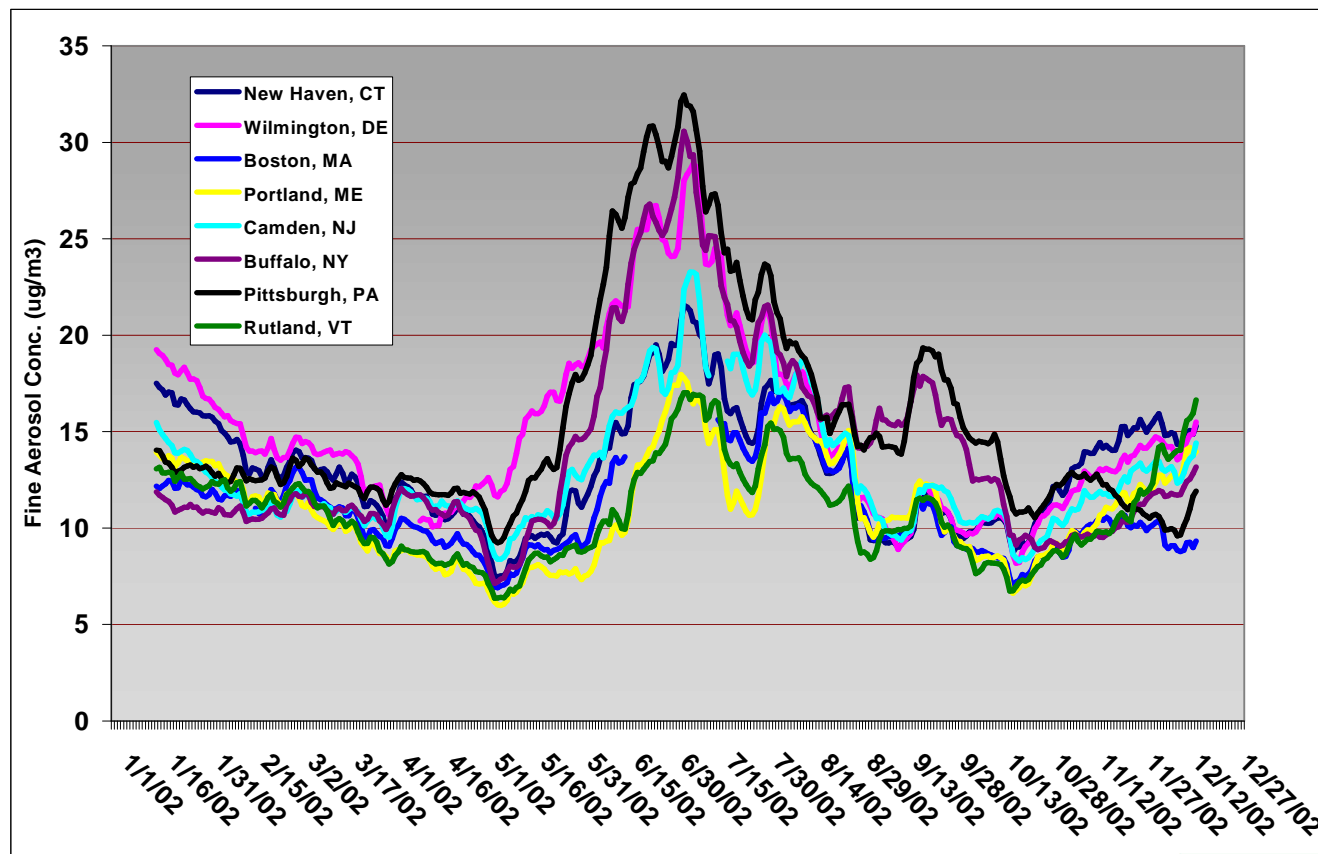
TEOM 60-day running average values for Boston & New Haven



Detailed Spatial Analysis

Regional Scales of Influence

30 Day Running Ave. Concentrations from Eight MANE-VU Sites

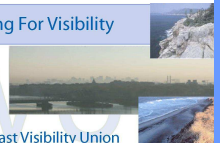


Data from 7/5/02 through 7/11/02 is excluded

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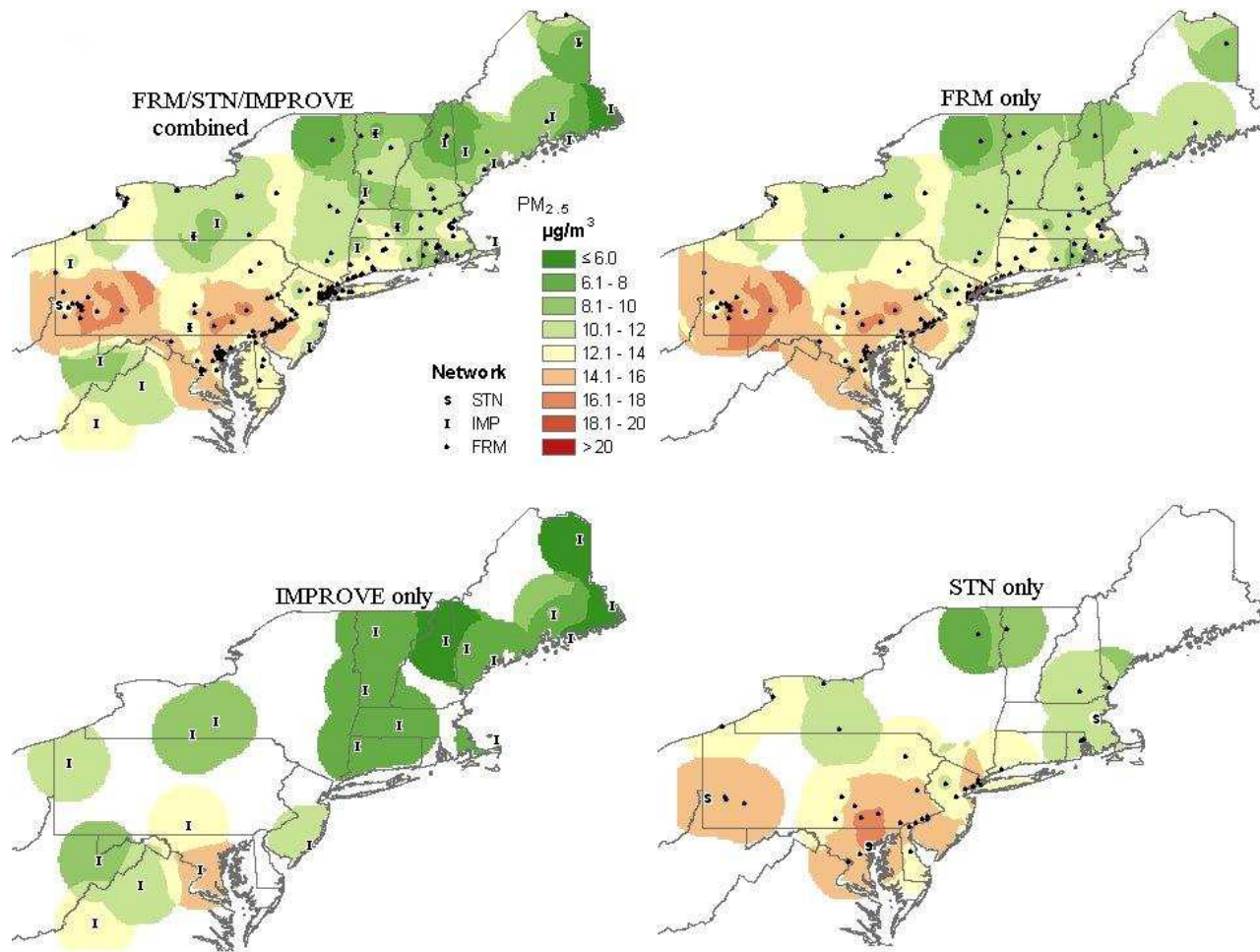
Mid-Atlantic / Northeast Visibility Union



