PM-2.5 FEM Performance in NYC

MetOne BAM 1020, Thermo 5014 BAM, TEOM FDMS Ver C, TEOM 1405DF

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NESCAUM MAC Meeting
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NYS Department of Environmental Conservation

FEM Shootout – Installed Dec-Jan 2010

8500 VerC 1405 DF BAM 1020 1405i (No Neph)

FEM Shootout

- The comparison continued through August 2010
- The site also has a daily PM-2.5 and PM-10 FRM

FEM Shootout: Inlets

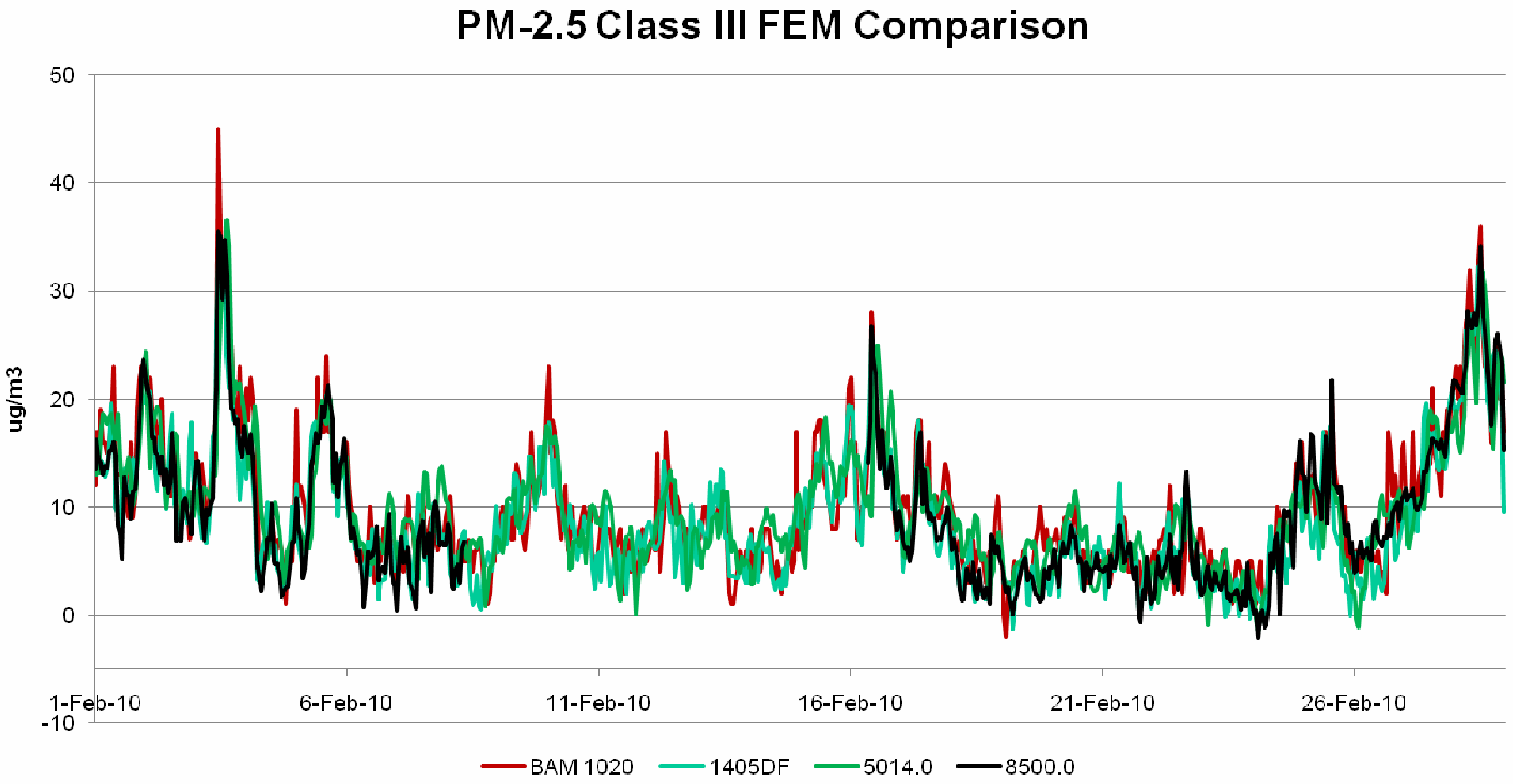
5014i BAM 1020 1405 DF 8500 VerC

FEM Shootout: BAM Zero Test

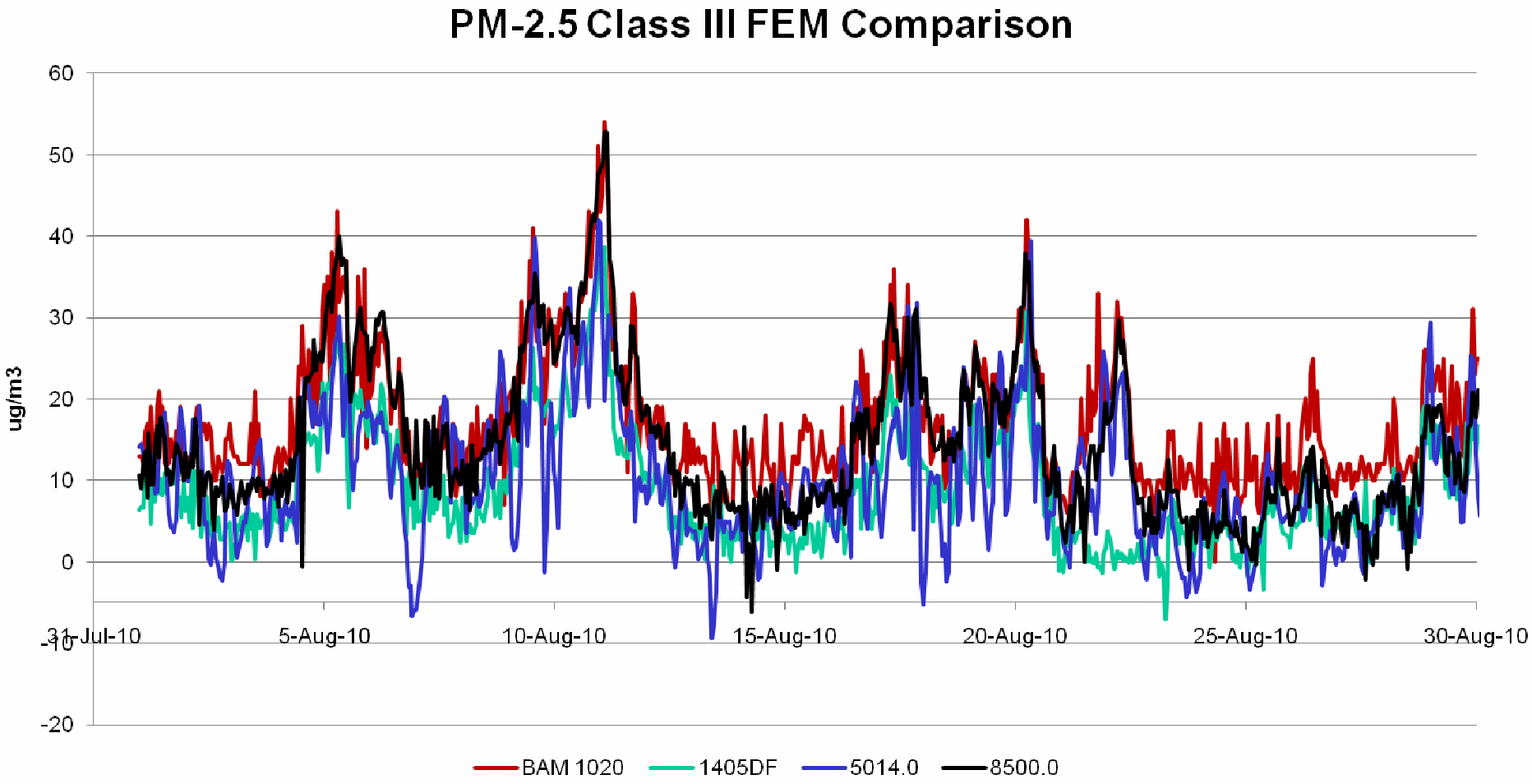
- BAM 1020 arrived with Background Coef. -5.4 ug/m3
- BAM Zeroed on-site new Background Cf -3.1 ug/m3
- BAM Zero check 2 Months later without reset to zero. 1.9 ug/m3

- BAM Zeroes may be related to background radiation at site (Radon), instrument conditions, seasonal affects: temperature and humidity.

