Continuous PM Monitoring Update

MARAMA Monitoring Committee Workshop - December 2016

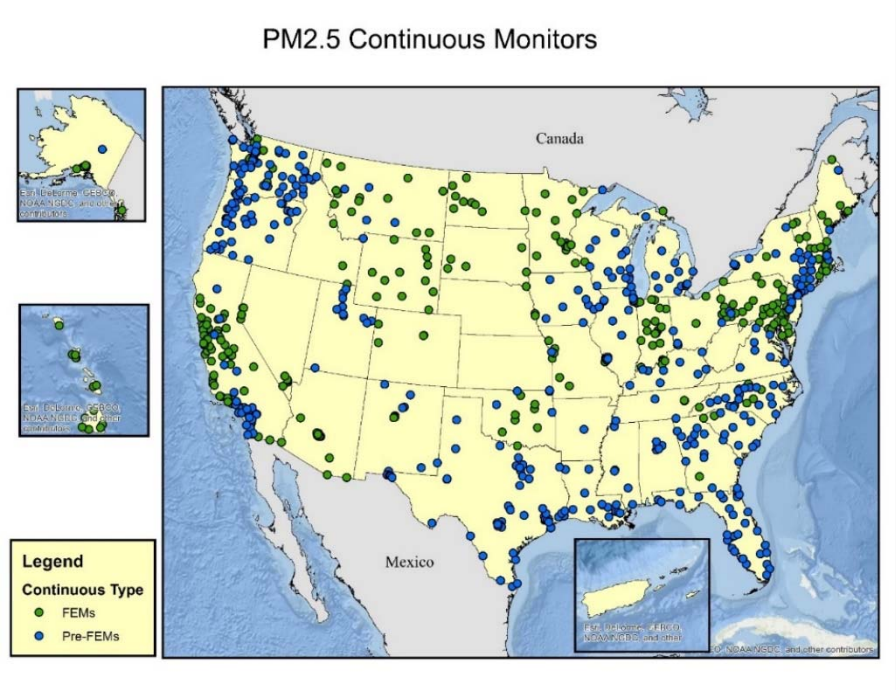
Tim Hanley & Lewis Weinstock
Office of Air Quality Planning and Standards

$PM_{2.5}$ Continuous Monitor Update

- Network and method update

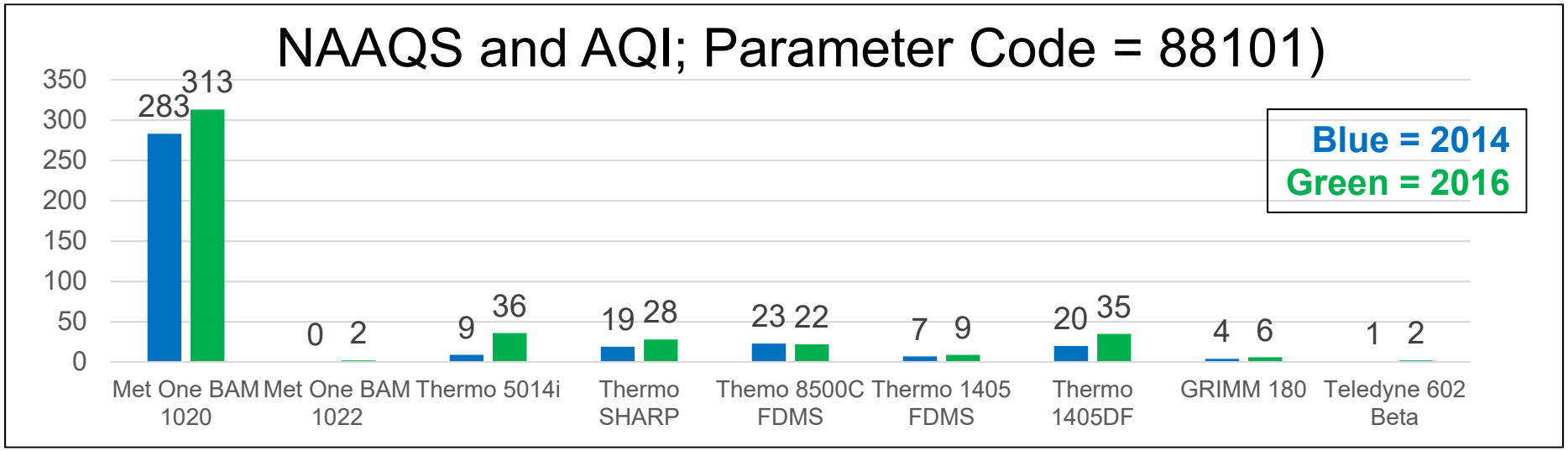
- Actionable recommendations from recent conferences that should improve FRM to continuous FEM data comparability:
  - Utilize VSCCs on FRMs
  - Ensure data below zero is reported if in the noise of the instrument, where appropriate