Detailed Spatial Analysis

Regional Scales of Influence

2002 Ann Ave PM_{2.5} maps comparing different measurement spatial density



Regional Planning For Visibility

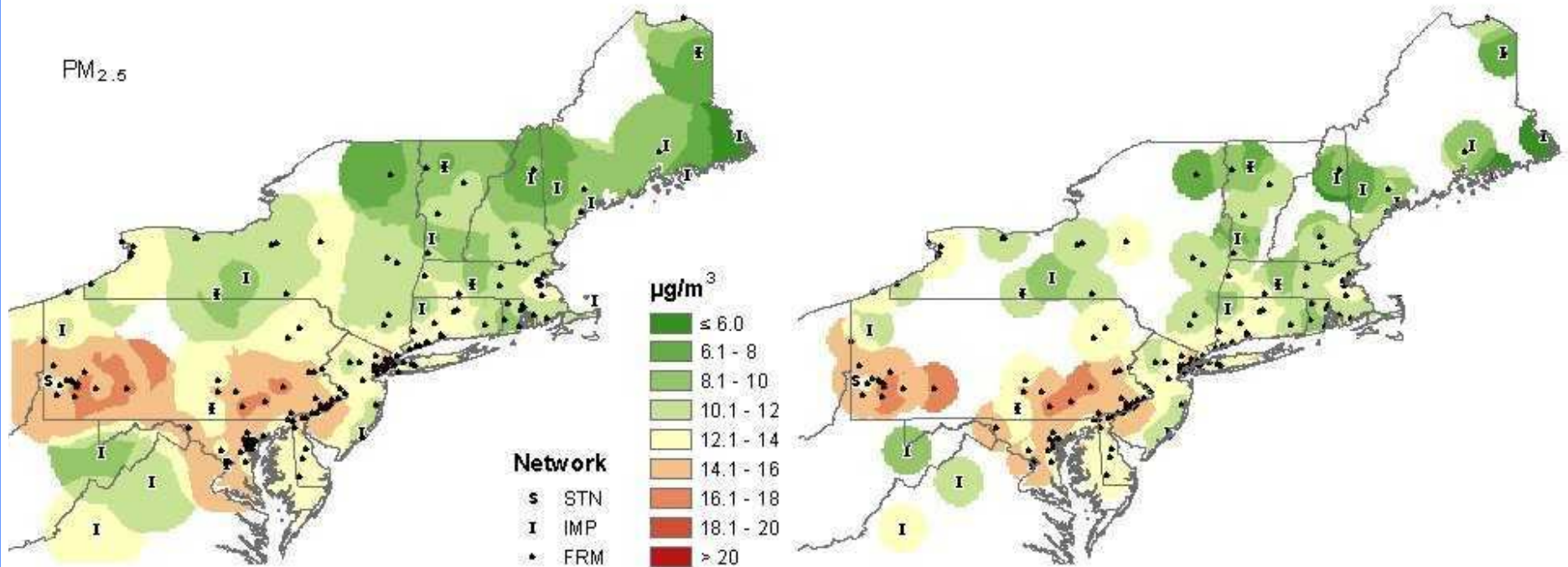
NE-VU

Mid-Atlantic / Northeast Visibility Union

Detailed Spatial Analysis

Regional Scales of Influence

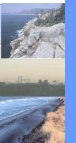
2002 Ann Ave PM_{2.5} maps comparing different spatial “representativeness”



Regional Planning For Visibility

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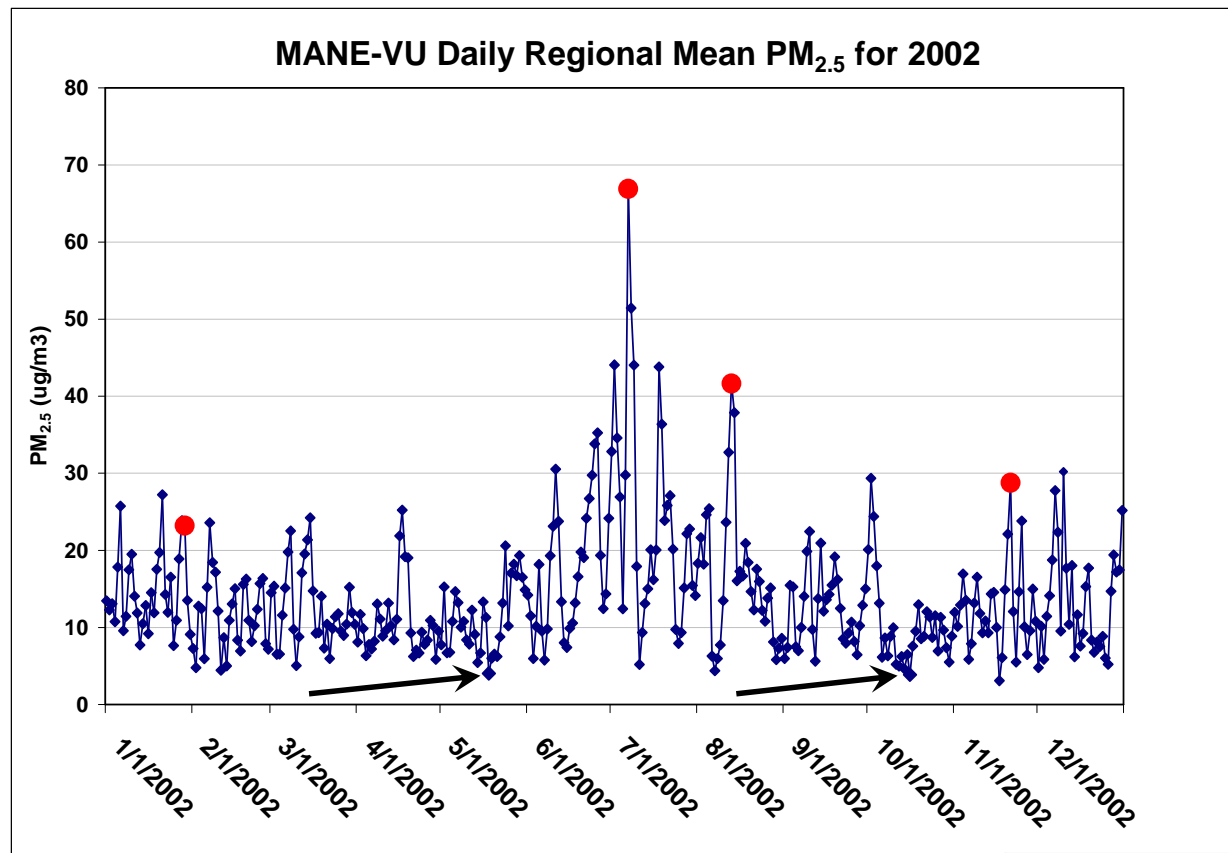
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Detailed Temporal Analysis

