Met One Instruments Model BAM-1020

FEM Configurations
$PM_{2.5}$ Method EQPM-0308-170
$PM_{10-2.5}$ Method EQPM-0709-185

AWMA PM2.5 Workshop 2011, Toronto, Ontario

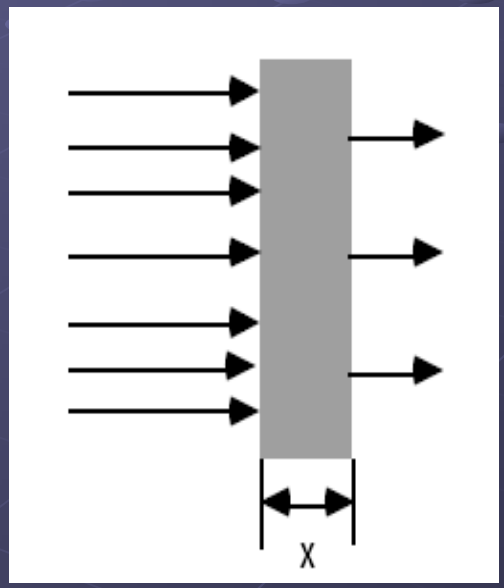
Erik Zamurs, AKRULOGIC

Beta Attenuation

Particle Concentration
C = mass/Volume

C = A*ρ/(μ*Volume) * ln(I0/I)

Where:
I = I0 * e-μx
With m = ρ * V and V = A * x
x=m/(ρ*A)
I = Io * e-μ/(ρ*A) * m
ln(I/Io) = -μ / (ρ*A) * m



Field Tests

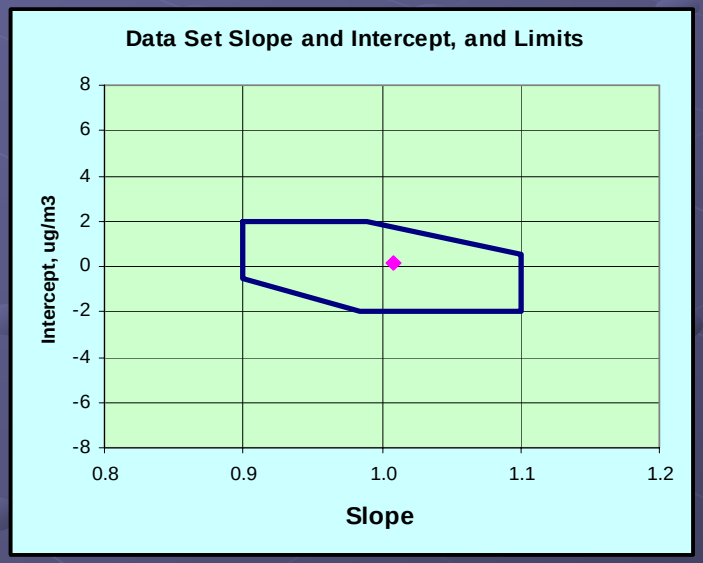
Test Results

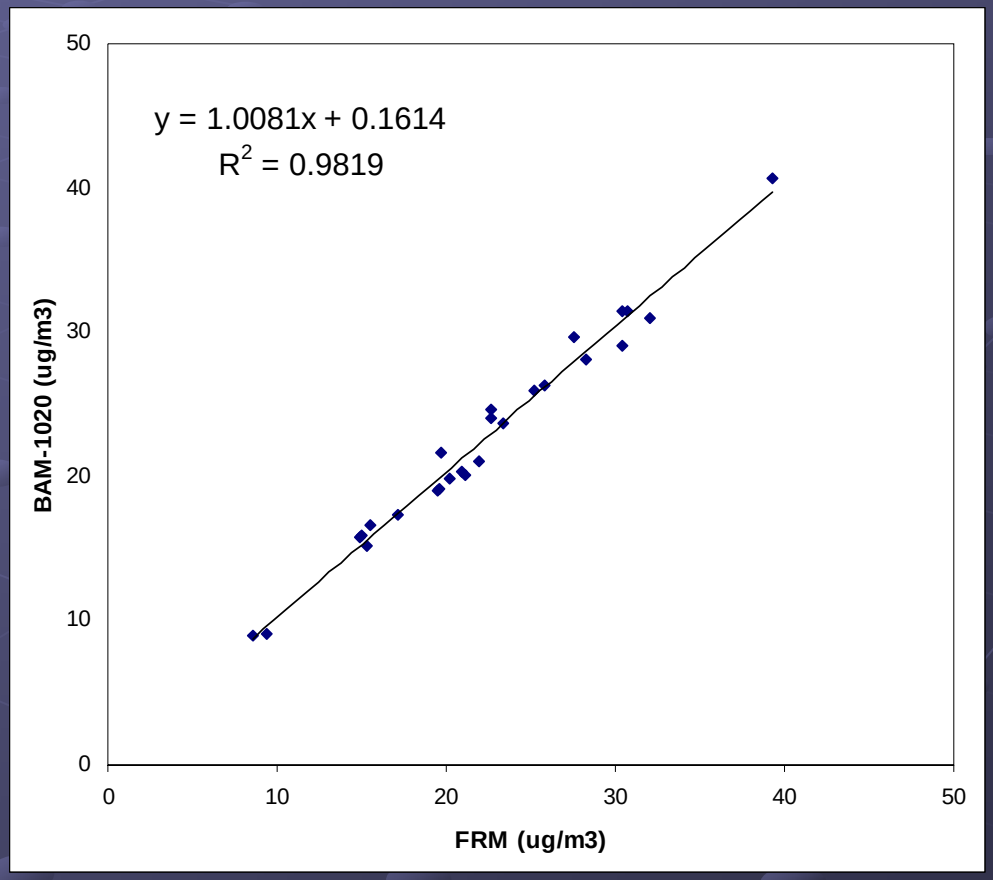
Elizabeth, New Jersey (2008)

Valid Sets: 26

FRM Precision: 2.4%

BAM Precision: 3.1%





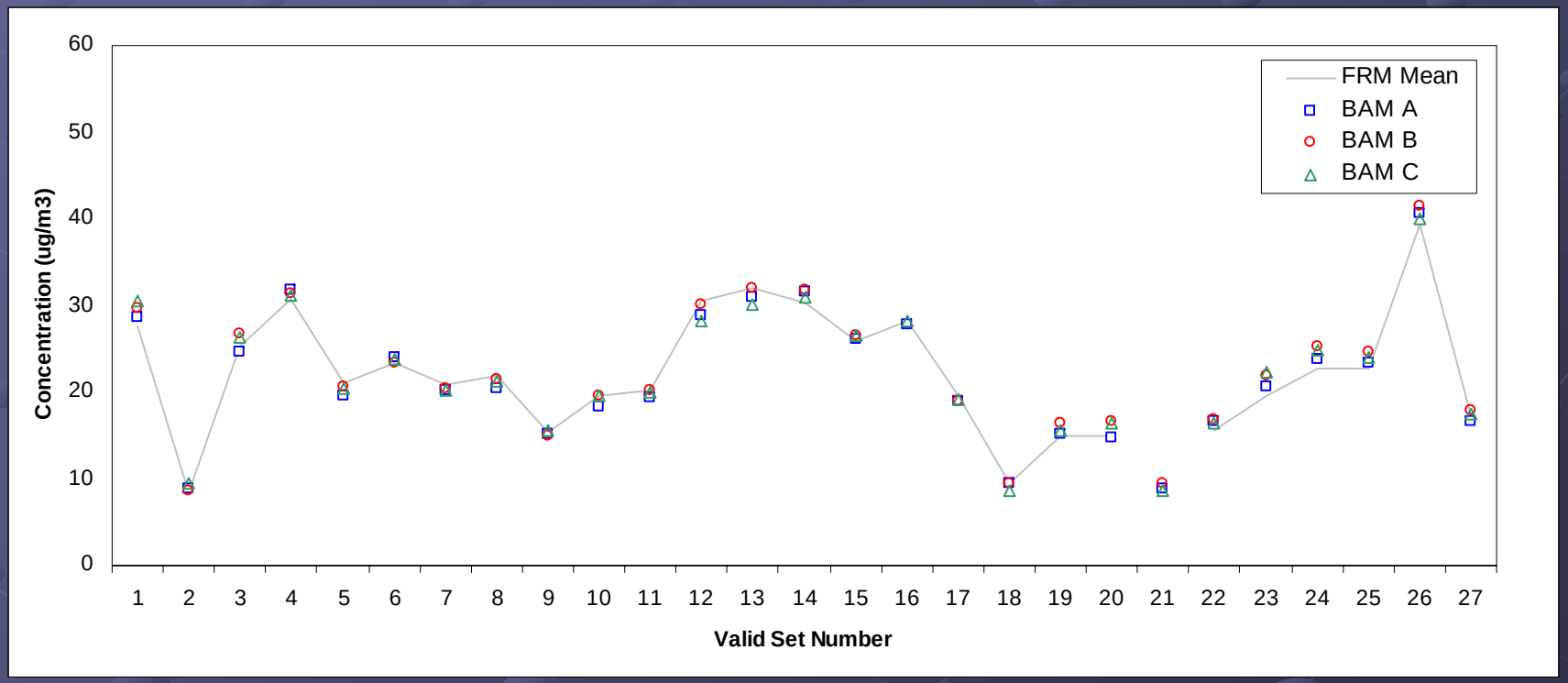
Test Results

Elizabeth, New Jersey (2008)