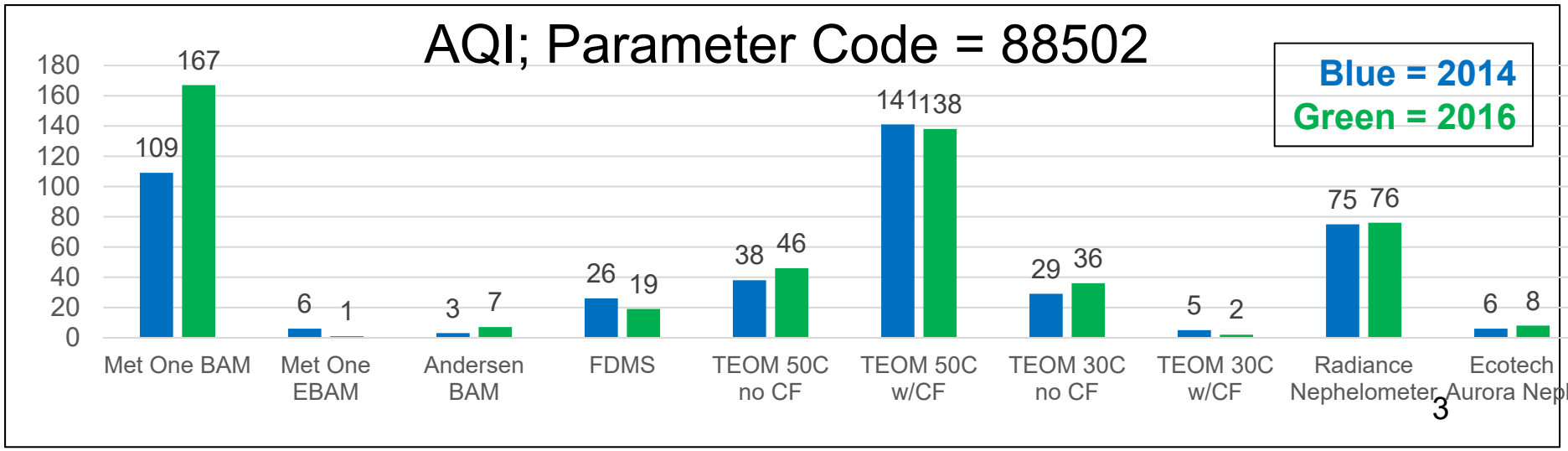
- Additional items we are following up on:
  - Availability of instrument specific Auditor Checklists
  - Training opportunities
  - Development of FRM data quality visual Assessment