Episodes of Interest

PM_{2.5} episodes of regional interest in 2002

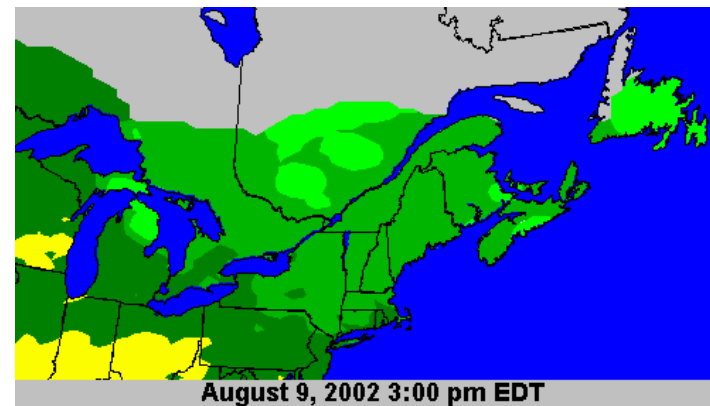
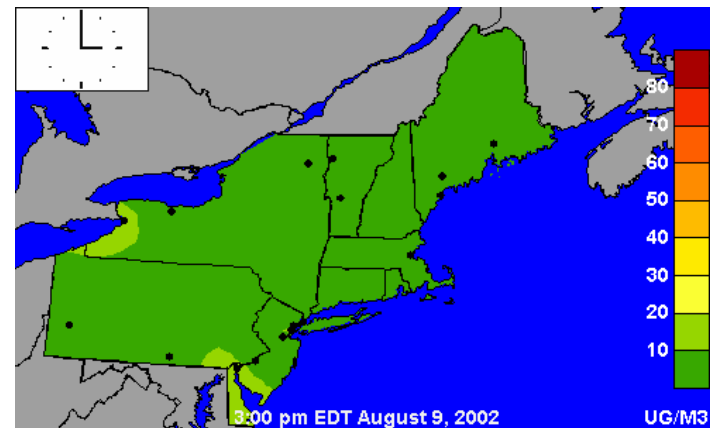
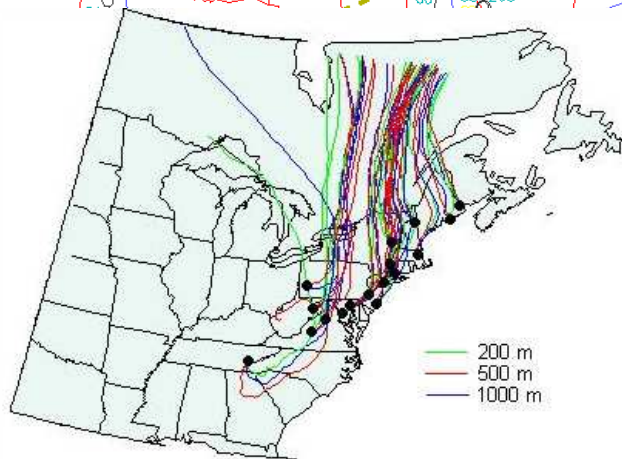
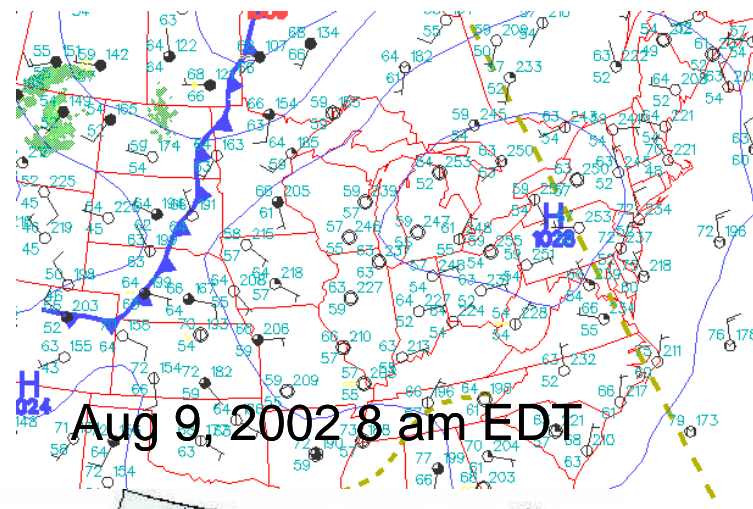


25-31 sites averaged per plotted point

Detailed Temporal Analysis

Episodes Analysis

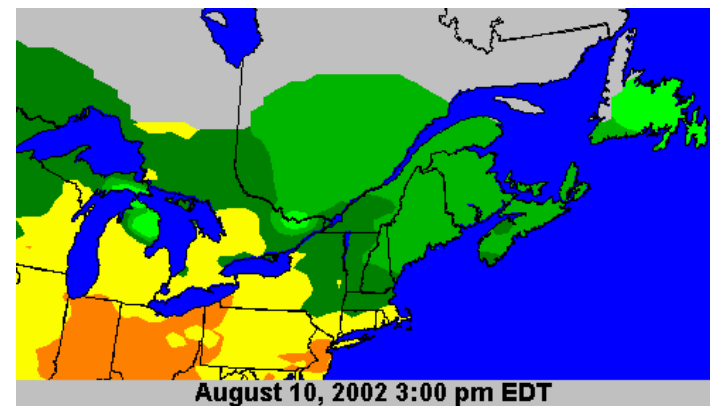
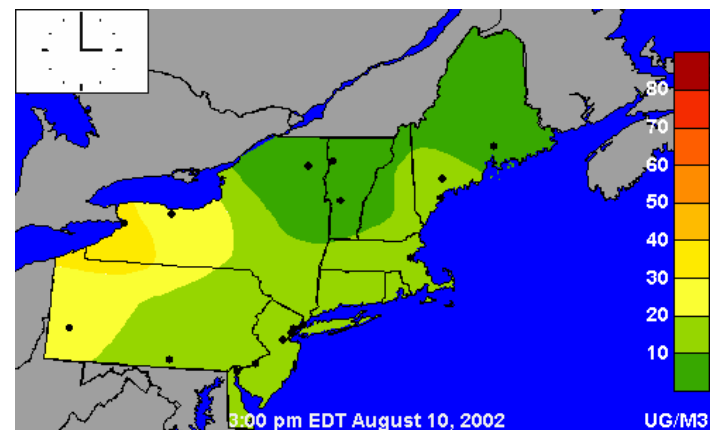
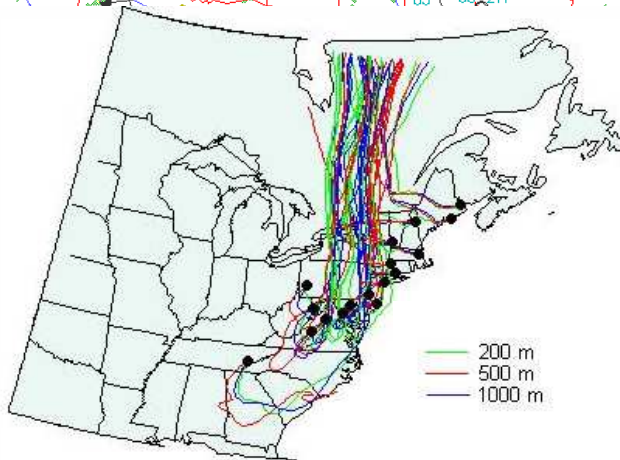
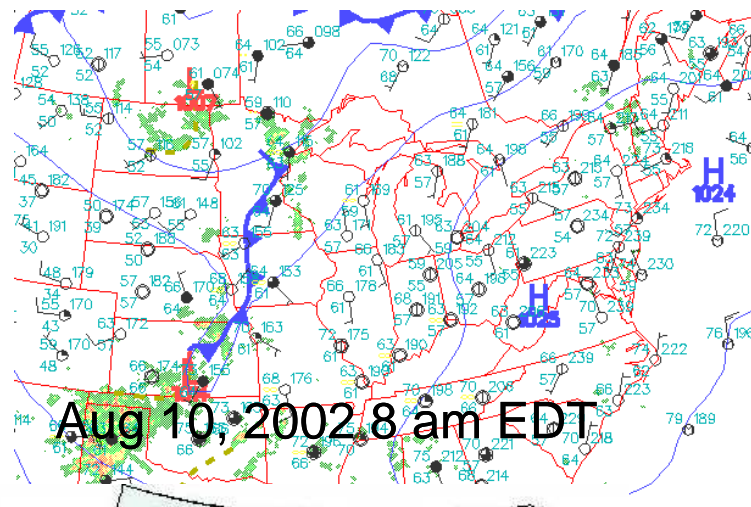
Surface Wx, Hourly PM_{2.5}, Hourly O₃, Back Trajectories