Individual BAM Results

(Compared to FRM Mean)

	BAM A	BAM B	BAM C
Slope	1.017	1.031	0.982
Int.	-0.403	0.034	0.781
r2	0.983	0.982	0.971

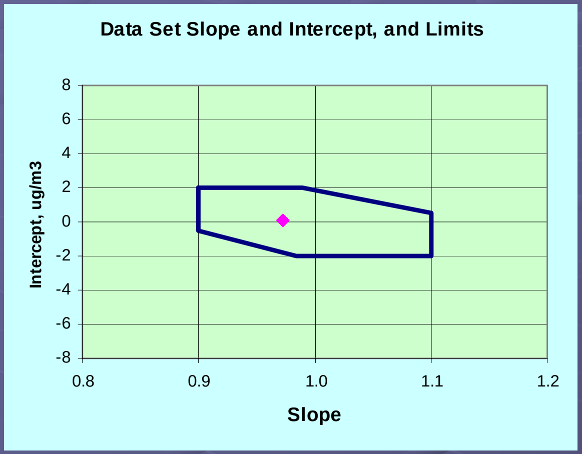


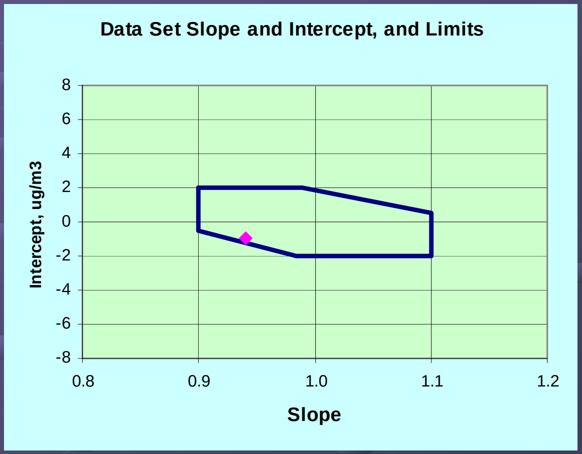
Field Test Findings

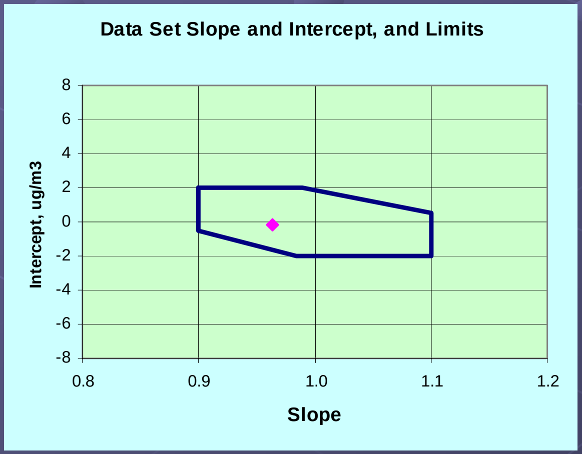
- BAM-1020 Tends to Underestimate PM During Cooler Periods (Winter)
- BAM-1020 Overestimates During Hot & Humid Periods (Summer)
- Field Test FRM Results Differ From State Agency FRM Results

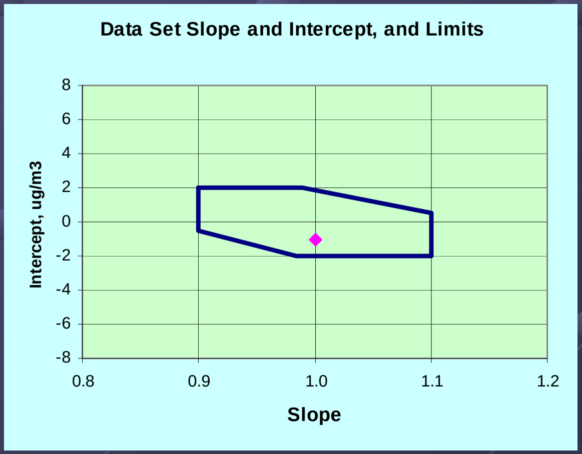
Test Results

Seasonal - Cool Test Sites
(Logan, Allen Park, Bakersfield Winter, Dearborn)



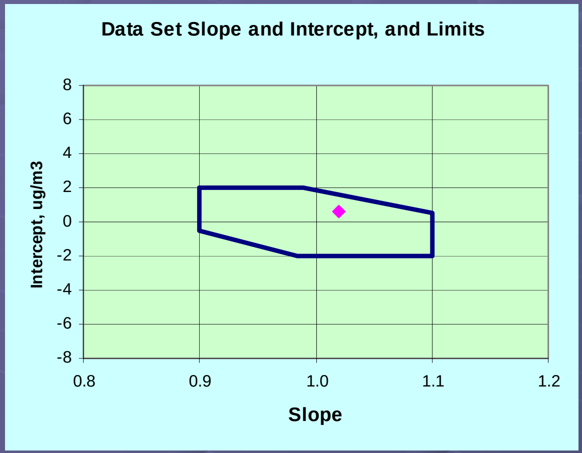


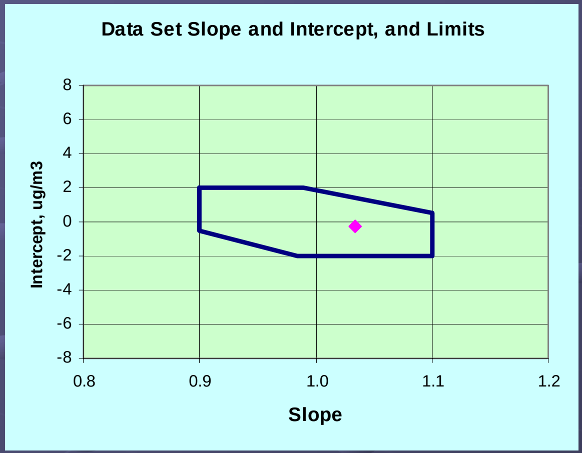


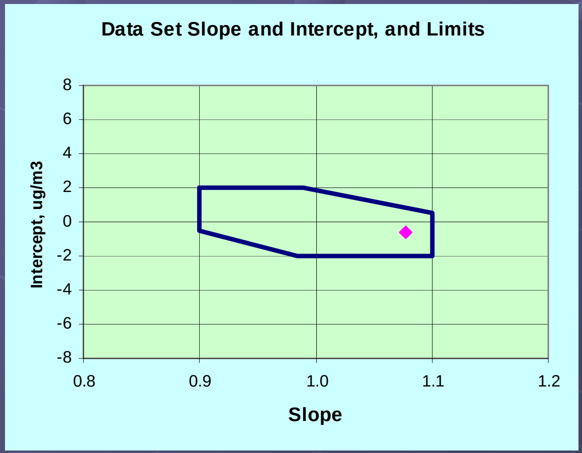


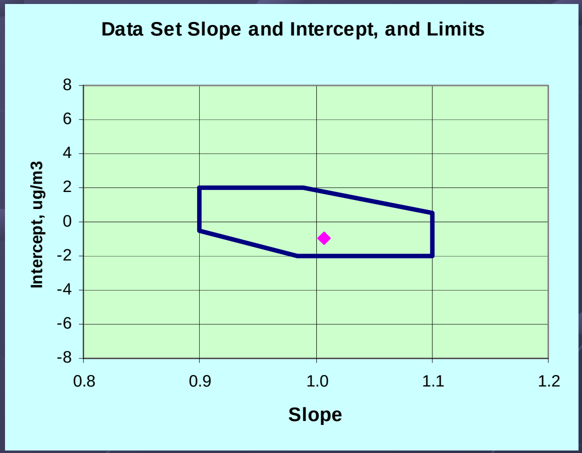
Test Results

Seasonal - Warm Test Sites
(New Haven, Elizabeth, Rubidoux Summer, Phoenix)



