

# ***Purpose and Goals of PM Continuous Program and FEM Status***

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# *U.S. PM Continuous Monitoring History*

- 1990
  - First PM<sub>10</sub> automated equivalent methods approved.
- 1997
  - PM<sub>2.5</sub> NAAQS and monitoring rules
    - Classes of equivalency introduced; however, specifics not included for class III (i.e., continuous monitors)
    - First specific network requirements for PM<sub>2.5</sub> continuous monitors – one per metropolitan areas over 1M people
- 2001
  - CASAC Workshop on accommodating emerging technologies into routine air monitoring networks
- 2002
  - Continuous Monitoring Implementation Plan developed and reviewed by CASAC
- 2003
  - AIRNOW goes public with reports and forecasts using PM<sub>2.5</sub> continuous monitoring data
- 2006
  - EPA finalizes PM NAAQS and monitoring rules with several provisions for PM<sub>2.5</sub> continuous monitors

# Monitoring Objectives

Monitoring Objective	FRM and Class II Methods	Class III Equivalent Method	Approved Regional Method (ARM)	Operating, but Non-Approved Continuous Method
NAAQS				
Trends				
AQI				
Vector Analysis				
Diurnal Analysis				
Post Sampling Speciation				

 = *Supports this monitoring objective*

 = *limited support of this monitoring objective*

# *Ambient Air Monitoring Regulations – PM continuous Monitoring Components*

- Part 50 - NAAQS
  - Appendix L now includes use of Very Sharp Cut Cyclone (VSCC) as an approved second stage impactor
  - Appendix N provides for use of FRM/**FEM/ARM** when determining attainment or non-attainment with the PM<sub>2.5</sub> NAAQS
- Part 53 – Approval of Reference and Equivalent Methods
  - Approval of reference and equivalent methods
    - **Revised performance based criteria for PM<sub>2.5</sub> and PM<sub>10-2.5</sub> equivalent methods**
    - **Specific criteria for test locations provided**
- Part 58 – Ambient Air Monitoring
  - Appendix A
    - Network DQO's apply to all methods used.
  - Appendix C
    - **Criteria for “Approved Regional Methods” for PM<sub>2.5</sub>**
  - Appendix D
    - **Revised network minimums PM<sub>2.5</sub> based on population and design value; each network is required to have PM<sub>2.5</sub> continuous monitoring sites at one half the number (rounded-up) of required NAAQS applicable PM<sub>2.5</sub> sites**
    - Introduction of NCore multi-pollutant sites
      - Requires PM<sub>2.5</sub> continuous monitors at NCore,