Detailed Temporal Analysis

Episodes Analysis

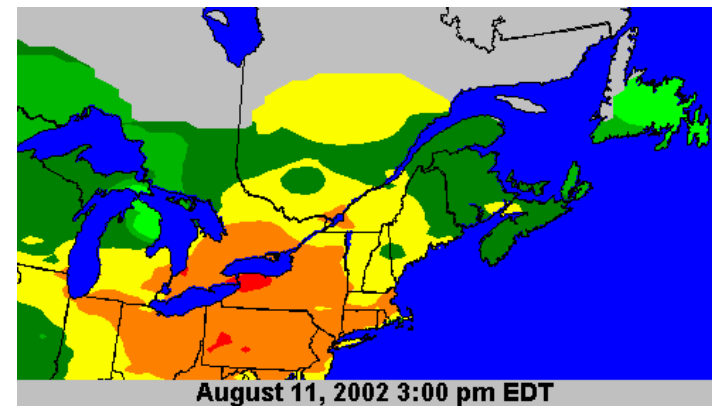
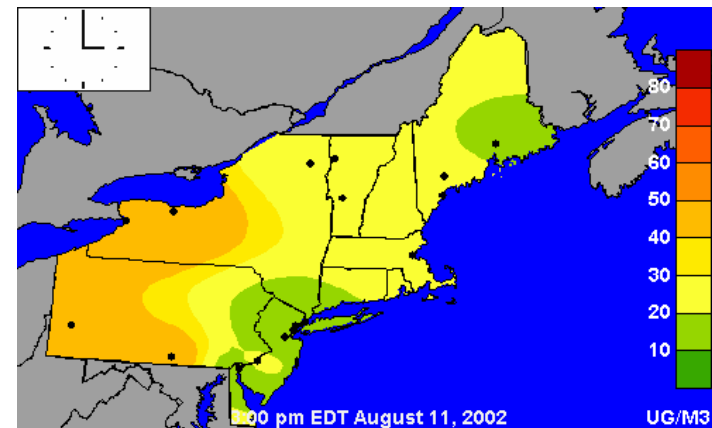
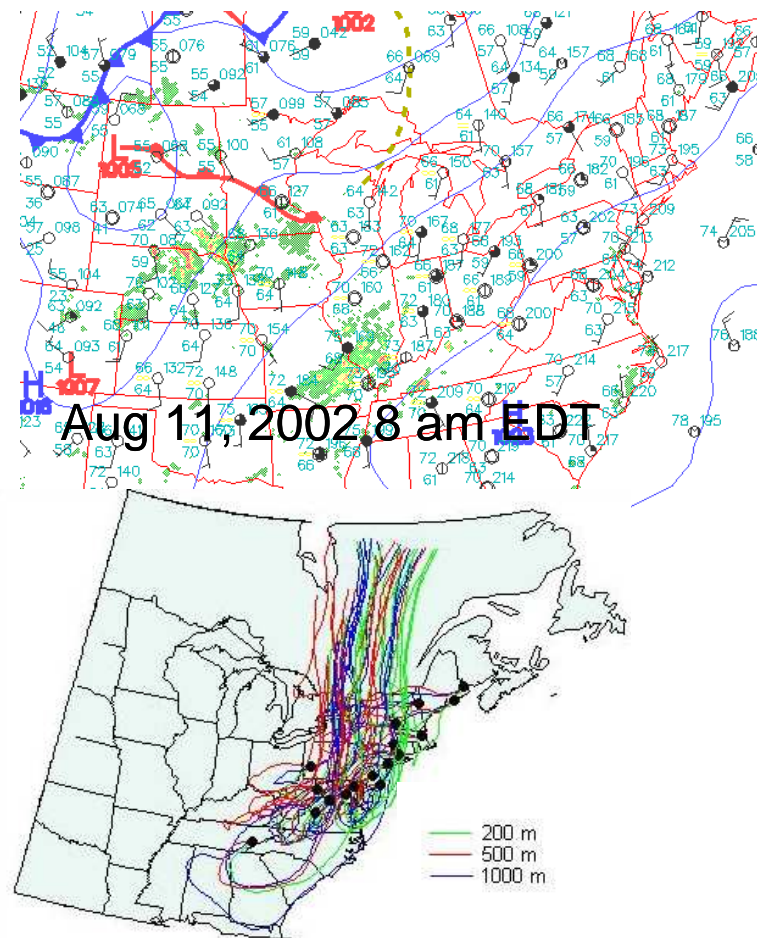
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Detailed Temporal Analysis