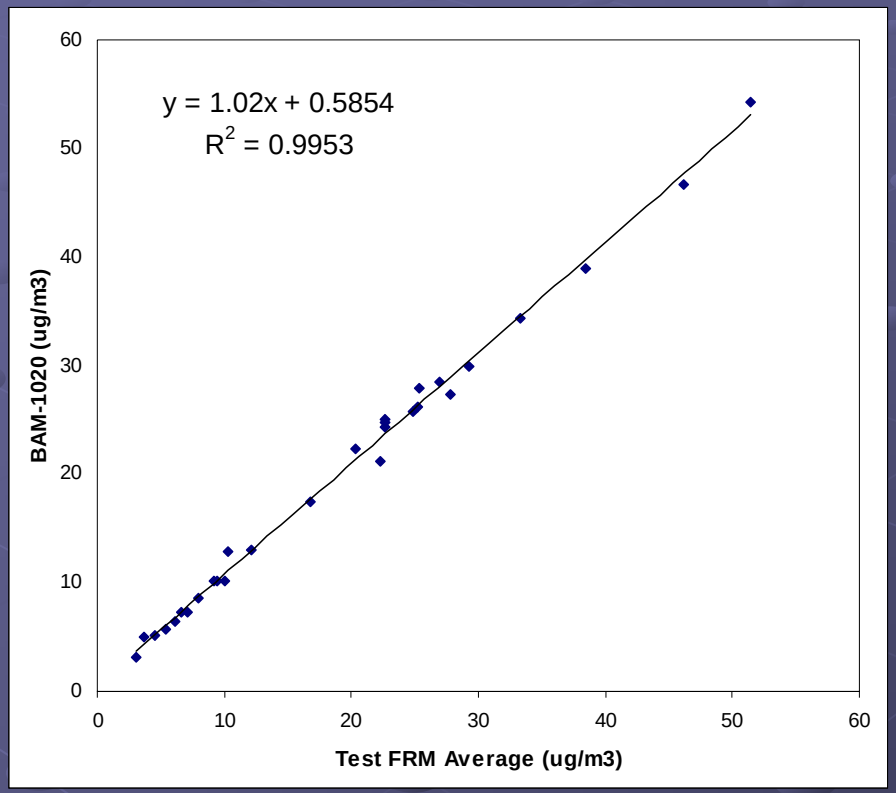


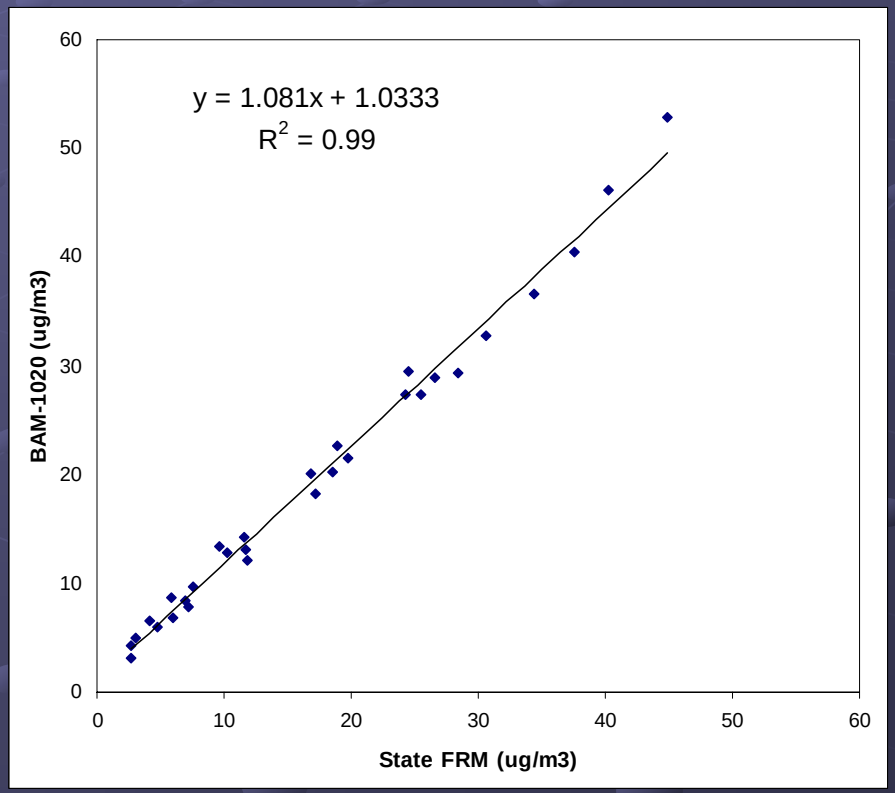




Test Results

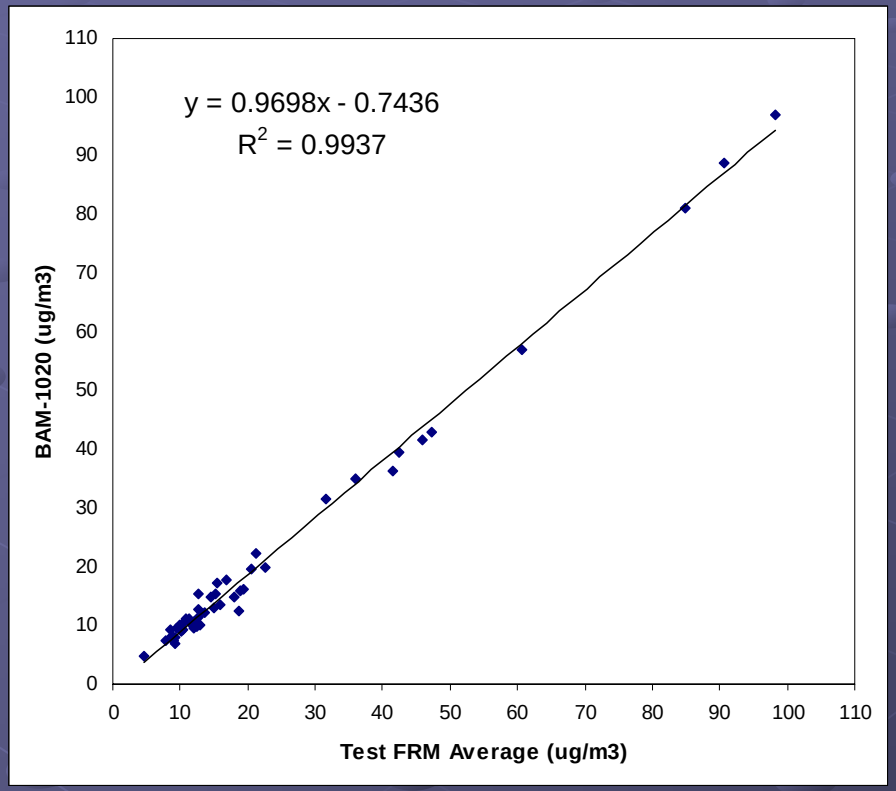
BAM vs. Test FRMs, compared to BAM vs. State FRM (New Haven)

