

Why continuous $PM_{2.5}$ FEM_{III} data may not be appropriate for attainment demonstrations

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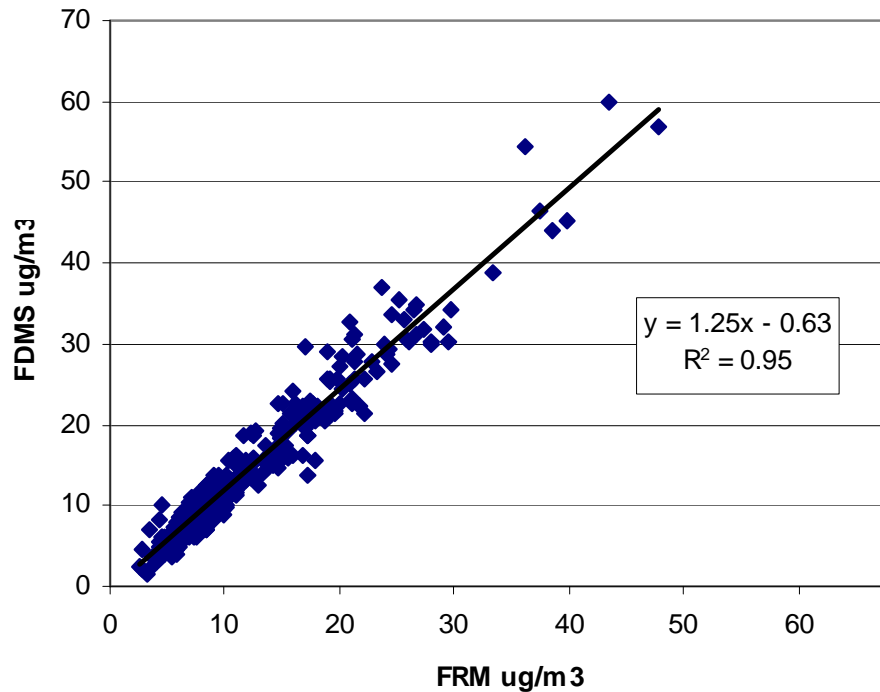
Recent versions of both the MetOne BAM and the FDMS TEOM have been evaluated and compared to a routine daily FRM in New York City.

Both the FDMS and the BAM measure significantly more mass than the FRM. The difference is greater in the summer months.

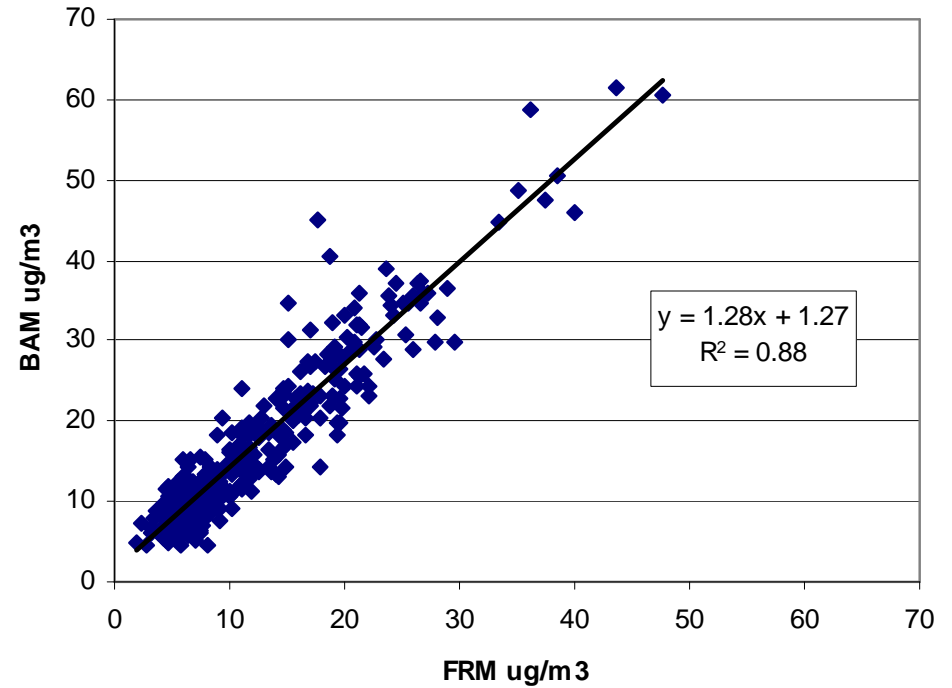
(FDMS TEOM Version B&C)