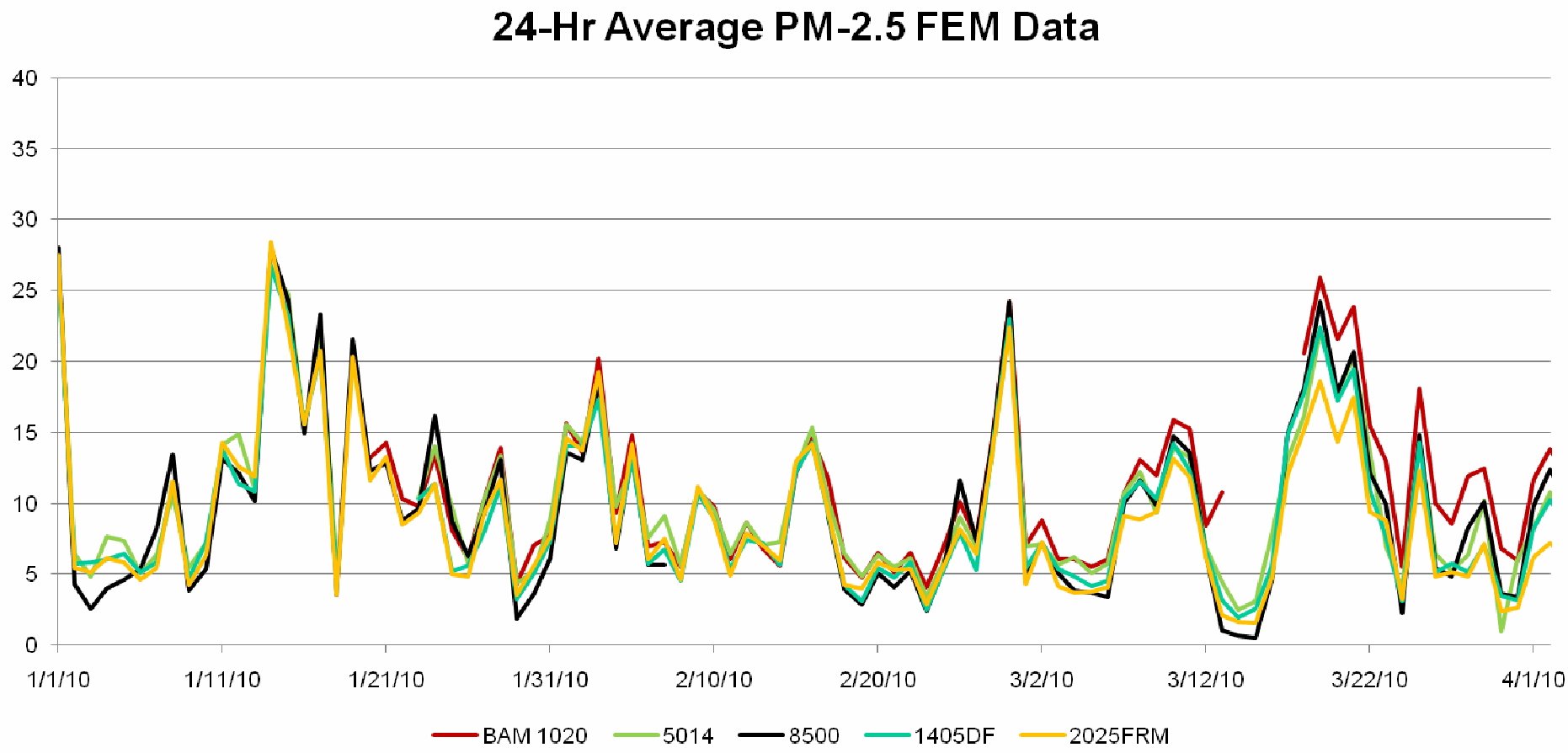
February: FEMs Hr-Average Time Series



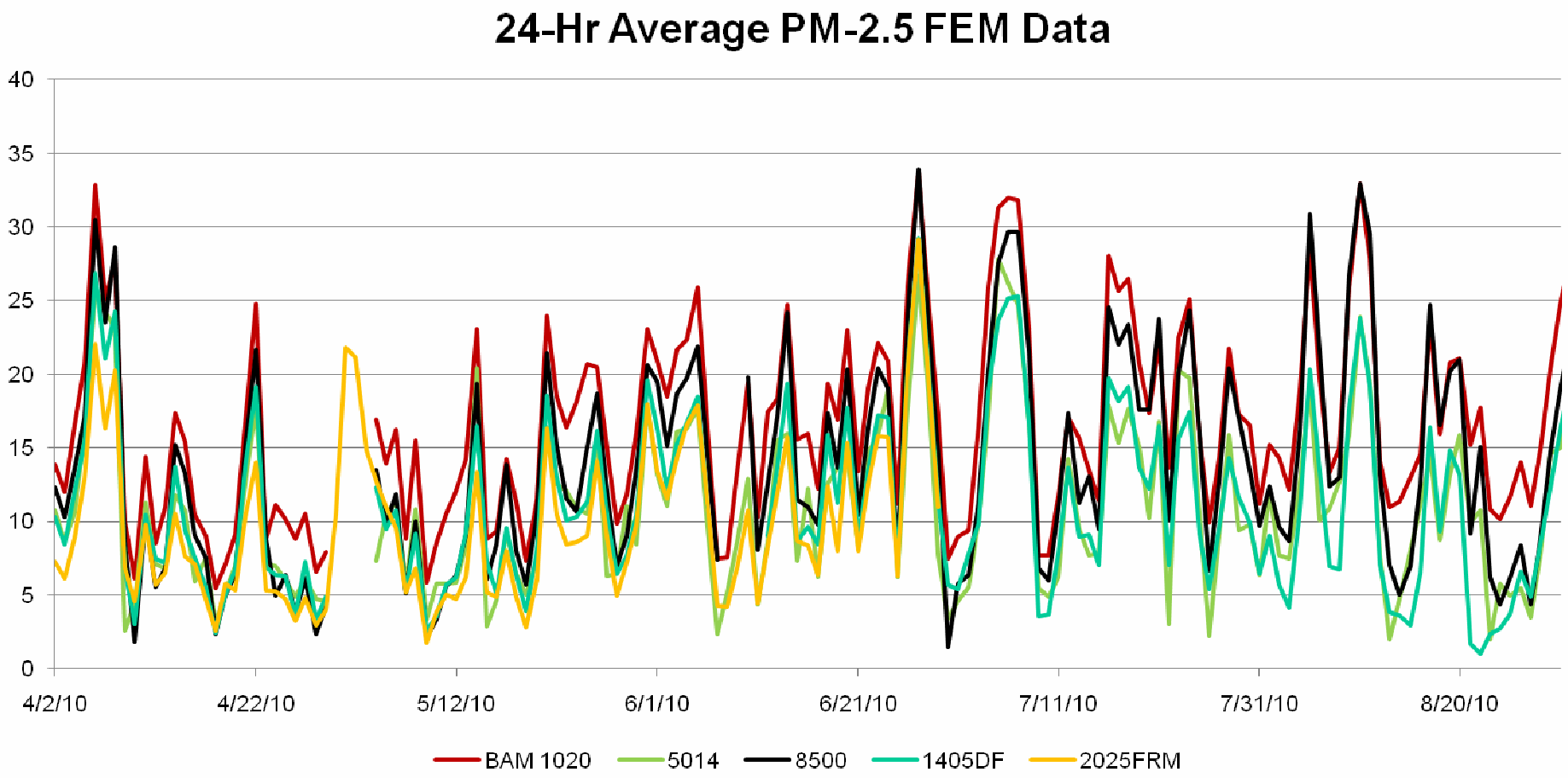
August: FEMs Hr-Average Time Series



Queens, NY FEMs and FRM Time Series