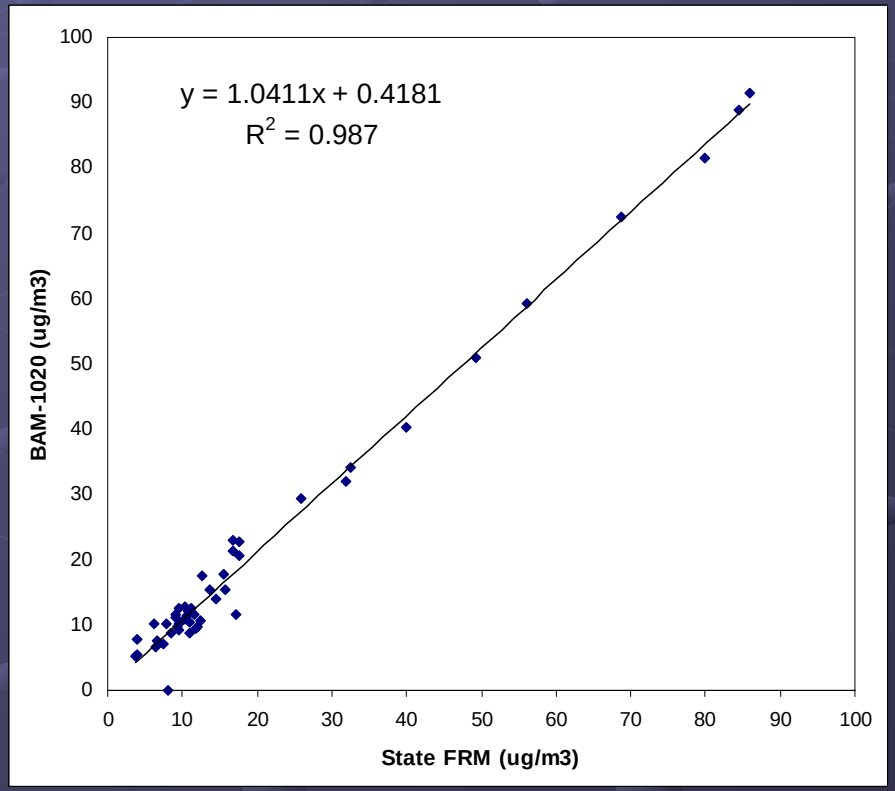




Test Results

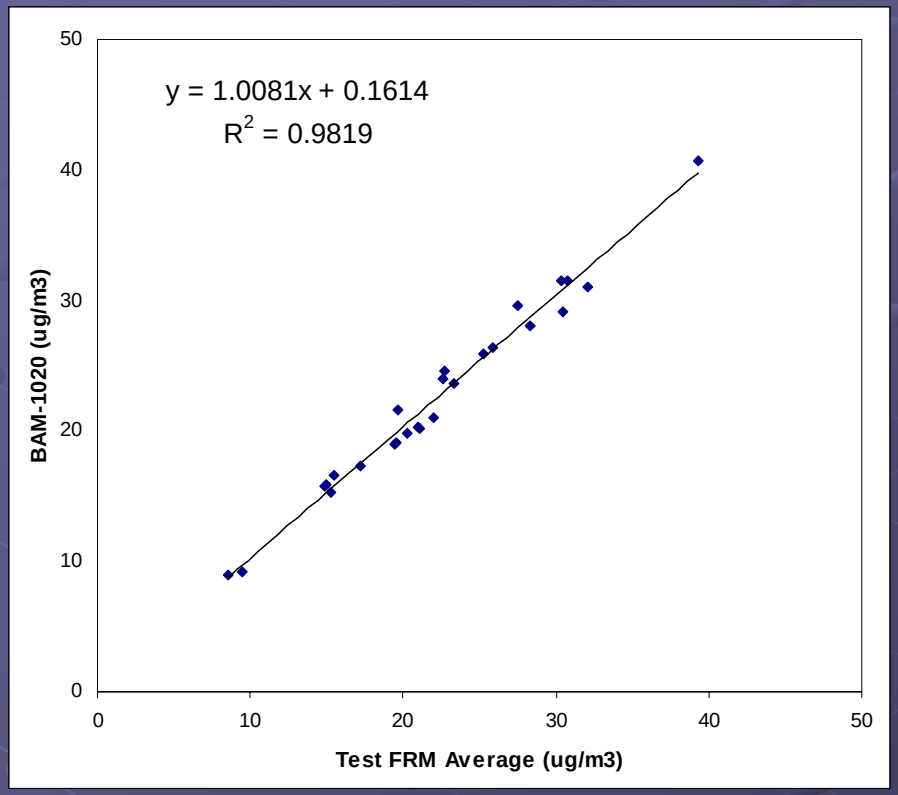
BAM vs. Test FRMs, compared to BAM vs. State FRM (Bakersfield)