Episodes Analysis

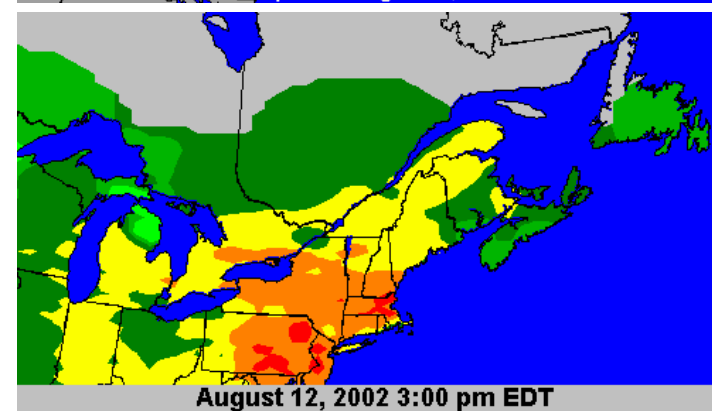
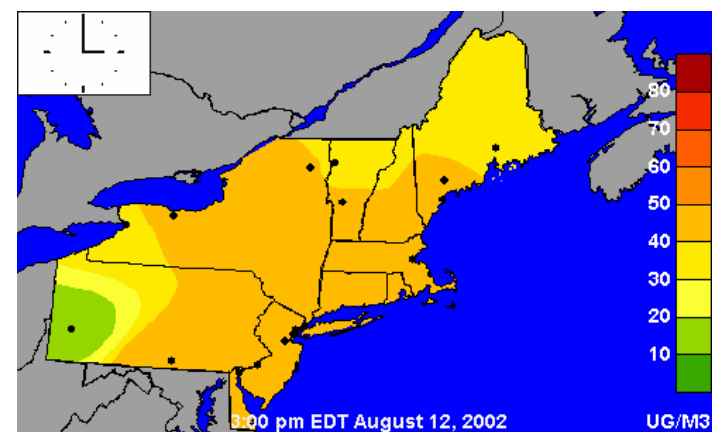
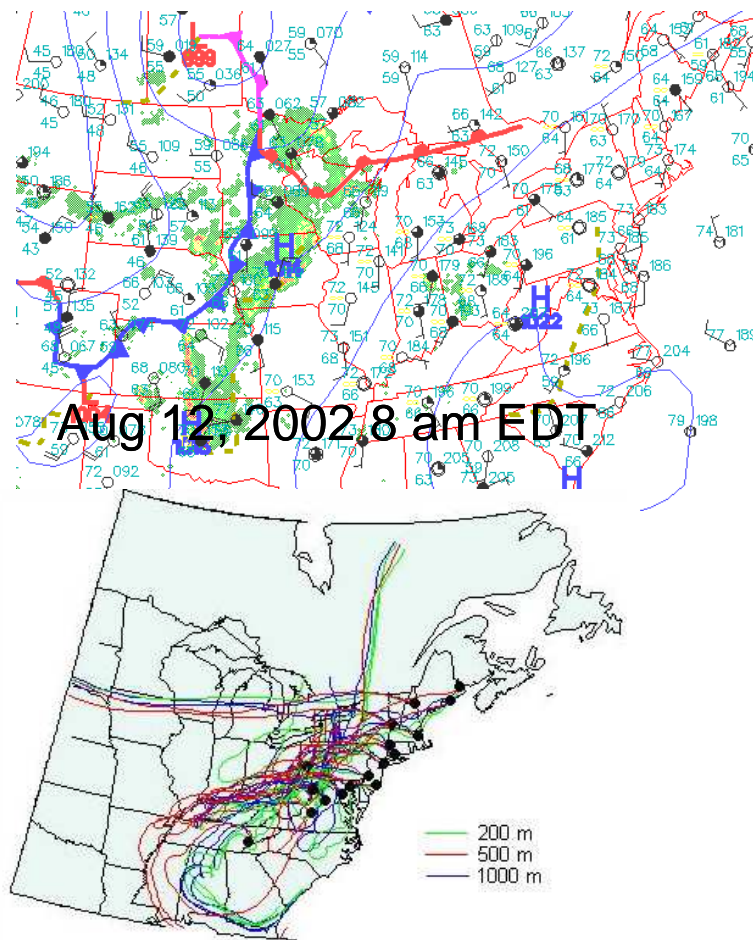
Surface Wx, Hourly PM_{2.5}, Hourly O₃, Back Trajectories



Detailed Temporal Analysis

Episodes Analysis

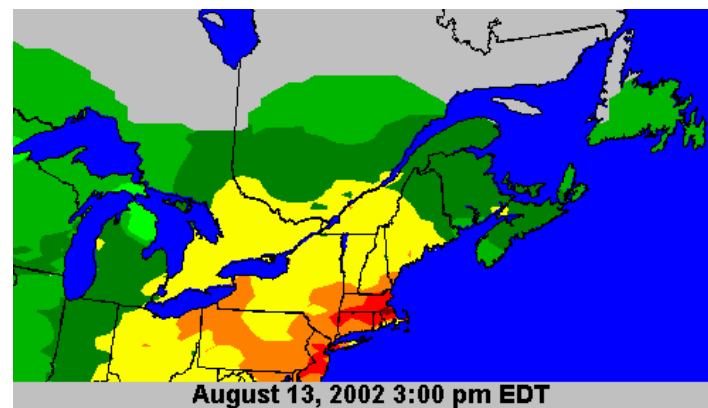
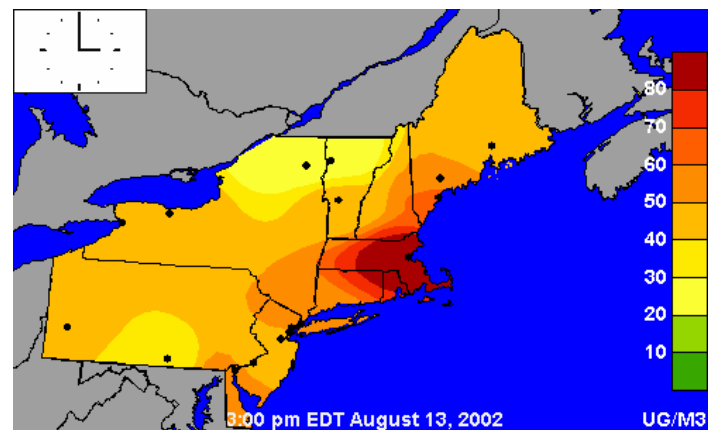
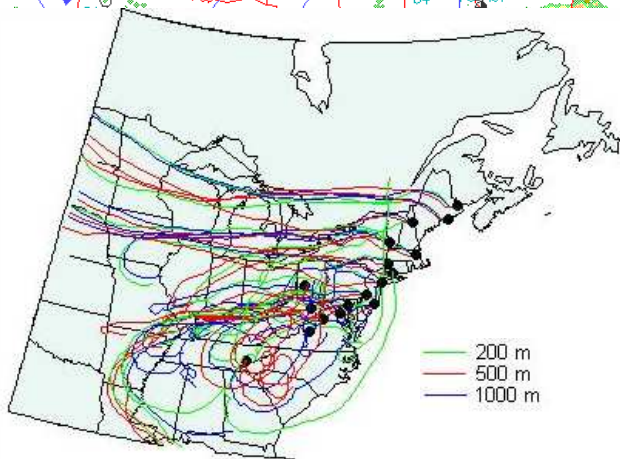
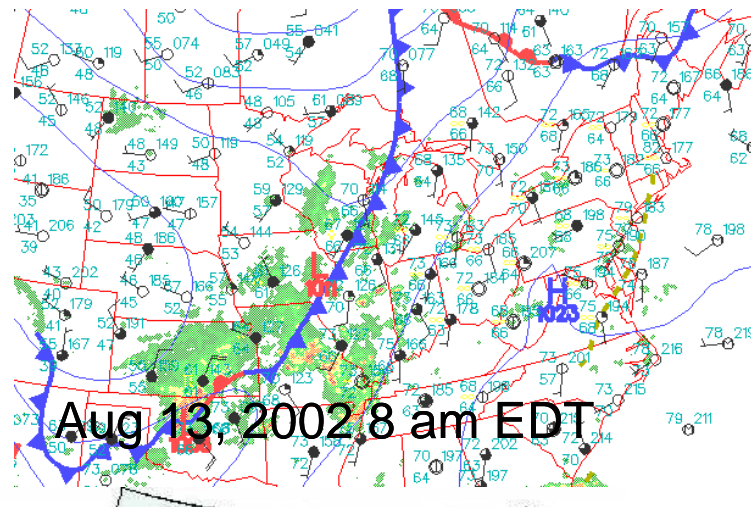
Surface Wx, Hourly PM_{2.5}, Hourly O₃, Back Trajectories



