Session A:
Air Quality and Related Health Research: Particulates (PM) and Co-Pollutants

What is in Ambient Particulate Matter?

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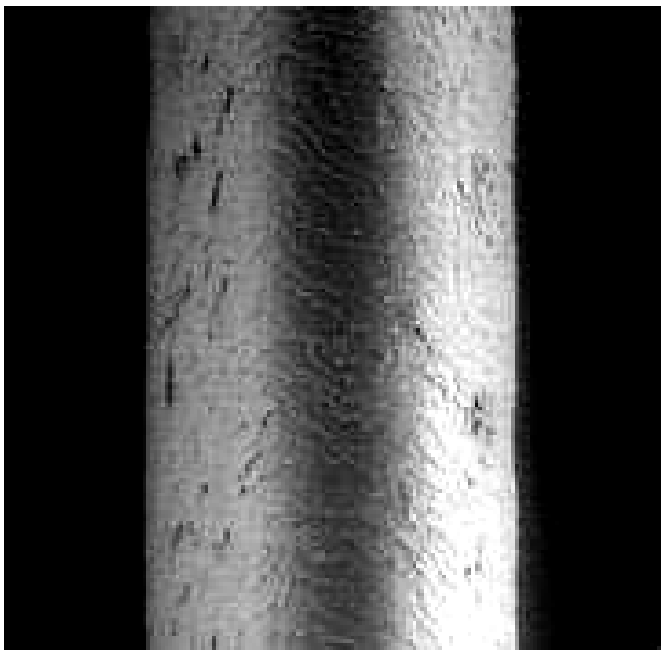
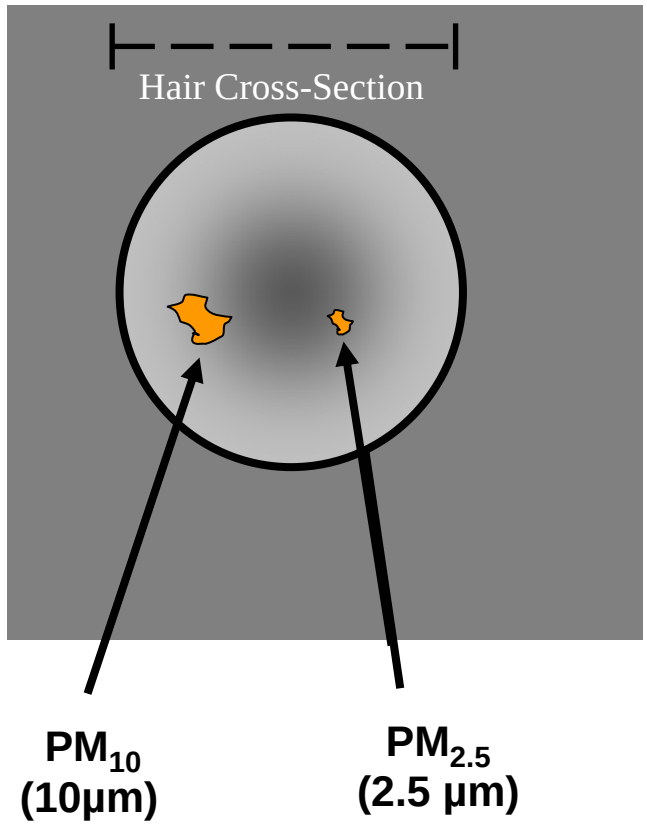
Particulate Matter – What is it?

A complex mixture of extremely small solid particles and drops of liquid in the air



Human Hair (70 µm diameter)