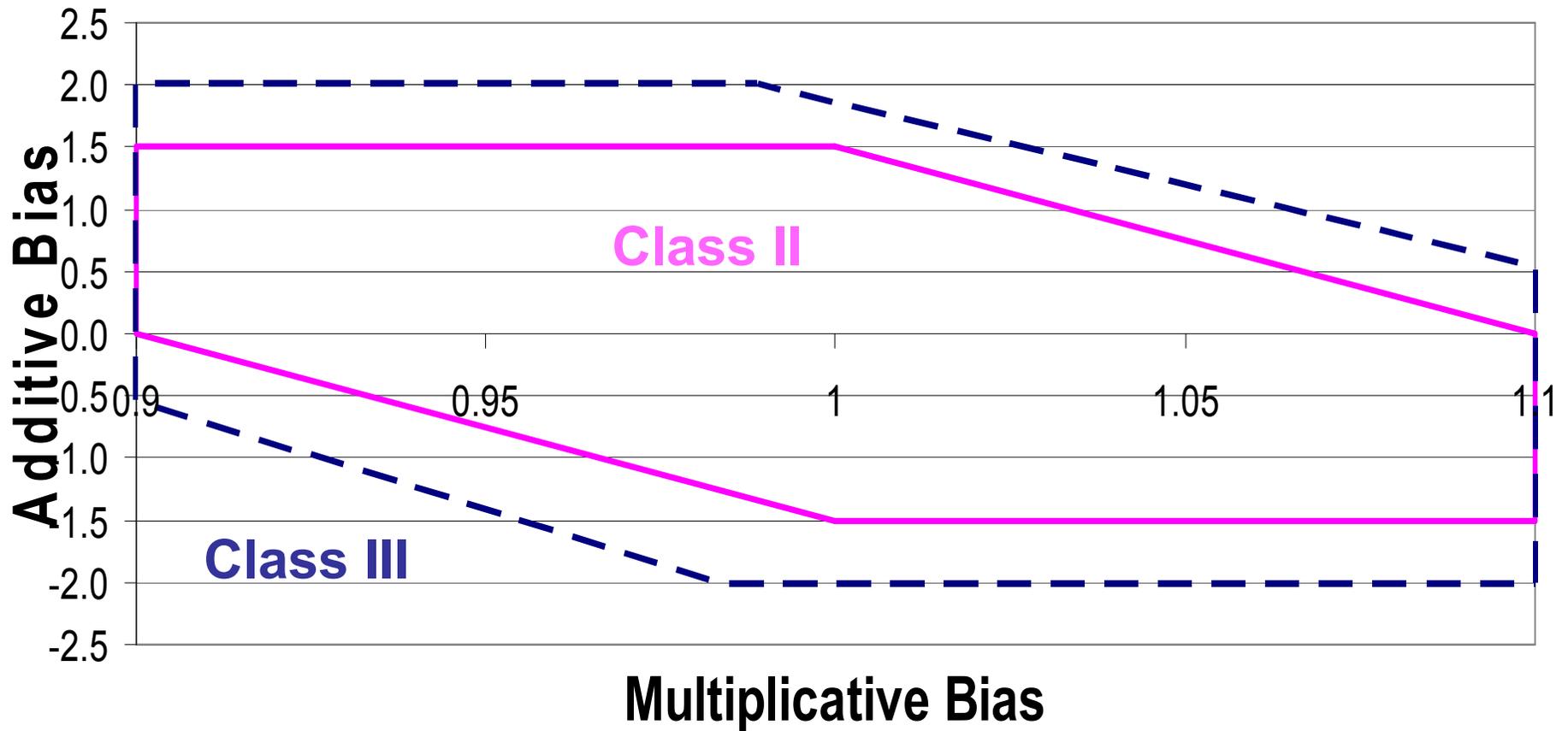
## Relationship among FRMs/FEMs/ARMs

	<b>FRM</b>	<b>FEM Class II</b>	<b>FEM Class III</b>	<b>ARM</b>
<b>Defined as</b>	Method defined by Appendix L to Part 50 for PM <sub>2.5</sub> or Appendix O for PM <sub>10-2.5</sub>	Samples collected by filtration, with filter conditioning, and gravimetric analysis, but having substantial design differences from FRM	Having one-hour or less concentrations as well as 24-hour	Continuous PM <sub>2.5</sub> method approved within a State or local air monitoring network
<b>Design or performance based</b>	Design	Performance	Performance	Performance
<b>Filter/Continuous</b>	Filter-based	Filter-based	Continuous	Continuous
<b>Time Resolution</b>	24-hour	24-hour	Hourly	Hourly
<b>Network Applicability</b>	National	National	National	Individual Network
<b>Applicable to</b>	PM <sub>2.5</sub> , PM <sub>10-2.5</sub>	PM <sub>2.5</sub> , PM <sub>10-2.5</sub>	PM <sub>2.5</sub> , PM <sub>10-2.5</sub>	PM <sub>2.5</sub> only