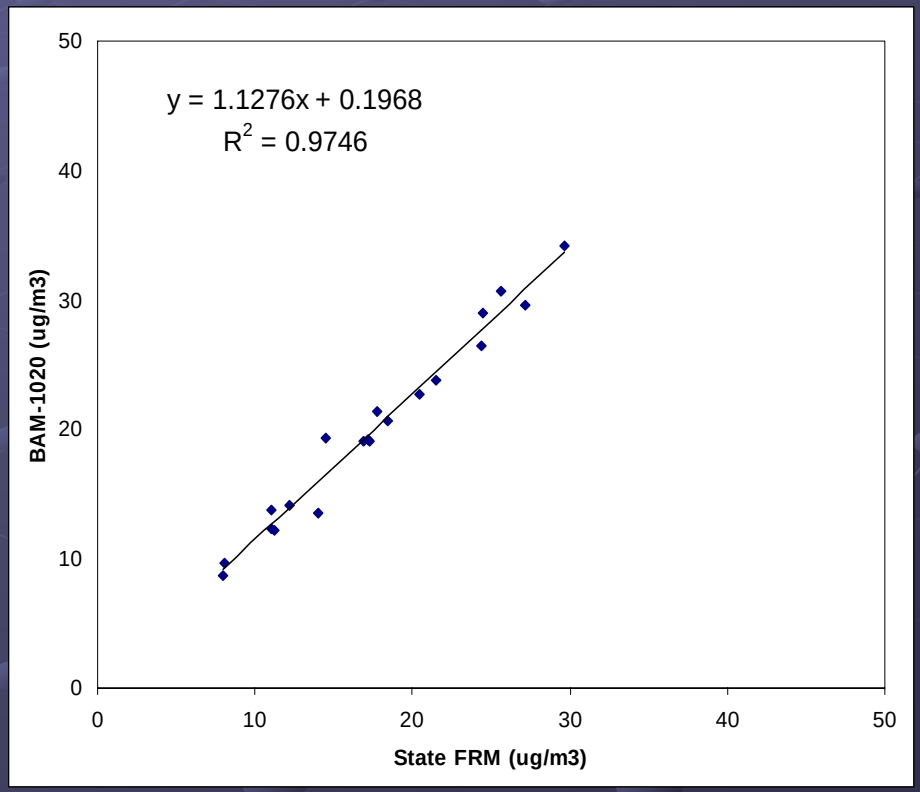




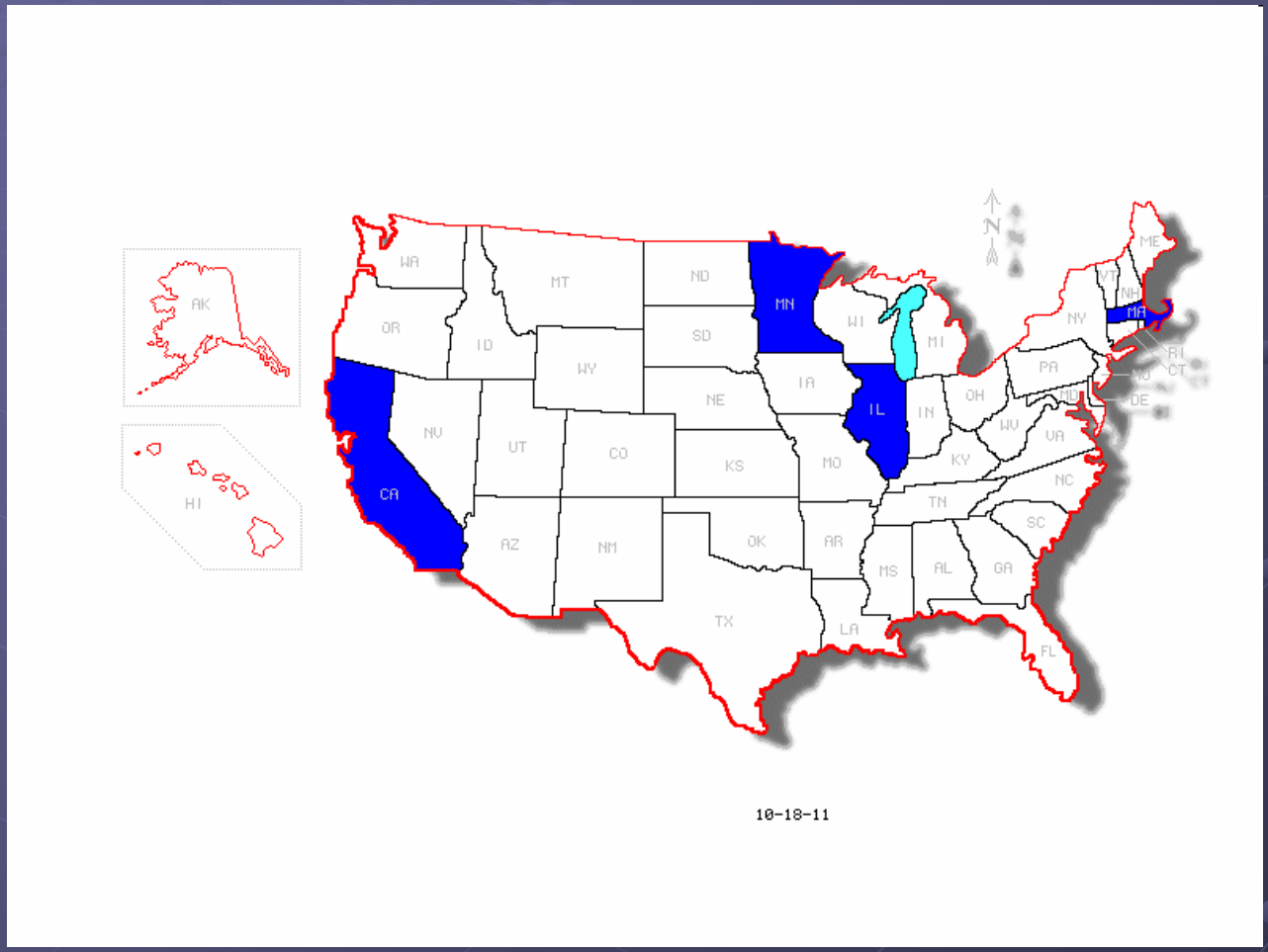
Test Results

BAM vs. Test FRMs, compared to BAM vs. State FRM (Elizabeth 2008)

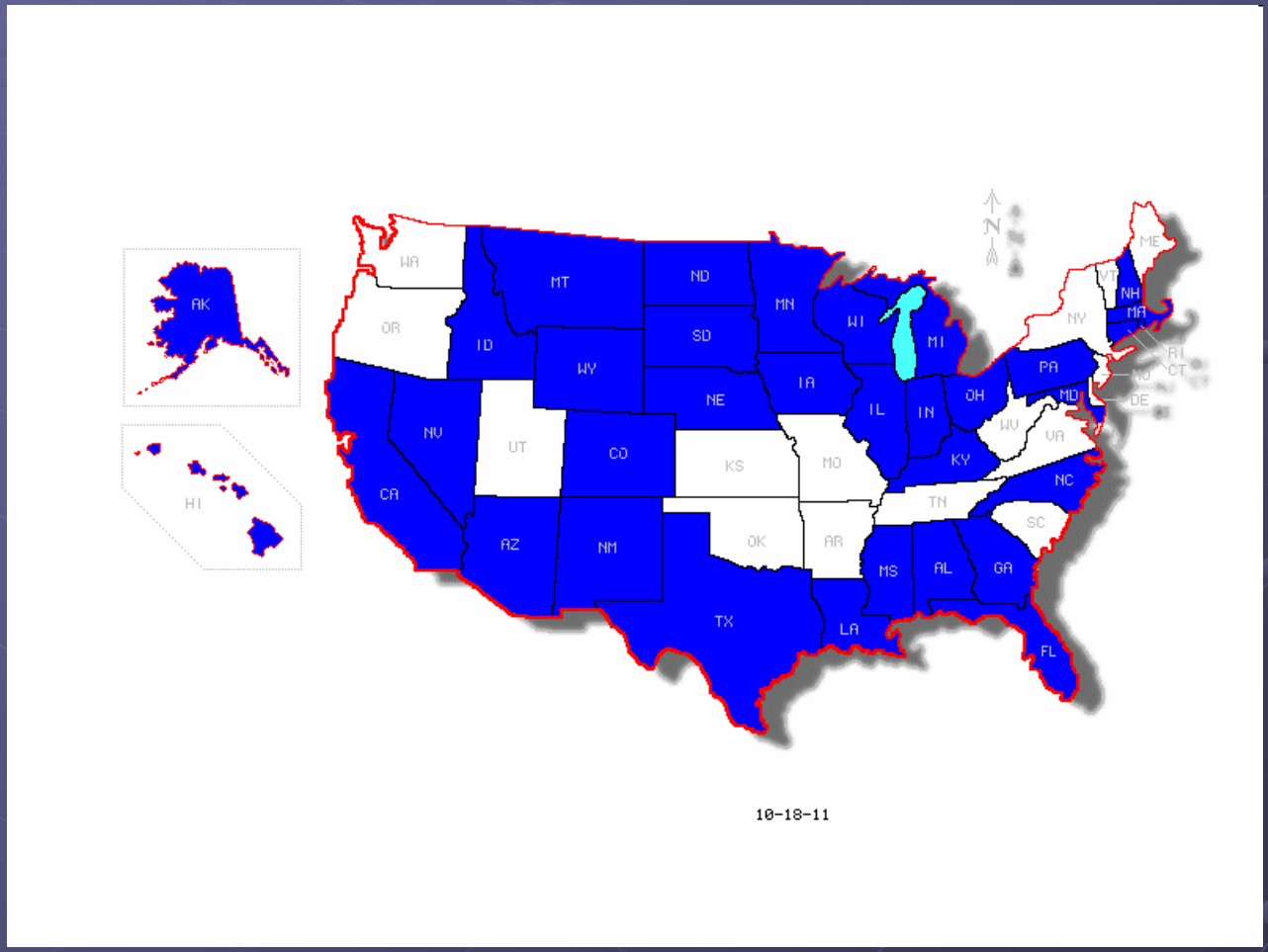




BAM-1020 Users 2006

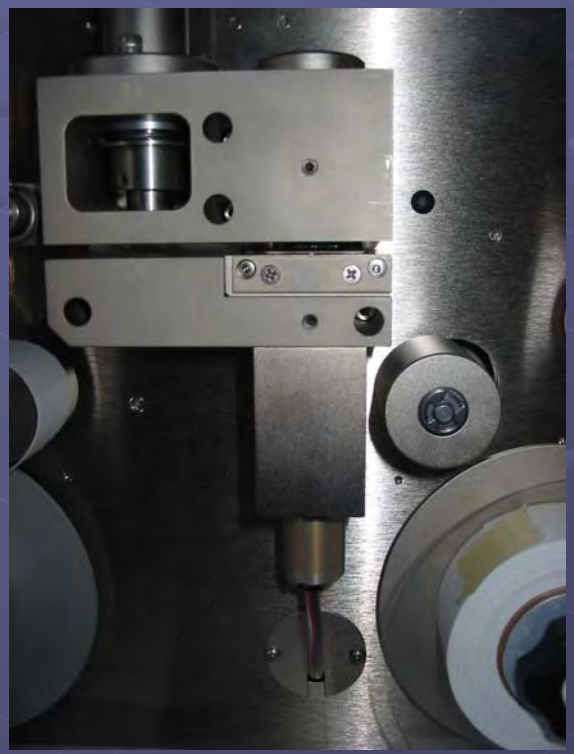


BAM-1020 Users 2011



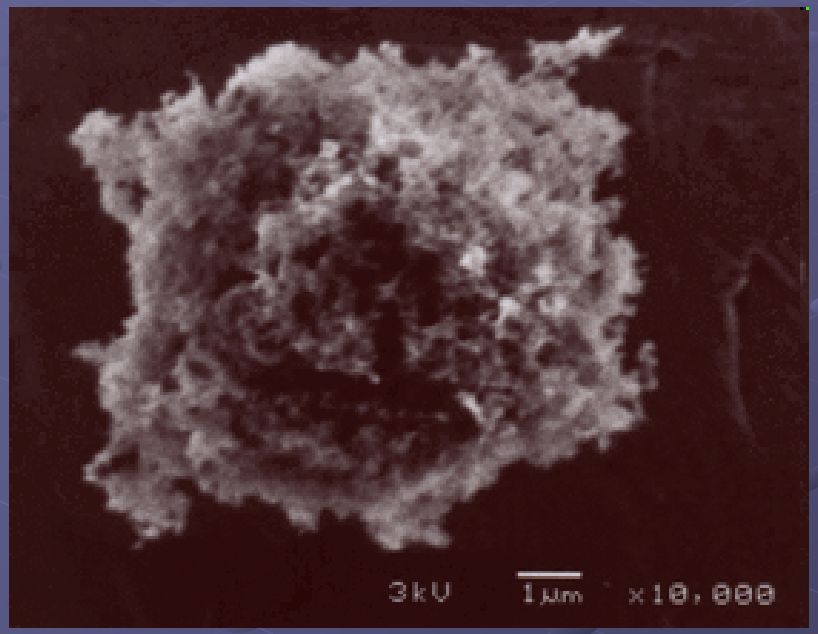
BAM-1020 Upgrades

- Reduced Beta Source PMT Spacing (Close Geometry)