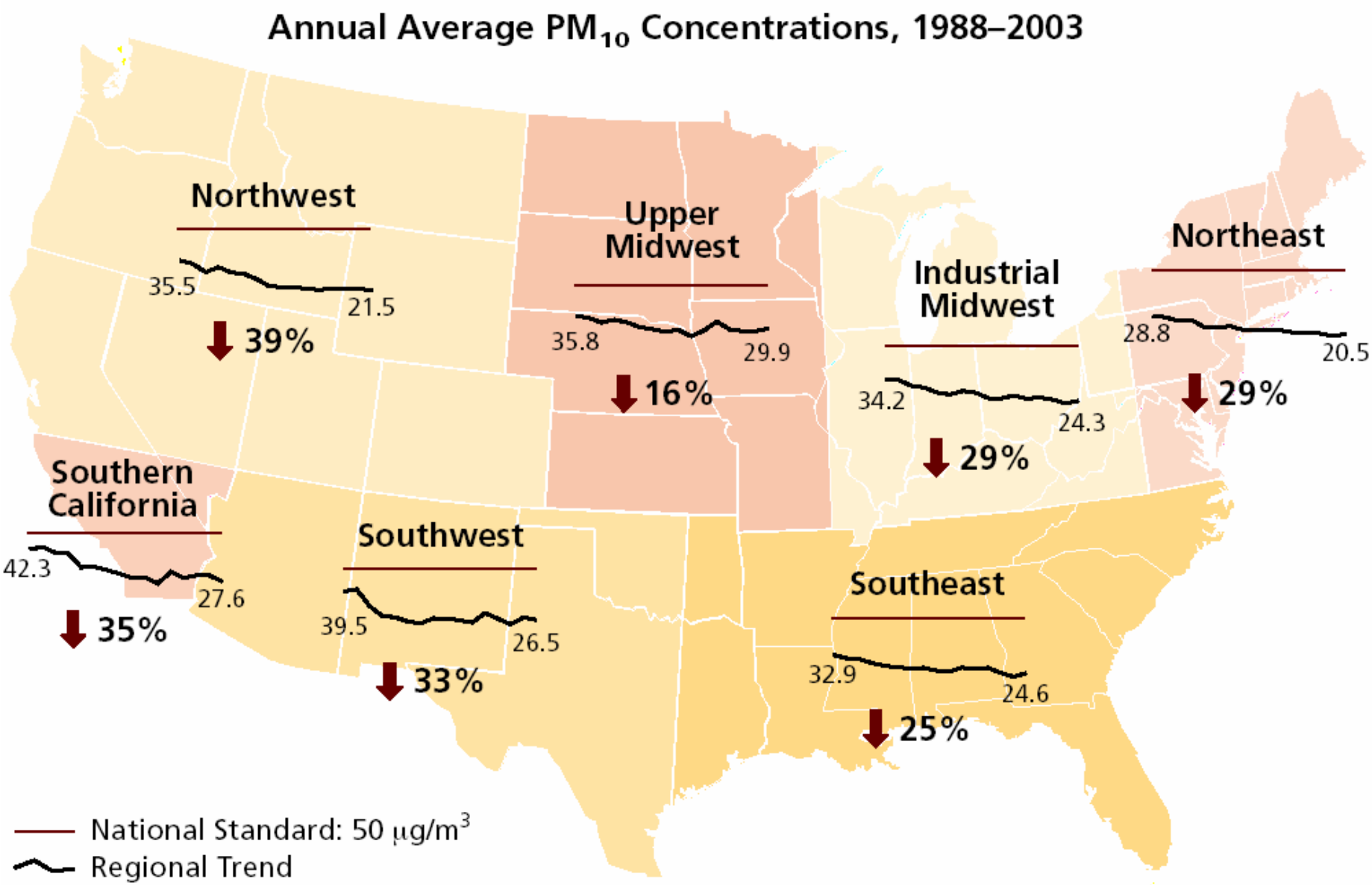


National Standards for Particulate Matter

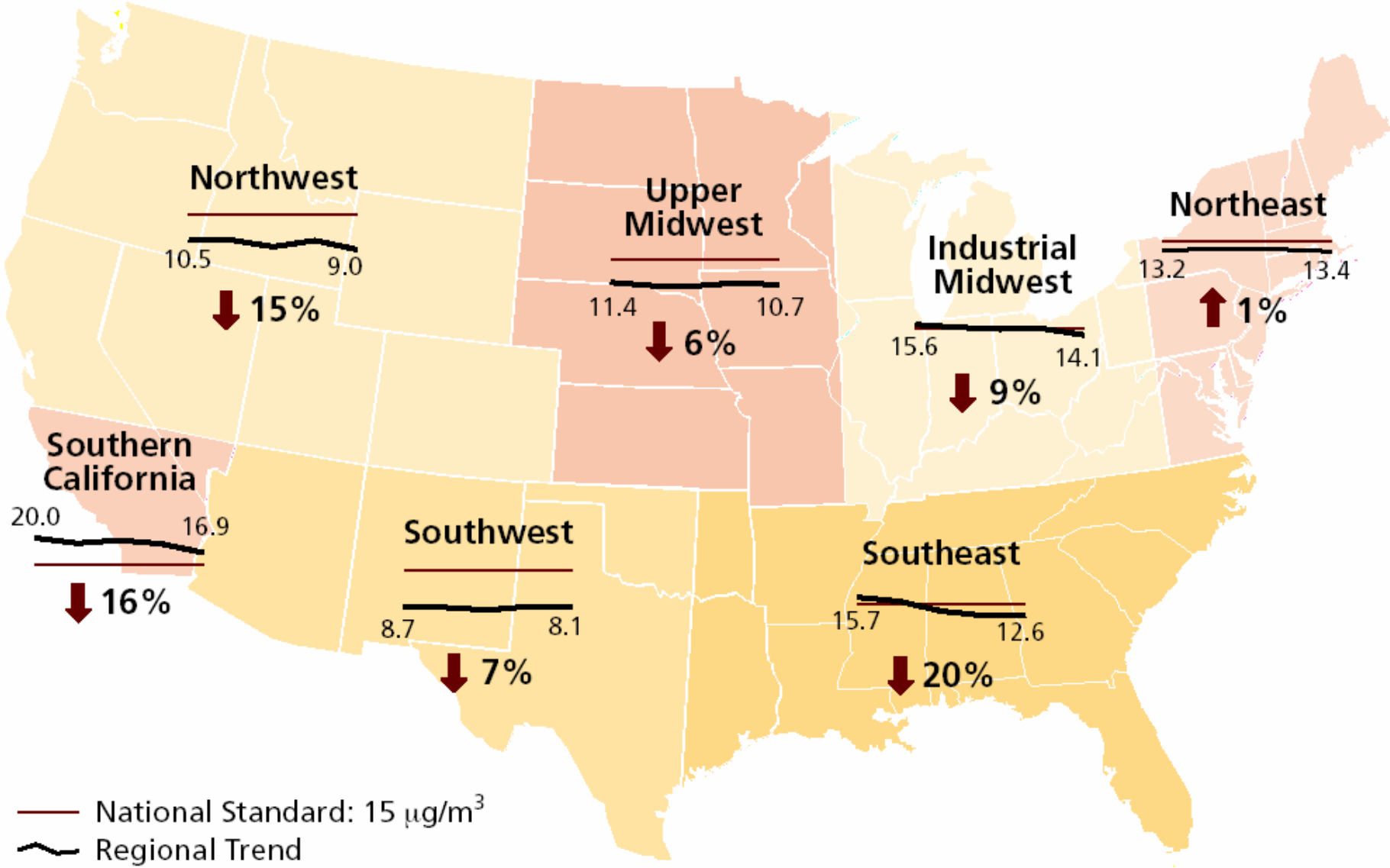
EPA first established National Ambient Air Quality Standards (NAAQS) for total suspended particulate (TSP) in 1971. When the standards were revised in 1987, TSP was replaced by PM_{10}. In 1997, EPA revised the primary (health) and secondary (welfare) PM NAAQS by adding standards for $PM_{2.5}$. EPA added $PM_{2.5}$ standards because fine particles are more closely associated with serious health effects.

The NAAQS for PM_{10} and $PM_{2.5}$ include both short-term (24-hour) and long-term (annual) standards:

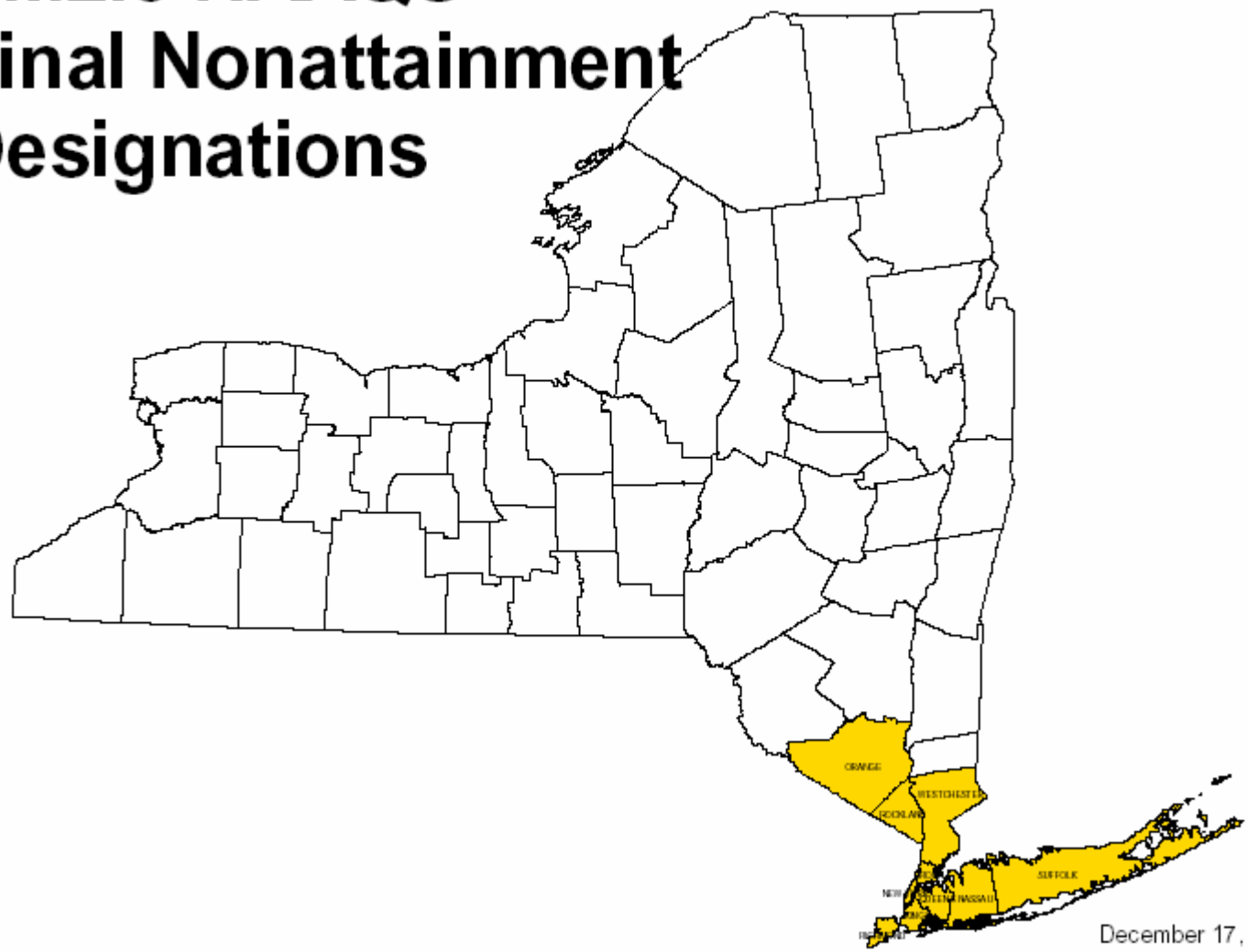
NAAQS	$PM_{2.5}$	PM_{10}
Short-term (24-hour average)	65 $\mu g/m^3$	150 $\mu g/m^3$
Long-term (annual average)	15 $\mu g/m^3$	50 $\mu g/m^3$


Annual Average PM10 Concentrations, 1988–2003
Northwest
35.5
21.5
39%
Upper Midwest
35.8
29.9
16%
Industrial Midwest
34.2
24.3
29%
Northeast
28.8
20.5
29%
Southern California
42.3
27.6
35%
Southwest
39.5
26.5
33%
Southeast
32.9
24.6
25%
National Standard: 50 μg/m3
Regional Trend