Detailed Temporal Analysis

Episodes Analysis

Surface Wx, Hourly PM_{2.5}, Hourly O₃, Back Trajectories



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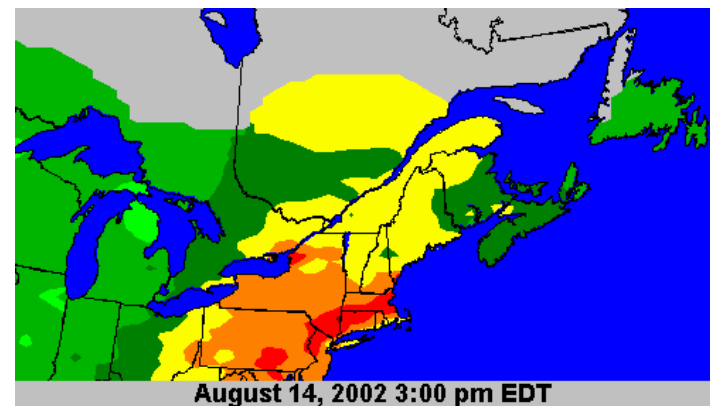
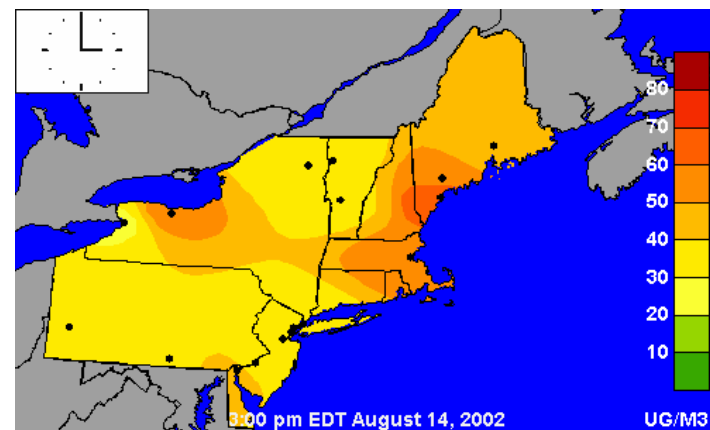
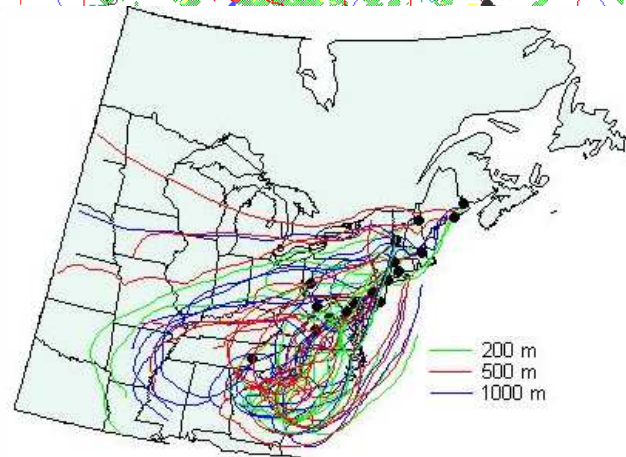
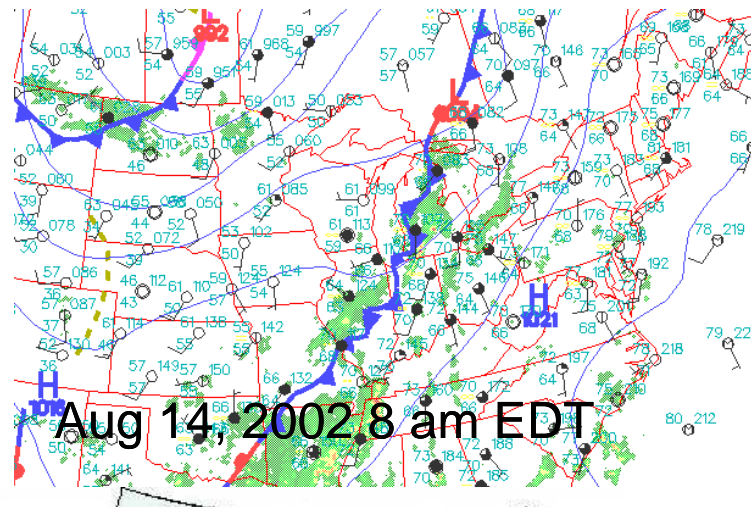
Mid-Atlantic / Northeast Visibility Union



Detailed Temporal Analysis

Episodes Analysis

Surface Wx, Hourly PM_{2.5}, Hourly O₃, Back Trajectories



Regional Planning For Visibility

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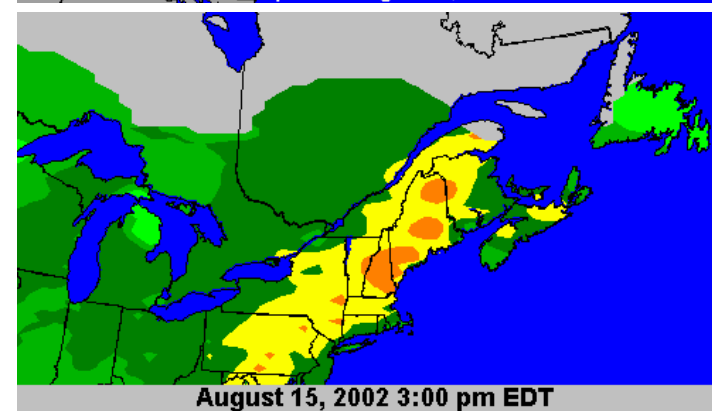
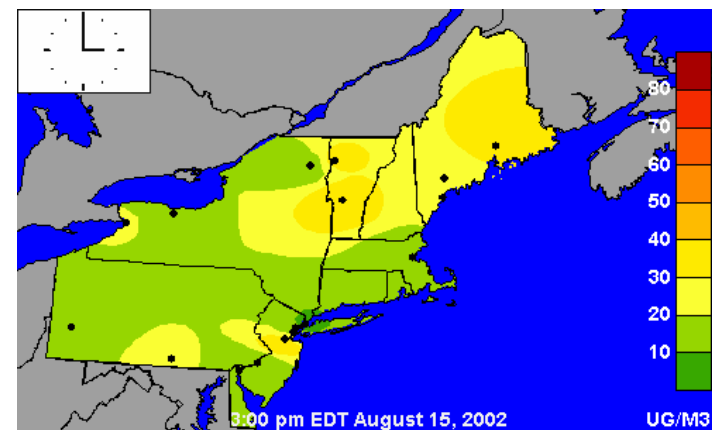
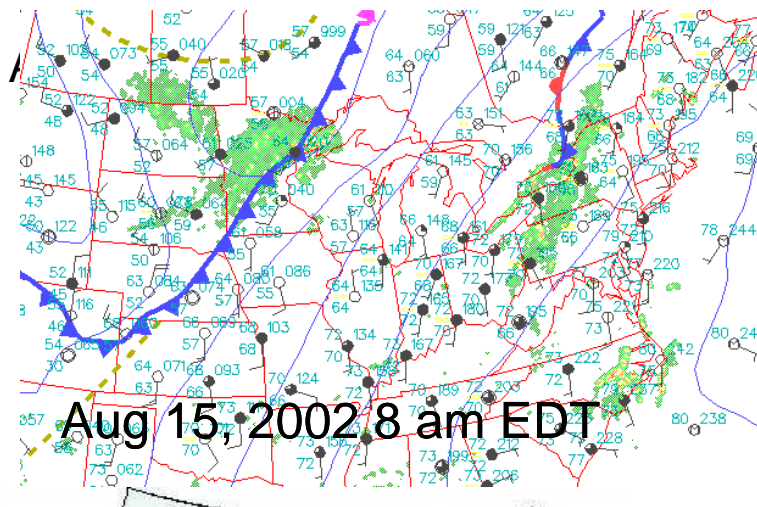
Mid-Atlantic / Northeast Visibility Union



