

# Current and Future Measurements of Air Pollutants

**Joann Rice**  
 EPA - Office of Air Quality Planning and Standards  
**Air Quality Data in Health Effects Research**  
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## Agenda


- a. What PM<sub>2.5</sub> mass, speciated PM<sub>2.5</sub>, and gaseous pollutant data are currently being collected and made publicly available?
- b. What biases and/or limitations exist in the reported measurements of individual air pollutants?
  - i. information concerning the use of blanks data to correct concentration measurements for carbon,
  - ii. measurement of organics by different networks (e.g., IMPROVE, STN) planned changes by EPA: implications for continuity in longitudinal analyses,
  - iii. information concerning detection limits and measurement of transition metals.
- c. Future of the monitoring networks: What changes in monitor locations and methods for PM mass, components, and gases are expected in the EPA/state air quality networks for the next 5 – 10 years? Will there be sufficient stability/consistency for epidemiologic research?

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## Overview of PM<sub>2.5</sub> Mass Networks

- Filter-based Federal Reference Method (FRM) Sampling
  - 933 FRMs
    - 125 sites operate every day
    - Over 600 operate every third day; about 50 of these sites to go to daily sampling in support of lower (35 ug/m<sup>3</sup>) daily standard
    - Another 100+ sites operate every sixth day
- Robust national QA/QC program
  - 90% sites within 7.3% precision
  - National bias estimates -2%
- 24-hour integrated samples
- FRM data typically available within 3 months on AQS

PM<sub>2.5</sub> FRMs




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## PM<sub>2.5</sub> Continuous Mass Sites

- Continuous Monitoring
  - 514 Continuous Mass Sites
  - Good coverage in most areas with fine particle issues
- Data Quality
  - Some methods have seasonal biases as compared to FRM/FEM
  - Some methods have better/worse precision than others
- Near real-time data
  - Reporting of the Air Quality Index (AQI) every hour on [www.AIRNow.gov](http://www.AIRNow.gov)
  - Hourly data available right away on AIRNowTech
  - Most data also available on AQS within ~3 month

PM<sub>2.5</sub> Continuous Mass Sites by Method




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## PM<sub>2.5</sub> Chemical Speciation Program

- Chemical Speciation sites
  - 54 Speciation Trend Network (STN) sites are for long-term trends
  - Additional 162 Speciation State and local Air Monitoring Stations (SLAMS)
  - IMPROVE (110 sites + 35 State operated and CASTNET sites).
- Most STN and SLAMS Speciation sites use Met One Sampler
- National QA/QC program
- All States use national contract lab for Trends sites
- IMPROVE lab support through UC Davis
- Data
  - Chemical Speciation data in AQS within ~3 months
  - IMPROVE on VIEWS web site (at least several month lag), recently added in AQS

PM<sub>2.5</sub> Chemical Speciation and IMPROVE Monitoring Sites

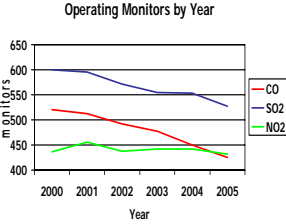


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## Gas Criteria Pollutant Monitor Counts for CO, SO<sub>2</sub>, and NO<sub>2</sub> by Year

- EPA's Monitoring Strategy encourages divestment of low value CO, SO<sub>2</sub>, and NO<sub>2</sub> monitoring sites
- Final Monitoring Rule 10/17/06 eliminates minimum monitoring requirements for these pollutants, except in areas with problems
- Although additional sites will go away, expect many sites will be retained, especially where collocated with other measurement systems
- CO, SO<sub>2</sub>, and NO<sub>2</sub> data available on AQS within ~3 months

Operating Monitors by Year



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## Future of Ambient Monitoring Networks - Stability