Annual Average $PM_{2.5}$ Concentrations, 1999–2003

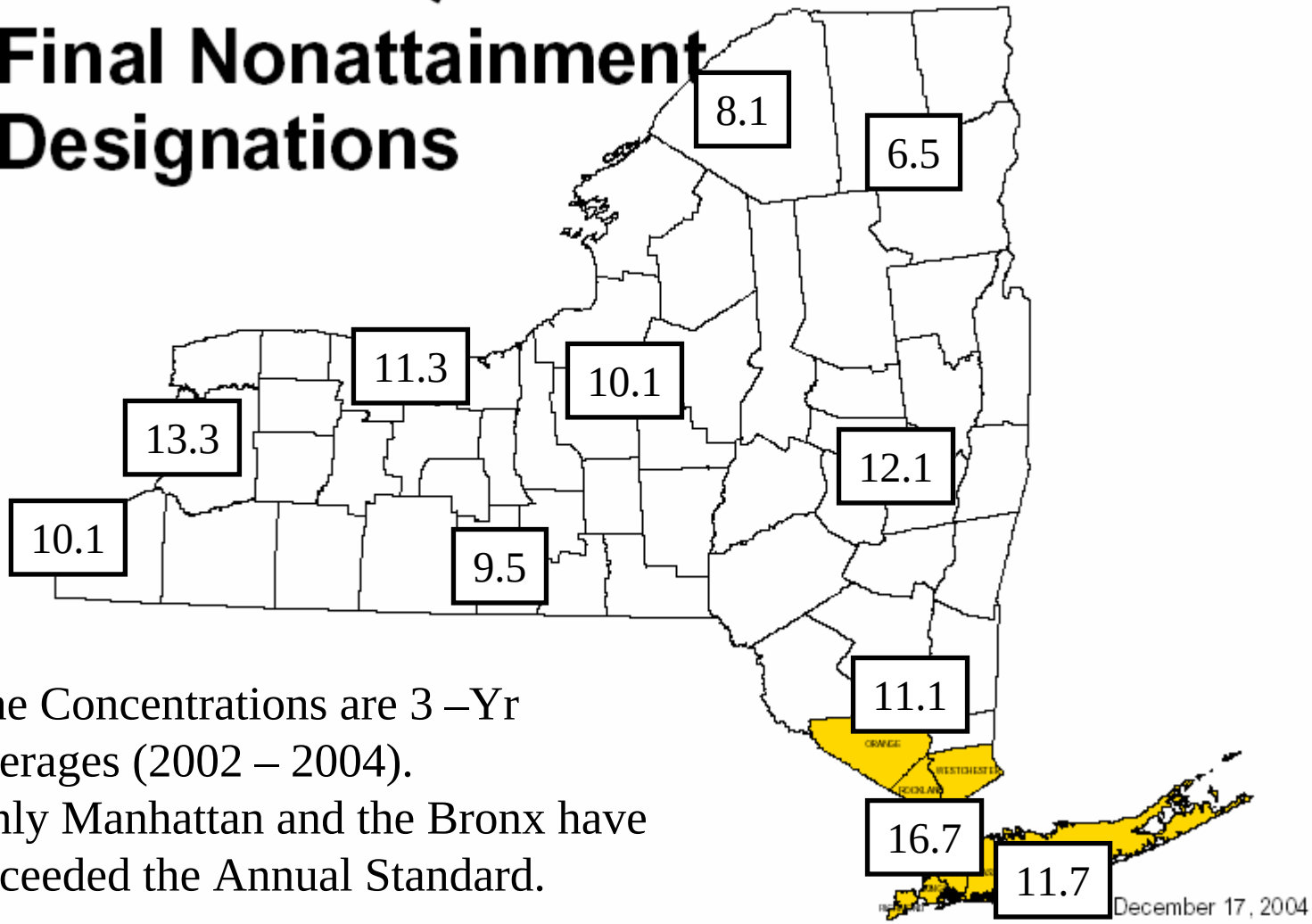


PM2.5 NAAQS Final Nonattainment Designations

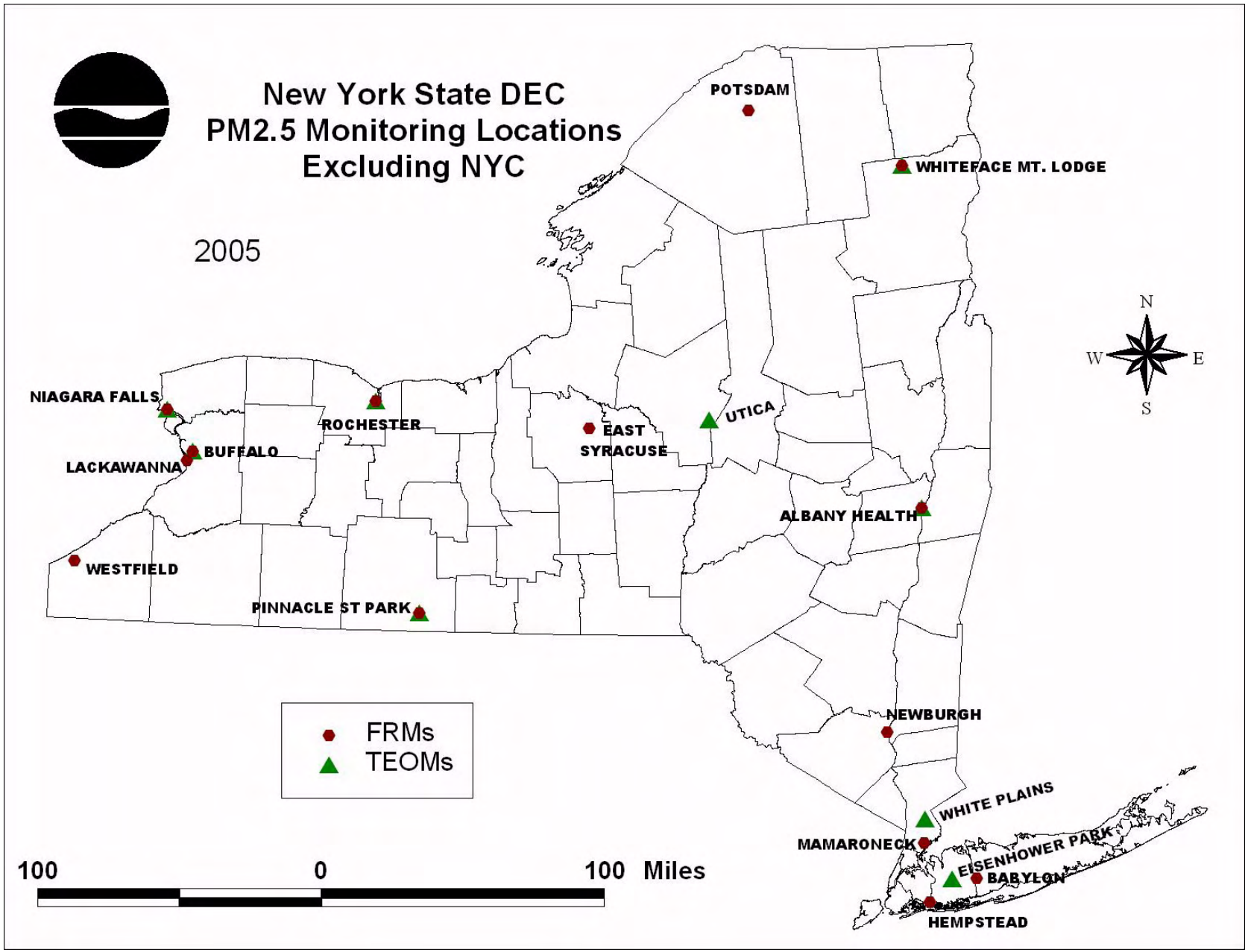


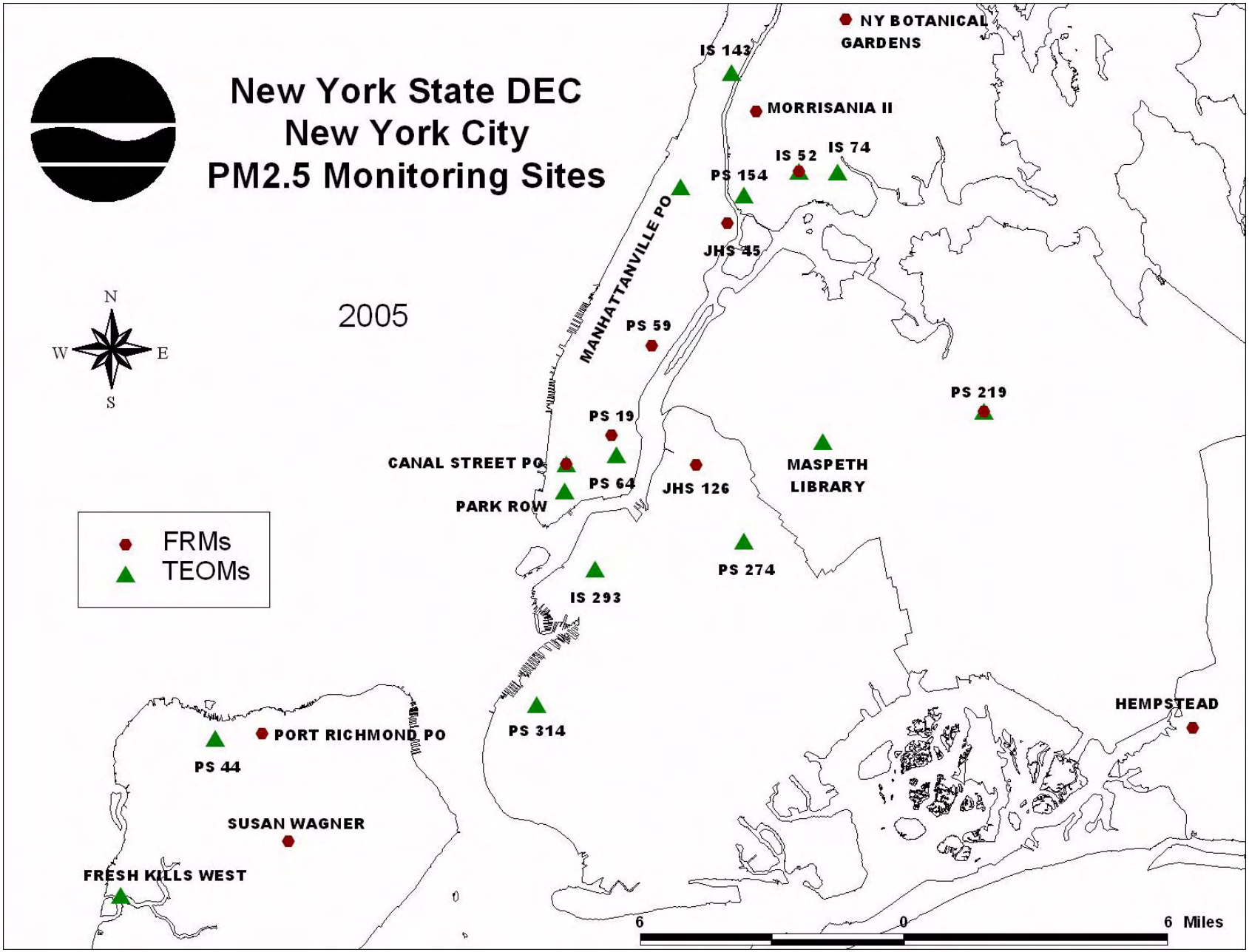
December 17, 2004

PM2.5 NAAQS Final Nonattainment Designations

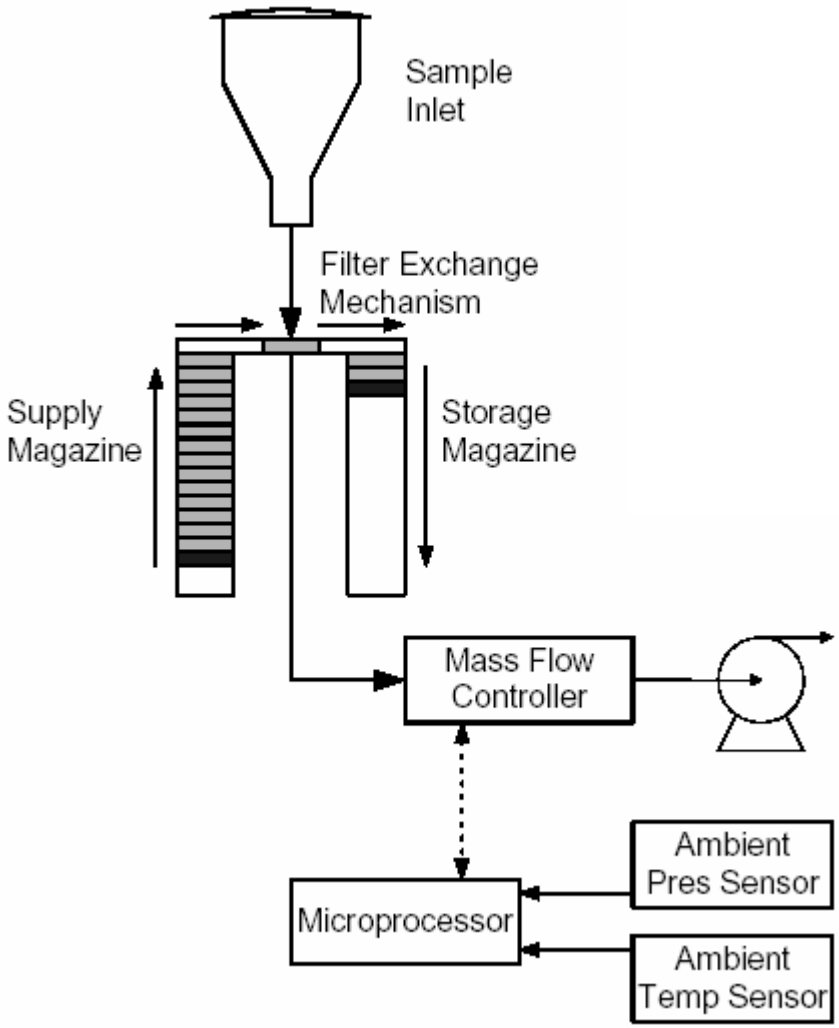


The Concentrations are 3 –Yr averages (2002 – 2004).
Only Manhattan and the Bronx have exceeded the Annual Standard.


New York State DEC
PM2.5 Monitoring Locations
Excluding NYC
2005
POTSDAM
WHITEFACE MT. LODGE
NIAGARA FALLS
ROCHESTER
BUFFALO
LACKAWANNA
EAST SYRACUSE
UTICA
ALBANY HEALTH
WESTFIELD
PINNACLE ST PARK
NEWBURGH
WHITE PLAINS
MAMARONECK
EISENHOWER PARK
BABYLON
HEMPSTEAD
N
W
E
S
FRMs
TEOMs
100
0
100 Miles


New York State DEC
New York City
PM2.5 Monitoring Sites
2005
N
W
E
S
FRMs
TEOMs
NY BOTANICAL GARDENS
IS 143
MORRISANIA II
IS 52
IS 74
PS 154
MANHATTANVILLE PO
JHS 45
PS 59
PS 219
PS 19
CANAL STREET PO
PS 64
JHS 126
MASPETH LIBRARY
PARK ROW
PS 274
IS 293
PS 314
HEMPSTEAD
PORT RICHMOND PO
PS 44
SUSAN WAGNER
FRESH KILLS WEST
6
0
6 Miles

Partisol®-Plus Model 2025 Sequential Air Sampler



PM-2.5 FRM Sampling:

24-Hr sample periods 1 day/3 Midnight to Midnight.

Federally purchased and tested 47 mm Teflon filters.