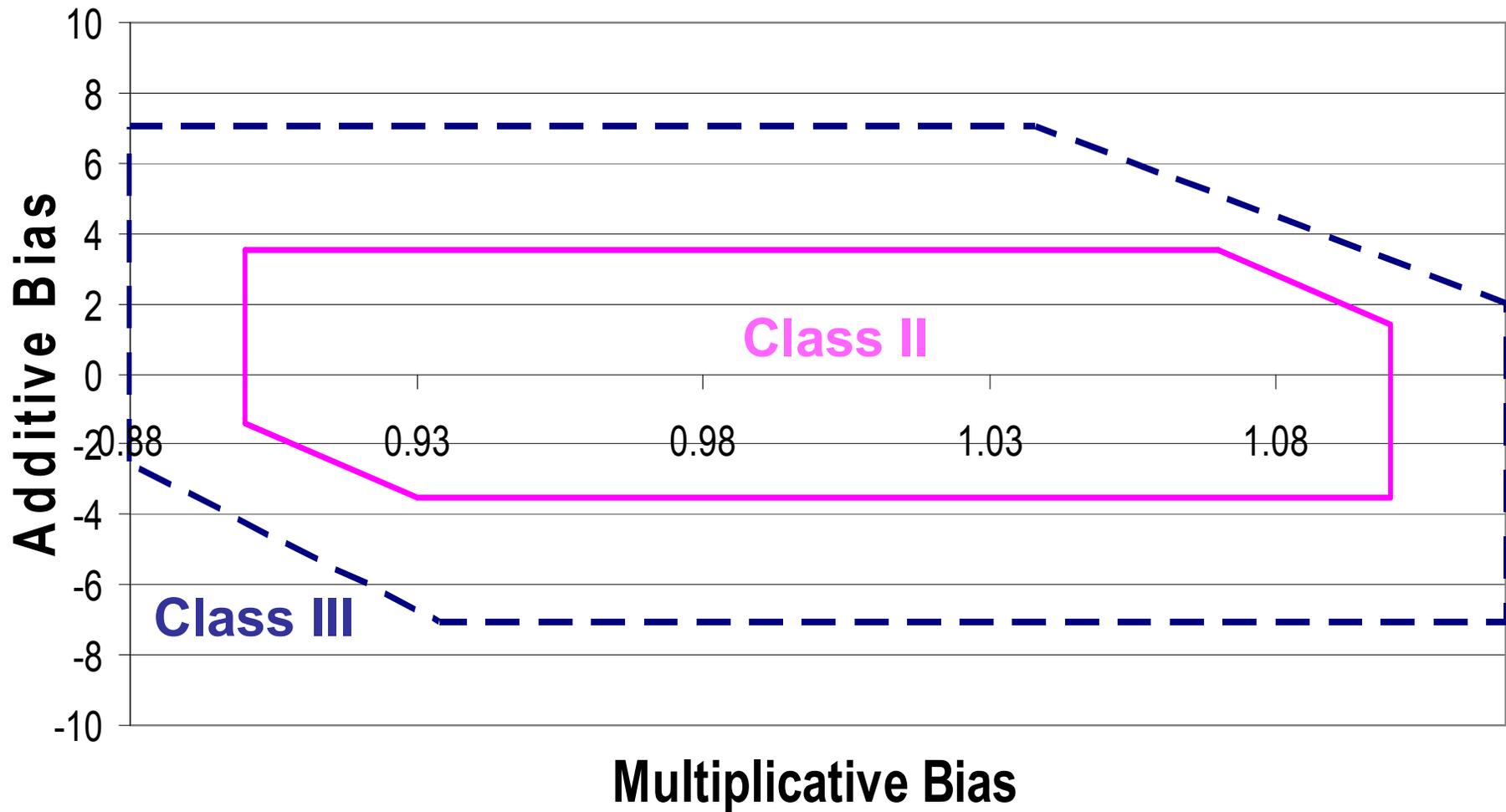
## *PM Federal Equivalent Methods Statistical Criteria*

- New performance criteria for Class II and III equivalent methods
- Based on Data Quality Objective Process
  - Considers tradeoffs between several inputs
  - Advantage of continuous methods (Class III) in this process is that they provide higher sample frequency and completeness
- Criteria
  - Sampler precision
  - Correlation,  $>0.93$  or  $>0.95$  based on sample population
  - Bias
    - Additive bias (intercept) – strengthened in response to comments
    - Multiplicative bias (slope)