- Rigid Tape Transport Mechanism

Characteristics of PM



Size (aerodynamic)

Density

Shape

Surface Texture

Color

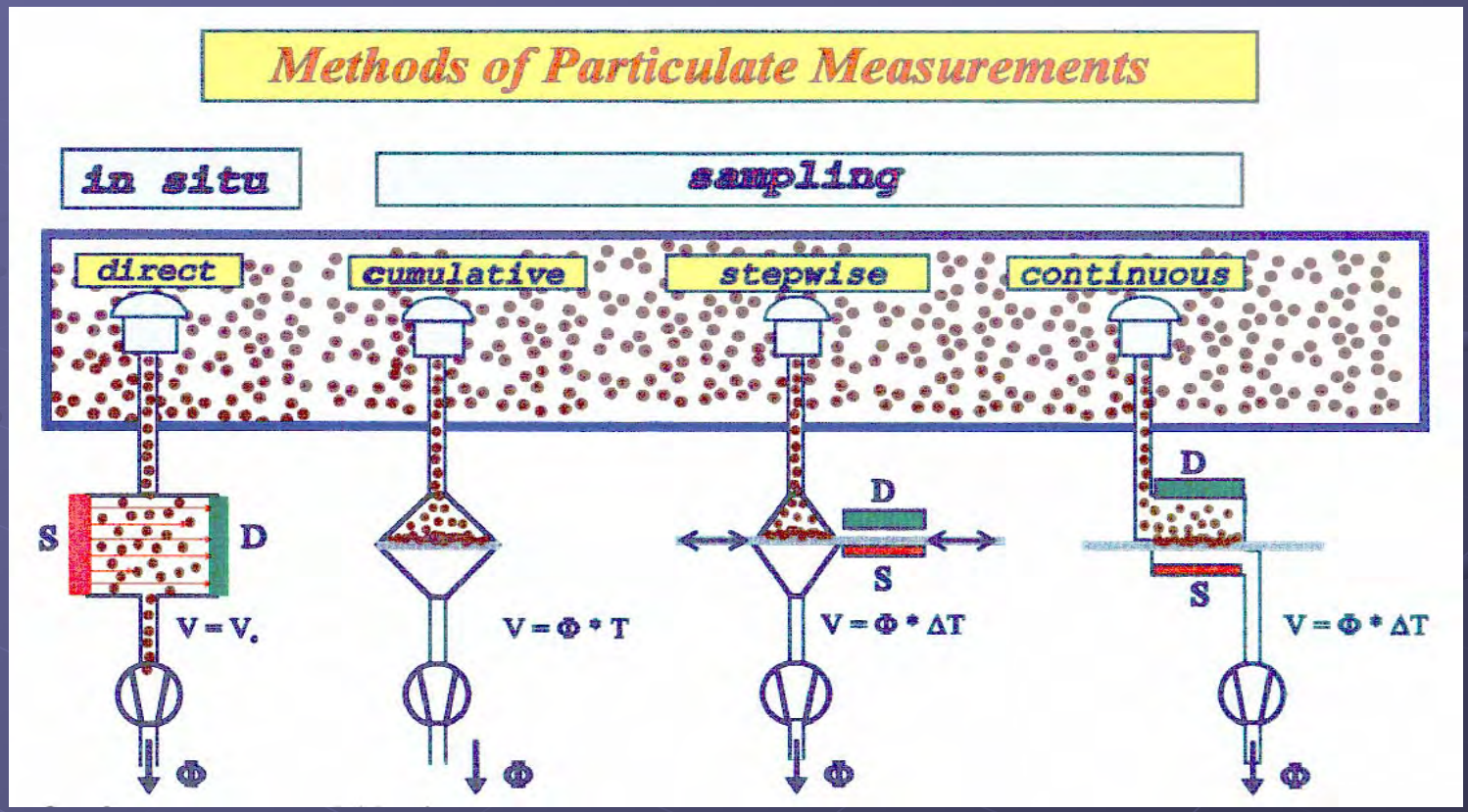
Composition

H2O Surface Absorption

Volatile Constituent

(Temperature + Humidity)