$PM_{2.5}$ Continuous Methods Reporting to AQS

Comparing 2014 and 2016



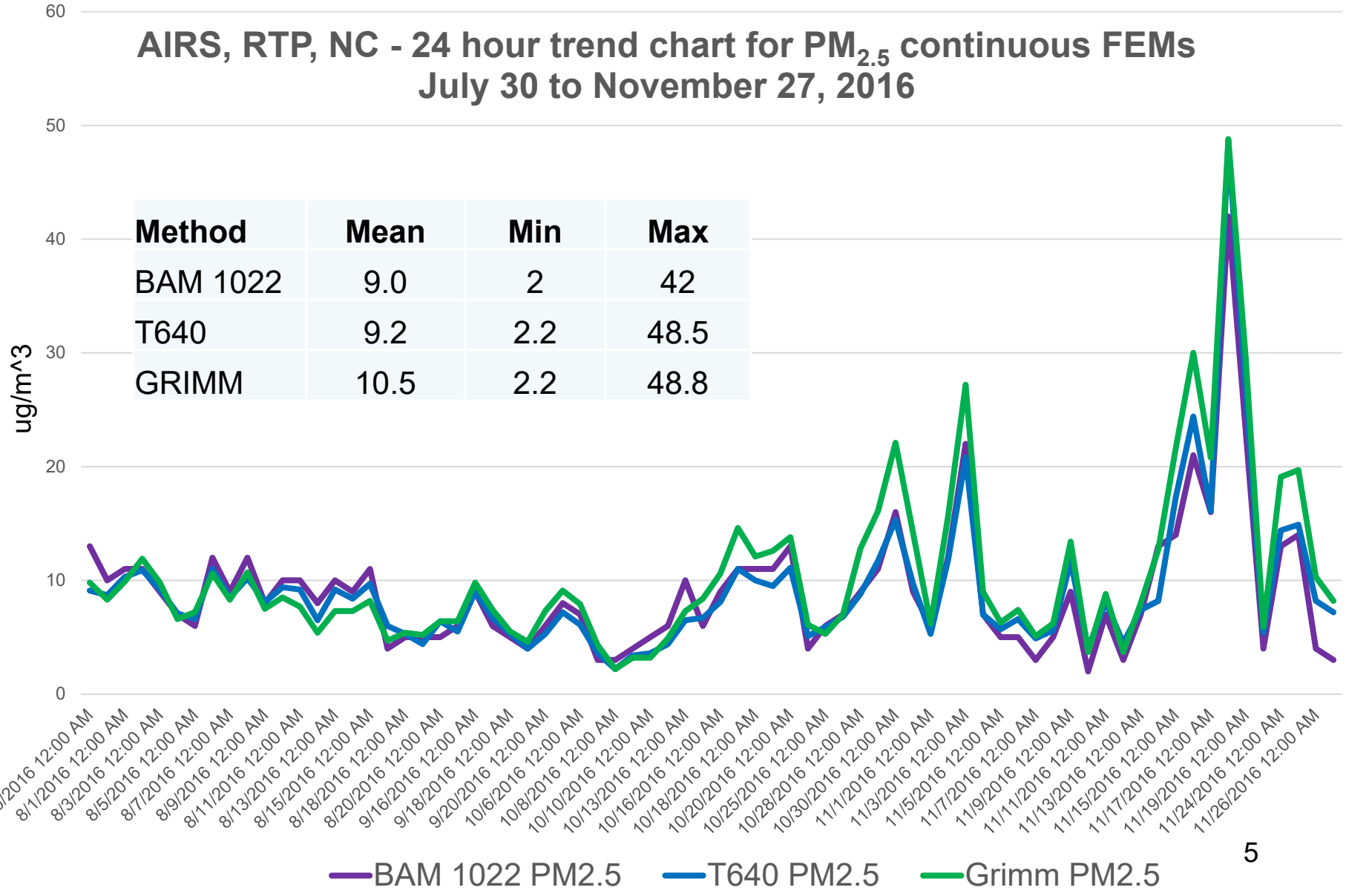


$PM_{2.5}$ Continuous Methods we are testing in RTP, NC

Method	Measurement Principle	Metrics Available	Key Maintenance Items (beyond inlet and separator cleaning, and flow checks)	What's different about this method compared to other available FEMs?	Who else is reporting data with this method?
GRIMM EDM 180	Laser light scattering	FEM = $PM_{2.5}$: Non-FEM =$PM_{10-2.5}$, $PM_{2.5}$	As needed Nafion® dryer replacement; Yearly aerosol calibration (typically offsite by manufacturer),	High time resolution data (1 minute available)	Colorado, Iowa
Met One BAM 1022	Beta Attenuation	FEM = $PM_{2.5}$	filter tape, nozzle cleaning, zero test	Relatively easy to set up and begin operation, must be run outside	North Carolina
Teledyne 640 or T640x	Broadband spectroscopy	FEM = PM_{10}, $PM_{10-2.5}$, $PM_{2.5}$	Field verification/ calibration of PMT using SpanDust™	High time resolution data (1 minute available); FEM status for PM_{10} and $PM_{10-2.5}$	No data in AQS yet.

Note: Mention of trade names does not constitute EPA endorsement

For MARAMA Discussion Purposes only



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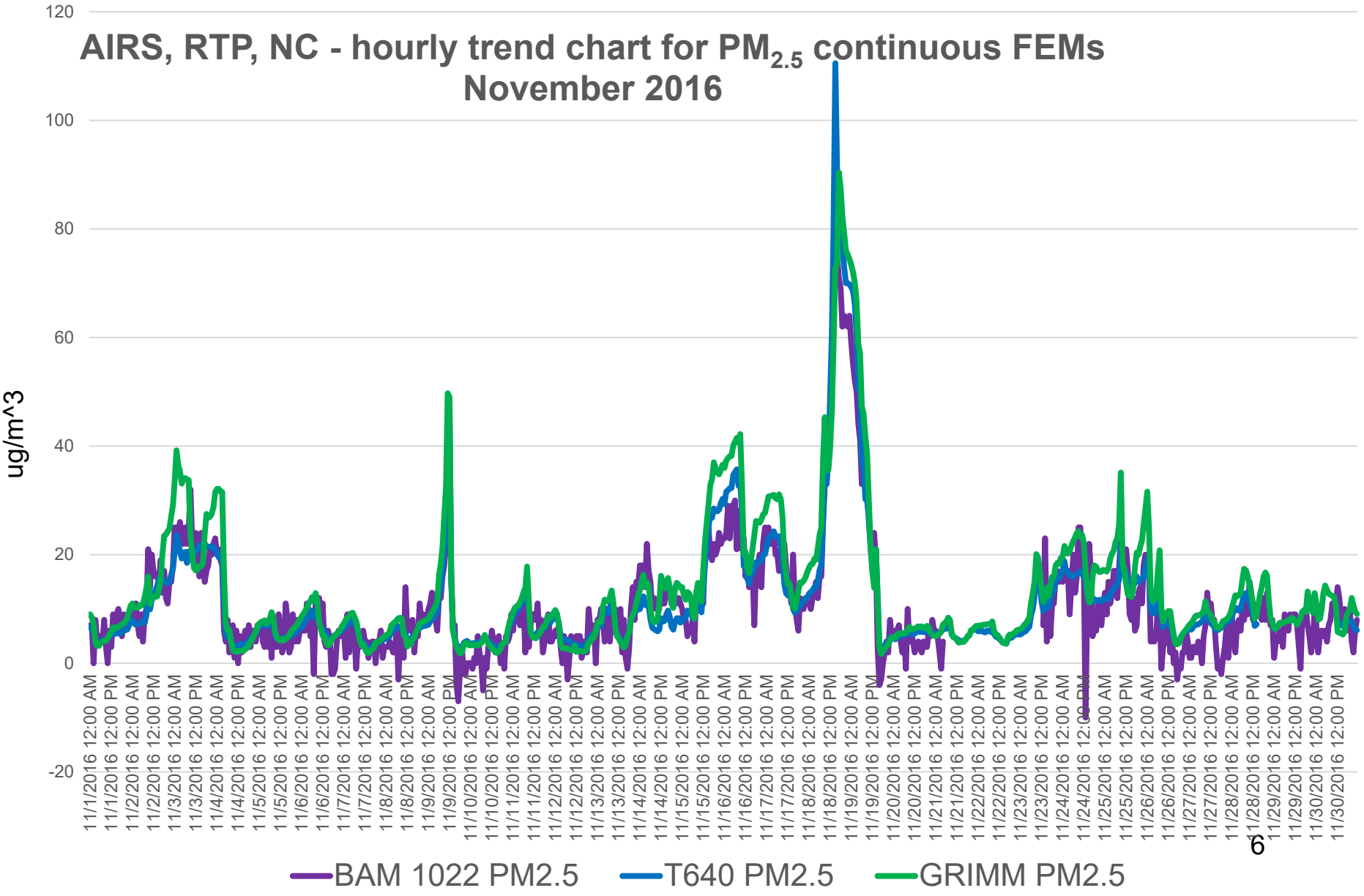