(BAM with Smart Heater set at 45%)

Queens, NYC Collocated FDMS and FRM
2004 Data (284 Valid Data Pairs)



Queens, NYC Collocated BAM and FRM
2004 Data (321 Valid Data Pairs)



Why doesn't the vendor data match S&L Data?

The candidate FEMs compare more favorably to the FRMs operated by the vendors than to the FRMs operated by the S & L Agencies.

- Primarily because the vendor's triplicate $PM_{2.5}$ FRMs are not operated the way instruments are operated by S&L Agencies.

“there is no requirement that the daily measurements start at any particular time of day, as long as they meet the 22 to 25 hour duration requirement of §53.35”

- The specifications for operating FRMs in the FEM Test Protocols bias the data high when compared to data from FRMs operated in a S&L Agency network.



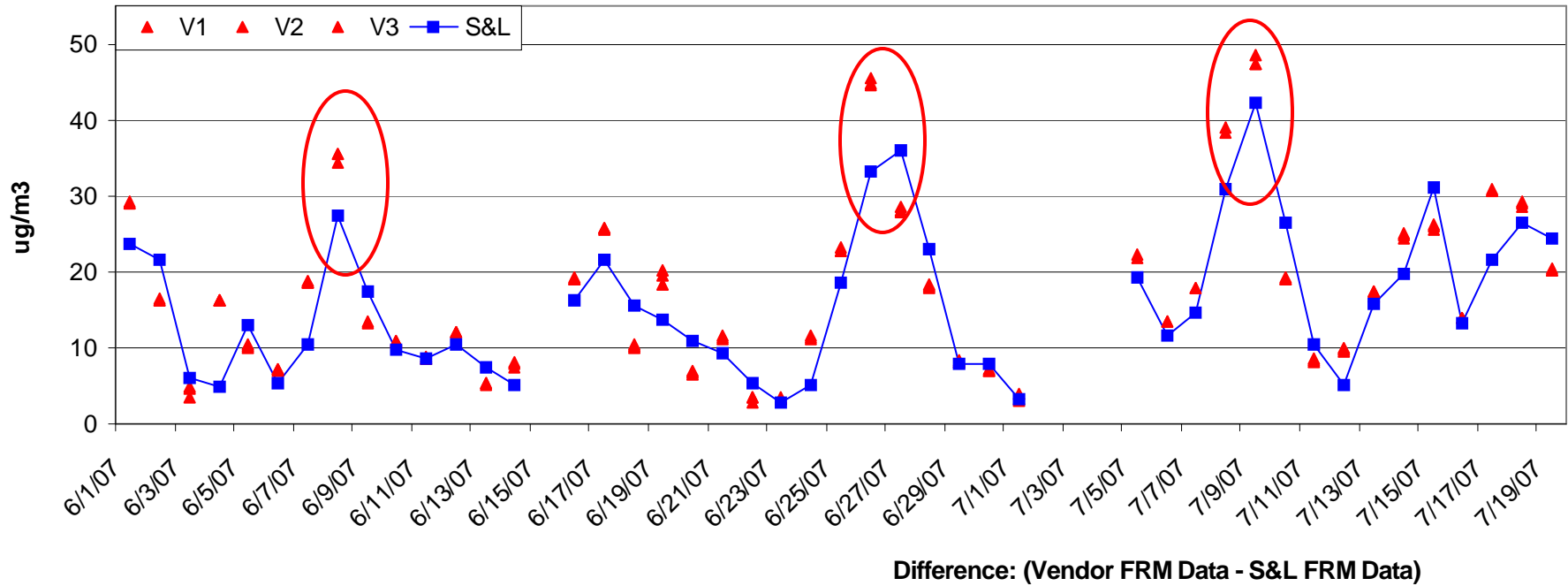
NY Hosted Class III FEM
Equivalency evaluation
for the TEOM 1405 last
summer.