PM Measurement Techniques



Quickest Response

Greatest Variability

Delayed Measurement

Best Detection Limit

Short Delayed Measurement

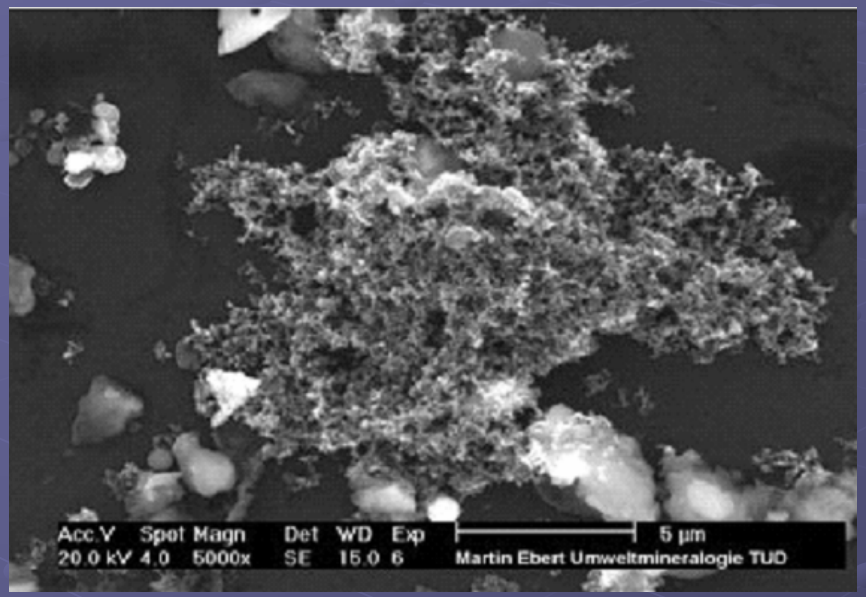
Detection Limit Adjustable

Accurate Mechanics Necessary

Online Measurement

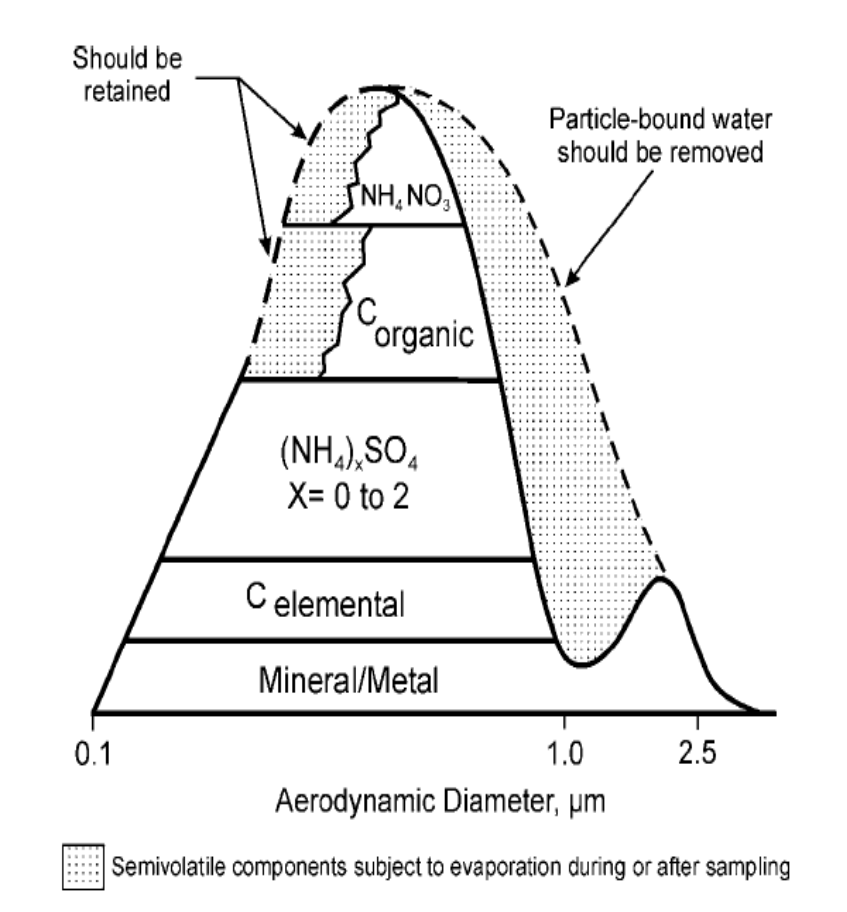
Compensation Systems Necessary

Moisture Trapped By Particles



- Agglomerated Particles Can Be Covered With H2O

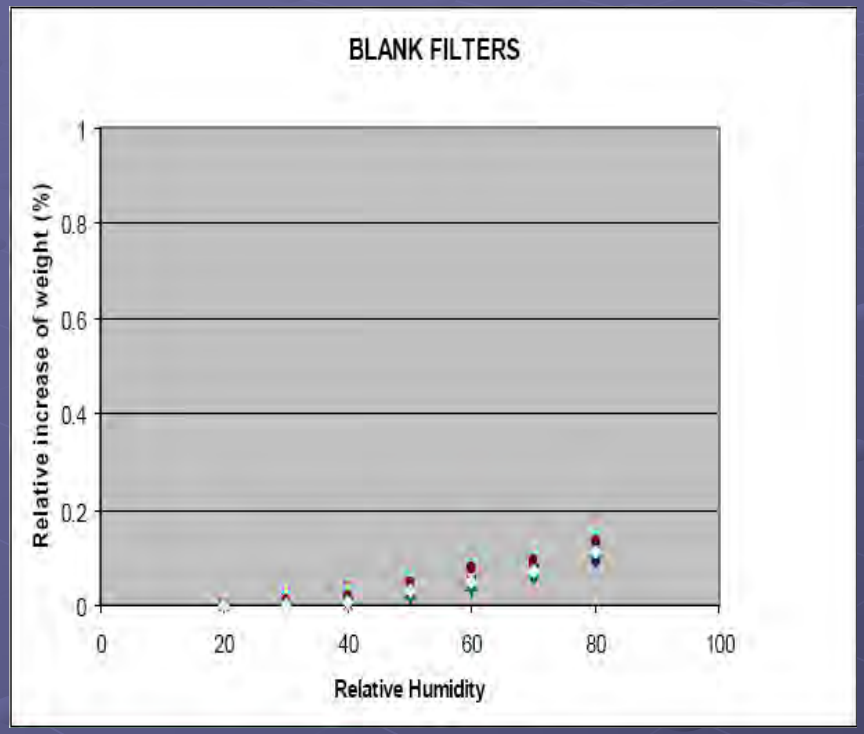
Moisture Trapped By Particles

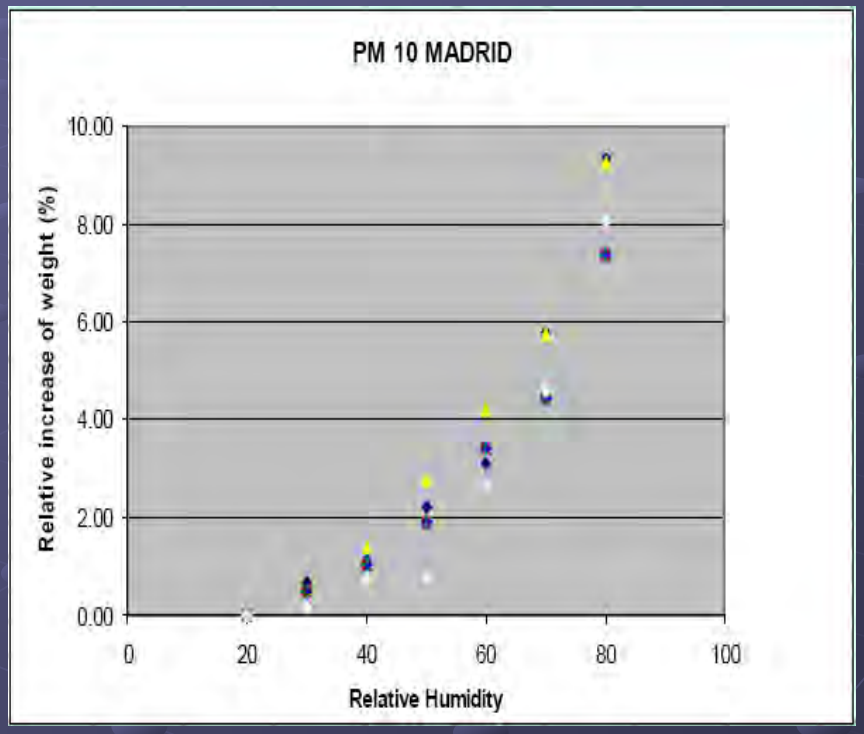


Effects on Measurement

- Improper Conditioning or Compensation
- Anomalous Measurements During Shifting Humidity
- Hysteresis effects for Particle-bound water

Weight Gain Of Filter

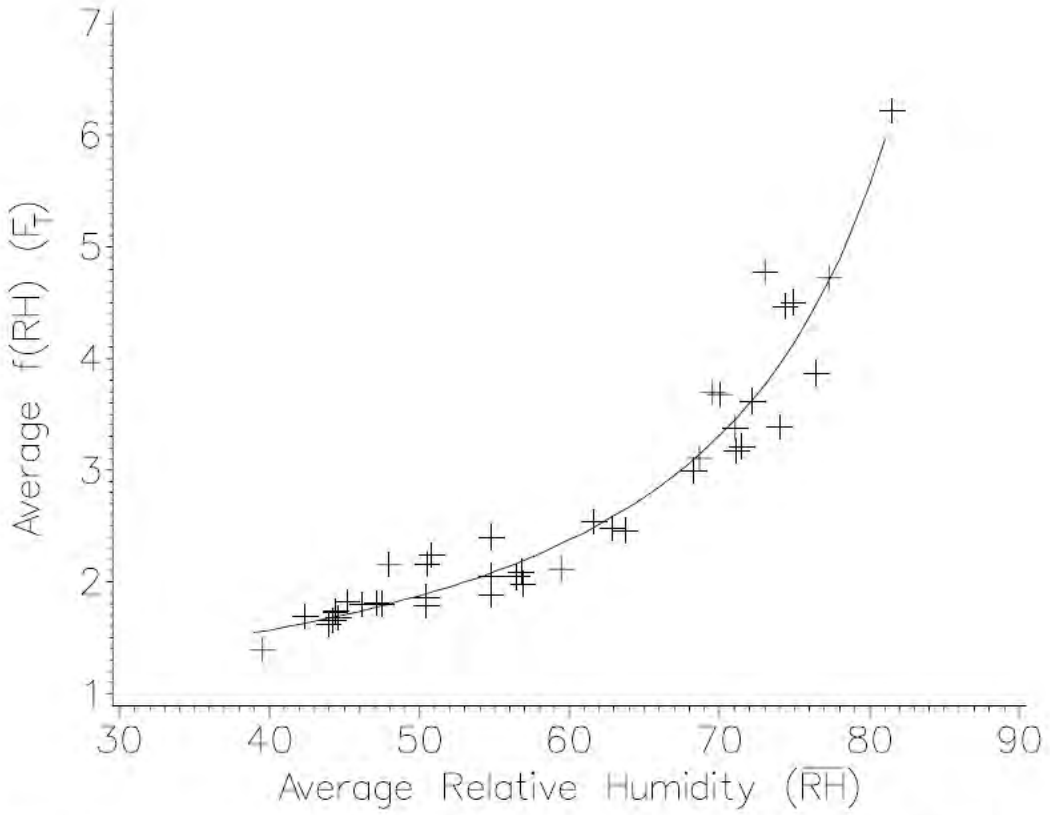




(ISPRA 2003 (Vittorio Forcina + Annette Borowiak)

Sample Condensation

Humidity Correction Improve Network



Best-fit relation between a site's annual average RH and its annual average RH correction factor.