The filters are conditioned for at least 24 hours prior to weighing.

The pre-weighed filters must be used within 30 days and conditioned and “post”weighed within 30 days of when the sample was collected. (if refrigerated)

Filter must be removed from the sampler within 7 days.

Volumetric Flow controlled and reported 16.7 l/m. (Approximately equal to Human Respiration)

Expensive Program: Labor, QA, Sample Shipping, Equipment Maintenance.

TEOM® Series 1400a Ambient Particulate Monitor

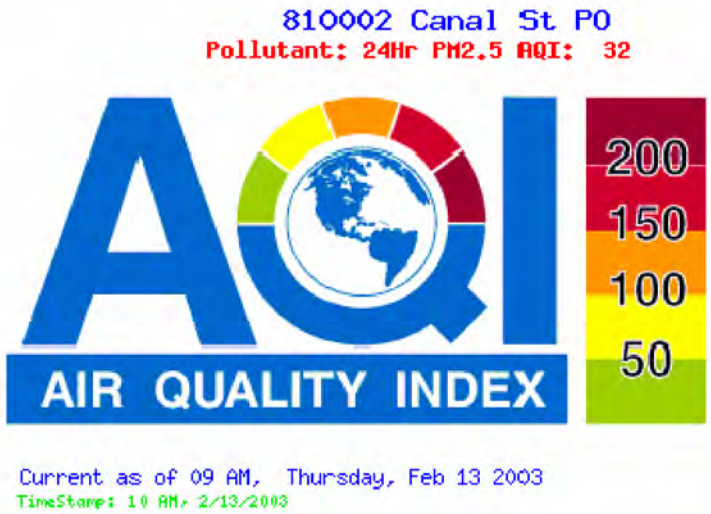
T - Tapered
E - Element
O - Oscillating
M - Microbalance

The NYSDEC uses R&P TEOM 1400 instruments for real-time monitoring of PM-2.5 and PM-10 at 26 locations across New York State.

Hourly data reporting is required for Health based public notification.

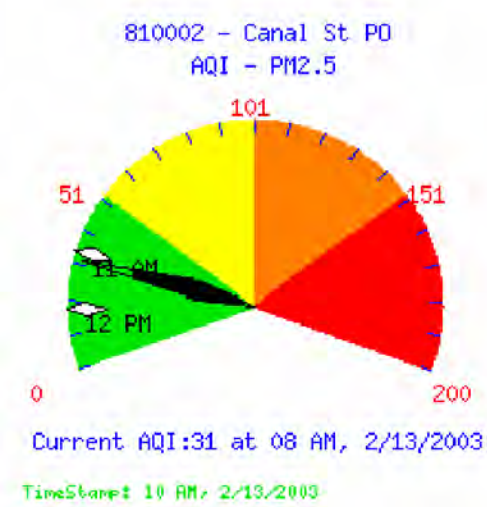
The TEOM installed as shown with a data logger and modem provides hourly concentrations updated within 20 minutes of the top of the hour.

Continuous instruments have higher initial costs but generally cost less to operate due to reduced labor needs.

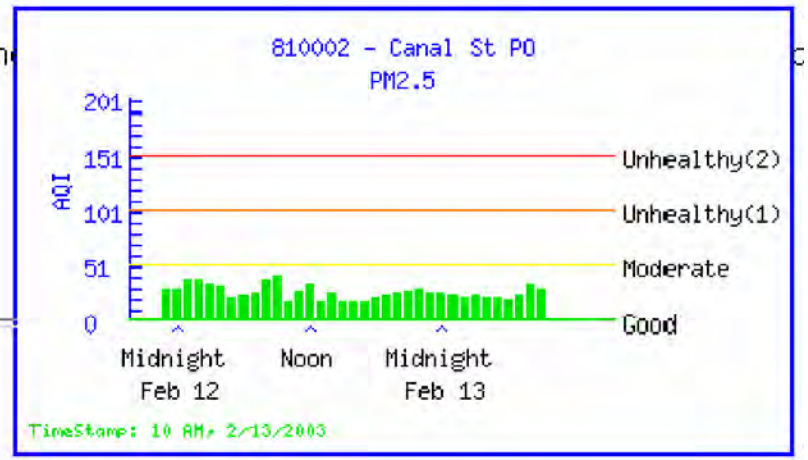


Metropolitan areas with populations over 350,000 are required to report AQI concentrations for the criteria pollutants.

Many Agencies also forecast the AQI concentrations 1 – 3 days in advance.



