



PM_{2.5} Monitoring and Reporting in Ontario

October 20th, 2011

Environmental Monitoring and Reporting Branch

Outline

Background:

- History of PM Monitoring in Ontario
- Ontario's Real-time PM_{2.5} Network

Next step:

- Federal Equivalency Method (FEM), Class III for Real-time PM_{2.5} Monitoring

History of PM Monitoring

1969 – NAPS program is established – measures TSP ($<100\mu\text{m}$) using hi-vol (filter-based) sampler.

1970- Coefficient of Haze (COH) used for real-time PM monitoring ($3.5\text{-}4.5\ \mu\text{m}$)

- COH analyzer was removed from the MOE network in 2004.

24-Hour Dichotomous $\text{PM}_{10}/\text{PM}_{2.5}$ sampling introduced in 1982.

1990 – R&P Tapered Element Oscillating Microbalance (TEOM[®]) continuous monitor receives Class III Federal Equivalency Monitor (FEM) designation for PM_{10} NAAQS reporting.

Ontario deploys 5 R&P TEOM[®] continuous monitors in 1995 and reports on the measurements of $\text{PM}_{2.5}$ in the Air Quality in Ontario -1996 Report

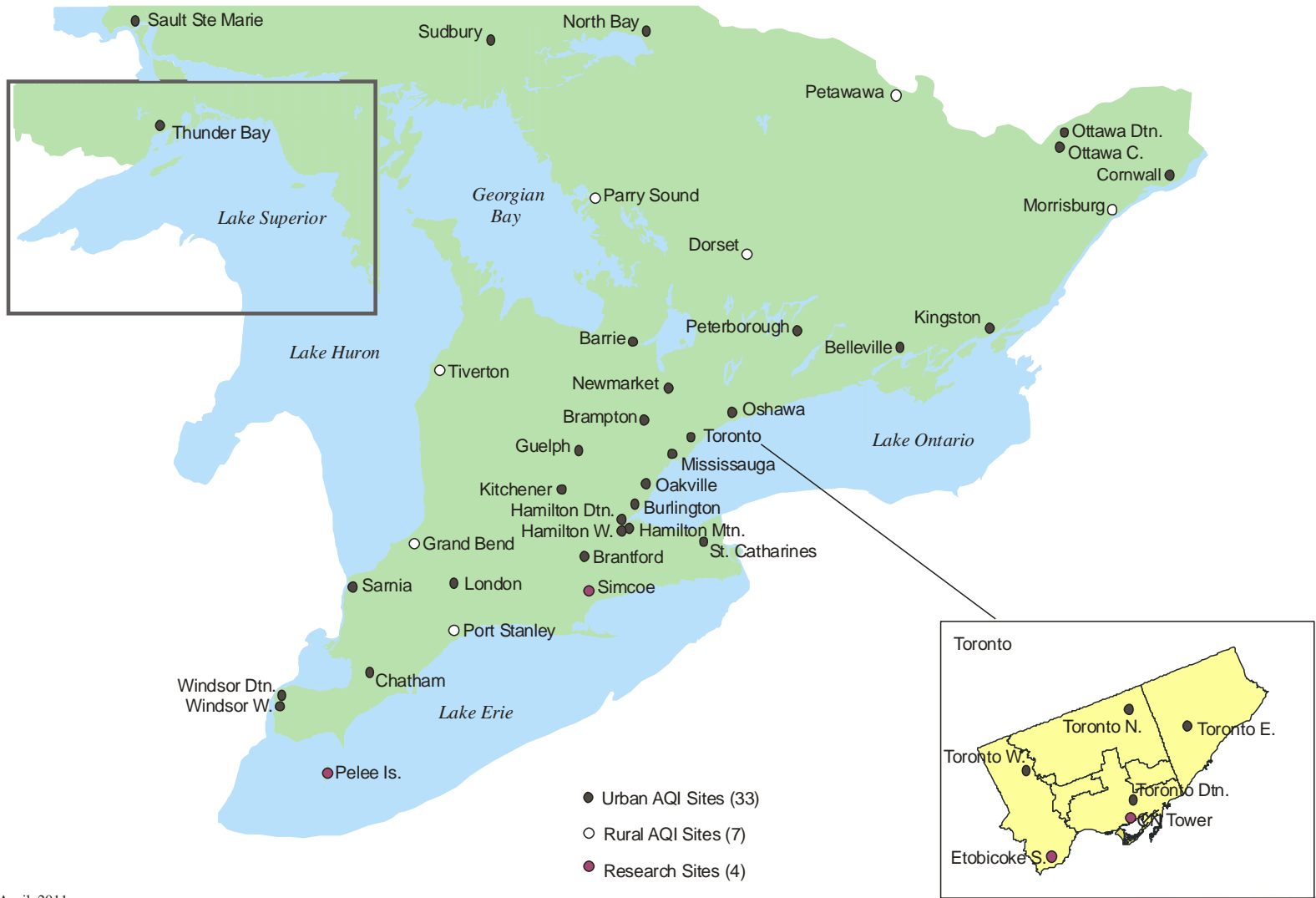
History of PM Monitoring – from 2000