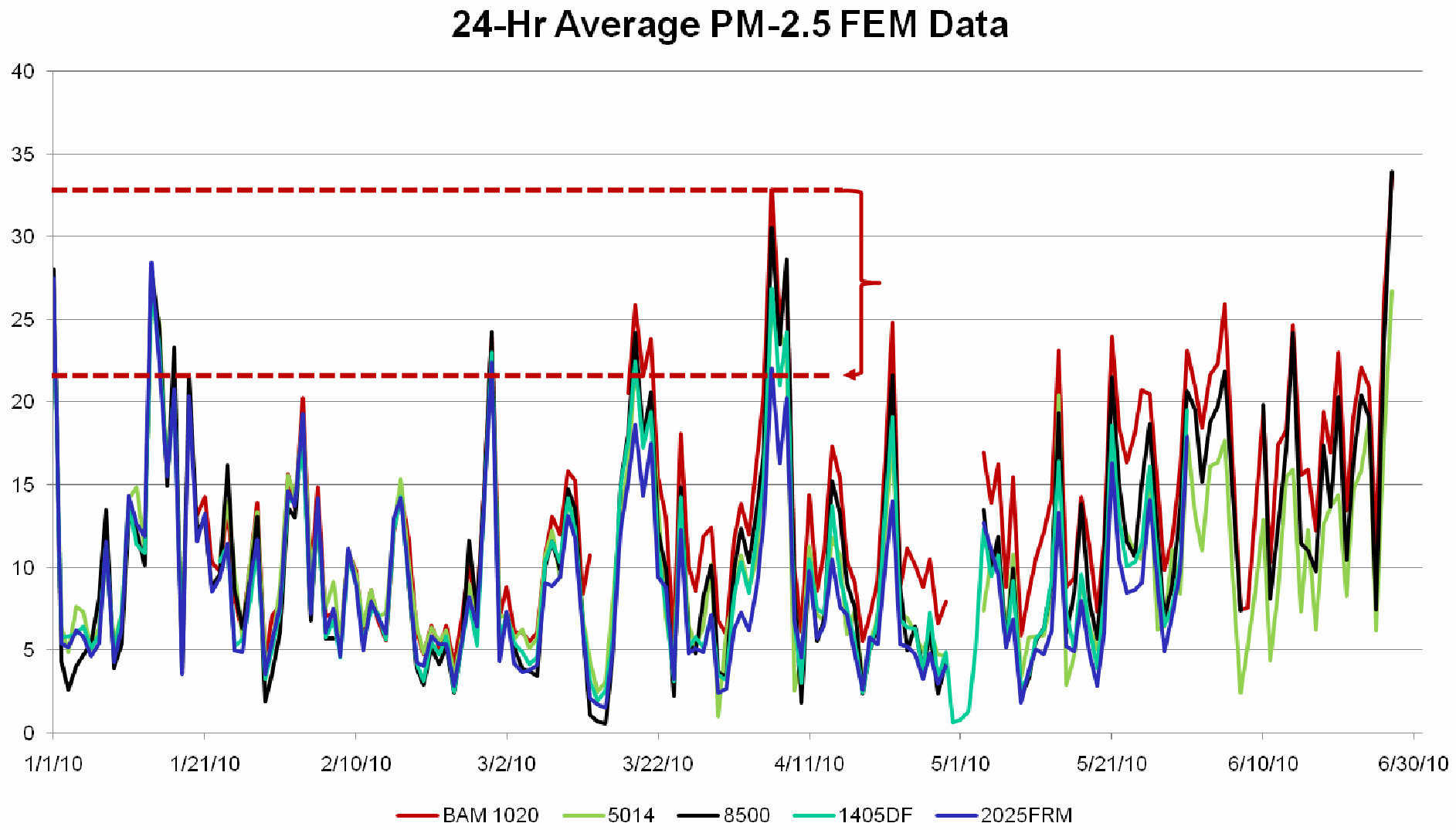


Queens, NY FEMs and FRM Time Series



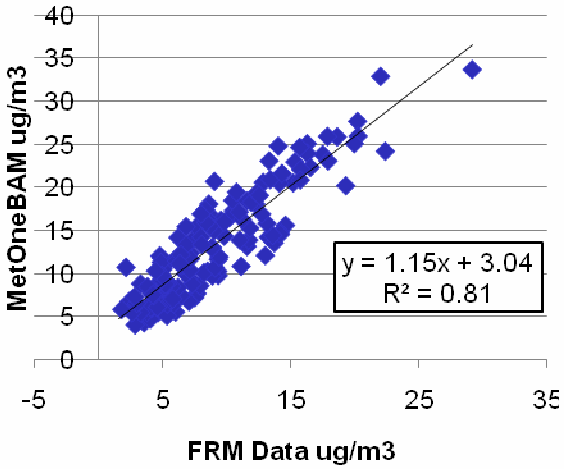
3rd Qtr FRM Data not yet available

Is 10 ug/m3 too much of a Difference in comparison to the Daily NAAQS?