1405 DF TEOM



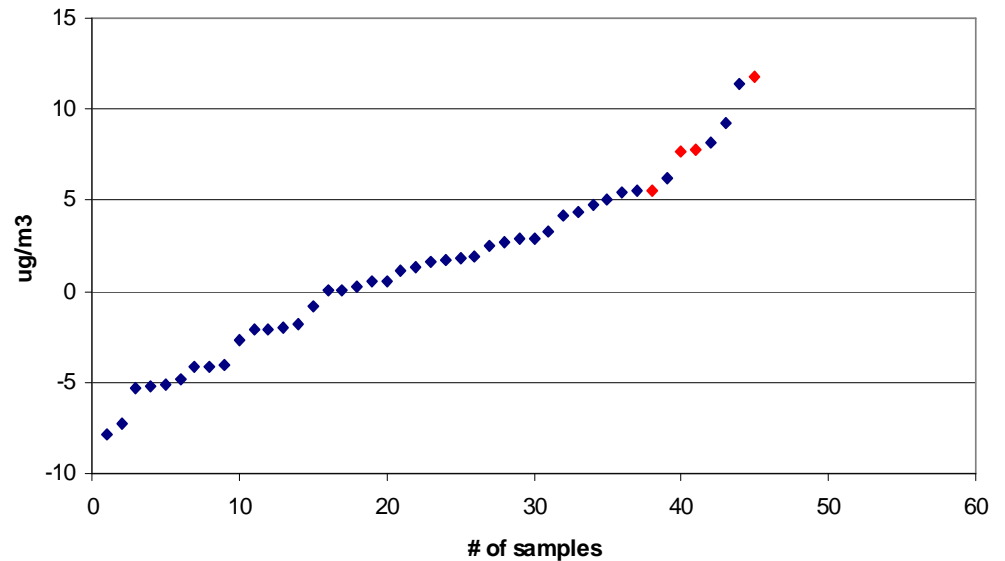


Daily S & L Agency Collection and Daily Triplicate Vendor FRM Data: FEM Test Queens NYC