- Most stable
  - Speciation Trends Network (STN)
  - National Core (NCore) Network Multi-pollutant Stations
- Reasonably stable
  - Design value sites in non-attainment areas
    - For  $PM_{2.5}$ , often includes FRM, continuous and speciation
  - Sites other than design value locations in non-attainment areas
  - Required, but low-reading sites in attainment areas
- Stable site locations, but budget constraints may result in loss of some sites
  - IMPROVE class 1 areas
- Least stable
  - Non-required sites in attainment areas

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## Monitoring Network Method Changes in Coming Years

- $PM_{2.5}$  mass
  - May see one or more continuous methods become Federal Equivalent Methods (FEMs)
    - Largely due to improvements in sample conditioning and new performance based criteria for approval of methods
- $PM_{10}$  mass
  - More agencies expected to use the low-volume (similar to  $PM_{2.5}$ ) FRM
- PM speciation
  - Development of  $PM_{10-2.5}$  speciation method
  - Changes to carbon method for urban speciation
- CO, SO<sub>2</sub>, NO<sub>y</sub>
  - High sensitivity measurements of these pollutants at NCore, but possibly other sites as well
- NO<sub>2</sub>
  - Use of direct method for measurement of NO<sub>2</sub>

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## New National Core (NCore) Multi-pollutant Monitoring Stations

- NCore Multi-Pollutant Network being added:
  - Network plans due July 1, 2009
  - Full network operational by January 1, 2011
    - ~ 75 Stations Nationally
    - ~ 55 Urban Sites at Neighborhood to Urban Scale
    - ~ 20 Rural Sites at Regional Scale
- Pollutants
  - Particles
    - $PM_{2.5}$  filter-based and continuous, speciated  $PM_{2.5}$ ,  $PM_{10-2.5}$  FRM/FEM or continuous  $PM_{10-2.5}$  FEM
  - Gases
    - O<sub>3</sub>, high-sensitivity - CO, SO<sub>2</sub>, NO<sub>y</sub>
  - Meteorology
    - Ambient Temperature, WS, WD, RH

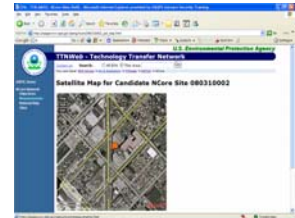
Working Draft of NCore Multi-pollutant Stations



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## NCore Multi-pollutant Site Tool

- Web-based tool is being developed to provide information and seek input on design of NCore
- Includes
  - Site metadata
  - Site pictures
  - Satellite and street maps
  - Networks station is being leveraged with
  - Links to information on NCore
  - Ability to review and post comments on each station**
- Expect to roll-out tool Jan 07



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## PM<sub>2.5</sub> Data Reporting Issues of Interest

- PM<sub>2.5</sub> site meta data improvements
  - Working with monitoring agencies to ensure  $PM_{2.5}$  sites have monitoring objectives properly recorded in AQS (e.g., population exposure, regional transport...)
- New parameter codes for  $PM_{2.5}$ 
  - EPA – OAQPS contact is Tim Hanley (hanley.tim@epa.gov)

Parameter Name	Parameter Code	Purpose	Notes
PM <sub>2.5</sub> LOCAL CONDITIONS	B8101	Appropriate code for all FRM/FEM/ARMs	Original code for $PM_{2.5}$ at local conditions
PM <sub>2.5</sub> TOTAL ATMOSPHERIC	B8500	Valid data from methods measuring total $PM_{2.5}$ aerosols in the atmosphere, including those that can be volatilized from the FRM	Introduced in 2005
PM <sub>2.5</sub> RAW DATA	B8501	Valid uncorrected data that does not reasonably match the FRM	Introduced in 2005
ACCEPTABLE $PM_{2.5}$ AQI & SPECIATION MASS <sup>1</sup>	B8502	Valid data that does reasonably match the FRM with or without correction, but not to be used in NAAQS decisions	Introduced in 2006
PM <sub>2.5</sub> VOLATILE CHANNEL <sup>1</sup>	B8503	Have important related data such as the FEMs reference channel	Introduced in 2006

1 - We anticipate it will take several months to align all reporting agencies with these new codes.