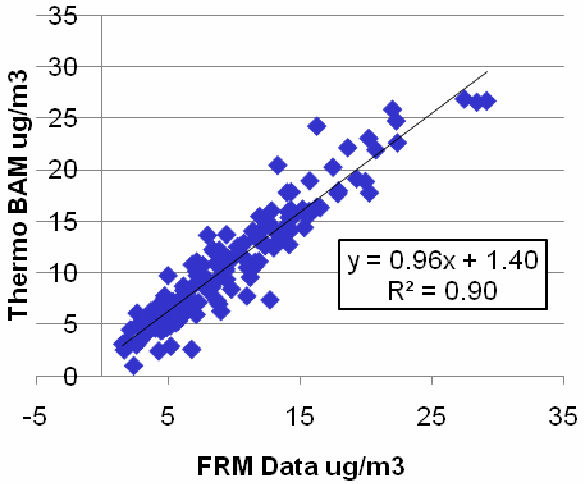


FEMs vs the FRM: January through June

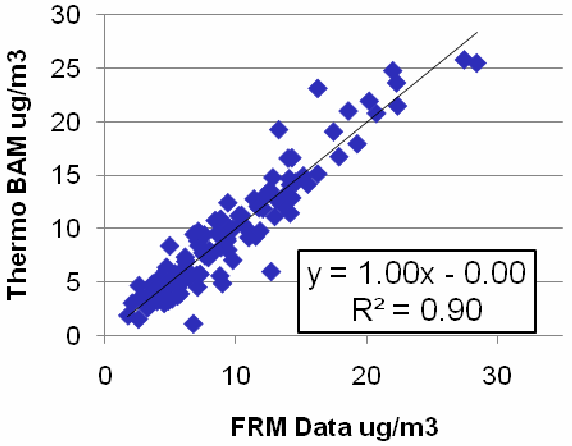
MetOne BAM vs FRM



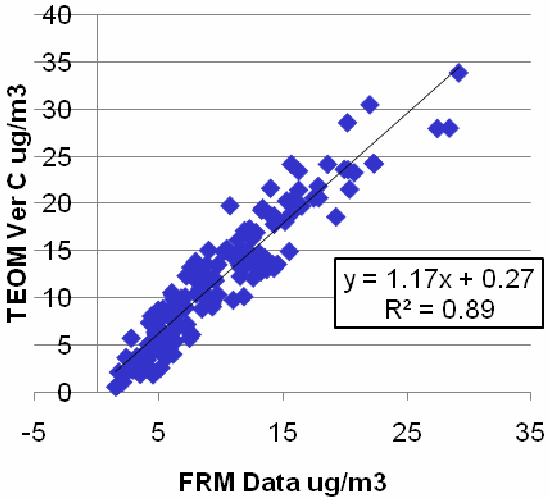
Thermo BAM vs FRM



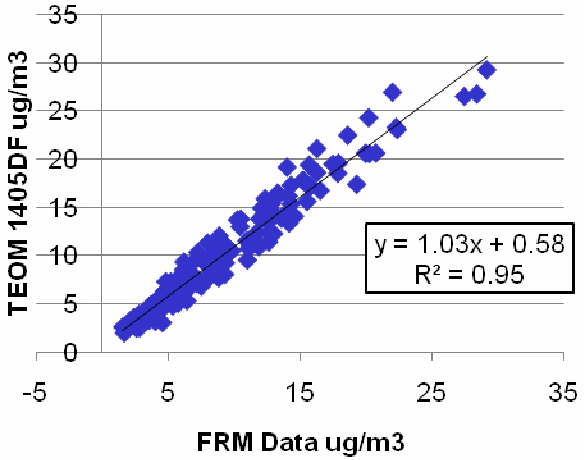
Thermo FEM BAM vs FRM through May



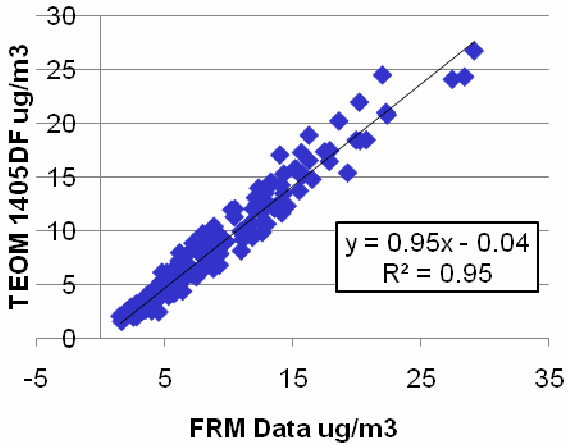
TEOM Ver C vs FRM



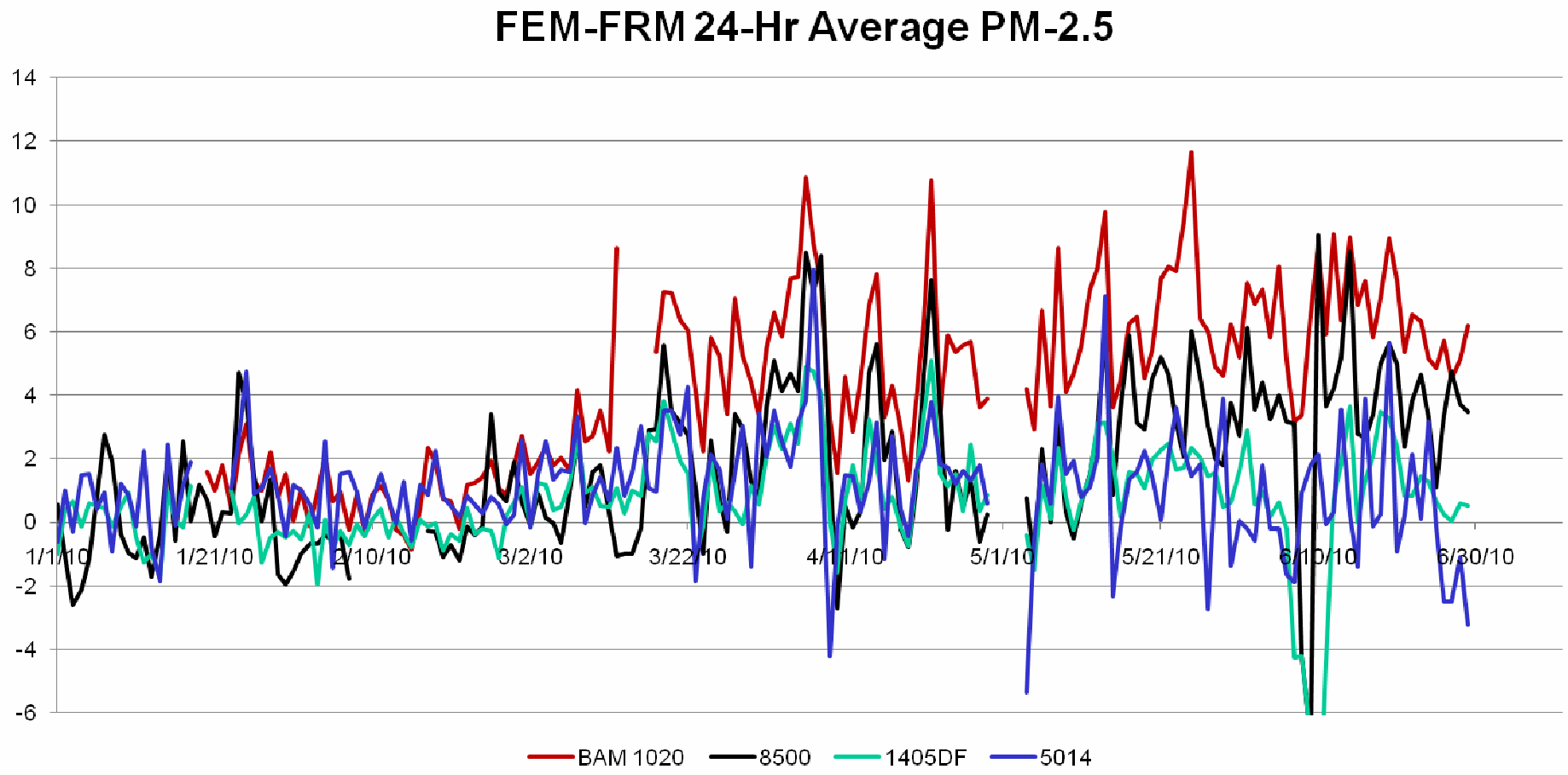
TEOM 1405DF vs FRM



TEOM FEM 1405DF vs FRM



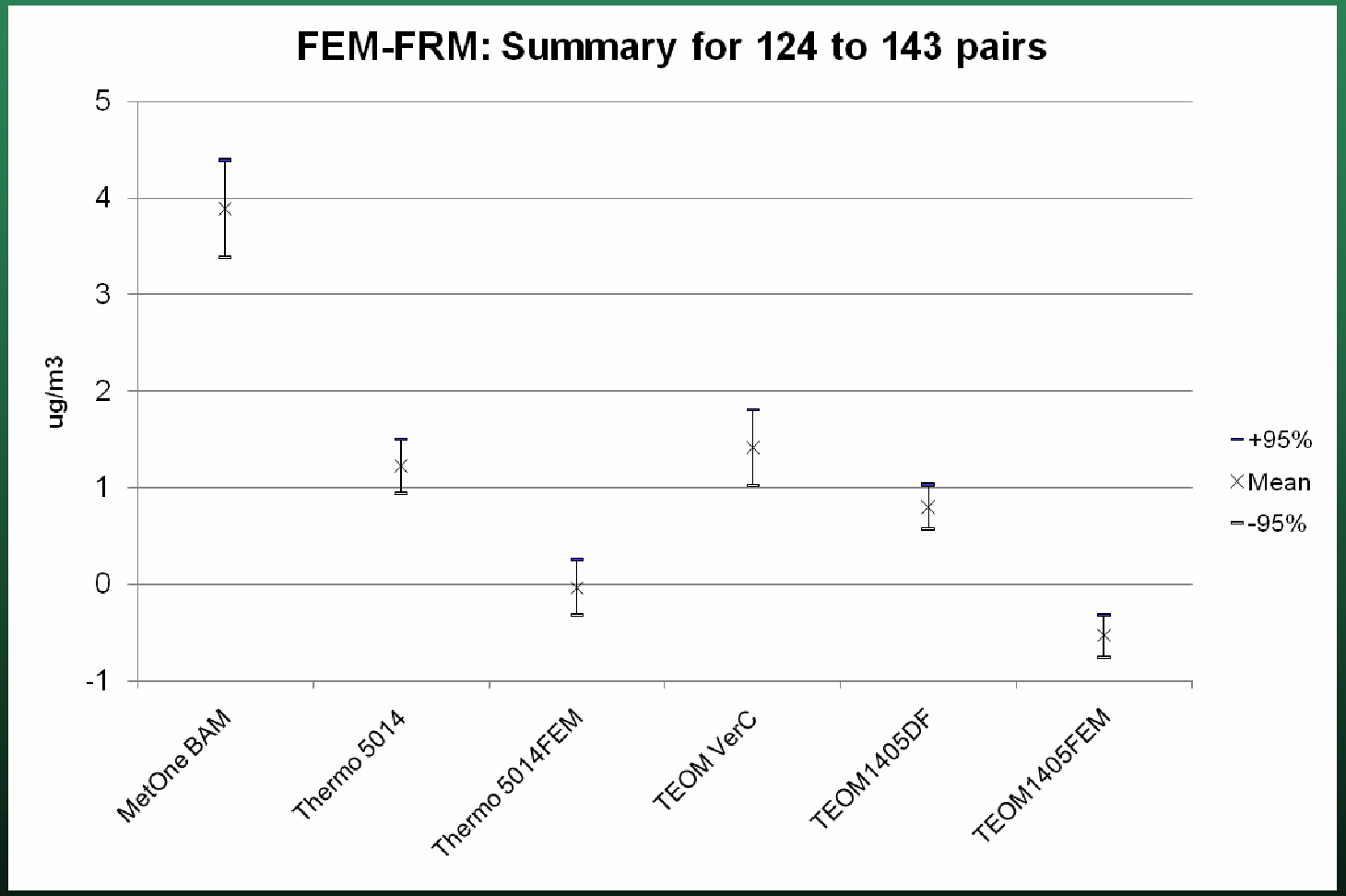
