Training Session - Best Practices for Operating PM$_{2.5}$ Continuous FEMs

Introductions, overview, web site references, and assessments

Tim Hanley – U.S. EPA - OAQPS

Monday May 14th, 2012

National Air Quality Conference – Ambient Monitoring 2012

Agenda

Time	Speaker	Topic
1:15 pm	Assemble in Room Colorado F	
1:30 pm – 1:50 pm	Tim Hanley – U.S. EPA	Introductions, overview, web site references, assessments
1:50 pm – 2:30 pm	Dr. David Gobeli, Steve Wilson - Met One	BAM 1020
2:30 pm – 3:00 pm	Adam Blundell – Southwest Ohio Air Quality Agency	Operation of Continuous $PM_{2.5}$ Best Practices, One Agency's Trials and Successes
3:00 pm – 3:15	Break	
3:15 pm	Reassemble	
3:20 pm – 4:20 pm	Jeff Ambs - Thermo Scientific	FDMS and SHARP
4:20 pm – 4:50 pm	Gil Cossett - GRIMM	The Use of Optical Technology for Continuous Mass Monitoring of Aerosol Particles
4:50 pm – 5:00 pm	Tim Hanley – U.S. EPA	Wrap-up and summary.
5:00 pm	Session Concludes	

Related Posters/Presentations this Week

Title	Presenter	Organization	Session
Thermo pDR-1500 Personal Nephelometer	George Allen	NESCAUM	Poster
Evaluation of Teledyne API Model 602 Beta^{PLUS} and PM10 & PM2.5 FRM Measurements in Logan, UT and East St. Louis, IL During Wintertime Conditions	Stephen Toner	Teledyne	Poster
12 Year Data Quality Assessment of the PM$_{2.5}$ Monitoring Network	Shelly Eberly	STI Subcontractor	Wednesday 1pm. Quality Assurance Room - Colorado G
Continuous PM coarse Monitoring in Texas (Met One BAMs)	Bryan Lambeth	TCEQ	Wednesday 3 pm. Criteria Pollutant Methods, Issues, & Updates Room – Colorado F
PM$_{2.5}$ Instrument comparison: FRM vs TEOM, BAM, & GRIMM	Cary Gentry	Forsyth County, NC	Wednesday 3 pm. Criteria Pollutant Methods, Issues, & Updates Room – Colorado F
PM$_{2.5}$ FEM Overview	Tim Hanley	EPA OAQPS	Thursday 8 am. Plenary Technical Program Updates

What Material/Information is available to support operation and evaluation of PM$_{2.5}$ Continuous Monitors?

➤ Presentations from:
  – This Week
  – Previous Conferences

➤ Tools on the web and SOPs

➤ Assessments
  – Assessment (Spring 2011)
  – Comparability Assessment Tool

Select Previous Conference Sessions on PM$_{2.5}$ Continuous Monitoring

Conference	Session	Instruments Covered	Topics Addressed	URL
2009 National Ambient Air Monitoring Conference – Nashville TN	Continuous PM Mass Instrument Training Session	Thermo: ➢ TEOM 1405-DF, ➢ TEOM 1400ab with 8500C, ➢ SHARP (5030), ➢ FH62C14-DHS Beta Monitor Met One: ➢ BAM 1020 Grimm: ➢ Model 180	➢ Method Descriptions ➢ FEM Field Testing ➢ Development Status ➢ Tips for operation and maintenance ➢ Operational Key Points	http://www.epa.gov/ttn/amtic/2009present.html
2008 National Air Quality Conference – Portland OR *Note: material in this session was presented by monitoring agency staff*	Continuous PM$_{2.5}$ Monitoring Issues	➢FDMS ➢Met One BAM 1020 ➢Nephelometers	➢Specific PM$_{2.5}$ continuous methods (tips on configuration, operation, maintenance, calibration and audit, data interpretation)	http://airnow.gov/index.cfm?action=naq_conf_2008.aq
2006 National Air Monitoring Conference – Las Vegas TN	Air Monitoring Instrumentation – Continuous PM Monitors	➢ TEOM FDMS ➢ Met One BAM 1020	➢History, Regs., FEM/ARM performance criteria, Field testing requirements, parameter codes ➢Setup, Operation, and maintenance	http://www.epa.gov/ttn/amtic/2006present.html