Detailed Temporal Analysis

Episodes Analysis

Surface Wx, Hourly PM_{2.5}, Hourly O₃, Back Trajectories



Regional Planning For Visibility

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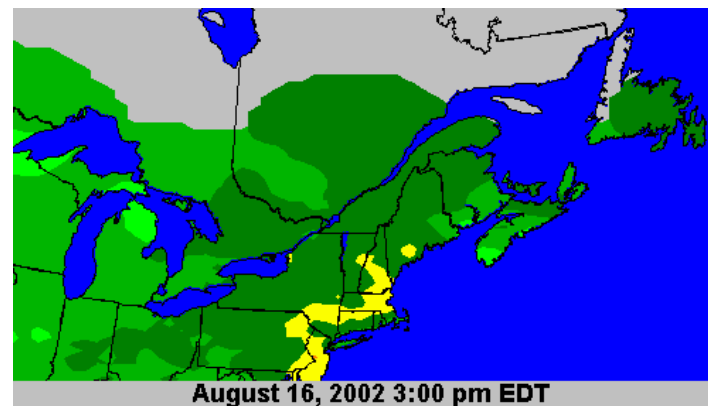
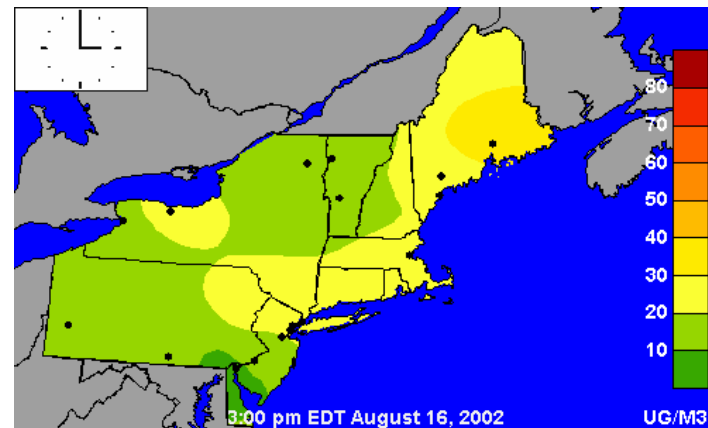
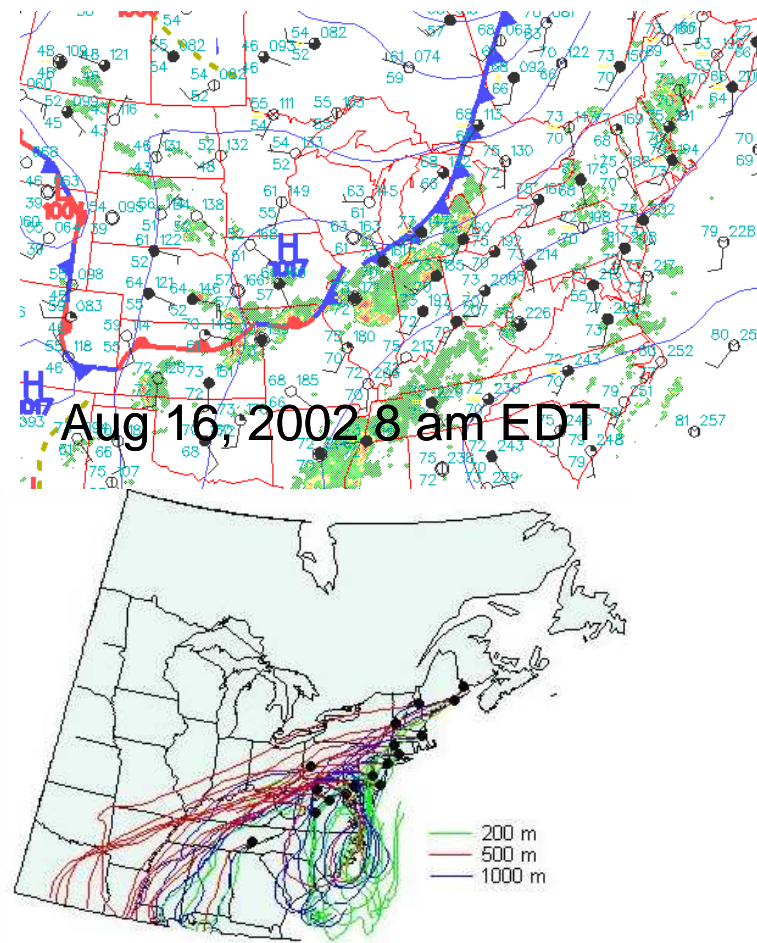
Mid-Atlantic / Northeast Visibility Union



Detailed Temporal Analysis

Episodes Analysis

Surface Wx, Hourly PM_{2.5}, Hourly O₃, Back Trajectories

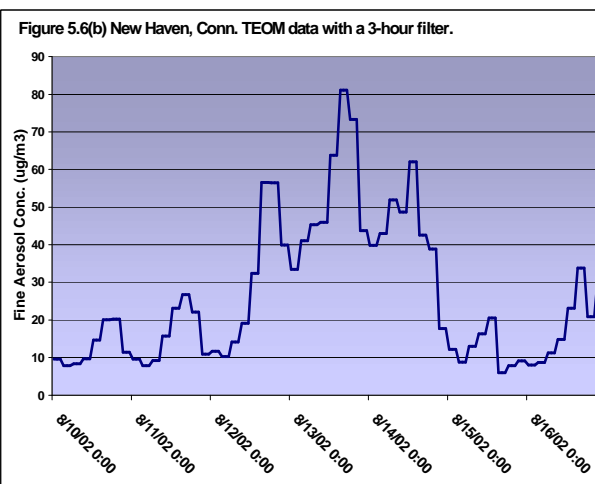
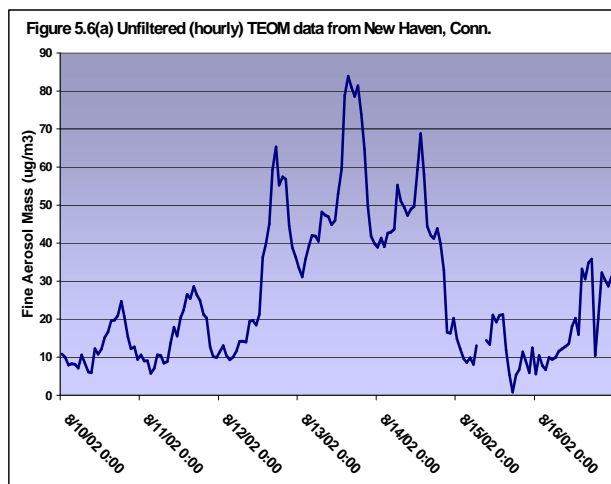