- 2002 – First PM_{2.5} Continuous Monitoring Workshop held – agree to remove TEOM “offset”, add sample driers and lower operating temperature to 30°C.
- 2003 – Ontario includes PM_{2.5} in the AQI Program
- 2008 – NAPS Managers agree that U.S. FEM Class III designation meets Canadian performance criteria for CWS reporting.
- 2009 – Four monitors (Thermo 1400ab/FDMS, 1405F, 5014i, SHARP5030) receives PM_{2.5} FEM designation.
- 2010 - Ontario deploys SHARP 5030, SHARP5030i, BAM 1020 and GRIMM 180 monitors for field evaluation.

Ontario's Real-time PM_{2.5} Monitoring Network

Air Quality Index & Research Monitoring Sites in Ontario

(2011)



*Reflective April, 2011

How well does TEOM perform in Ontario? FRM versus TEOM-SES (2006-2008) for Ontario

Determine the variability of warm and cold season measurements for TEOM-SES when compared to FRM.

Develop a potential cold weather data transformation for TEOM-SES values specific for MOE reporting applications (i.e. CWS).

PM_{2.5} Measurement Comparison for FRM vs TEOM-SES (2006-2008)

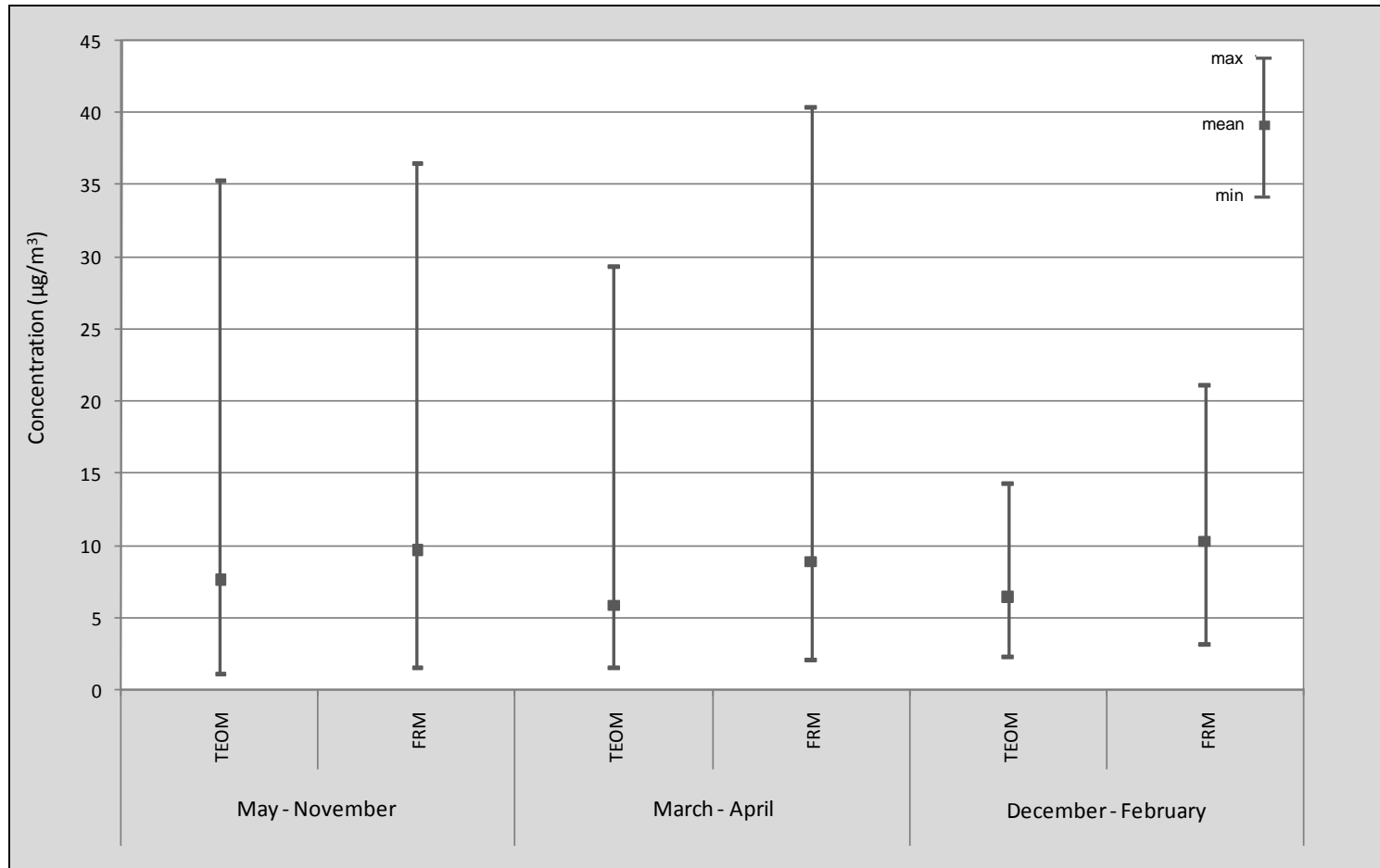
FRM Network (7 stations)