Note: PM-2.5 is m



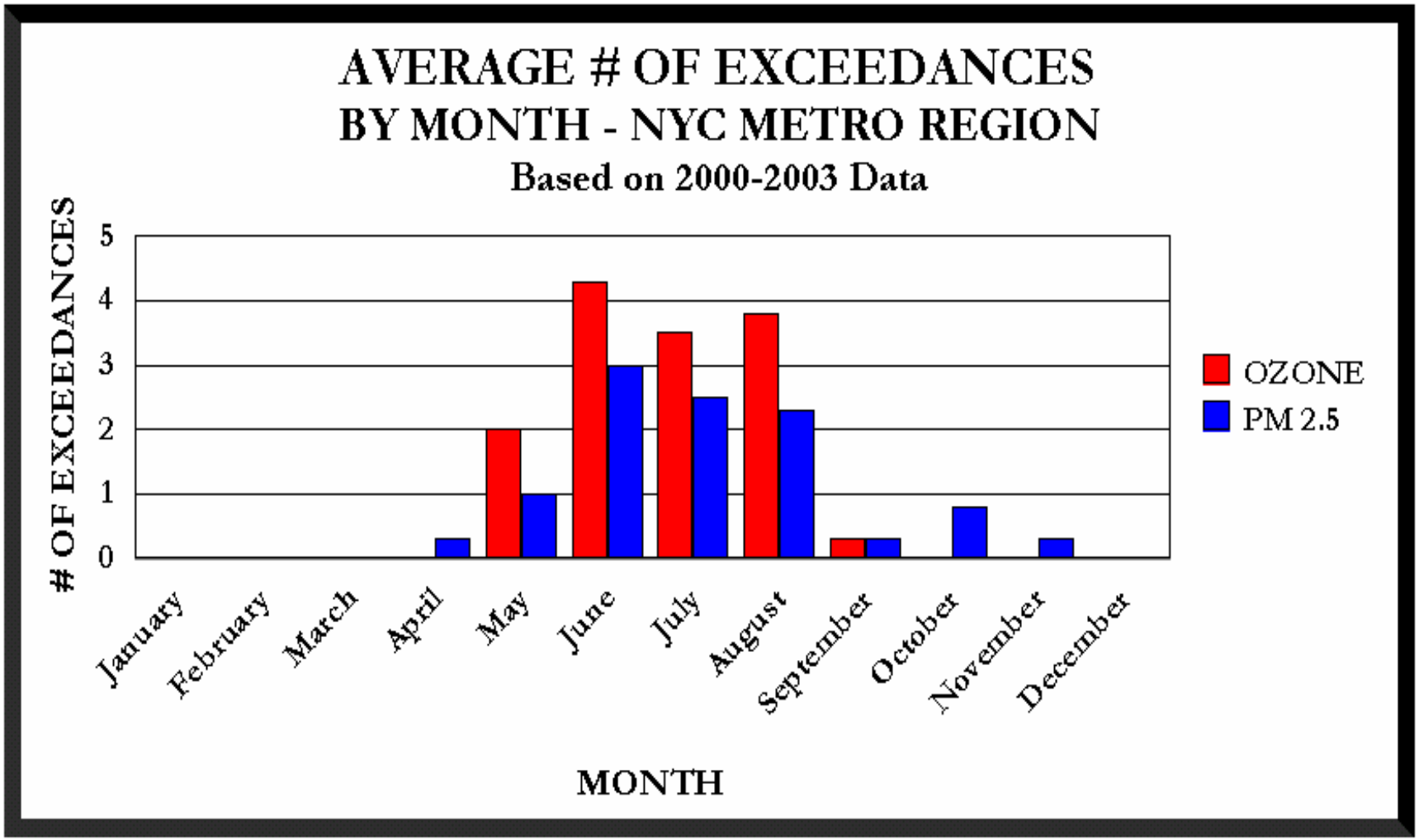
NYSDEC's Forecast:
http://www.dec.state.ny.us/apps/aqi/

Each Criteria Pollutant has its own range of concentrations for each AQI category.

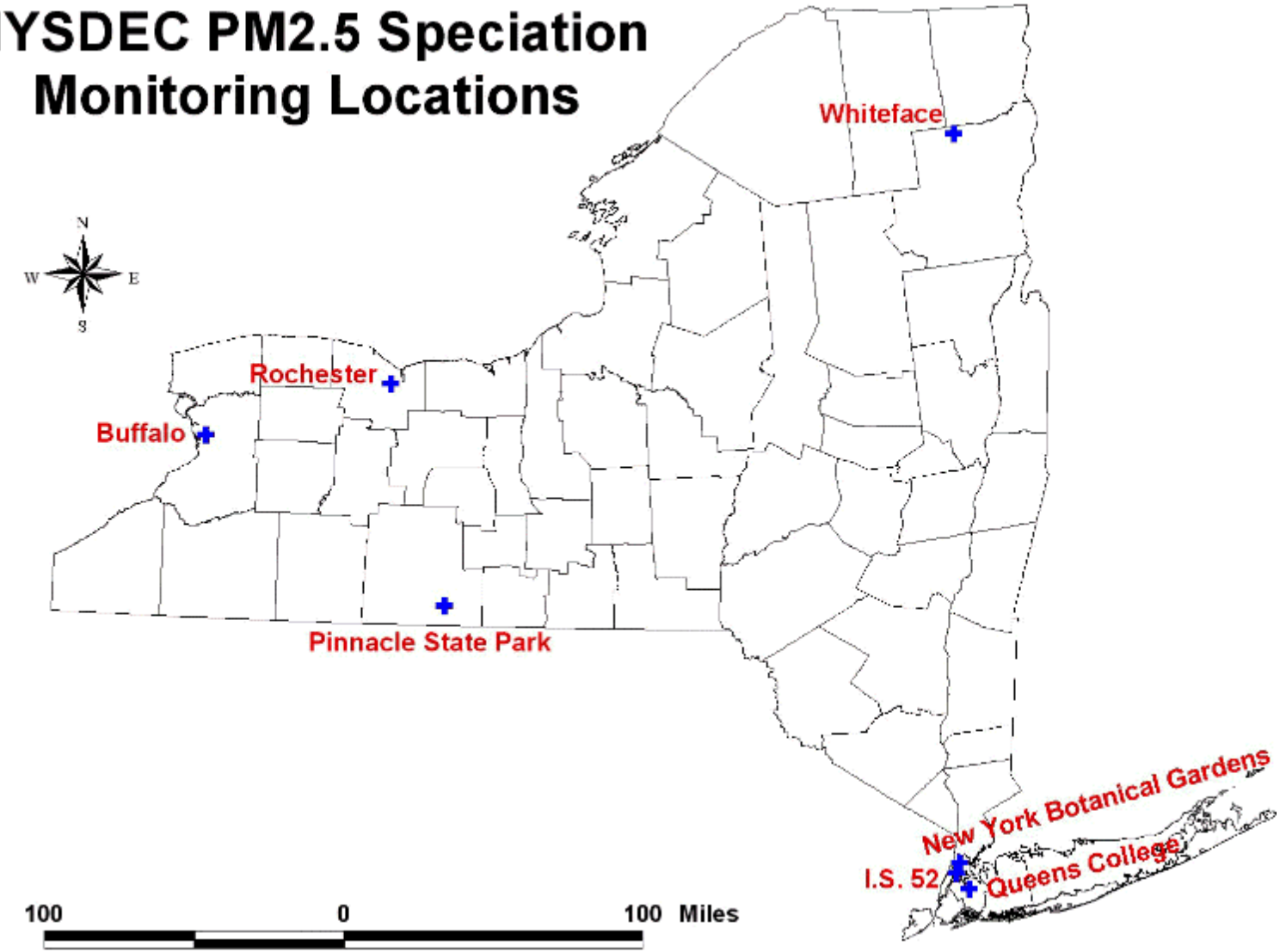
- Good
- Moderate
- Unhealthy for Sensitive Groups
- Unhealthy
- Very Unhealthy

AQI	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	Health Advisory
0–50	0.0–15.4	0–54	None.
51–100	15.5–40.4	55–154	Unusually sensitive people should consider reducing prolonged or heavy exertion.
101–150	40.5–65.4	155–254	People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion.
151–200	65.5–150.4	255–354	People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should reduce prolonged or heavy exertion.
201–300	150.5–250.4	355–424	People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy exertion.

Ozone monitoring is seasonal because exceedances only occur in NY during the photochemically active months from May through September. PM-2.5 exceedances can occur in all but the coldest months.



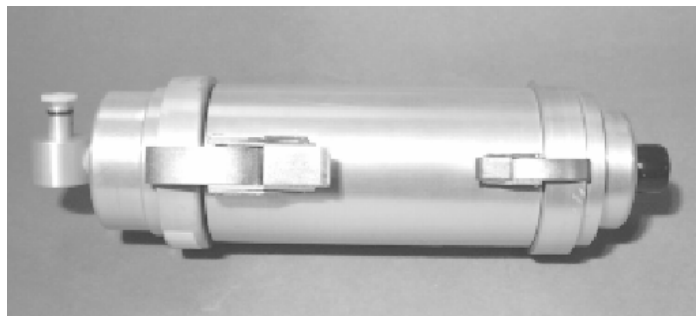
NYSDEC PM2.5 Speciation Monitoring Locations

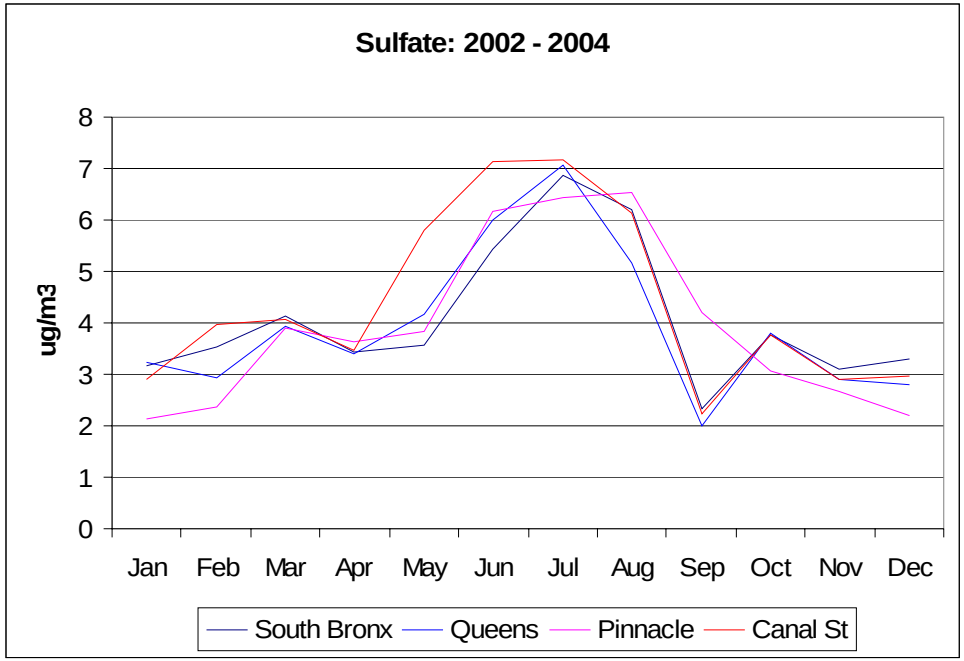


The Speciation Trends Network (STN) Sampler uses 3 filters to collect 24-Hr samples 1 Day in Three.