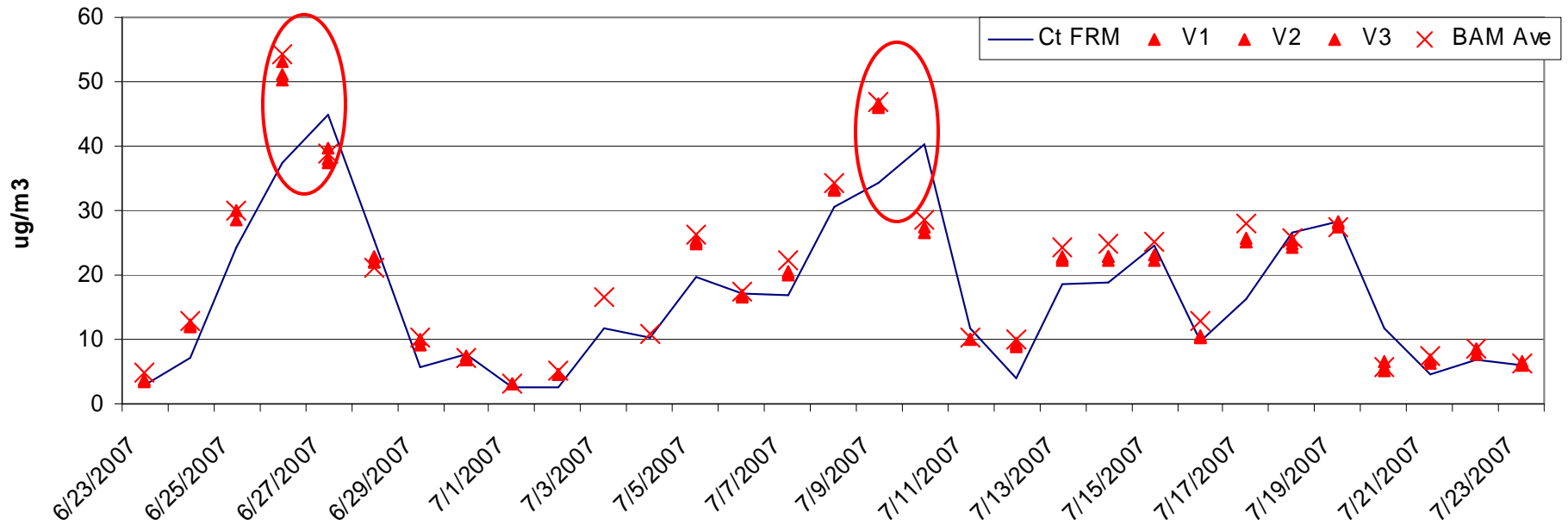


The first thing to notice is that the vendor data is higher than the S&L Agency data on high days. In urban areas, the proportion of volatile mass is often higher on days with high PM_{2.5} concentration.

Vendor: ThermoFisher



Daily S & L Agency and Daily Vendor Triplicate FRM Data: FEM Test NH, CT



In this example, the S & L Agency is different, the vendor is different but the results are the same.

The FEM test protocols produce “FRM” data that is not comparable enough to routine FRM data to provide a basis for determining how a candidate Class III FEM will operate in a real world application.

Vendor: MetOne

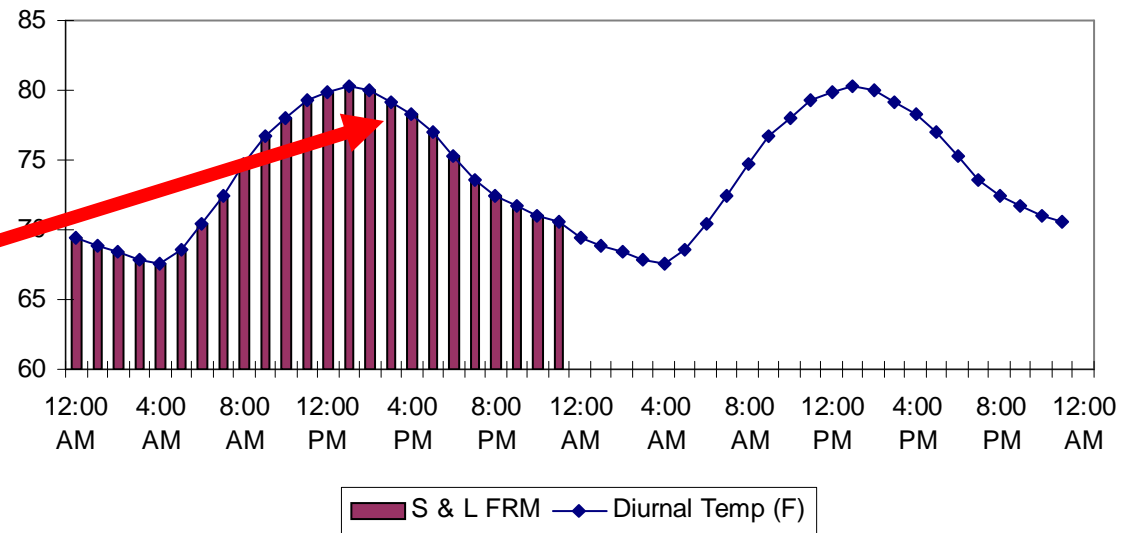


Reason #2:

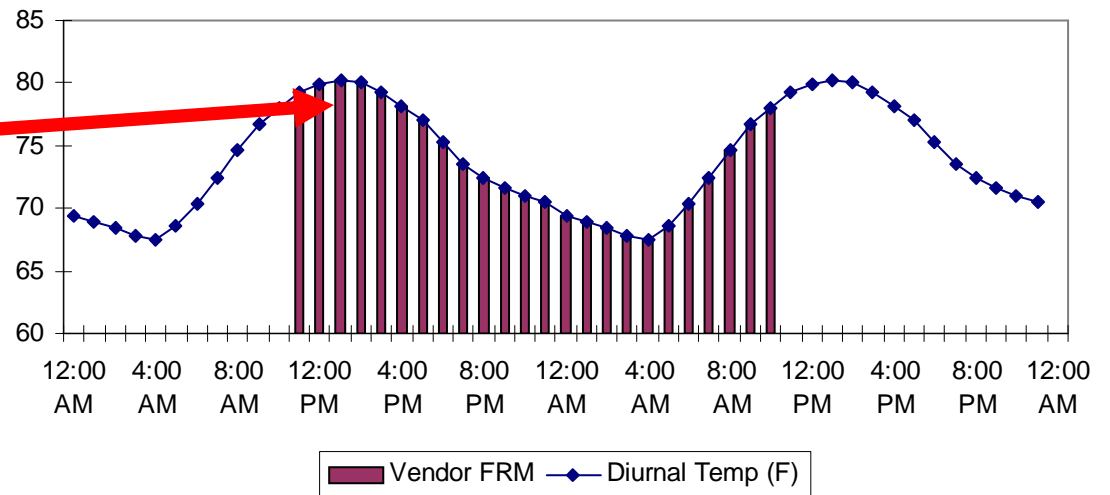
The sample collection interval also effects the FRM's ability to retain volatile mass:

Collecting the sample from midnight to midnight exposes the sample to the highest evaporative losses in the hottest part of the day when the sample is at relatively high loading.

FRM: State & Local Collection Period (Queens NYC)



FRM: Vendor FEM Test Collection Period (Queens NYC)



Collecting the sample from 9:00 to 9:00 or 11:00 to 11:00 am exposes the sample to the highest ambient temperatures before much of the mass has been collected.

(Summer test site actual average diurnal temperatures: Ave 74⁰ F)

What will NY do with Class III FEM Data?

We do not plan to use Method code 88101.

Method code 88500 is more appropriate for these instruments.

Parameter Name	Parameter Code	Purpose	Notes
PM2.5 LOCAL CONDITIONS	88101	Appropriate code for all FRM/FEM/ARMs	Original code for PM2.5 at local conditions
PM2.5 TOTAL ATMOSPHERIC	88500	Valid data from methods measuring total PM2.5 aerosols in the atmosphere, including those that can be volatilized from the FRM	Introduced in 2005
PM2.5 RAW DATA	88501	Valid uncorrected data that does not reasonably match the FRM	Introduced in 2005
ACCEPTABLE PM2.5 AQI & SPECIATION MASS ¹	88502	Valid data that does reasonably match the FRM with or without correction, but not to be used in NAAQS decisions	Introduced in 2006
PM2.5 VOLATILE CHANNEL ¹	88503	Store important related data such as the FDMS reference channel	Introduced in 2006

Figure 1: EPA Technical Note: June 1, 2006

Conclusions

- The Bias is most significant on high concentration days in urban areas in warm months (This is very important for data used for comparisons to the 24-hr std) (Org Carbon & Nitrate)
- The availability of FEMs provides greater flexibility for monitoring Agencies (Can reduce filter based network)
- There is value in producing more accurate, hourly $PM_{2.5}$ data (Health Research, Atmospheric Science Studies)
- The current FEM tests should not be viewed as predictors of results in S&L Agency networks
- NAAQS comparison issues should be discussed with the Regional EPA office before the decision is made to operate and where to operate a Class III FEM



How do we resolve this situation?

MetOne BAMs and FDMS TEOMs work as designed and provide data that includes a higher proportion of the volatile mass

It's the FRM that is flawed. The "Gold Standard" is tarnished and in need of an overhaul. This is not new information.

The FRM design should include a chiller to keep the filters cold and a drier to prevent condensation at the end of the sample period.

This design change should be implemented in time for the next review of the PM_{2.5} NAAQS (2010)

The result will be a PM_{2.5} dataset that is more consistent and responsive to the needs of health researchers.
(After all we should try to measure what we are breathing)