PM _{2.5} Measurement Method	Regression (Time Base: 2006-2008)	R ²	n
TEOM-SES (Warm Season, May-Nov)	$0.9928 * TEOM - 0.145$	0.9051	831
TEOM-SES (Cold Season, Dec-Feb)	$1.5534 * TEOM + 0.5974$	0.8142	392
TEOM-SES (Transition Months, Mar-Apr)	$1.3347 * TEOM + 0.3602$	0.9043	221

Hamilton Downtown (29000)

PM _{2.5} Measurement Method	Regression (Time Base: 2006-2008)	R ²	n
TEOM-SES (Warm Season, May-Nov)	$0.9404 * TEOM + 1.516$	0.9298	73
TEOM-SES (Cold Season, Dec-Feb)	$1.5313 * TEOM + 0.5974$	0.9275	31
TEOM-SES (Transition Months, Mar-Apr)	$1.2179 * TEOM + 0.3602$	0.8792	20

Comparison of Seasonal Summary Statistics for TEOM and FRM at Hamilton Downtown (2006-2008)



Analysis of the CWS PM Reporting for 2006-2008 Impact on CWS Metric when transformations* applied

Station		2006	2007	2008	CWS
Oakville	TEOM	23.6	27.5	20.8	24
	Modified	26	27.5	23.4	26
Burlington	TEOM	25.0	27.5	22.8	25
	Modified	25.9	27.5	23.5	26
Hamilton	TEOM	28.3	31.1	26.6	29
	Modified	28.3	31.1	29.5	30
Oshawa	TEOM	24.3	29.1	20.8	25
	Modified	24.3	29.1	22.0	25

*Transformation rules, as calculated from the Hamilton Downtown Station data:

- No correction applied for the period of May to November
- 1.2 times correction applied for the period of March to April
- 1.5 times correction applied for the period of December to February

Next Step

Current PM_{2.5} Policy Initiatives

New Canadian Ambient Air Quality Standard (CAAQS) for 24-hour and annual PM_{2.5}

- Ontario is participating in a process to develop an Air Quality Management System (AQMS) for the country
 - Key components of the AQMS include: CAAQS for PM_{2.5} and ozone for 2015 and 2020, Base-Level Industrial Emission Requirements, and Air Zone Management and Airshed Coordination
- Proposed CAAQS expected by year end 2011
- 24-hour PM_{2.5} CAAQS expected to be more stringent than the existing Canada-wide Standard of 30 mg/m³
- First national annual PM_{2.5} standard in Canada

FEM Monitoring

- To determine achievement of the PM_{2.5} CAAQS, it is recommended that jurisdictions strive to deploy FEM instruments or its equivalent by 2013
- This recommendation aligns with the direction of the NAPS monitoring agencies that all new purchases of continuous PM_{2.5} monitors for the NAPS network should be restricted to those that receive EPA Class III FEM designation or equivalent

PM_{2.5} Review

- In January 2010, the ministry received an "Application to Require a New Air Pollution Act or Regulation" under section 61 of the Environmental Bill of Rights (EBR), requesting a review for a new Act or regulation that addresses PM_{2.5}, including direct emissions of PM_{2.5}
- In November 2010, the ministry responded to the applicant indicating that the ministry would undertake a scoped review to examine how Ontario regulates PM_{2.5}, including direct emissions of primary PM_{2.5}
- Final draft report will be posted for comment on the Environmental Registry