Memory Issues

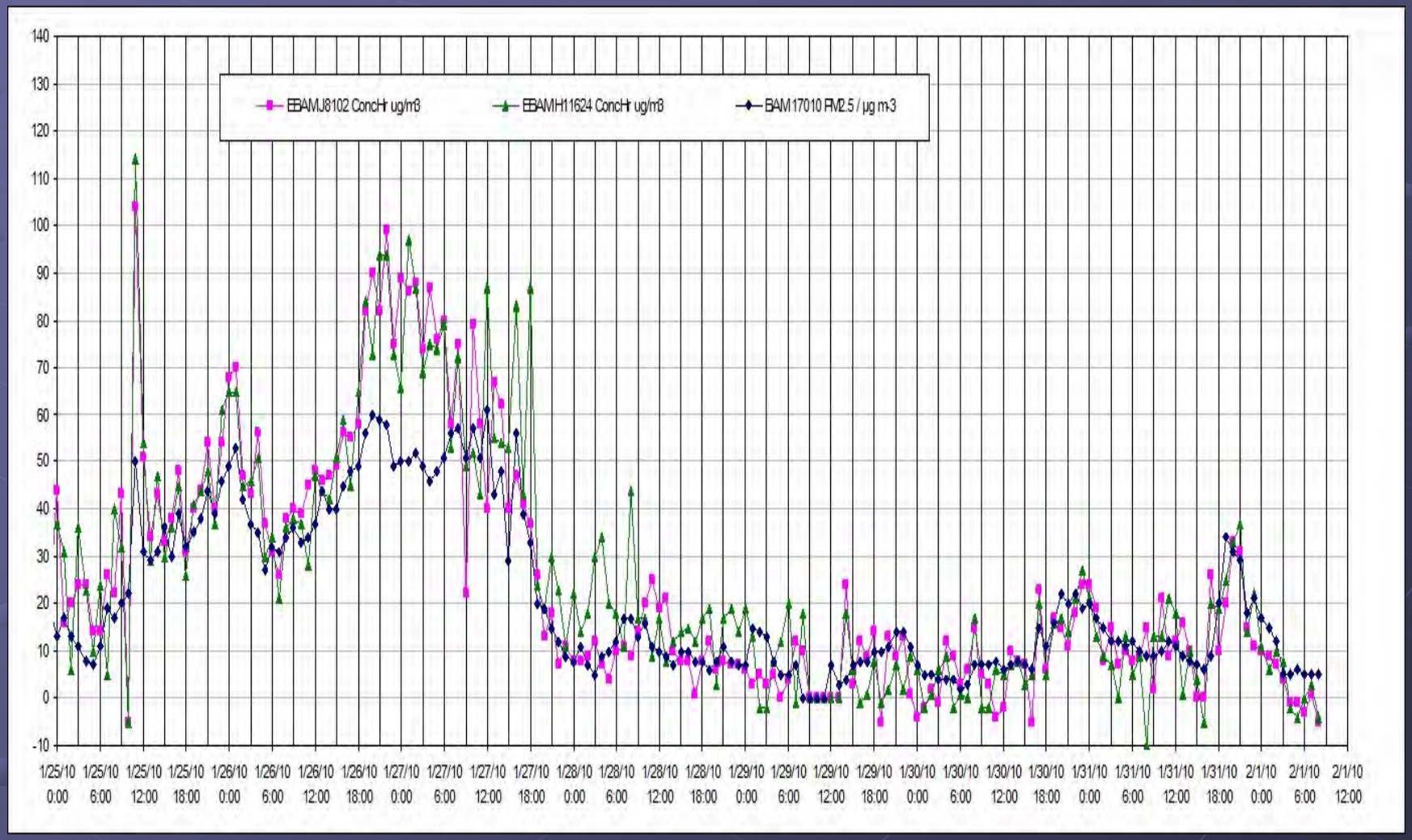
Mass anomalies on filter media is possible due to:

- Change in Humidity
- Change in Temperature

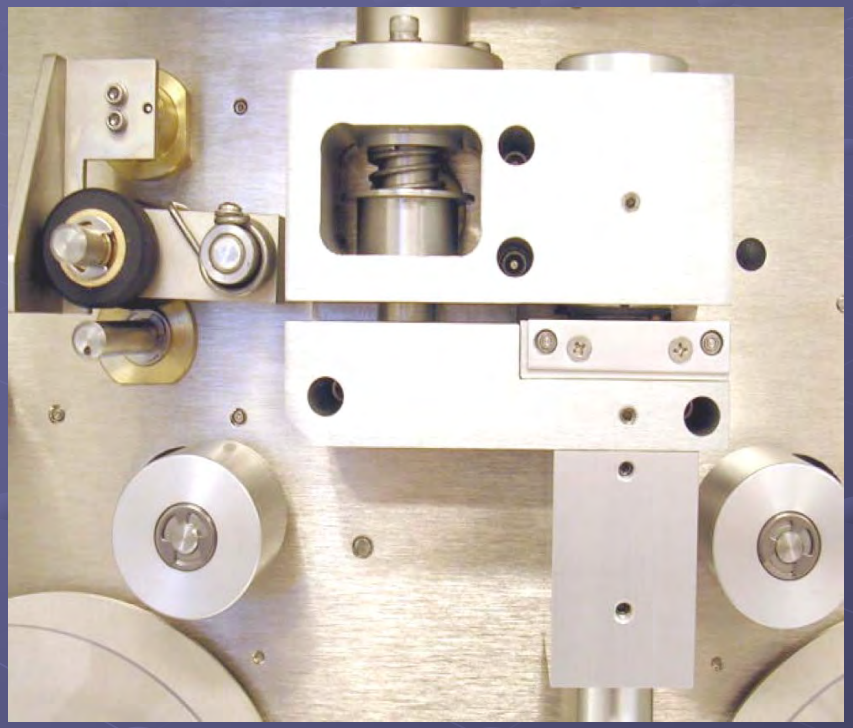
Sampling on the same spot continually multiplies these effects.

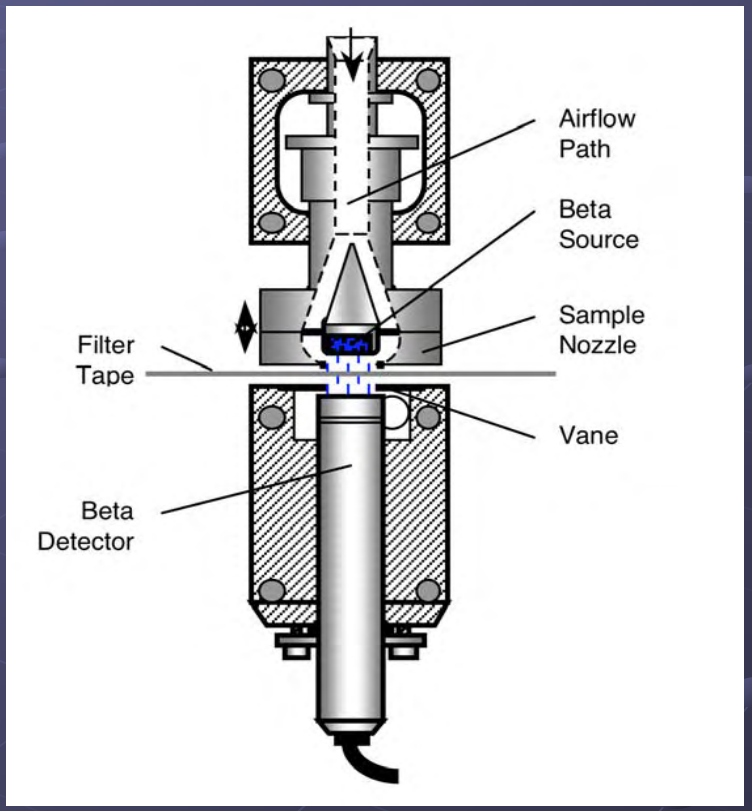
The BAM-1020 reduces the likelihood of these errors by advancing the tape every hour.

Example of Memory & RH Effects



Stepwise vs. Continuous





Conclusion

Gravimetric Samplers

Advantages

- Values are the Reference
- Simple Measurement Technique

Disadvantages

- Expensive Operation
- Laboratory Costs
- No Real Time Concentration

Continuous Monitors

Disadvantages

- Equivalent to FRM?
- More Complex and More Expensive Than Sampling

Advantages

- Results are Readily Available with Good Time Resolution
- Lower Operating Costs