Is the Bias Seasonal?
All of the FEMs are higher as it gets warmer



Data Assessment Techniques

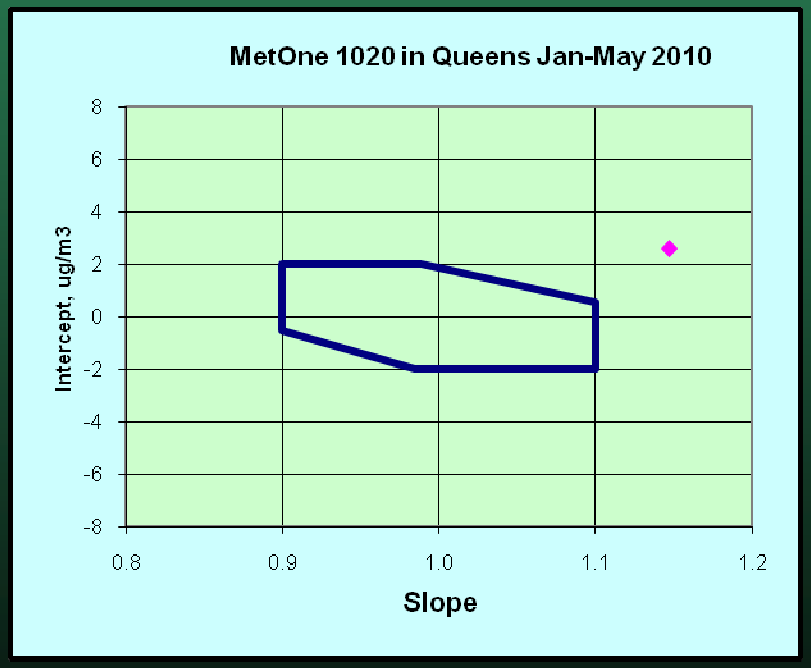
- Initial Evaluation of FEM in S&L Network
  FEM Test Statistics from CFR:
  Correlation ≥ 0.95 and slope and intercept within irregular parallelogram
- Evaluation as Component of Network Data Quality Objectives:
  Bias ± 10% and CV ± 10%
- Comparison on individual episode days

FEM Comparison to FRM: The Difference (FEM-FRM) should have 0.0 within Confidence Interval