Ontario Decision: Next Generation of PM Monitors

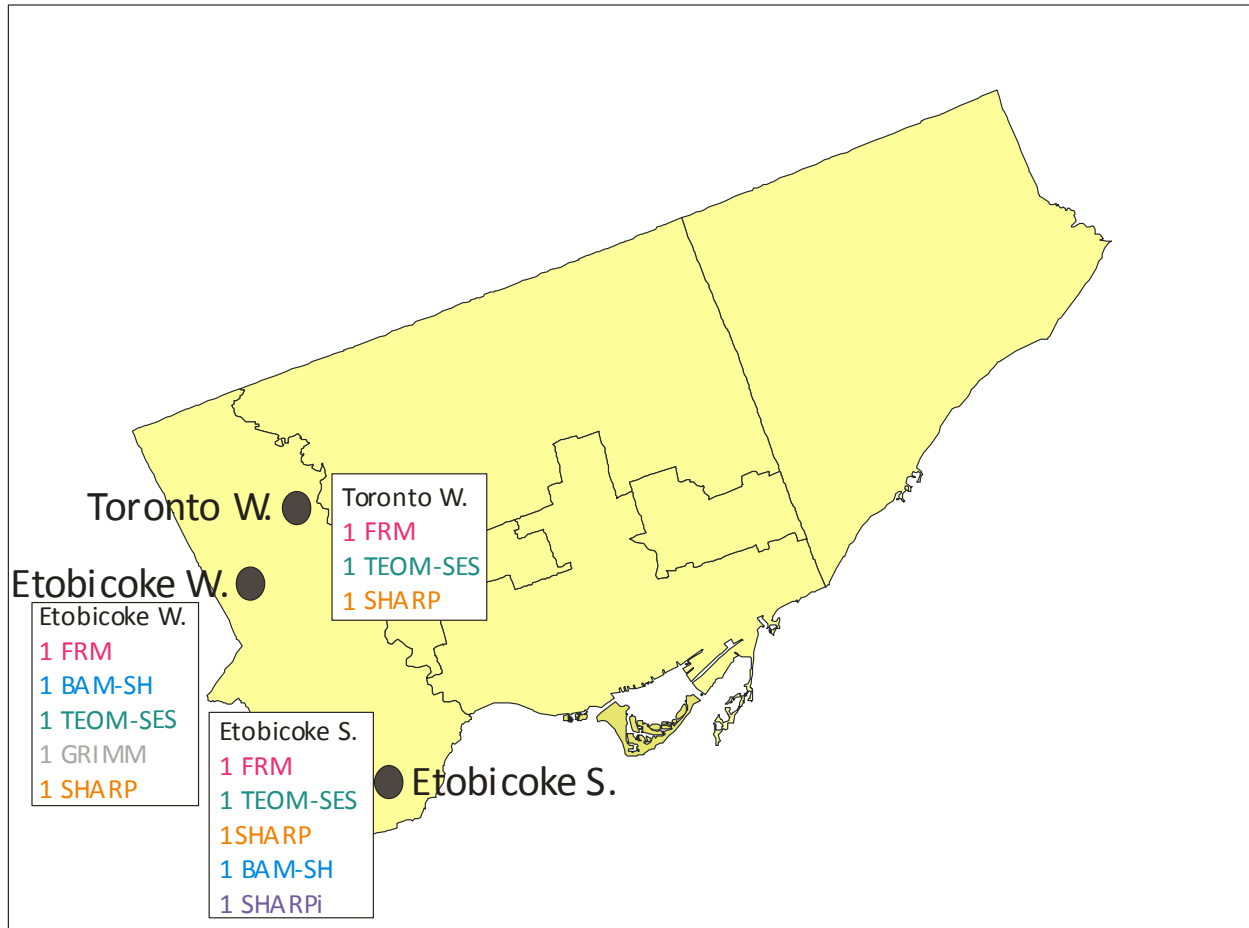
Evaluate FEM Class III designated monitors for:

- Overall performance
- Ease of installation and operation
- Total cost of ownership

Four systems under evaluation:

- Met-one BAM 1020
- Thermo SHARP5030i
- Thermo SHARP5030
- GRIMM EDM 180

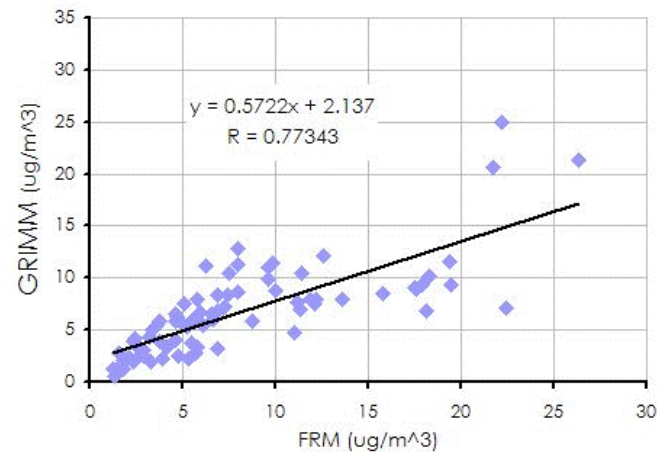
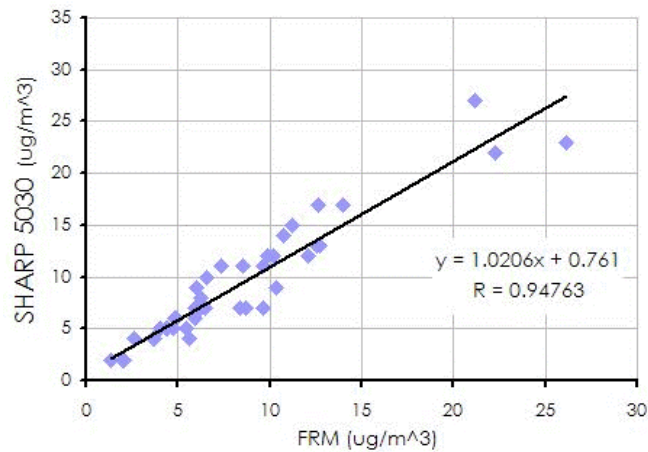
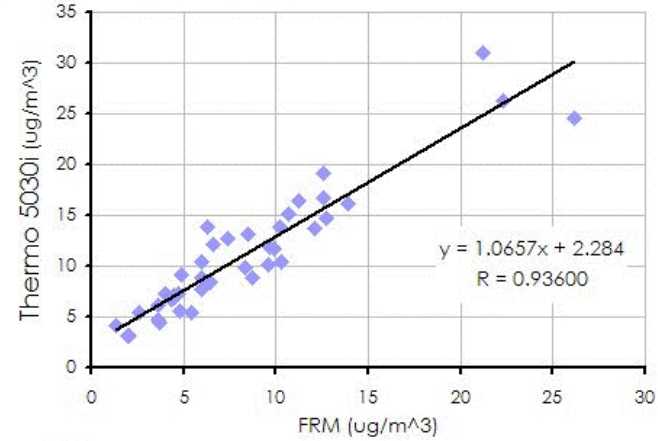
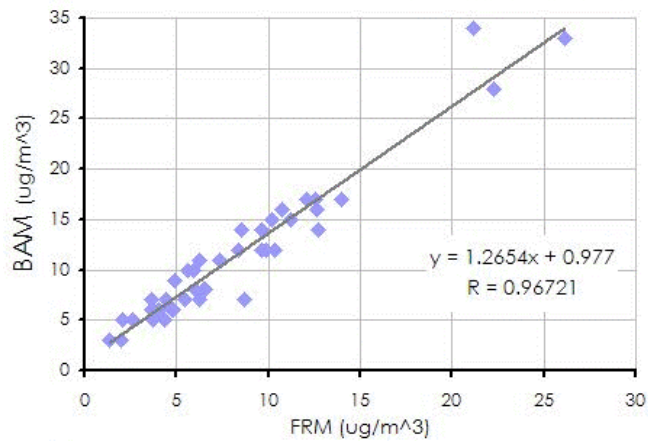
Ontario PM_{2.5} Research Network