# PM<sub>2.5</sub> Equivalency Criteria



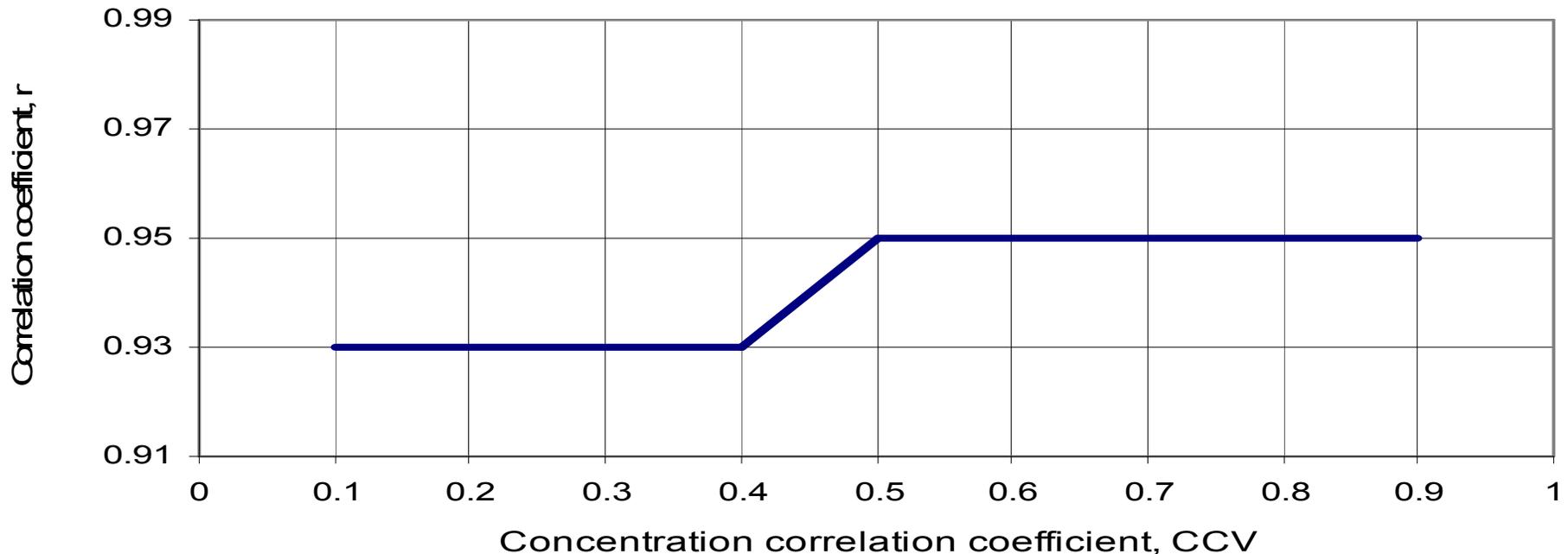
# *PM<sub>10-2.5</sub> Equivalency Criteria*



# *PM<sub>2.5</sub> and PM<sub>10-2.5</sub> Class II and III Methods Correlation Criteria*

- Correlation is  $r$  (not  $r^2$ )
- CCV is a measure of the spread of the sample concentrations

## **Minimum Limits for Correlation Coefficient**



## *Test Sites for Class II and III Equivalent Methods*

- Test Locations
  - Four test sites identified – A, B, C, and D.
    - Changed from 5 test campaigns at 3 locations to 5 test campaigns at 4 locations in final rule
- Testing for both  $PM_{2.5}$  and  $PM_{10-2.5}$ 
  - Class II - at two sites in any season
    - One east
    - One west
  - Class III – At four sites
    - Winter and Summer at test site A,
    - Winter season only at test site B and C
    - Summer only at test site D

## *PM<sub>2.5</sub> Class II and III Test Site Summary*

<b>Test Site</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>Location Area</b>	Los Angeles basin or California Central Valley	Western city such as Denver, Salt Lake City, or Albuquerque	<b>Midwestern City</b>	Northeastern or mid-Atlantic city
<b>Site Characteristics</b>	Relatively high PM <sub>2.5</sub> nitrates, and semi-volatile organic pollutants	Cold weather, higher elevation, winds, and dust	<b>Substantial temperature variation, high nitrates, wintertime conditions</b>	High sulfate and high relative humidity
<b>Class III Field Test Campaigns</b>	Winter and Summer	Winter	<b>Winter</b>	Summer
<b>Class II Field Test Campaigns</b>	Site A or B, any season		Site C or D any season	

## **PM<sub>10-2.5</sub> Class II and III Test Site Summary**

<b>Test Site</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
<b>Location Area</b>	Los Angeles basin or California Central Valley	Western city such as Las Vegas or Phoenix	Midwestern City	Large city east of the Mississippi River
<b>Site Characteristics</b>	Relatively high PM <sub>2.5</sub> nitrates, and semi-volatile organic pollutants	High PM <sub>10-2.5</sub> to PM <sub>2.5</sub> ratio, wind-blown dust.	Substantial temperature variation, high nitrates, wintertime conditions	High sulfate and high relative humidity
<b>Class III Field Test Campaigns</b>	Winter and Summer	Winter	Winter	Summer
<b>Class II Field Test Campaigns</b>	Site A or B, any season		Site C or D any season	