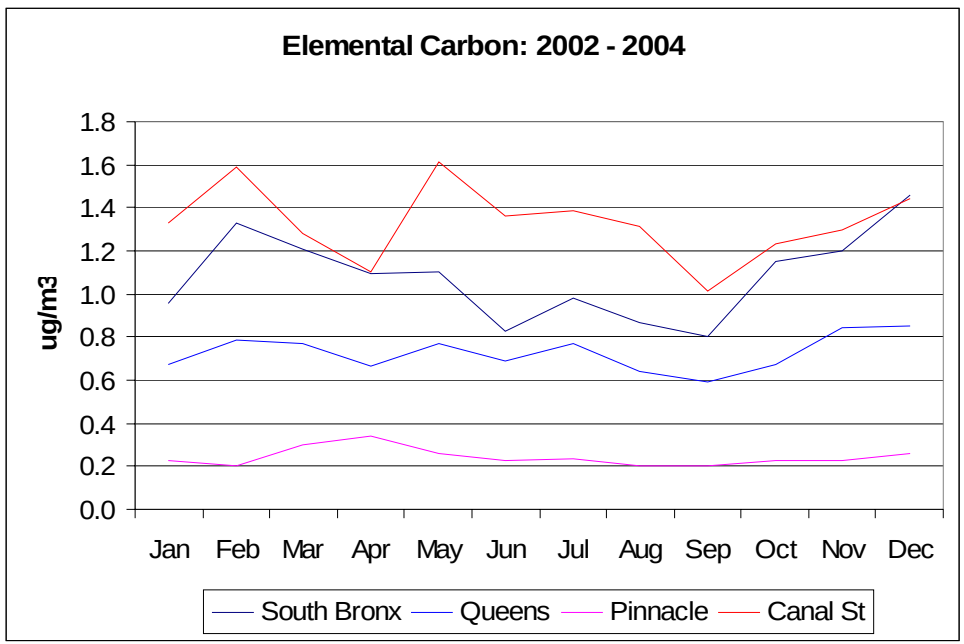
Teflon: Mass & Elements
Nylon with Denuder: Ions
Quartz: Carbon EC and OC

The filters are shipped to and from the lab in Harvard Impactors.





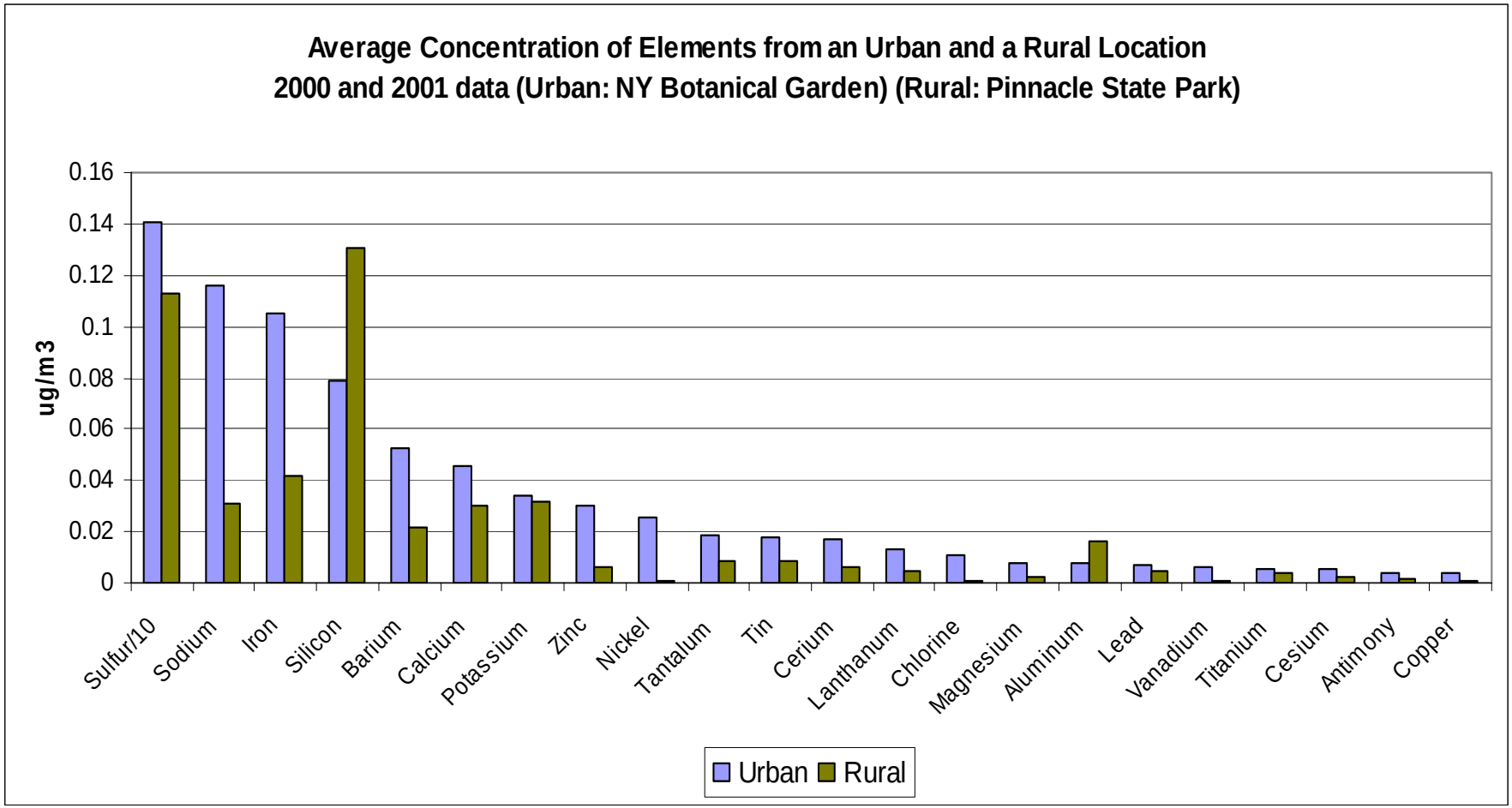
Sulfate is primarily a Regional pollutant. The concentrations are similar in both urban and rural locations.