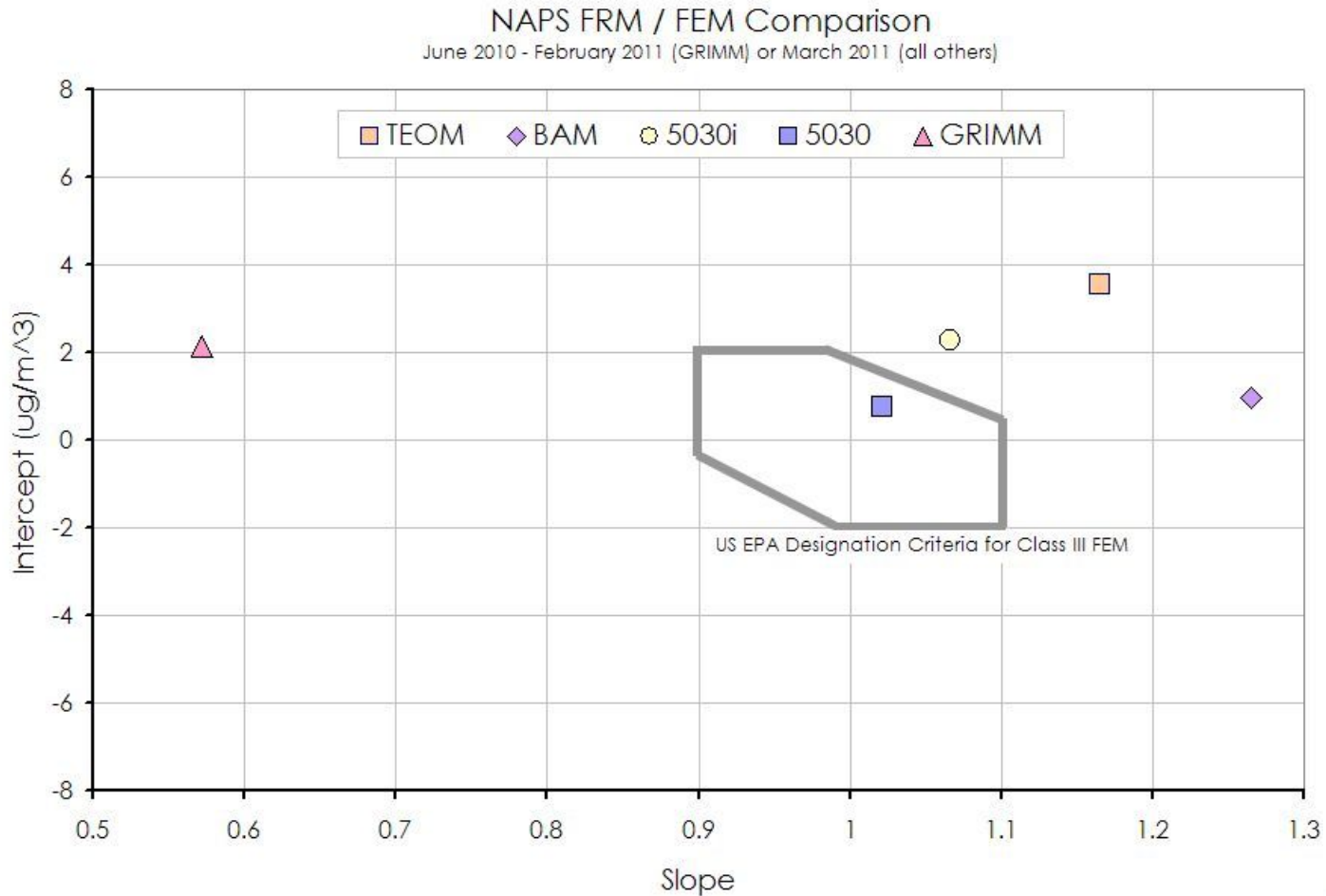
Evaluating Performance of FEM Methods

Regression Analysis - FEM / FRM

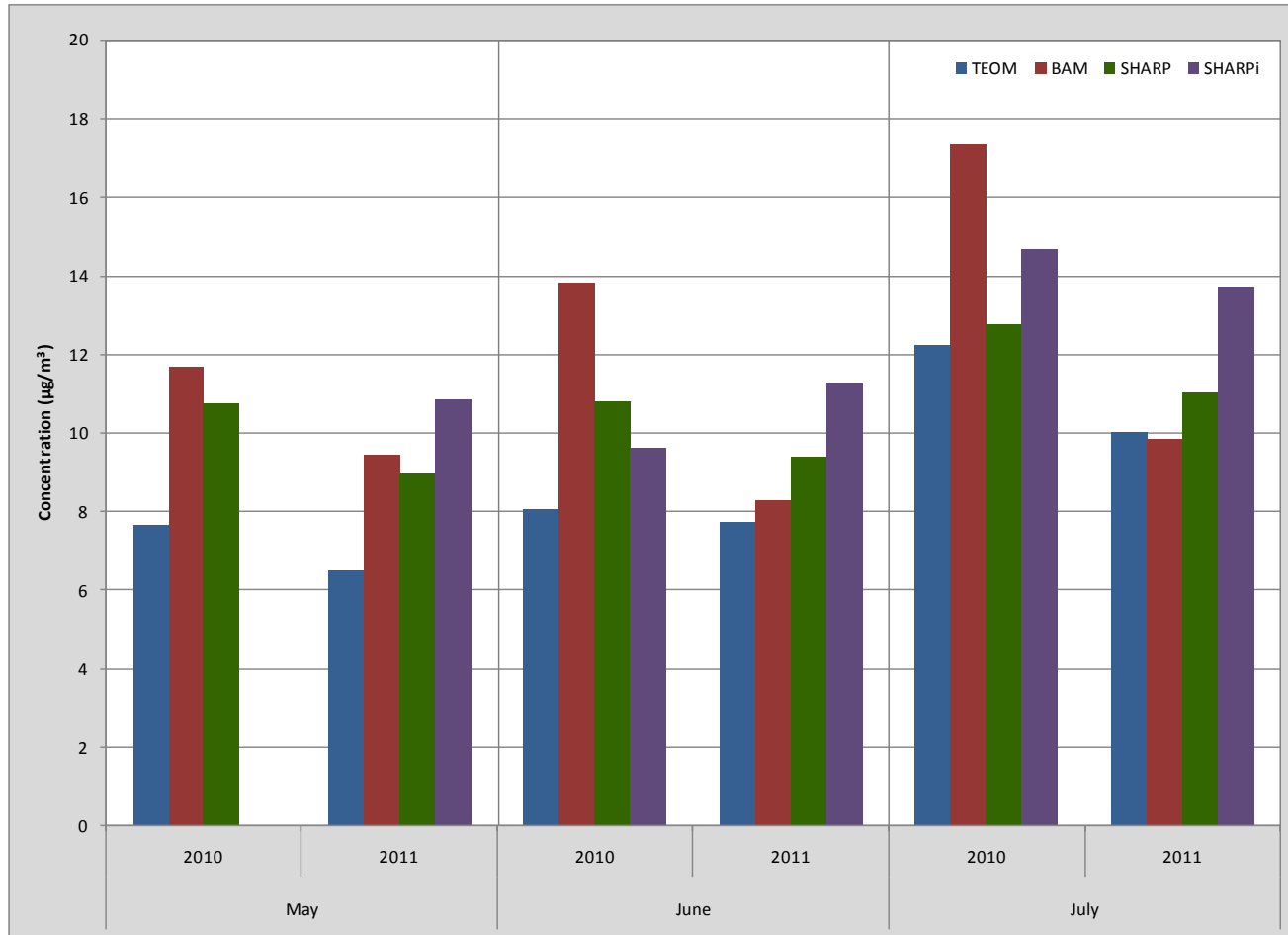
June 2010 - February 2011 (GRIMM) or March 2011 (all others)