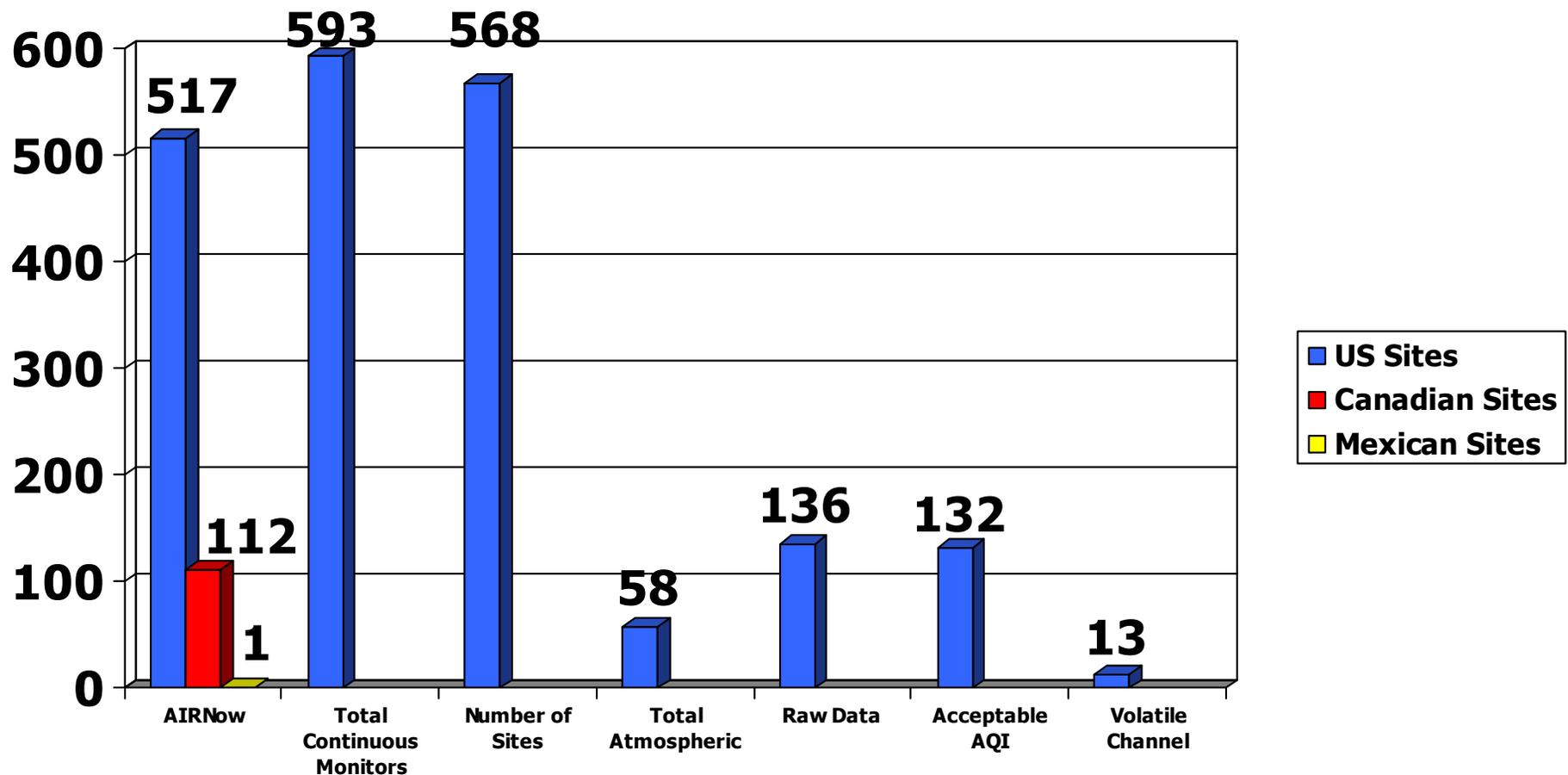
## *Approved Regional Methods (ARMs) for PM<sub>2.5</sub>*