PM$_{2.5}$ Continuous Monitoring Website on AMTIC
(http://www.epa.gov/ttn/amtic/contmont.html)

- Guidance and supporting Documents:
    - Comparability assessment tool
    - FEM/ARM spreadsheet templates
- Policy and data management memos
- SOPs
- CASAC related files
- Assessments/verifications
- Presentations

Standard Operating Procedures (SOPs)

- Consensus SOPs are available for three PM$_{2.5}$ continuous FEMs:
  - DRAFT - <u>Met One BAM-1020</u>; Federal Equivalent Method EQPM-0308-170 for PM2.5 (111p) - 8/28/2009
  - DRAFT - <u>Thermo Scientific FDMS® 1405-DF</u>; Federal Equivalent Method EQPM-0609-182 for PM2.5 (96pp) - 9/1/2009
  - DRAFT - <u>Thermo Scientific 1400a Ambient Particulate Monitor with 8500C FDMS®</u>; Federal Equivalent Method EQPM-0609-181 for PM2.5 (101pp) - 3/1/2011
- SOPs were developed with input from monitoring agency stakeholders three years ago.
- Available at:
  http://www.epa.gov/ttn/amtic/contmont.html

Standard Operating Procedure for the Continuous Measurement of Particulate Matter

Met One BAM-1020 PM$_{2.5}$ Federal Equivalent Method EQPM-0308-170

STI-905505.05-3645-SOP

AUTHOR:

_____ Date

APPROVED:

_____ Date
Manager

_____ Date
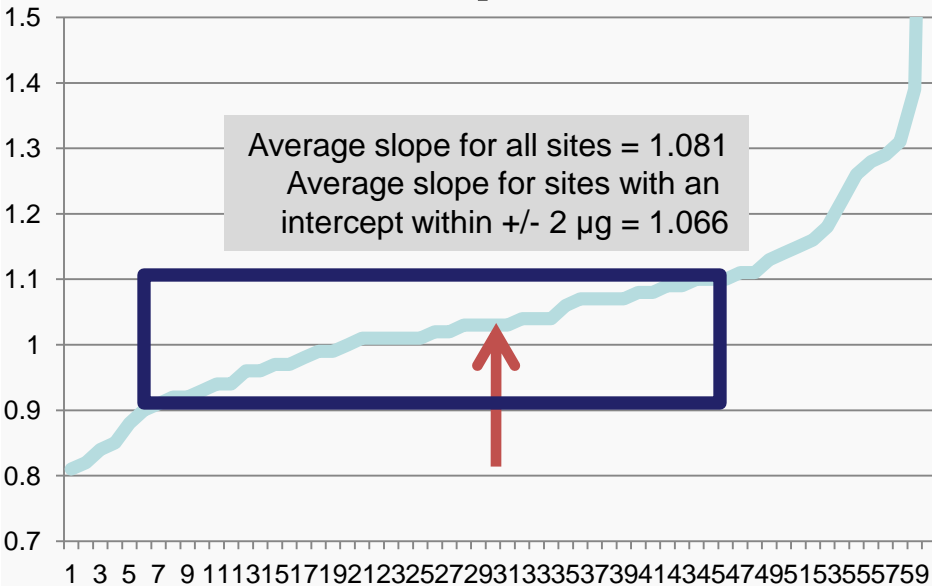Quality Assurance Manager

Assessments

- An assessment of available $PM_{2.5}$ FEMs operated by routine monitoring agencies was performed in Spring of 2011

- Assessment was referenced in the PM Policy Assessment (April, 2011) and is included in the PM NAAQS docket:
    - Assessment of $PM_{2.5}$ FEMs Compared to Collocated FRMs; Tim Hanley and Adam Reff, OAQPS; PM NAAQS Docket, EPA - HQ - OAR - 2007 – 0492
    - Memo is available at: http://www.epa.gov/ttn/naaqs/standards/pm/data/HanleyandReff040711.pdf