Migration to VSCCs for second stage separation on $PM_{2.5}$ FRMs

- At Atlanta Conference we recommended utilizing VSCCs on FRMs.
  - WINS and VSCC are statistically the same when both are clean.
  - VSCC maintains a consistent cut-point over a longer period of time
  - VSCC requires less maintenance than a WINS
  - WINS cut-point shifts downward when not maintained
- Sensitivity test *(presented at Atlanta conference)* indicated that an FRM with a VSCC will read ~2% closer to a continuous FEM than an FRM with a WINS
- To expedite migration to VSCCs, EPA issued a national contract for State, local and tribal agencies to receive VSCC's for their FRMs
  - All VSCCs have shipped.
    - We fulfilled all requests for primary and collocated samplers
    - Provided requests for spares at ~50% of operating samplers
    - **A small number of spares are available for cases where an agency has not previously requested VSCCs. (e.g., perhaps agency was intending to move to FEMs, but not ready to do so yet).**

Reporting of slightly negative hourly data?

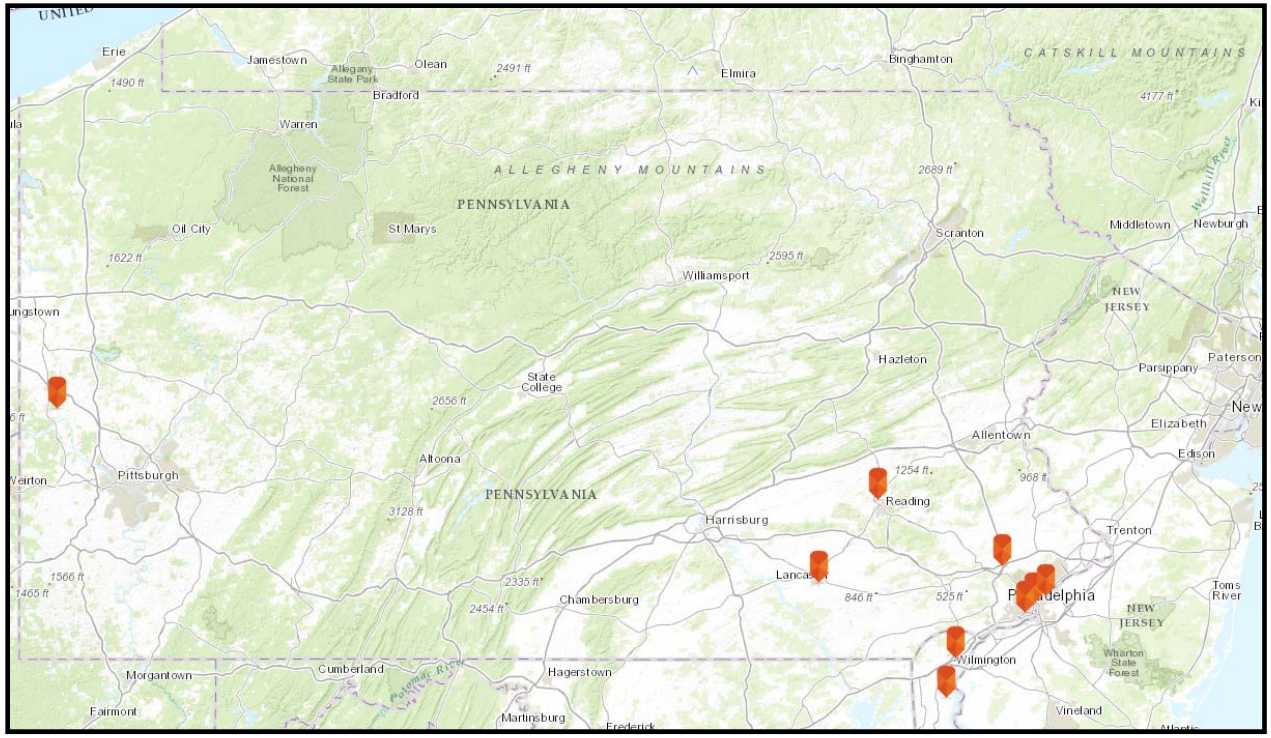
From recent conferences:

- How to handle negative numbers?
  - Of course the atmosphere cannot have a negative amount of PM in it.
  - The regulation does not address negative numbers.
  - EPA has had a long standing convention of allowing negative data into AQS
    - If the atmosphere is very clean (approaching 0 µg/m^3) and there is noise in the measurement, then a negative number may in fact be valid.
      - Invalidating data or correcting to 0 would lead to biasing data higher
    - How much is too negative?
      - Reference instrument manual, if addressed (e.g., Met One BAM allows up to -15 µg/m^3)
- Databases:
  - **AQS** - generally allows negative data for $PM_{2.5}$ continuous monitors up to a -10 ug/m3
  - **AIRNow** – default flag of data less than -4.99 ug/m3

- Valid negative numbers should be carried and included in reporting to data bases; however, public reports of data should not include negative numbers

Just a few remaining sites in Region 3 without any apparent negative data

(data summary below includes data from 10/1/15 through 11/30/16)



PQAO	STATE	COUNTY	SITE	POC	MEAN	COUNT_of_SAMPLE	MIN	METHOD_CODE	METHOD
Delaware Dept Natural Resources and Environmental Control	10	003	1008	3	8.1	1907	0.5	184	Thermo 5030 SHARP
Delaware Dept Natural Resources and Environmental Control	10	003	2004	4	9.2	7528	0	184	Thermo 5030 SHARP
Philadelphia Air Management Services	42	101	0057	3	9.8	6249	3.3	170	Met One BAM-1020
Philadelphia Air Management Services	42	101	0048	3	9.9	6059	0.3	170	Met One BAM-1020
Philadelphia Air Management Services	42	101	0055	3	11.1	6058	0.2	170	Met One BAM-1020
Pennsylvania Department Of Environmental Protection	42	007	0014	3	4.8	464	0	181	TEOM 1400 FDMS or 1405 8500C FDMS
Pennsylvania Department Of Environmental Protection	42	011	0011	3	10.7	4341	0	181	TEOM 1400 FDMS or 1405 8500C FDMS
Pennsylvania Department Of Environmental Protection	42	071	0007	3	10.5	4957	0	181	TEOM 1400 FDMS or 1405 8500C FDMS
Pennsylvania Department Of Environmental Protection	42	091	0013	3	2.3	2097	0	181	TEOM 1400 FDMS or 1405 8500C FDMS

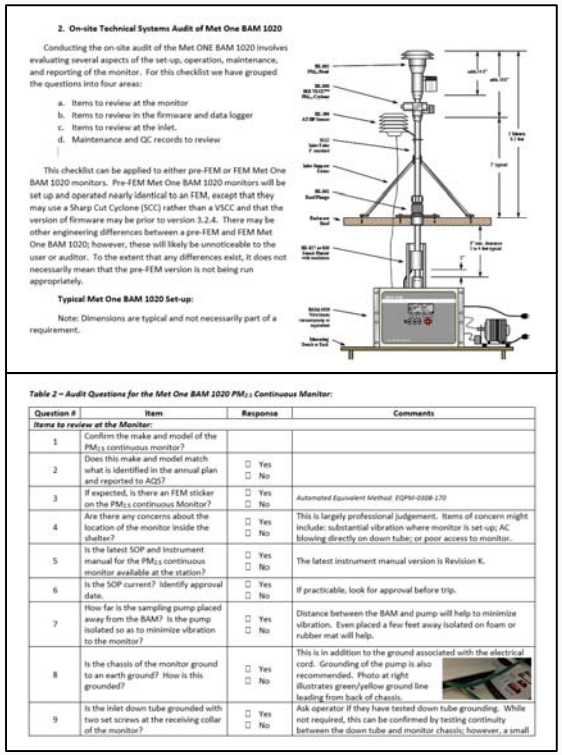
Recommend checking monitor firmware and data system to ensure negative data can be reported.

Availability of PM continuous Technical System Audit (TSA) Checklists

- We have developed two TSA Checklists that cover the most widely used PM continuous methods
  - Met One BAM
  - Thermo TEOM and TEOM-FDMS
- Checklists cover four broad areas of operation
  - Monitor
  - Firmware and data logger
  - Inlet and separator
  - Maintenance and QC records
- Checklists will be/are available on AMTIC at:

  https://www3.epa.gov/ttn/amtic/contmont.html

Met One BAM 1020



2. On-site Technical Systems Audit of Met One BAM 1020

Conducting the on-site audit of the Met ONE BAM 1020 involves evaluating several aspects of the set-up, operation, maintenance, and reporting of the monitor. For this checklist we have grouped the questions into four areas:

a. Items to review at the monitor
b. Items to review in the firmware and data logger
c. Items to review at the inlet.
d. Maintenance and QC records to review

This checklist can be applied to either pre-FEM or FEM Met One BAM 1020 monitors. Pre-FEM Met One BAM 1020 monitors will be set up and operated nearly identical to an FEM, except that they may use a Sharp Cut Cyclone (SCC) rather than a VSCC and that the version of firmware may be prior to version 3.2.4. There may be other engineering differences between a pre-FEM and FEM Met One BAM 1020; however, these will likely be unnoticeable to the user or auditor. To the extent that any differences exist, it does not necessarily mean that the pre-FEM version is not being run appropriately.