- PM<sub>2.5</sub> continuous method approved for use within a State, local, or Tribal agency used to meet multiple monitoring objectives such as NAAQS, AQI...
- Would allow S/L/T to optimize their PM<sub>2.5</sub> network with well performing continuous methods
- Testing Criteria
  - Uses same performance criteria as Class III methods; however, flexibility to demonstrate sample precision
  - Testing occurs at subset of sites in network within which it's intended to be used
  - Testing Criteria for additive bias also tightened for PM<sub>2.5</sub> ARM

## *Ambient Air Monitoring Network Design*

- Must meet three basic objectives (section 1.1 Appendix D to Part 58)
  - All are equally important*
  - Provide air pollution data to the general public in a timely manner.
  - Support compliance with ambient air quality standards and emissions strategy development.
  - Support air pollution research studies.
- PM<sub>2.5</sub> continuous monitors are needed to support all three objectives, especially in light of the more stringent daily PM<sub>2.5</sub> standard.

# *PM<sub>2.5</sub> Continuous Monitoring Data Reporting Summary*

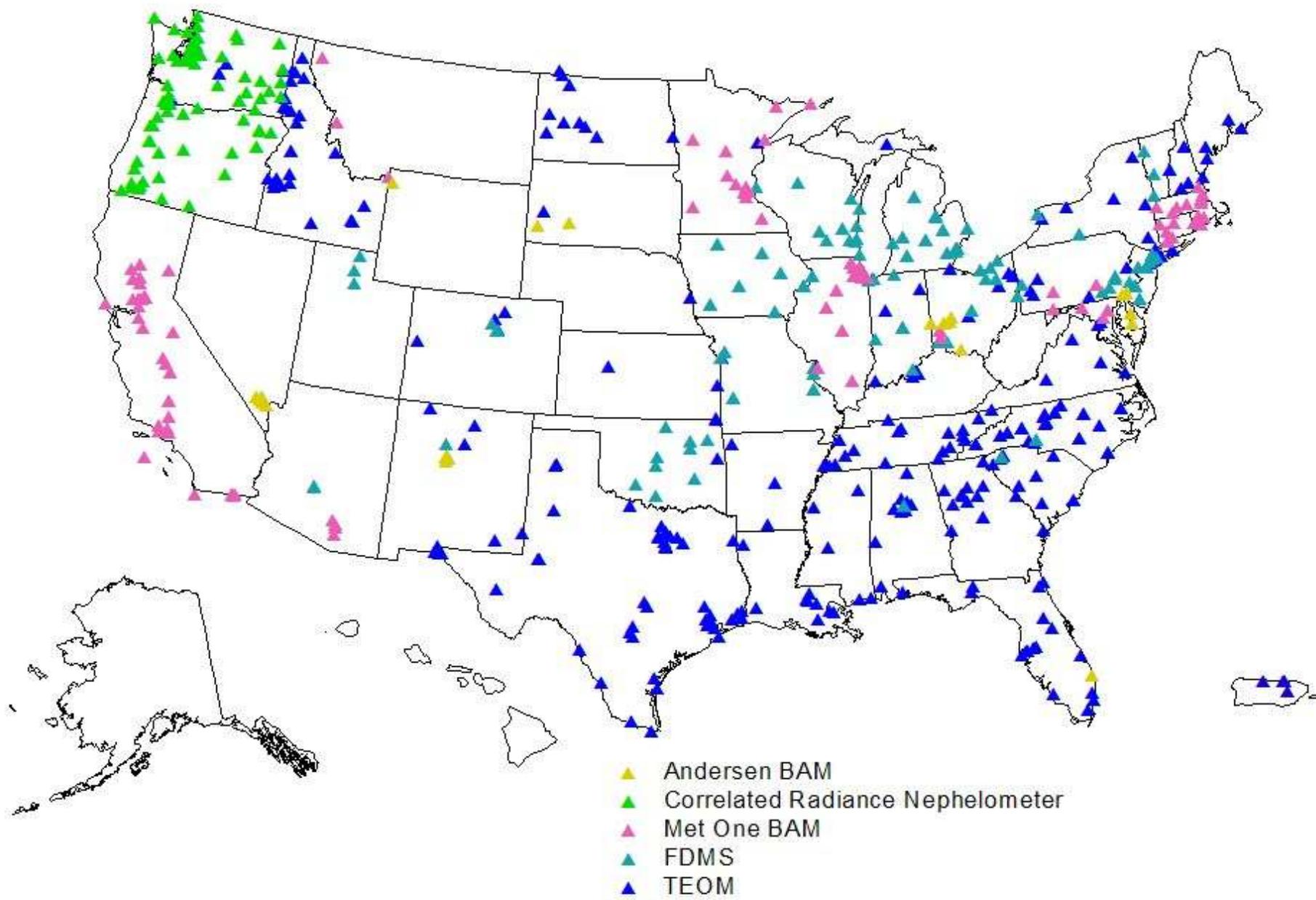


**Data from AQS and DMC on 10/26/2005**

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

- Strengths
  - Sites
    - Good coverage in most areas with fine particle issues