- Detailed one page assessments are available at: http://www.epa.gov/ttn/analysis/pm.htm
    - Met One BAM 1020 Assessments - 61 sites
    - Thermo Scientific Ambient Particulate Monitor with Series 8500C FDMS Assessments - 17 sites
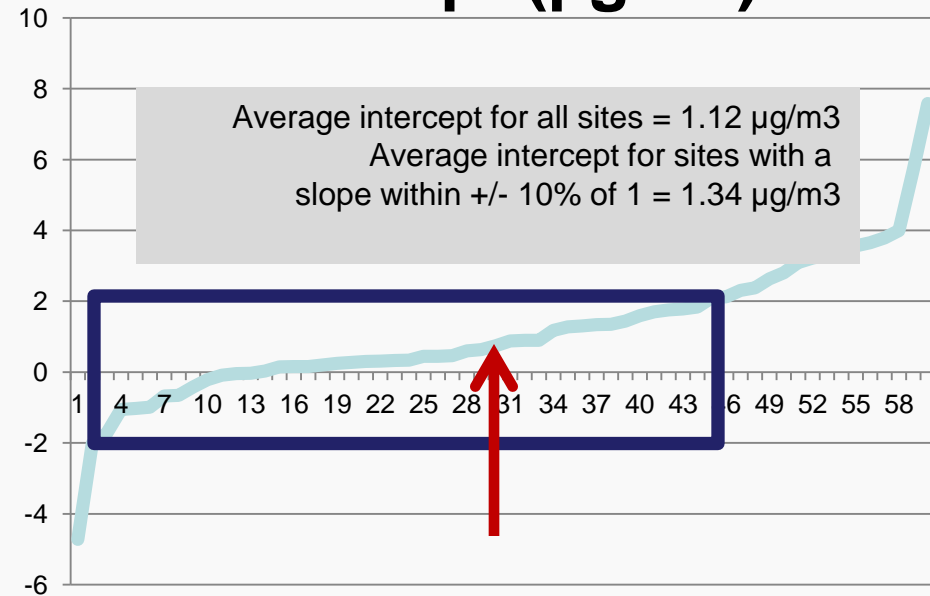   - Thermo Scientific Model 5030 SHARP Assessments - 2 sites

Met One BAM 1020 – PM$_{2.5}$ FEM

*National Assessment Summary can be
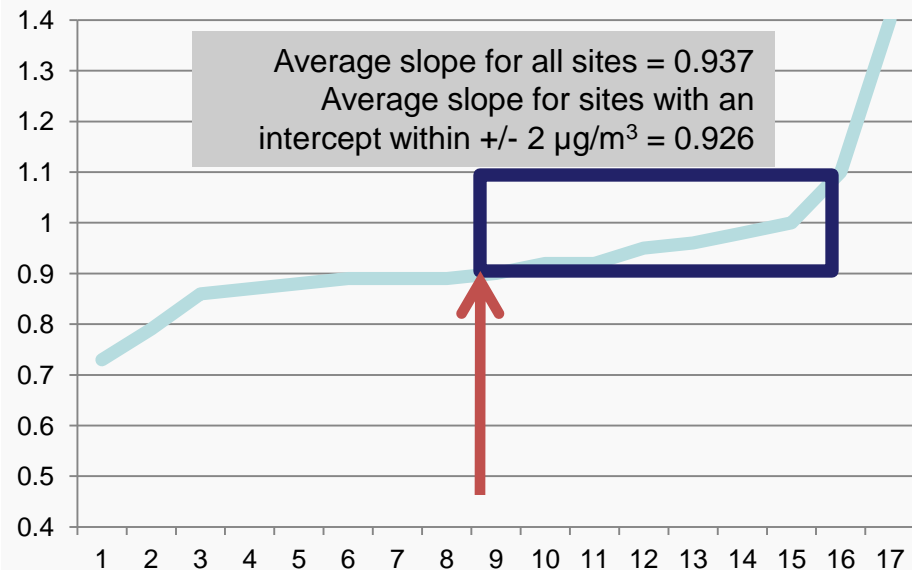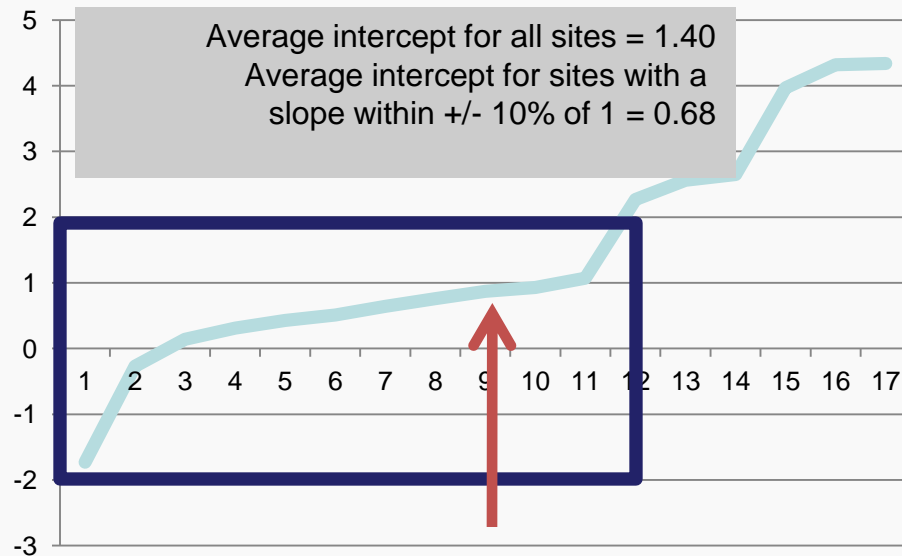very useful for comparison with your monitor*