FEM Test Results for MetOne BAM

Regression statistics		Slope[1]	Intercept[2]	Correlation (r)
Statistics for this test site:		1.147	2.598	0.87164
Limits for	Upper:	1.100	-0.092	
PM2.5 Class III	Lower:	0.900	-2.000	0.95000
Test Results (Pass/Fail):		FAIL	FAIL	FAIL



The data will be invalidated if it is found that the instrument needs to be repaired

116 Valid Pairs

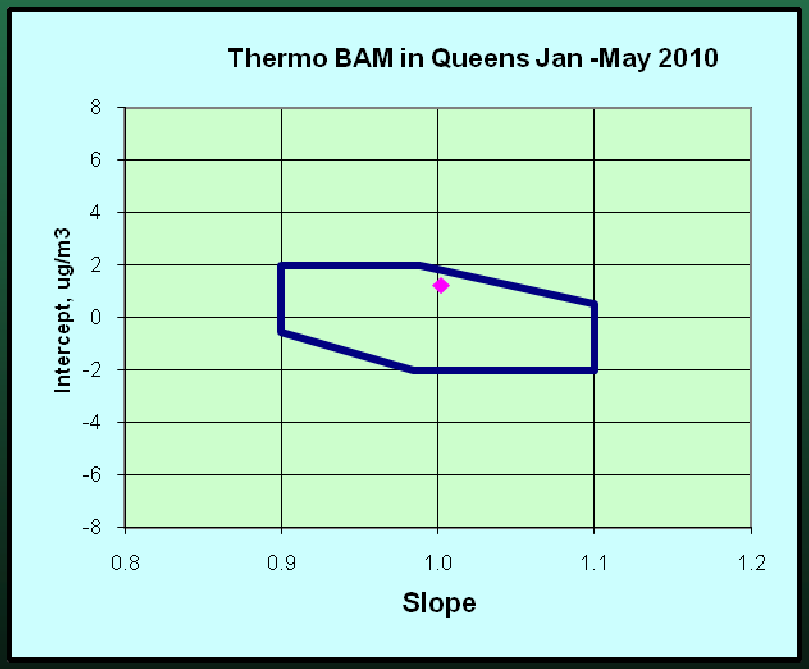
D(%) = 18.53
(16.21-20.85)