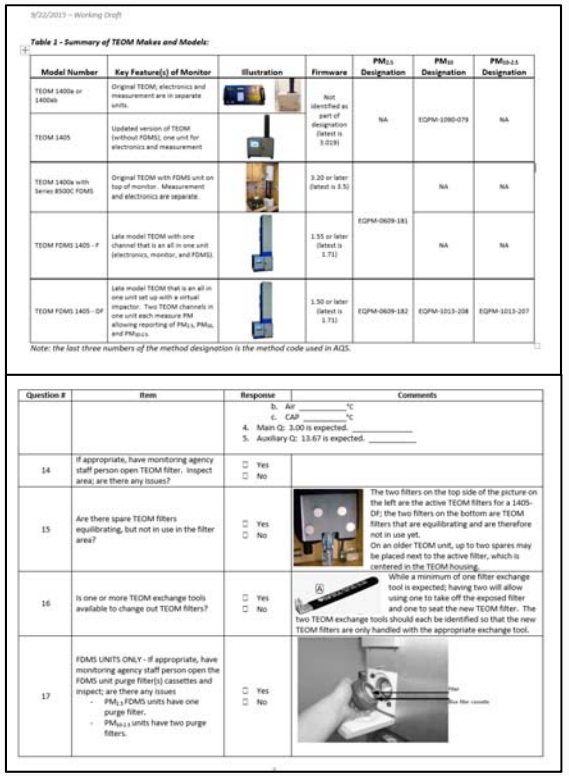
Typical Met One BAM 1020 Set-up:

Note: Dimensions are typical and not necessarily part of a requirement.

Table 2 – Audit Questions for the Met One BAM 1020 $PM_{2.5}$ Continuous Monitor:

Question #	Item	Response	Comments
Items to review at the Monitor:			
1	Confirm the make and model of the $PM_{2.5}$ continuous monitor?		
2	Does this make and model match what is identified in the annual plan and reported to AQS?	☐ Yes ☐ No	
3	If expected, is there an FEM sticker on the $PM_{2.5}$ continuous Monitor?	☐ Yes ☐ No	*Automated Equivalent Method: EQPM-0308-170*
4	Are there any concerns about the location of the monitor inside the shelter?	☐ Yes ☐ No	This is largely professional judgement. Items of concern might include: substantial vibration where monitor is set-up; AC blowing directly on down tube; or poor access to monitor.
5	Is the latest SOP and Instrument manual for the $PM_{2.5}$ continuous monitor available at the station?	☐ Yes ☐ No	The latest instrument manual version is Revision K.
6	Is the SOP current? Identify approval date.	☐ Yes ☐ No	If practicable, look for approval before trip.
7	How far is the sampling pump placed away from the BAM? Is the pump isolated so as to minimize vibration to the monitor?	☐ Yes ☐ No	Distance between the BAM and pump will help to minimize vibration. Even placed a few feet away isolated on foam or rubber mat will help.
8	Is the chassis of the monitor ground to an earth ground? How is this grounded?	☐ Yes ☐ No	This is in addition to the ground associated with the electrical cord. Grounding of the pump is also recommended. Photo at right illustrates green/yellow ground line leading from back of chassis.
9	Is the inlet down tube grounded with two set screws at the receiving collar of the monitor?	☐ Yes ☐ No	Ask operator if they have tested down tube grounding. While not required, this can be confirmed by testing continuity between the down tube and monitor chassis; however, a small

Thermo TEOM and TEOM-FDMS



9/22/2013 – Working Draft

Table 1 - Summary of TEOM Makes and Models:

Model Number	Key Feature(s) of Monitor	Illustration	Firmware	$PM_{2.5}$ Designation	PM_{10} Designation	$PM_{10-2.5}$ Designation
TEOM 1400a or 1400ab	Original TEOM, electronics and measurement are in separate units.		Not identified as part of designation (latest is 3.019)	NA	EQPM-1090-079	NA
TEOM 1405	Updated version of TEOM (without FDMS), one unit for electronics and measurement					
TEOM 1400a with Series 8500C FDMS	Original TEOM with FDMS unit on top of monitor. Measurement and electronics are separate.		3.20 or later (latest is 3.5)	EQPM-0609-181	NA	NA
TEOM FDMS 1405 - F	Late model TEOM with one channel that is an all in one unit (electronics, monitor, and FDMS).		1.55 or later (latest is 1.71)		NA	NA
TEOM FDMS 1405 - DF	Late model TEOM that is an all in one unit set up with a virtual impactor. Two TEOM channels in one unit each measure PM allowing reporting of $PM_{2.5}$, PM_{10}, and $PM_{10-2.5}$.		1.50 or later (latest is 1.71)	EQPM-0609-182	EQPM-1013-208	EQPM-1013-207

Note: the last three numbers of the method designation is the method code used in AQS.