    - 500+ Continuous Mass Sites
  - Sampler and Methods
    - Reporting monitors are correlated to FRM/FEMs
    - No post-sampling laboratory analysis
  - Data Reporting
    - Everyday monitoring with hourly data reports updated nationally on AIRNow and AIRNowTech
    - Data support forecast reports for most large and many other cities each day
    - Reporting of current AQI uses last 12 hours of data with weighting for more recent hours for estimate of “mid-point” 24 hour AQI.
    - Reporting of previous days AQI based on average of midnight-to-midnight mass concentration.

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



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

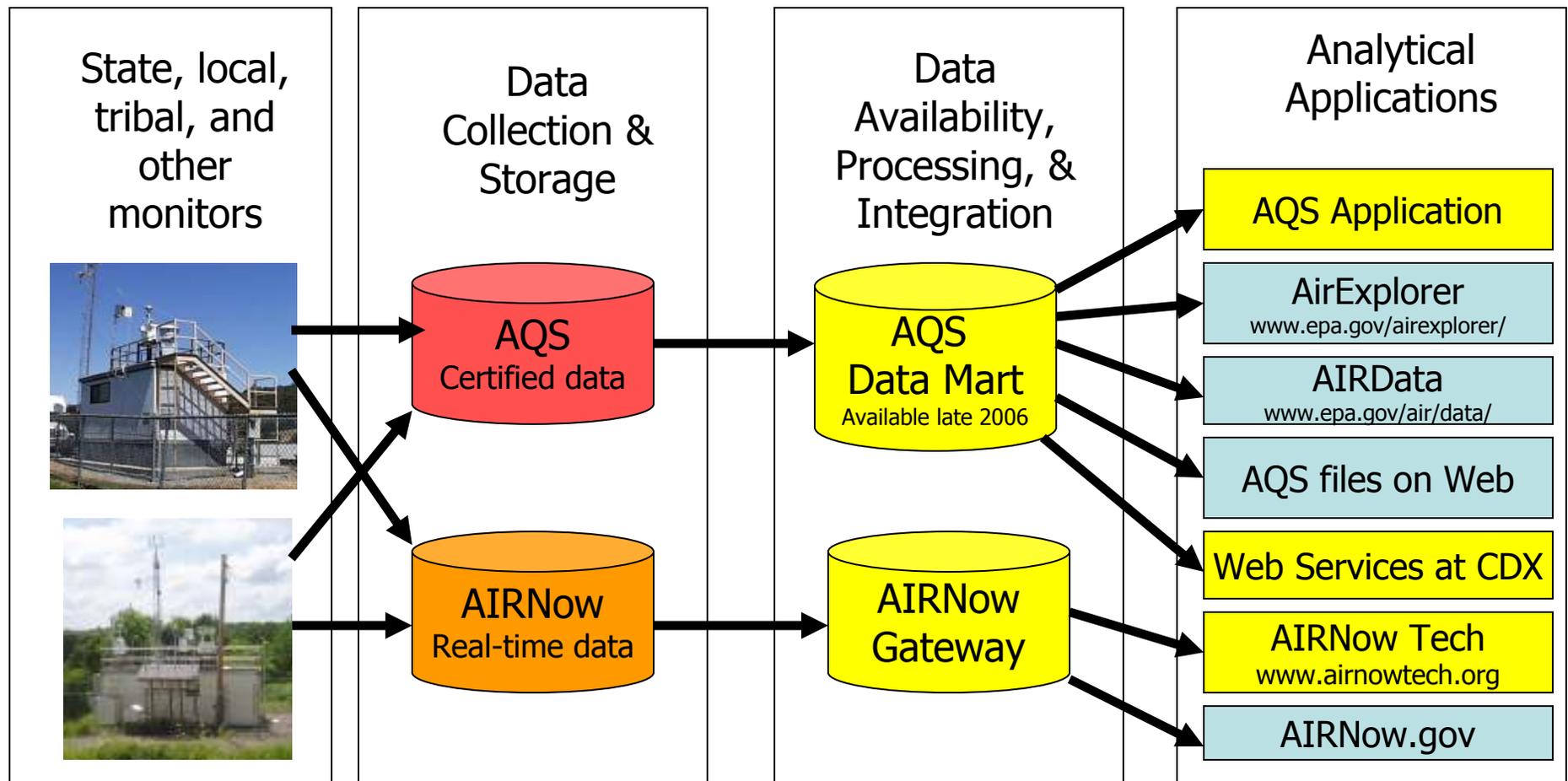
- Limitations
  - Methods
    - No methods have been approved as equivalent methods
    - Various methods have been implemented based on selection of State, local, and tribal agencies
  - Data Transformations
    - Although many states have statistically correlated their PM<sub>2.5</sub> continuous methods; its often difficult to track down what these are and how often they are updated
  - Data Quality
    - Some methods have seasonal biases as compared to FRM/FEM
    - Some methods have better/worse precision than others, especially for short-term (1-3) hour data