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## Web Sites of Interest

- Real-time air pollution data and maps
  - <http://airnow.gov/>
    - AIRNOW - Ozone and  $PM_{2.5}$  maps, State/Local Air Quality forecasts
  - <http://airnowtech.org>
    - Recent real-time maps and data
  - <http://idea.spsc.wisc.edu/>
    - IMPROVE
    - Uses MODIS Satellite data and AIRNow observations
- Historical AIR Monitoring Data
  - <http://www.epa.gov/ttn/airs/airsaqs/>
  - <http://www.epa.gov/air/datal/>
  - <http://vista.cira.colostate.edu/views/>
    - IMPROVE
  - <http://www.epa.gov/airexplorer/>
- Ambient Monitoring Technology Information Center (AMTIC)
  - <http://www.epa.gov/ttn/amtic/>
    - Ambient Monitoring Technology Information Center
    - Program information, methods, links to regulations
  - <http://www.epa.gov/ttn/amtic/supersites.html>
    - Supersites Research

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## STN Carbon Conversion

- Speciation Trends Network (STN)
  - 54 Trends sites: Largely static urban monitoring stations and protocols for sampling and analysis
- Speciation State and Local Air Monitoring Stations (SLAMS)
  - Currently ~160 sites: Somewhat dynamic network of monitors for state and local agency directed monitoring objectives
- Changes in the network to address inconsistencies in carbon sampling and analysis procedures used in urban STN/SLAMS and rural IMPROVE programs
  - Field blank collection and subtraction also to change

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## STN Carbon Conversion

- Logistical plans for conversion
  - EPA will manage coordination and implementation of conversion
  - EPA is using a contractor to procure, install and train operators on URG 3000-N sampler use
  - Contractor (with EPA) will contact and coordinate installation with Region/State agencies
  - Once installations are complete, analysis will be switched to TOR analysis
    - All sites will move to new analysis at once
    - Concurrent TOT and TOR collection and analysis will be done for about one month
  - Sampling modules, cassettes, and analysis will continue to be supported and supplied by RTI
  - Process will be repeated for rest of the network in batches of 50
- Expect to complete first phase of conversion in early '07

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## 1<sup>st</sup> Phase Selection Rationale

- Area-based approach using 2010 CAIR projected non-attainment areas
  - Trends and SLAMS in NA counties based on 2010 CAIR projections using 15 ug/m<sup>3</sup>
  - Trends and SLAMS in NA counties in the Northwest and Utah based on 2010 CAIR projections using 35 ug/m<sup>3</sup>
- Sites in MD, DC, NJ and NY corridor selected based on PM<sub>2.5</sub> design values
- Six sites\* where health studies are ongoing 2004-2014: These sites to be converted all at once. Four of six sites selected using first 2 criteria so additional 2 sites (St. Paul, MN and Winston-Salem, NC) added to the list.
- Six sites currently doing collocated STN/IMPROVE measurements will continue as is. These sites are in: Pittsburgh, Atlanta, Bronx\*, Birmingham, Fresno, and Detroit
- 17 Trends with 2 collocated sites in CA
- 40 SLAMS
- Total of 57 Trends/SLAMS plus 2 collocated sites

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## 1<sup>st</sup> Phase Trends/SLAMS



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## Precursor Gas Monitoring – SO<sub>2</sub>

- High sensitivity monitoring at reduced concentration levels for NCore
  - New category of monitoring devices with improved sensitivity
  - Lower Detectable Level (LDL)
    - SO<sub>2</sub> ~ 100 ppt
  - Method Detection Limit (MDL)
    - SO<sub>2</sub> ~ 60 ppt
  - About 10 times more sensitive than standard monitors
- Linear range great enough to also support NAAQS (National Ambient Air Quality Standard) monitoring
- Typical concentrations in Southeast (SEARCH)
  - Urban ~ 5 ppb
  - Rural ~ 2 ppb