Detailed Temporal Analysis

Temporal Resolution of the Data

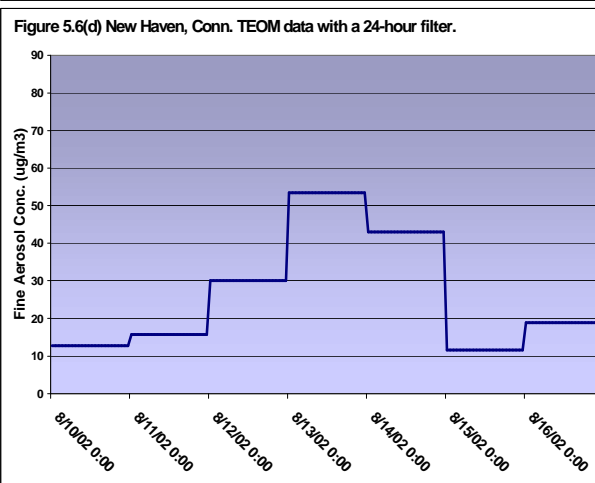
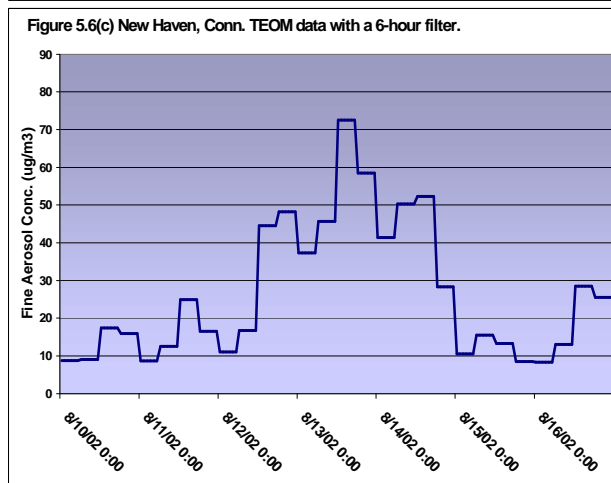
Effect of averaging time (or temporal resolution) on time series information

Unfiltered



3-Hour
filter

6-Hour
filter

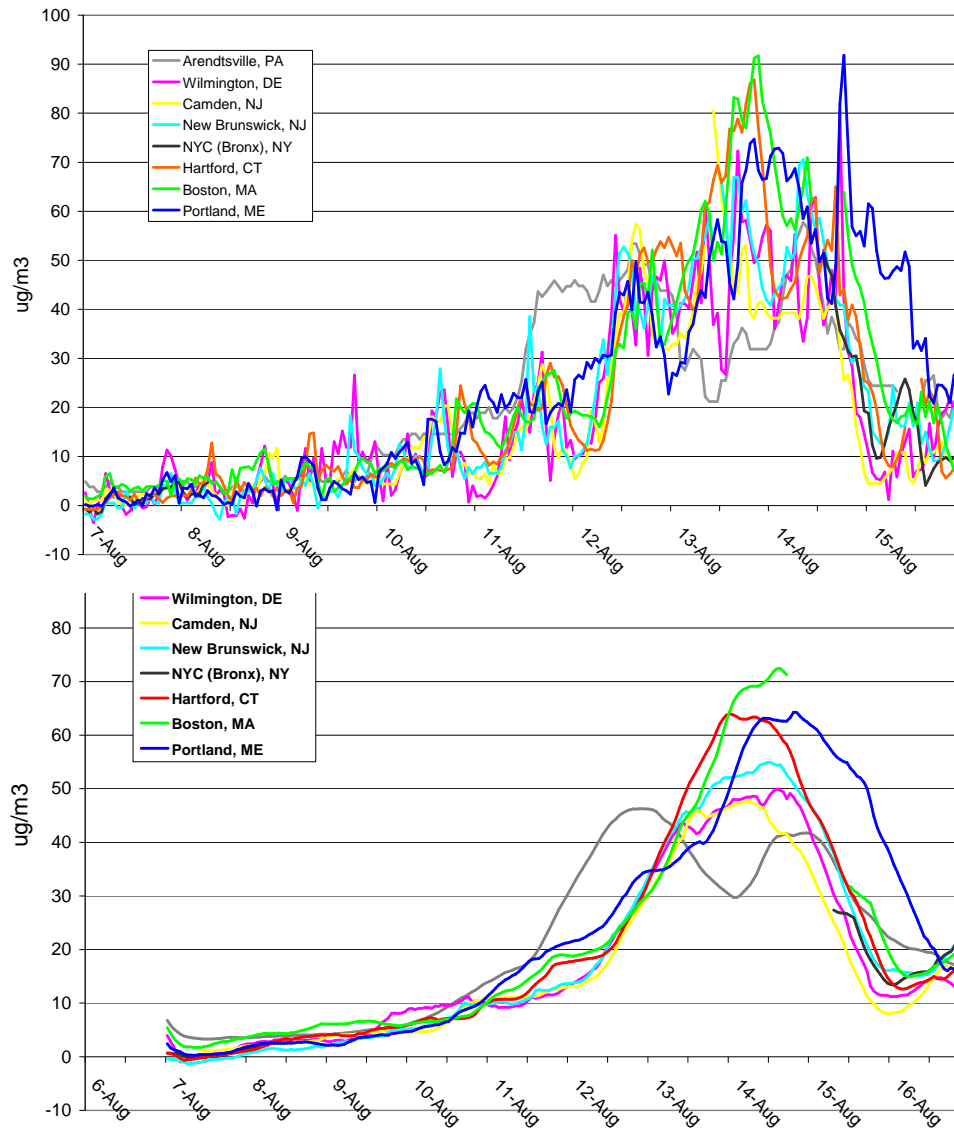


24-Hour
filter

New Haven
TEOM

Detailed Temporal Analysis

Temporal Resolution of the Data



Hourly average and 24-Hour rolling average fine aerosol at 8 MANE-VU sites during the August, 2002 episode

Gray: Arendtsville, PA

Purple, Aqua, Yellow: DE, NJ sites

Red: Hartford, CT

Green: Boston, MA

Blue: Portland, ME

Conclusion

Report Findings

- Fine particulates in the Northeast and Mid-Atlantic U.S. consist of approximately half sulfate, with the balance consisting of a mix of organic material, nitrates, elemental carbon, soil, and other trace components.
- Fine particle concentrations tend to peak during summer months and winter months with relatively few high PM episodes occurring during the spring or fall.
- During the summer, sulfates are highest in concentration over the southern and western portion of the MANE-VU region, closer to source regions associated with high SO₂ emissions.

Conclusion

Report Findings

- Limited atmospheric mixing during the winter months, changes in thermodynamic stability of secondary organic aerosol and particulate nitrate, as well as potential increases of local emission sources during winter months all contribute to PM episodes during winter which, though usually less severe, tend to be more localized in urban locations where the greatest potential for human exposure exists.
- In general, sites tend to track together across very broad geographic scales suggesting the regional influence on ambient fine particulate concentrations. The most significant differences are observed between coastal and inland sites and those in the far southern portions of the MANE-VU domain relative to the Northeast portions.