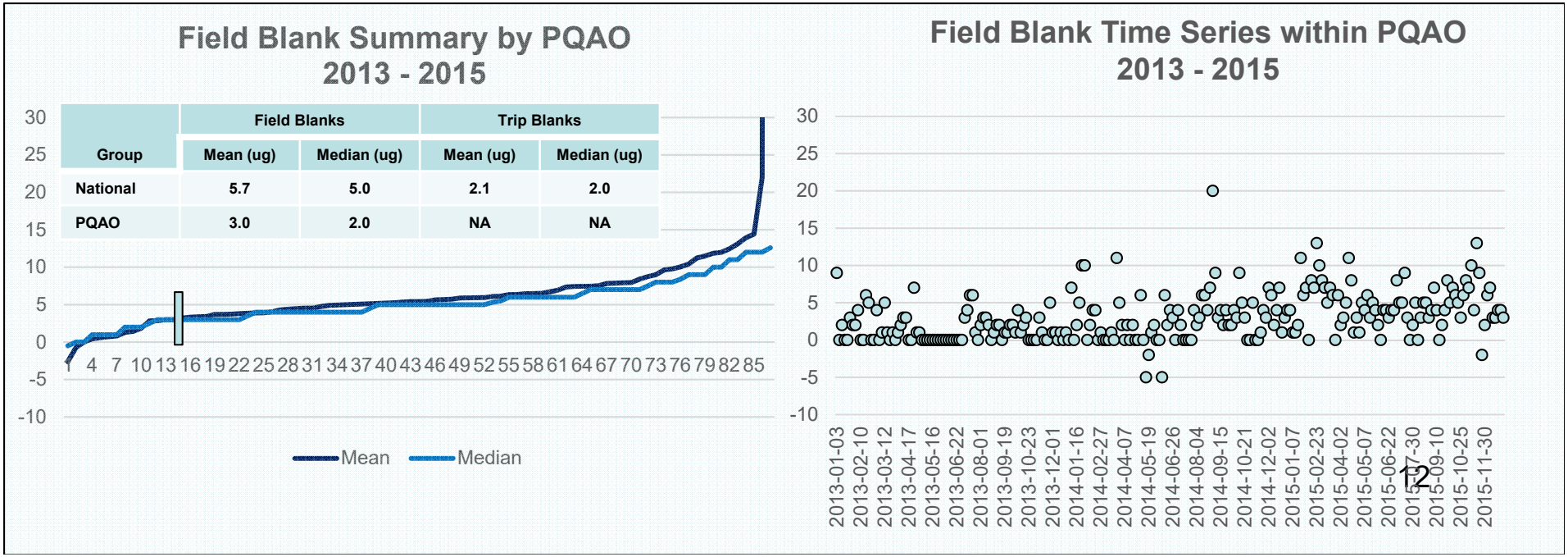
Question #	Item	Response	Comments
			b. Air _____ °C c. CAP _____ °C 4. Main Q: 3.00 is expected. _____ 5. Auxiliary Q: 13.67 is expected. _____
14	If appropriate, have monitoring agency staff person open TEOM filter. Inspect area; are there any issues?	☐ Yes ☐ No	
15	Are there spare TEOM filters equilibrating, but not in use in the filter area?	☐ Yes ☐ No	The two filters on the top side of the picture on the left are the active TEOM filters for a 1405-DF; the two filters on the bottom are TEOM filters that are equilibrating and are therefore not in use yet. On an older TEOM unit, up to two spares may be placed next to the active filter, which is centered in the TEOM housing.
16	Is one or more TEOM exchange tools available to change out TEOM filters?	☐ Yes ☐ No	While a minimum of one filter exchange tool is expected; having two will allow using one to take off the exposed filter and one to seat the new TEOM filter. The two TEOM exchange tools should each be identified so that the new TEOM filters are only handled with the appropriate exchange tool.
17	FDMS UNITS ONLY - If appropriate, have monitoring agency staff person open the FDMS unit purge filter(s) cassettes and inspect; are there any issues - $PM_{2.5}$ FDMS units have one purge filter. - $PM_{10-2.5}$ units have two purge filters.	☐ Yes ☐ No	

Training Opportunities

- We have invited instrument companies to provide hands on training at EPA Regional Offices
  - Many Regions have invited monitoring agencies to join them.
  - Goal is to get staff, managers, and auditors up to speed on the right things to look for to ensure methods are running appropriately.
- We have asked to have the applicable $PM_{2.5}$ continuous monitoring Technical System Audit (TSA) Checklist covered as part of the training.
- **What steps could we (or others) take to ensure training is available to those who need it?**