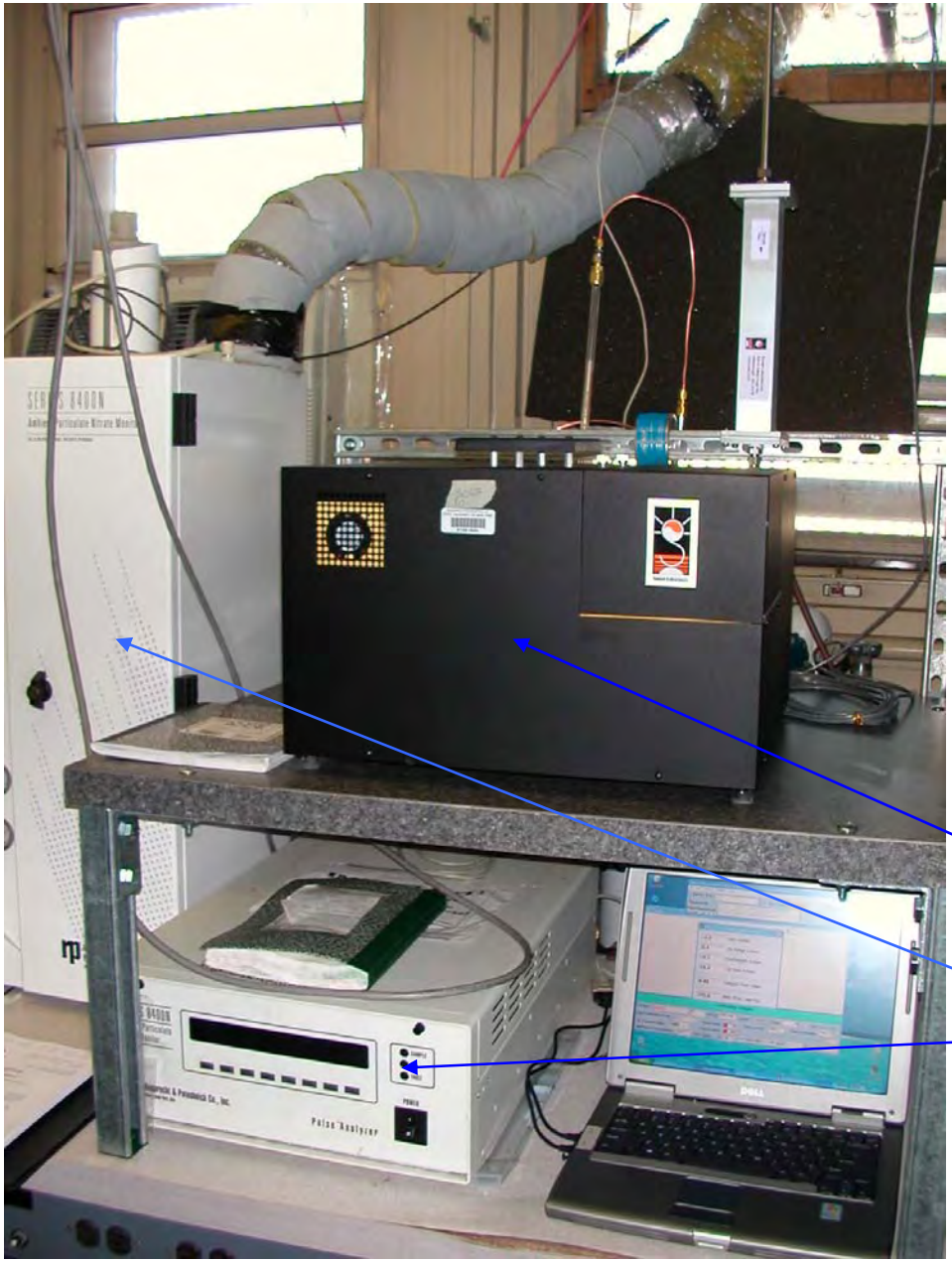


Elemental Carbon has significant spatial gradients even between sites located in the same urban area.

The South Bronx and Queens sites are separated by 6.8 miles.

The STN filters are analyzed by X-Ray Fluorescence for Elements.
The concentrations of individual Elements are not significant for their mass but they are useful as tracers for larger sources.





New instruments can provide hourly PM-2.5 species data.

The NYSDEC operates:

Carbon Elemental, Organic, Black

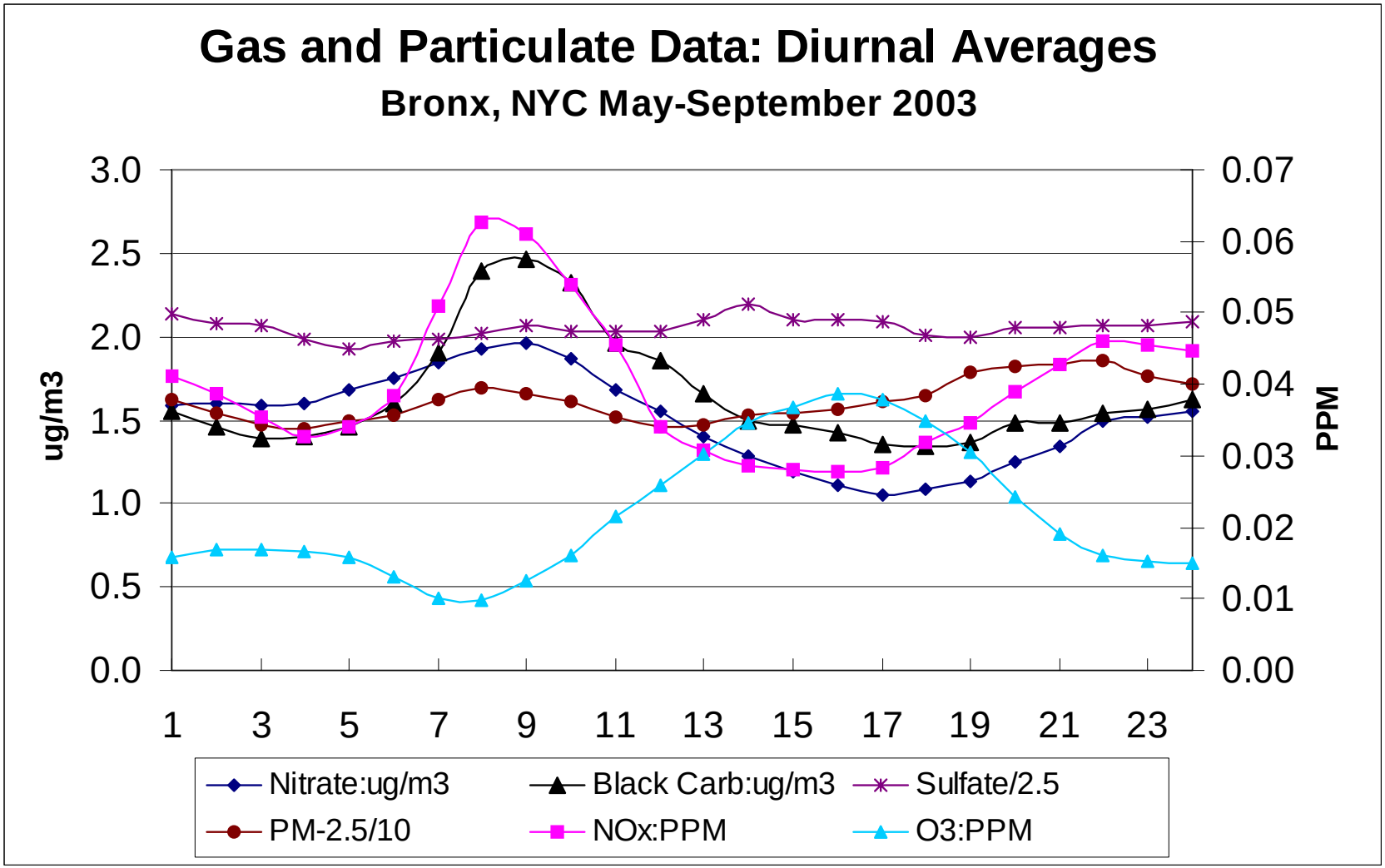
Sulfate

Nitrate

Sunset EC/OC Instrument

R&P 8400N Instrument

Examining Hourly Gas and Particulate data at the same location provides insight into the origin of specific pollutants.



R&P F D M S 8500

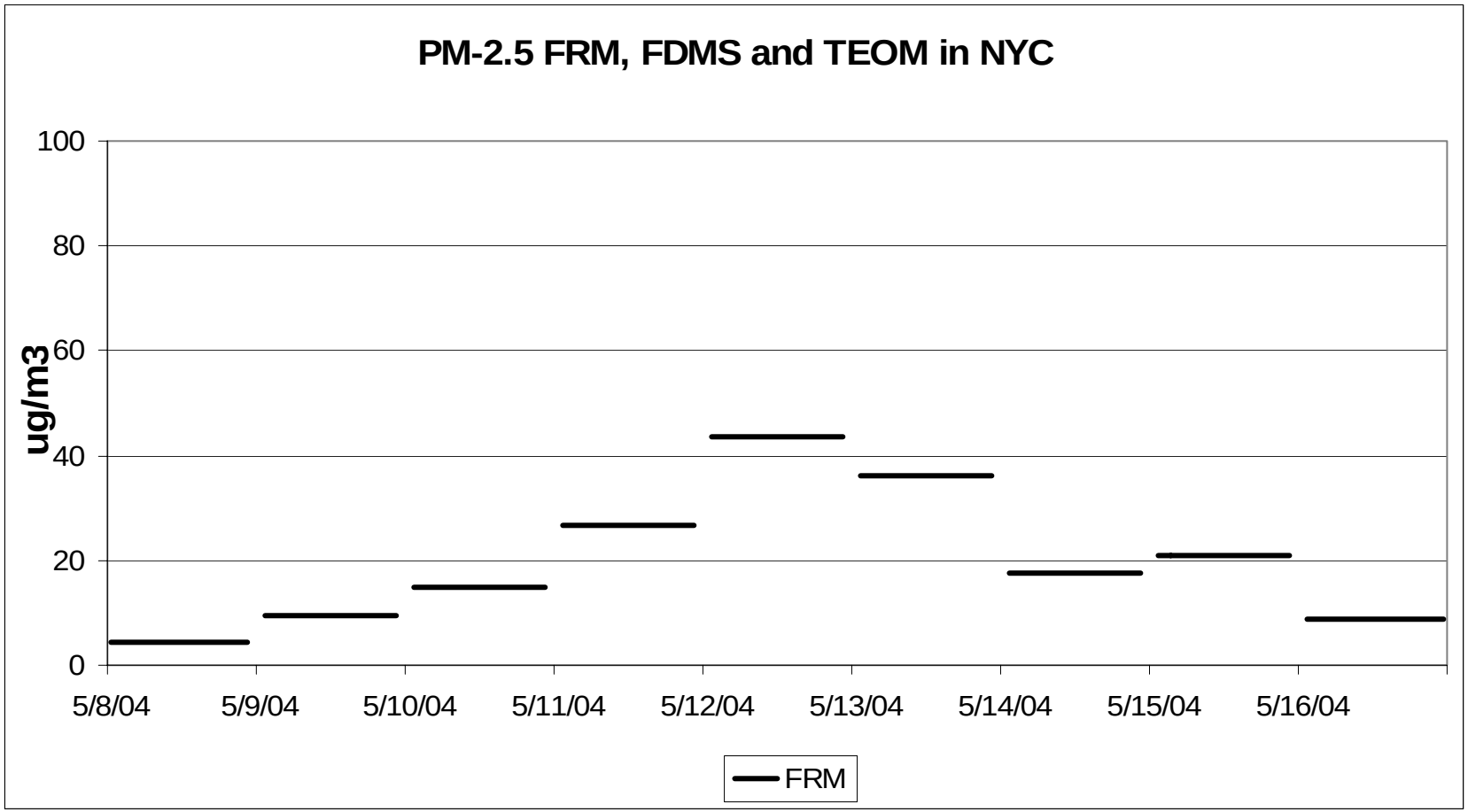
System
Measurement
Dynamic
Filter

The FDMS is designed to characterize the volatile and non-volatile portions of ambient PM-2.5.