Slope

Average slope for all sites = 1.081
Average slope for sites with an
intercept within +/- 2 µg = 1.066

Intercept (µg/m³)

Average intercept for all sites = 1.12 µg/m3
Average intercept for sites with a
slope within +/- 10% of 1 = 1.34 µg/m3

Thermo 8500C FDMS - PM$_{2.5}$ FEM

Slope

Average slope for all sites = 0.937
Average slope for sites with an intercept within +/- 2 µg/m^3 = 0.926

Intercept (µg/m^3)

Average intercept for all sites = 1.40
Average intercept for sites with a slope within +/- 10% of 1 = 0.68
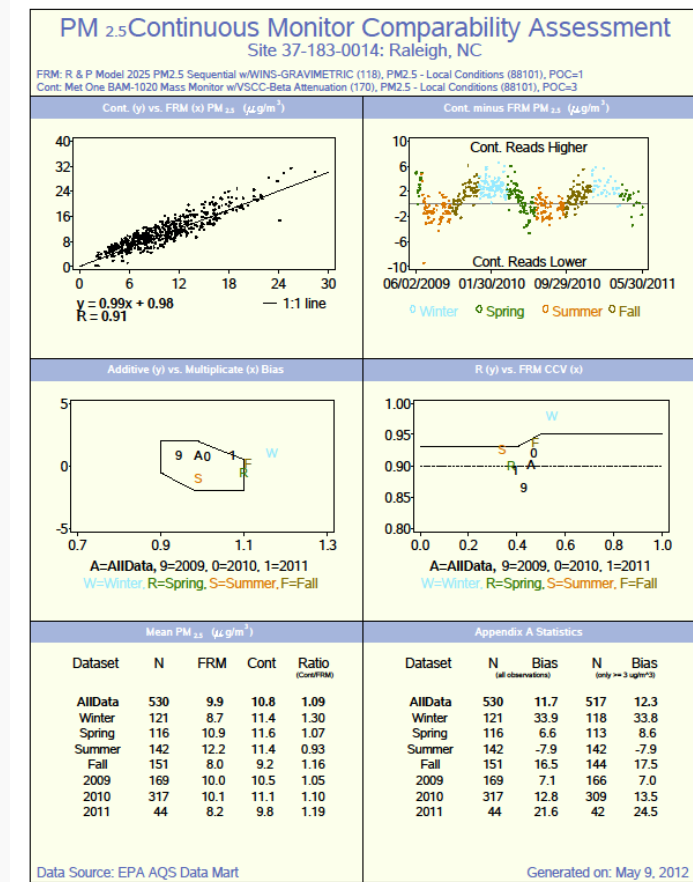
Comparability Assessment Tool

- Available at: http://www.epa.gov/airquality/airdata/ad_rep_frmvfem.html

- Provides one-page assessment

- Data is from <u>AQS Data Mart</u> where there is a collocated $PM_{2.5}$ FRM and $PM_{2.5}$ continuous monitor.