CV(%) = 20.97

D & CV ≠ meet DQOs

FEM Test Results for Thermo 5014 BAM Mass Concentration Channel

Regression statistics		Slope[1]	Intercept[2]	Correlation (r)
Statistics for this test site:		1.002	1.234	0.94951
Limits for	Upper:	1.100	1.825	
PM2.5 Class III	Lower:	0.900	-2.000	0.95000
Test Results (Pass/Fail):		PASS	PASS	FAIL



133 Valid Pairs

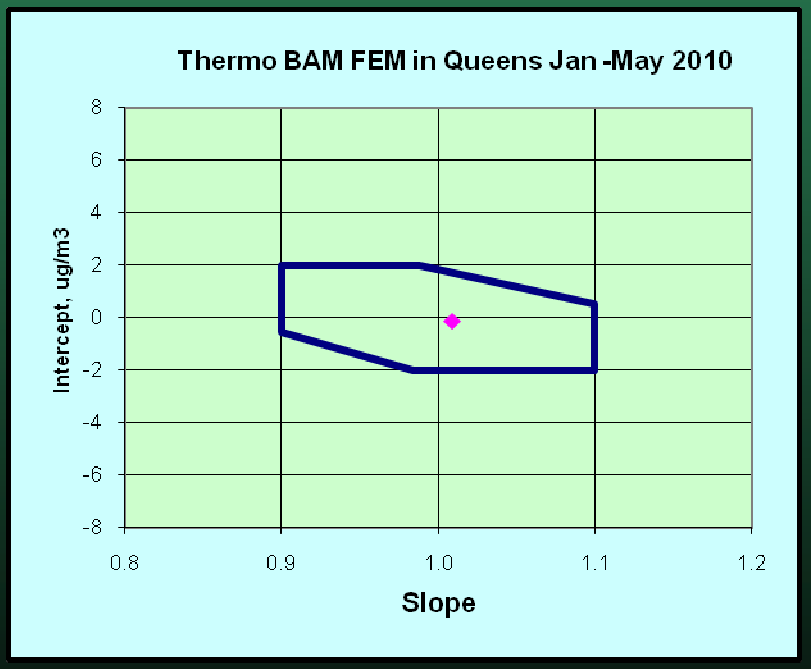
Bias:D(%) = 9.99
(8.15 to 11.82)

CV(%) = 18.31

CV ≠ meet DQO

FEM Test Results for Thermo 5014 BAM with FEM Algorithm

Regression statistics		Slope[1]	Intercept[2]	Correlation (r)
Statistics for this test site:		1.009	-0.135	0.94894
Limits for	Upper:	1.100	1.734	
PM2.5 Class III	Lower:	0.900	-2.000	0.95000
Test Results (Pass/Fail):		PASS	PASS	FAIL



133 Valid Pairs

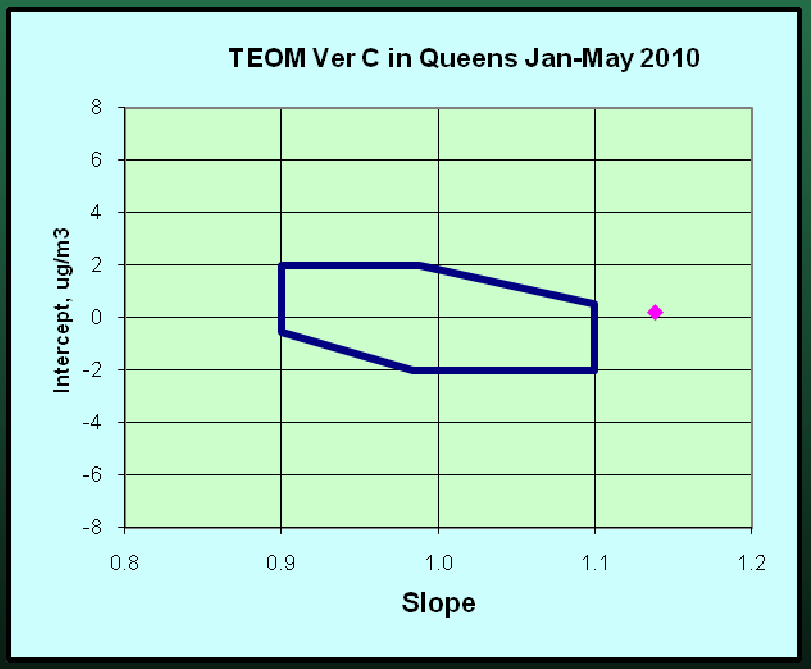
Bias:D(%) = -9.13
(-7.61 to -10.66)

CV(%) = 26.59

CV ≠ meet DQO

FEM Test Results for TEOM Ver C Mass Concentration Channel

Regression statistics		Slope[1]	Intercept[2]	Correlation (r)
Statistics for this test site:		1.138	0.213	0.93469
Limits for	Upper:	1.100	0.023	
PM2.5 Class III	Lower:	0.900	-2.000	0.95000
Test Results (Pass/Fail):		FAIL	FAIL	FAIL



128 Valid Pairs

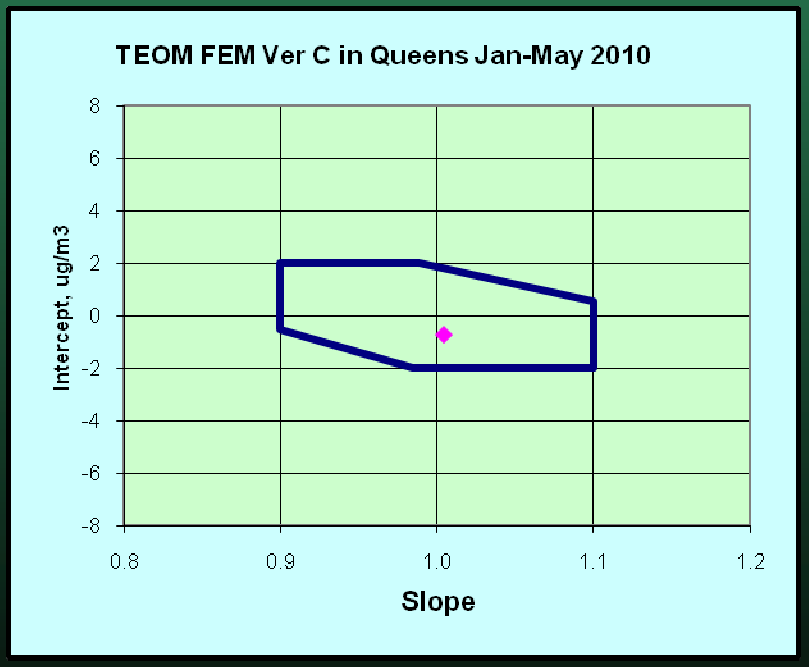
Bias D(%) = -6.88
(-10.44 to -3.33)