The NYSDEC operates 3 FDMS TEOMs in:

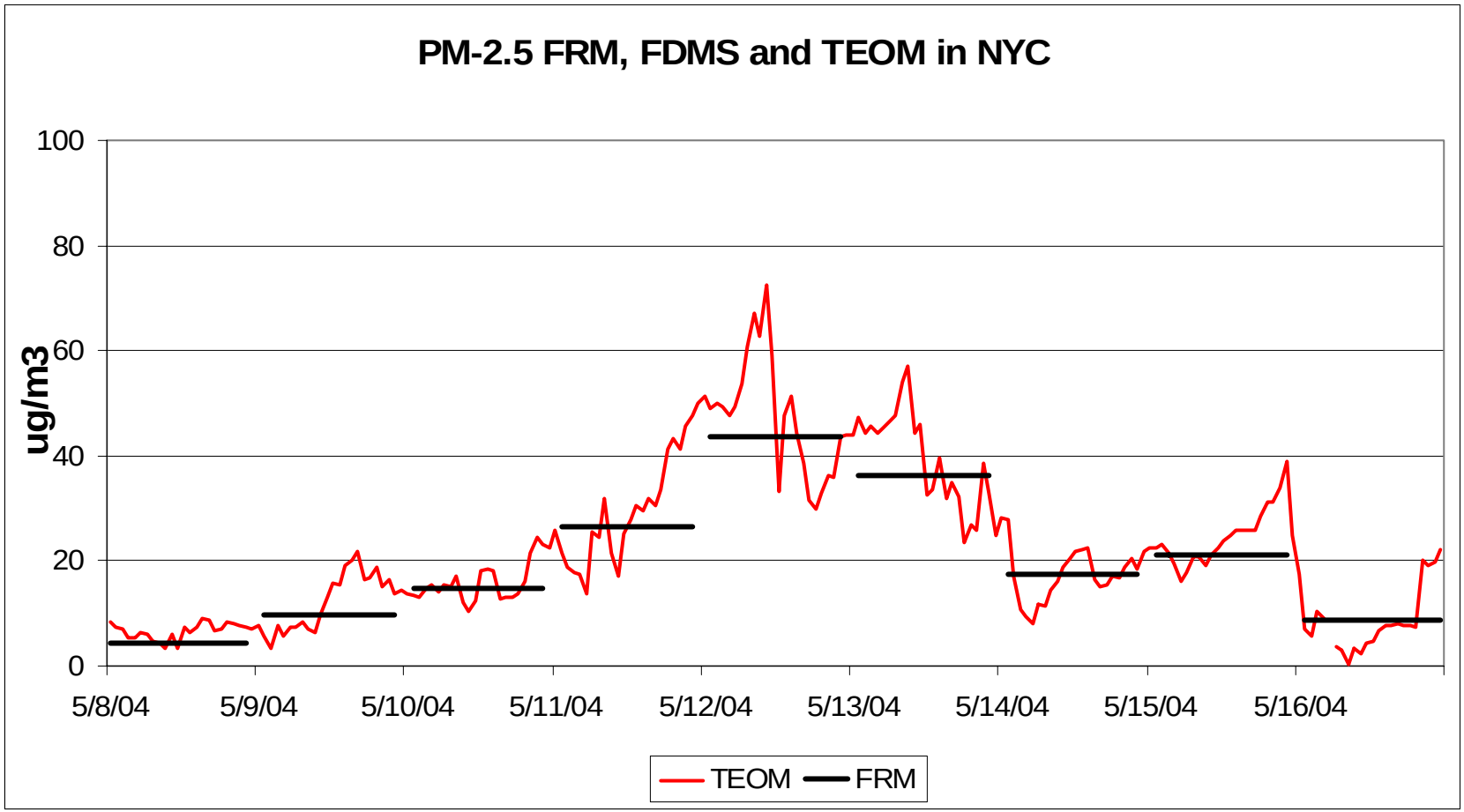
- New York City
- Niagara Falls
- Addison - Southern Tier

This pollution episode occurred in May 2004.
The majority of FRMs collect one sample on every third day.
At four locations in NY the FRM operates daily.

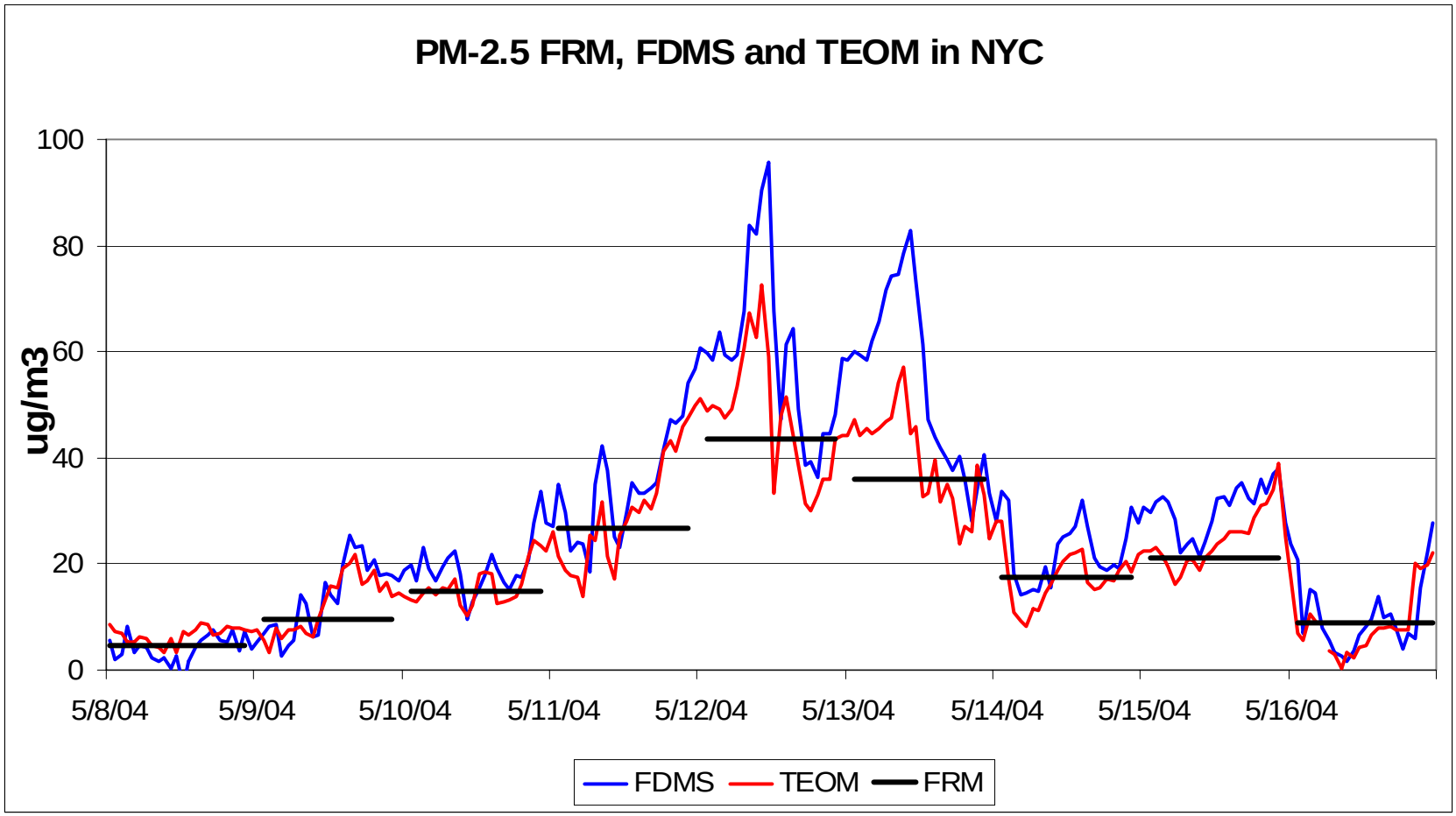


The TEOM's hourly data shows how much information is lost due to the averaging period of the FRM.

The 50 Deg C. TEOM data matches the FRM more closely in warm Months.



The FDMS data indicates that the FRM and the 50 Deg C TEOM did not capture a substantial fraction of PM-2.5 during this pollution episode.



The NYSDEC Monitors PM-2.5 for many reasons:

Regulatory: The NYSDEC is the Agency charged with determining if the air in New York State meets the health based NAAQS.

The EPA requires Air Monitoring Agencies to produce near real-time public notification and forecasts of the air quality in larger cities. (NYSDEC Website and EPA's AirNow website)

State Needs: The NYSDEC must have specific information about the components of PM-2.5 for source apportionment, examination of atmospheric reactions and for toxics.

Method Development: The NYSDEC understands that the FRM does not comprehensively measure the quantity of all PM-2.5 species in each season. The result of this work will improve our ability to predict the response of the environment to pollution control strategies as measured by the FRM.

It is also anticipated that the additional information provided by speciation and volatile PM mass monitoring programs will be valuable to the Health community.