## New Parameter Codes for Reporting PM<sub>2.5</sub> Data to AQS

Parameter Name	Parameter Code	Purpose
PM2.5 LOCAL CONDITIONS	88101	Appropriate code for all FRM/FEM/ARMS
PM2.5 TOTAL ATMOSPHERIC	88500	Valid data from methods measuring total PM <sub>2.5</sub> aerosols in the atmosphere, including those that can be volatilized from the FRM
PM2.5 RAW DATA	88501	Valid uncorrected data that <u>does not</u> reasonably match the FRM
ACCEPTABLE PM2.5 AQI & SPECIATION MASS (new 2006)	88502	Valid data that <u>does</u> reasonably match the FRM with or without correction, but not to be used in NAAQS decisions
PM2.5 VOLATILE CHANNEL (new 2006)	88503	Store important related data such as the FDMS reference channel

**88101 only for methods eligible for NAAQS decision-making**  
**Technical Note covering new codes available at <http://www.epa.gov/ttn/amtic/cpreldoc.html>**

# Ambient Air Monitoring Data Flow



## *PM<sub>2.5</sub> Data Issue that may be of Interest*

- PM<sub>2.5</sub> site meta data improvements
  - EPA is working with monitoring agencies to ensure every PM<sub>2.5</sub> site has the appropriate monitoring objective (e.g., population exposure, regional transport...)

## *Web Sites of Interest*

- **Real-time air pollution data and maps**
  - <http://airnow.gov/>
    - AIRNOW - Ozone and PM2.5 maps, State/local Air Quality forecasts
  - <http://airnowtech.org>
    - Recent real-time maps and data
  - <http://idea.ssec.wisc.edu/>
    - Uses MODIS Satellite data and AIRNow observations
  
- **Historical AIR Monitoring Data**
  - <http://www.epa.gov/ttn/airs/airsaqs/>
  - <http://www.epa.gov/air/data/>
  - <http://vista.cira.colostate.edu/views/>
    - IMPROVE
  - <http://www.epa.gov/airexplorer/>
  
- **Methods and Monitoring Information**
  - **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
  - <http://www.arb.ca.gov/amtac/>
    - California Site – BAM data and information

## *Where do we go from here?*

- EPA
  - Developing case study for FEM/ARM that includes an example of the written documentation and spreadsheets for an application.
    - Expect draft this coming winter, perhaps by NAQC.
- Instrument Manufacturers
  - Improvements in sample conditioning
  - Consider FEM applications
- Monitoring Agencies
  - Lots of data already collected
  - Consider ARM applications
- All
  - How to ensure new continuous monitors, when installed in the field, are producing data of the same quality from when they were field tested and approved?
    - Lab tests, collocate with other continuous or FRMs?