- Includes $PM_{2.5}$ continuous data submitted to any the following parameter codes:
  - 88101, 88500, 88502, 88501

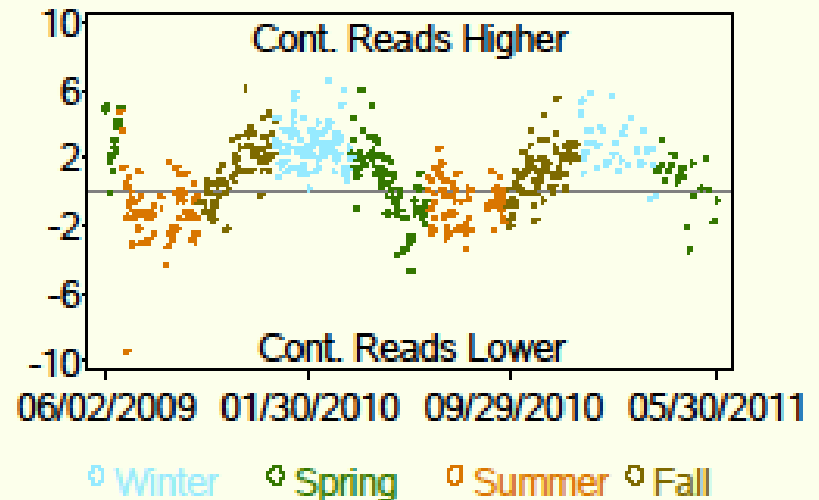- Technical note explaining tool is available at: http://www.epa.gov/ttn/amtic/files/ambient/pm25/comparabilityassessmenttool.pdf

PM 2.5 Continuous Monitor Comparability Assessment
Site 37-183-0014: Raleigh, NC

Title, Site, Methods, and Difference Trend

Cont. (y) vs. FRM (x) PM$_{2.5}$ (μg/m^3)

y = 0.99x + 0.98
R = 0.91

— 1:1 line

Additive (y) vs. Multiplicate (x) Bias

A=AllData, 9=2009, 0=2010, 1=2011
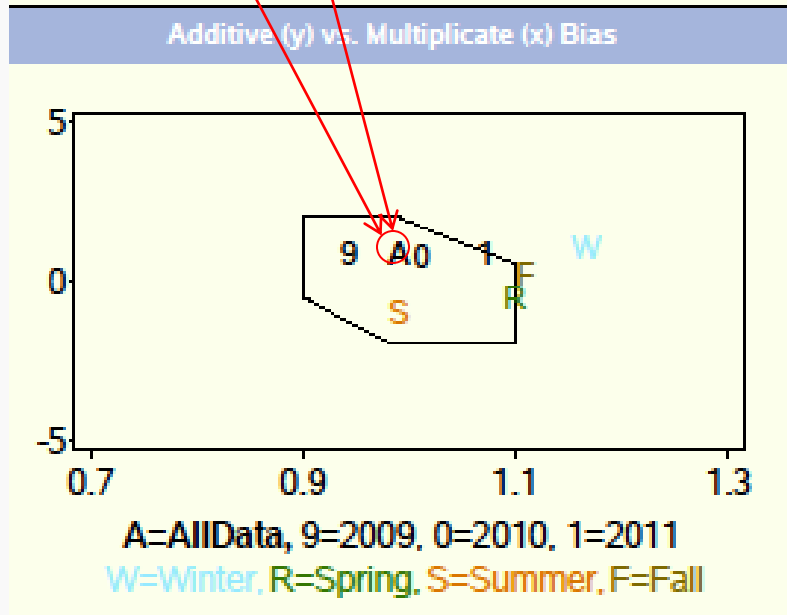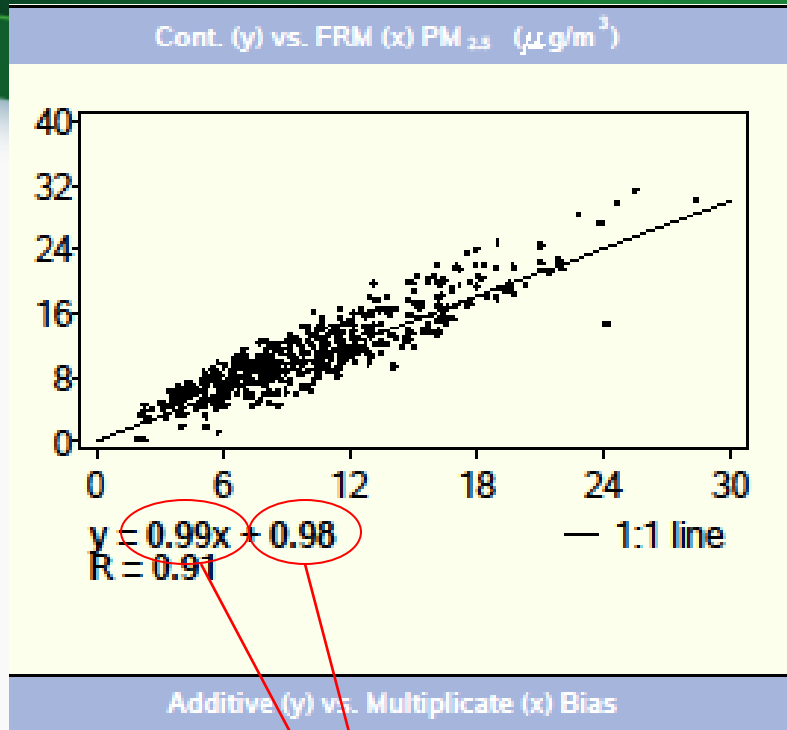W=Winter, R=Spring, S=Summer, F=Fall