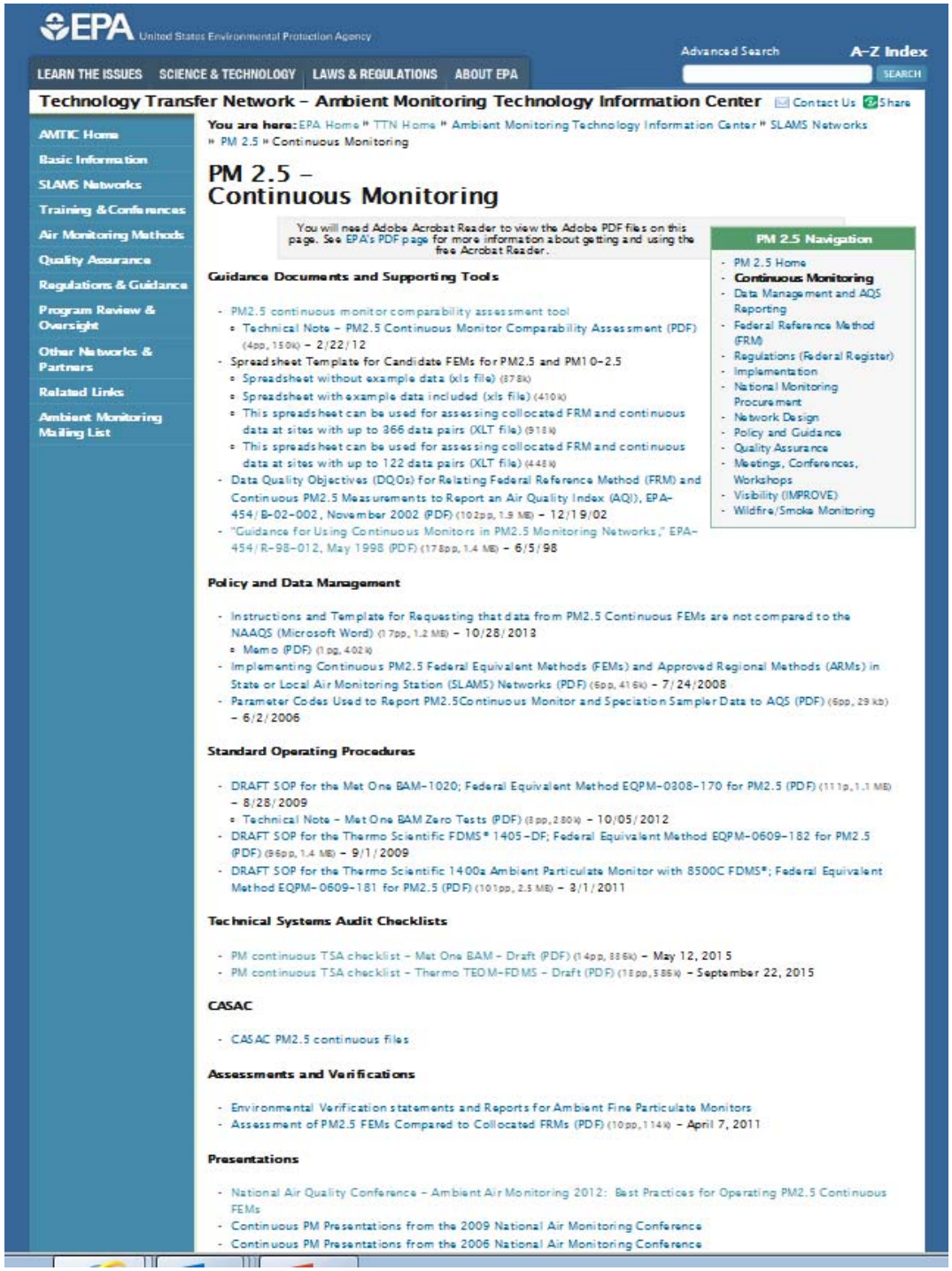
We are developing an automated $PM_{2.5}$ FRM Visual Assessment

- In order to know if we are getting good $PM_{2.5}$ continuous monitoring data we need to know if we are getting good FRM data.
- Similar to the $PM_{2.5}$ continuous monitoring one page assessment, we are developing a one-page visual assessment of a PQAO's $PM_{2.5}$ FRM data quality
- Will include up to 3 years of data for four indicators of $PM_{2.5}$ data quality:
  - Collocated precision
  - Bias via Performance Evaluation Program
  - Flow Rate Audits/Verifications
  - **Field Blanks**
- Development is underway – availability winter 2016/2017
- Working with STI on this project



Summary of Best PM Practices

- ✓ **Ensure you are getting good FRM data**
- ✓ For most continuous methods, slightly negative numbers can be valid and are to be reported
- ✓ Align your second stage separators (i.e., VSCC to VSCC)
- ✓ Site and Method Set-up
- ✓ Leak Tests
- ✓ Quality Assurance/Quality Control
- ✓ Utilize QC checks in your own data system and/or AIRNowTech.
- ✓ Data Transfer and Reporting
- ✓ Method Specific Topics, e.g., zero tests on Met One BAM
- ✓ Assessments – you need to look at your data and compare to other methods and sites.



AMTIC Web Site at
https://www3.epa.gov/ttn/amtic/contmont.html

Provides detailed information on:

- Guidance Documents and Tools
- Policies and Data Management
- Available SOPs
- **Technical Systems Audit checklists**
- CASAC files
- Assessments and Verifications
- Presentations