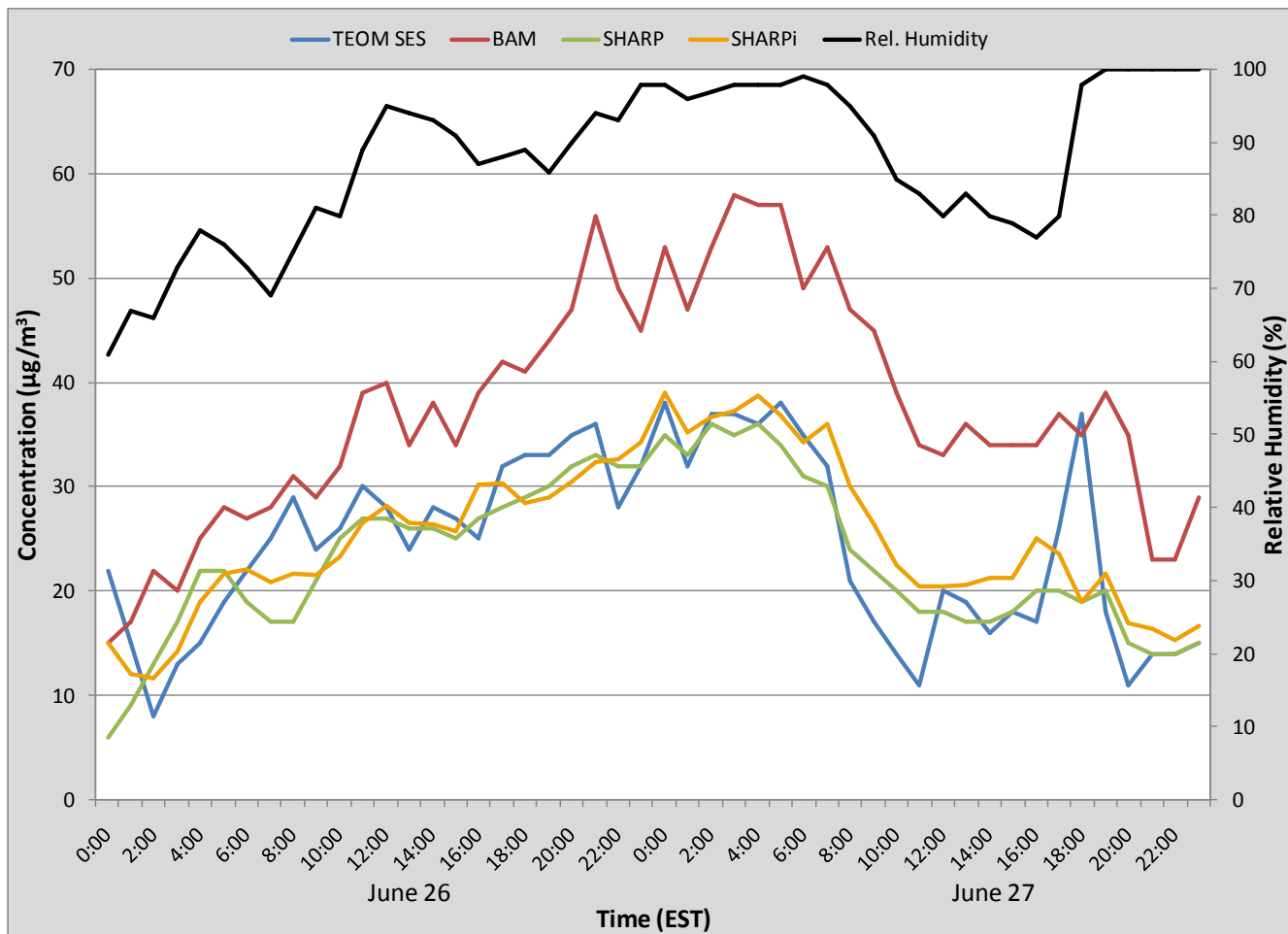
FEM Methods Compared



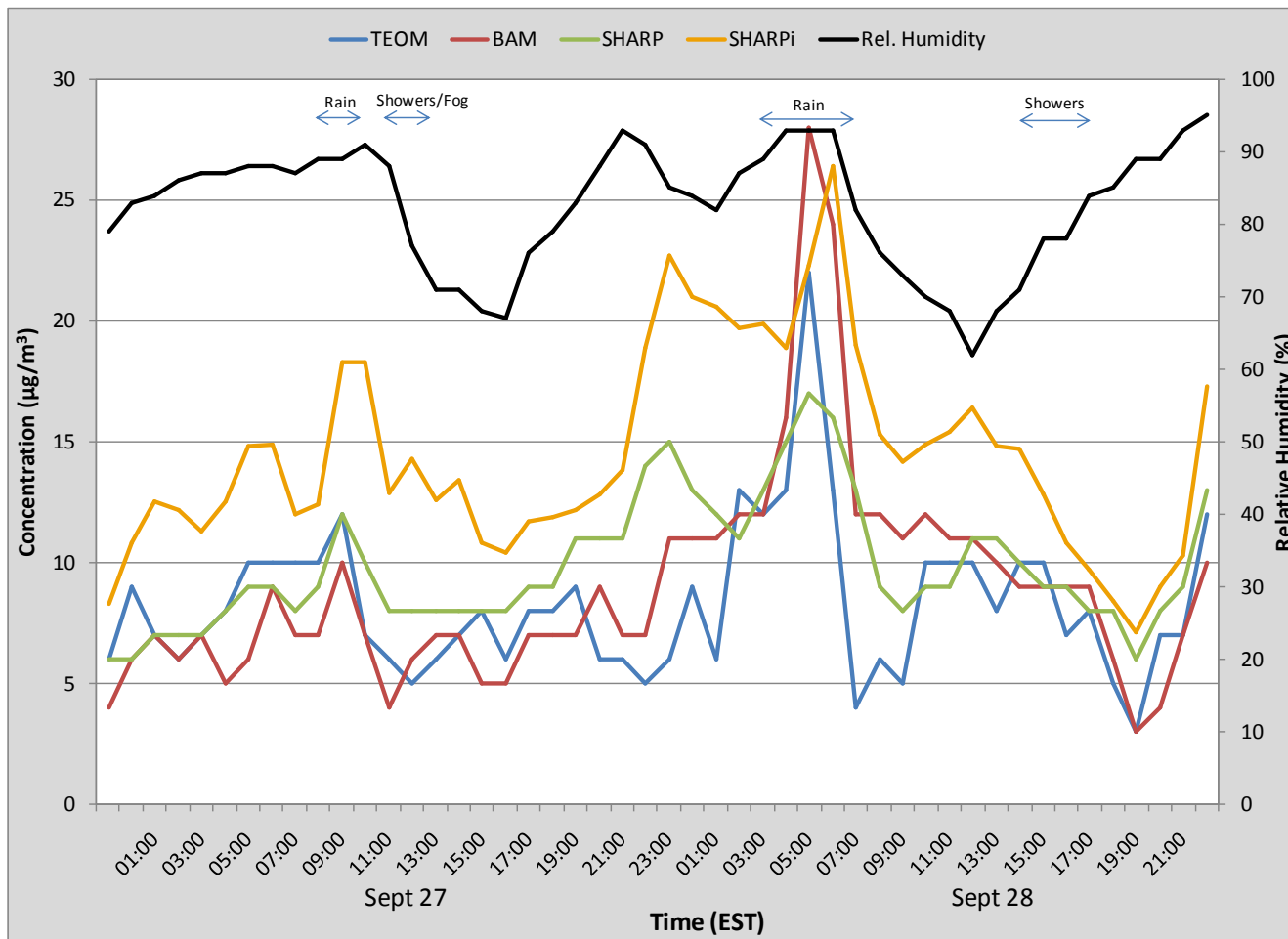
Monthly Average PM_{2.5} Concentrations at Etobicoke South Measured Using TEOM, BAM, SHARPi and SHARP Instruments May to July, 2010 and 2011



PM_{2.5} Concentrations Measured with TEOM SES, Met-One BAM, SHARP and SHARPi Instruments at Etobicoke South Along with Relative Humidity June 26-27, 2010



PM_{2.5} Concentrations Measured with TEOM SES, Met-One BAM, SHARP and SHARPi Instruments at Etobicoke South Along with Relative Humidity September 27-28, 2011



Conclusion

- Further evaluation of the FEMs is required due to the variability observed between the NAPS FRM and FEM Methods
- Ontario does not have a clear choice for the next generation PM_{2.5} monitor