Regression Equations

One regression equation is displayed; however, several regression equation outputs are illustrated below.
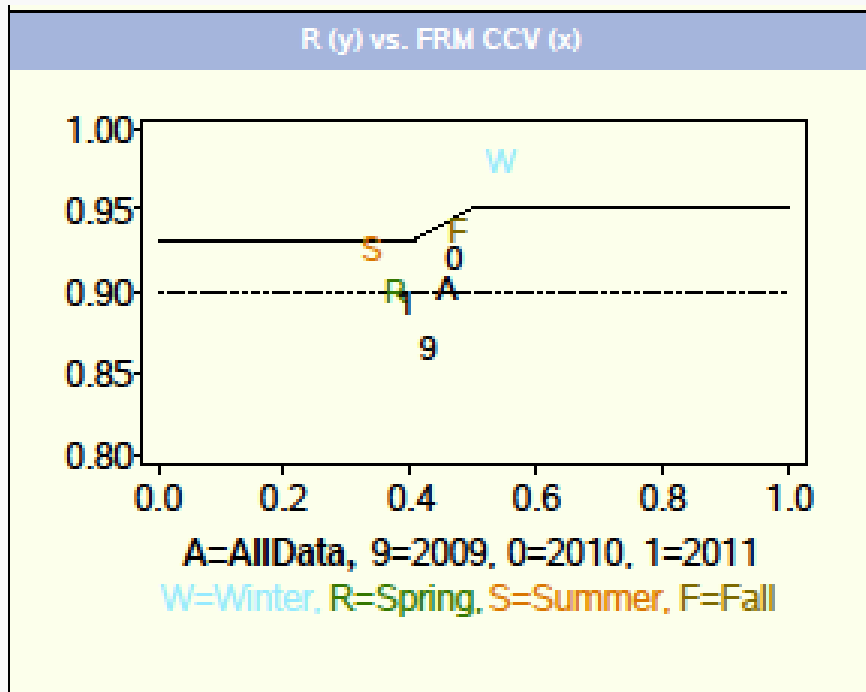
Line in regression figure is a 1:1 line

Slope from regression equation is displayed as multiplicative bias along x-axis

Intercept from regression equation is displayed as additive bias along y-axis

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Correlation Criteria

R (y) vs. FRM CCV (x)

A=AllData, 9=2009, 0=2010, 1=2011
W=Winter, R=Spring, S=Summer, F=Fall

Part 53 performance criteria for acceptance of a method includes a statistic for correlation

Appendix A and DQO's do <u>not</u> include a correlation goal

Note: (r), not (r^2)

Interpreting correlation can be challenging, especially at sites with low concentrations

X-axis is CCV which describes the spread of the sample population; the higher the CCV the higher r (on y-axis) we should expect

Means for each Method & Ratio of Cont/FRM

Appendix A Statistic for Bias

Mean PM$_{2.5}$ (μg/m^3)				
Dataset	N	FRM	Cont	Ratio (Cont/FRM)
AllData	530	9.9	10.8	1.09
Winter	121	8.7	11.4	1.30
Spring	116	10.9	11.6	1.07
Summer	142	12.2	11.4	0.93
Fall	151	8.0	9.2	1.16
2009	169	10.0	10.5	1.05
2010	317	10.1	11.1	1.10
2011	44	8.2	9.8	1.19