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## Trace Elements by XRF

- Currently collecting data for 48 elements
  - MDLs range from 0.001 ug/m<sup>3</sup> for Cobalt to 0.06 ug/m<sup>3</sup> for Sodium for RTI instruments
- CASAC panel commented in 2005 regarding data quality for elements "rarely/barely reported" and not reported by IMPROVE
  - Having consistency is good, but some of the additional elements reported by STN useful for source apportionment and other analysis
  - Exploring whether a reduction in target list is appropriate
- Method of calculating uncertainties revised in 2006
  - Previously determined estimates low for some elements and variable
  - RTI has included additional components of uncertainty and revised estimates of others to provide better overall estimates and improve consistency across RTI instruments
  - All uncertainty data in AQS revised – back to 2003
  - Detailed information on calculations and approach can be found at: <http://www.epa.gov/ttn/amtic/specdat.html>

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## Trace Elements by XRF

- Method sensitivity is not the only issue
- Have better sensitivity with ICP-MS...
- BUT other limitations/issues were considered with method selection
  - Cost (\$75 versus \$350+)
  - Extraction is optimized for certain elements so sensitivity is element specific and multiple extractions from multiple filters may be needed for optimal results
  - ICP-MS is a destructive analysis and Teflon filter also used for mass
  - Consistency with rural IMPROVE program
- No plans to change from XRF to ICPMS for urban Speciation program

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## Additional Background Information - Supplement

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## Ozone Monitoring Network

- Strengths
  - Sites
    - O<sub>3</sub> is well characterized in almost all urban areas, via 1226 active sites
  - Sampler and Methods
    - Consistent Method – almost all use UV method
    - Hourly data available in near real-time
  - Data Quality - robust QA/QC program
    - Precision – National estimate is that 90% sites controlled to within 3%
    - Bias – National bias estimate is that 90% of sites between (-4.79) and (+5.76) percent.
- Limitations
  - Limited ozone season in most areas typically only covers warm weather months
  - Growth in VMT/highways may be causing some sites to be more susceptible to titration by NOx.
  - Limited rural coverage; NPS and CASTNET sites can help

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## Coarse Particle Monitoring Notes

- PM<sub>10-2.5</sub>
  - Complex NAAQS and monitoring proposals from January 2006 were not finalized
  - PM<sub>10-2.5</sub> FRM and equivalency criteria were finalized
  - PM<sub>10-2.5</sub> mass and speciation monitoring required at expected 75 National Core (NCore) monitoring stations by January 1, 2011
- PM<sub>10</sub>
  - EPA retained daily NAAQS for PM<sub>10</sub>
  - Most sites at middle and neighborhood scale
  - If States and Tribes reduce their PM<sub>10</sub> networks, EPA has recommended retaining monitors sited in urban and industrial areas

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## PM<sub>10</sub> Monitoring Sites

- Strengths
  - Sites
    - Large, long-term operational network
    - Large number of sites in most large cities with coarse particle problems
  - Sampler and Methods – Special Notes
    - 146 samplers are the same make and model as a PM<sub>2.5</sub> FRM without the second-stage separator.
    - 220 continuous monitors, with 86 sites reporting to AIRNowTech in near real-time

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## Current PM<sub>10</sub> Network



1206 – Monitors reporting data in 2005

835 – Monitors within CBSAs (whole counties)

647 – Monitors within urbanized areas >50,000 population

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## PM<sub>10</sub> Monitoring Sites

- Limitations

- Similar to PM<sub>2.5</sub>
  - Sample frequency – most filter sites operate on 1:6 or 1:3 sample frequency.
  - Time resolution – 24 hour integrated samples.
  - Lag in data availability due to post-sampling laboratory analyses and data validation of ~1-3 months.
  - May not have many sites to evaluate gradients in some areas, especially medium and small cities.
  - Gravimetric method has similar sampling issues to PM<sub>2.5</sub> FRM.
- Unique to PM<sub>10</sub>
  - Decision not to retain annual PM10 standard may result in some changes to network.
  - Hi-volume method used at majority of sites is less precise than low-volume method.
  - Virtually no speciation data for PM<sub>10</sub>
  - No independent QA program to assess method bias.

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