CV(%) = 22.43

CV ≠ meet DQOs

FEM Test Results for TEOM Ver C
FEM Algorithm Channel

Regression statistics		Slope[1]	Intercept[2]	Correlation (r)
Statistics for this test site:		1.005	-0.719	0.93699
Limits for	Upper:	1.100	1.790	
PM2.5 Class III	Lower:	0.900	-2.000	0.95000
Test Results (Pass/Fail):		PASS	PASS	FAIL



128 Valid Pairs

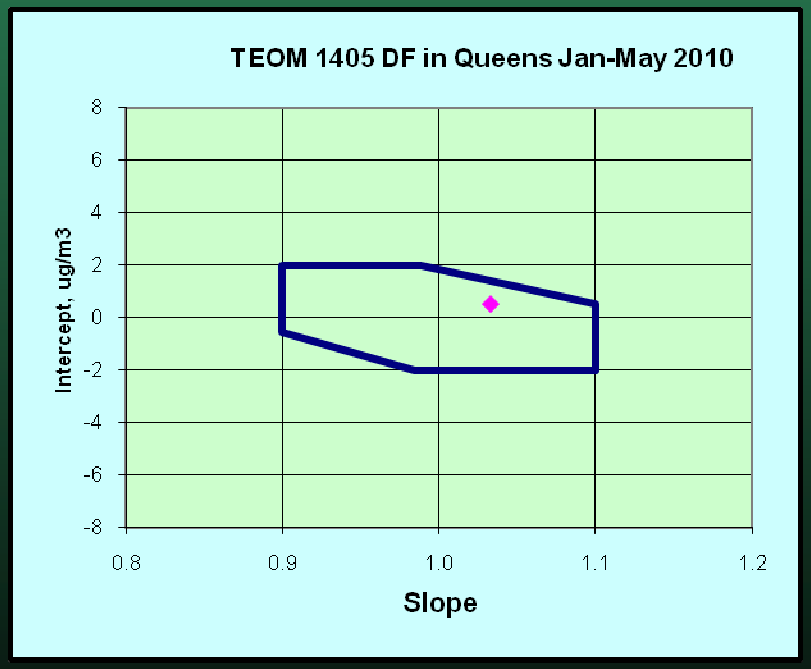
Bias D(%) = -29.44
(-32.46 to -26.43)

CV(%) = 25.32

D&CV ≠ meet DQOs

FEM Test Results for TEOM 1405DF Mass Concentration Channel

Regression statistics		Slope[1]	Intercept[2]	Correlation (r)
Statistics for this test site:		1.033	0.508	0.96712
Limits for	Upper:	1.100	1.416	
PM2.5 Class III	Lower:	0.900	-2.000	0.95000
Test Results (Pass/Fail):		PASS	PASS	PASS



133 Valid Pairs

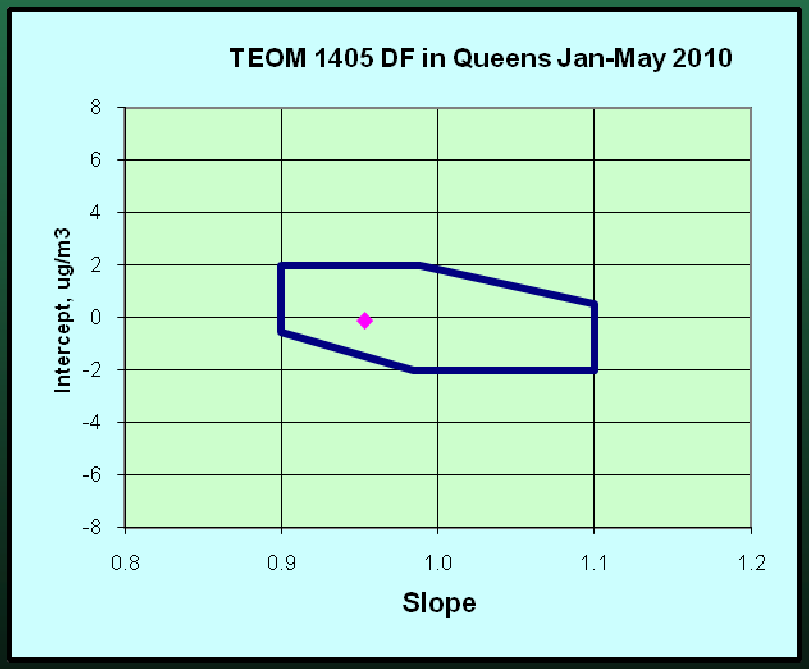
Bias D(%) = 3.47
(2.26 – 4.68)

CV(%) = 11.07

DQOs: Almost

FEM Test Results for TEOM 1405DF with FEM Algorithm

Regression statistics		Slope[1]	Intercept[2]	Correlation (r)
Statistics for this test site:		0.953	-0.125	0.96755
Limits for	Upper:	1.100	2.000	
PM2.5 Class III	Lower:	0.900	-1.462	0.95000
Test Results (Pass/Fail):		PASS	PASS	PASS



133 Valid Pairs

Bias: D(%) = -12.8
(-12.03 to -13.61)

CV(%) = 11.7

DQOs: Almost Met

Conclusions

- The designation of FEMs that do not perform adequately have put State and Local Monitoring Agencies in a very difficult position.

  - Agencies can switch to FEMs to reduce labor costs and risk non-attainment

  - Agencies can retain costly daily FRMs in order to avoid unnecessary nonattainment and maintain economic viability

Resolution

- The “Science Oriented” EPA Administration should review the PM-2.5 FRM and revise it to include more of the volatile components of PM.
- This will permit the FEMs to more easily emulate and eventually replace the filter based PM-2.5 FRM.
- This can easily be done by changing the FRM filter environmental conditions at the conclusion of the sampling period.