Data Source: EPA AQS Data Mart

Appendix A Statistics				
Dataset	N (all observations)	Bias	N (only >= 3 ug/m^3)	Bias
AllData	530	11.7	517	12.3
Winter	121	33.9	118	33.8
Spring	116	6.6	113	8.6
Summer	142	-7.9	142	-7.9
Fall	151	16.5	144	17.5
2009	169	7.1	166	7.0
2010	317	12.8	309	13.5
2011	44	21.6	42	24.5

Generated on: May 9, 2012

Evaluating the means and ratio of means provides a quick way to assess the comparability of the methods

Appendix A calls for calculating bias when both methods are >= 3 µg/m^3 This is presented in the column on the right

Comparability Assessment Tool Summary

- Tool provides quick and valuable assessment
  - However, some runs may take several minutes
- The assessment assumes the FRM represents the true value, even though the FRM will have its own uncertainty
- Assessments should be used as a guide and not a bright line

From Section 2.3.1.1 of Appendix A to Part 58:

Measurement Uncertainty for Automated and Manual $PM_{2.5}$ Methods.

The goal for acceptable measurement uncertainty is defined as 10 percent coefficient of variation (CV) for total precision and plus or minus 10 percent for total bias

Bias is calculated from samples collected in PEP program.

PM$_{2.5}$ Continuous FEM QA Requirements

<u>Collocated Sampling Procedures for PM$_{2.5}$</u> - Section 3.2.5 (a). Have 15 percent of the monitors collocated (values of 0.5 and greater round up)

Number of Continuous PM$_{2.5}$ FEMs (same make and model) in PQAO network	Minimally Required Collocated FRM(s)	Minimally Required Collocated FEM(s) of the same make and model as primary monitor
1 - 9	1	0
10 – 16	1	1
17 – 23	2	1
24 - 29	2	2

<u>Flow Rate Verifications</u> – Section 3.2.3. A one-point flow rate verification check must be performed at least once every month on each automated analyzer used to measure PM$_{10}$, PM$_{10-2.5}$ and PM$_{2.5}$.

<u>Flow Rate Audits</u> – Section 3.2.4. Every 6 months, audit the flow rate of the PM$_{10}$, PM$_{10-2.5}$ and PM$_{2.5}$ particulate analyzers.

PM$_{2.5}$ Continuous Monitoring Data Reporting Summary

- General
  - Report hourly data, make sure flow system is operating on local conditions, ensure data for a given hour is placed as the "Start Hour".
- Two related policy Memo's addressing this data reporting to AQS:
  - Implementing Continuous PM$_{2.5}$ Federal Equivalent Methods (FEMs) and Approved Regional Methods (ARMs) in State or Local Air Monitoring Station (SLAMS) Networks, 7/24/2008
  - Parameter Codes Used to Report PM$_{2.5}$ Continuous Monitor and Speciation Sampler Data to AQS, 6/2/2006
- Monitoring Agency decision to use FEM continuous PM$_{2.5}$ data for comparison to the NAAQS:
  - Generally "SLAMS" and "Primary monitor" to use data, or
  - "SPM" and "Non-regulatory" to not use it; however, other FRM/FEM must be operating as primary monitor.
  - Recommend your agency state intentions in Annual Network Plan

AQS Parameter Codes for PM$_{2.5}$ Continuous Monitoring Data Reporting

Parameter Name	Parameter Code	Purpose	Data uses
PM2.5 LOCAL CONDITIONS	**88101**	**Appropriate code for all FRM/FEM/ARMs**	➤ **AlrData AQI calculations** ➤ **NAAQS (unless coded with "non-regulatory")**
PM2.5 TOTAL ATMOSPHERIC	88500	Valid data from methods measuring total PM$_{2.5}$ aerosols in the atmosphere, including those that can be volatilized from the FRM	
PM2.5 RAW DATA	88501	Valid uncorrected data that does not reasonably match the FRM	
ACCEPTABLE PM2.5 AQI & SPECIATION MASS	**88502**	**Valid data that does reasonably match the FRM with or without correction, but not to be used in NAAQS decisions**	➤ **AlrData AQI calculations**
PM2.5 VOLATILE CHANNEL	88503	Store important related data such as the FDMS reference channel	

Technical Note covering codes available at http://www.epa.gov/ttn/amtic/cpreldoc.html

88101 is only parameter code eligible for NAAQS decision-making