

Emerging Continuous PM Measurement Technologies

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AWMA-OS Real-time PM Monitoring Workshop
Toronto, ON
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Scope:

New continuous aerosol methods suitable for routine network operation

both PM_{2.5} and physical/chemical characterization

in production or nearing production

Not:

conceptual stage products

research instruments

single particle speciation methods

wet speciation (MARGA, PILS)

PM2.5

- Nothing really new
- Products in the pipeline: variations on existing themes

TAPI BAM [model 602]

“FRM-like” MetOne BAM

Thermo 1405xx TEOM

TAPI BAM model 602

- FEM testing [almost?] finished
- Italian instrument adapted to US needs
- Dual-channel: PM2.5 and PM10
- Channels closely matched
 - same detector
 - closely controlled flows
- 59-min hourly sample!
 - Other nice features
- Expensive...
- See vendor presentation/exhibit

MetOne “T-BAM”

- Modification to existing 1020 FEM instrument retrofit process
new round of FEM testing in progress
- Major changes:
 - Teflon tape (was glass fiber)
 - improved beta detectors and chamber geometry
 - better moisture control
 - compensation algorithms (P, T, moisture)
- Result:
 - higher sensitivity [factor of 2 or more]
 - reduced water interference
 - no more nozzle fluff cleaning
 - data should be more “FRM-like”

Low cost optical PM2.5 surrogate:
Thermo (IH division): pDR-1500
Based on legacy MIE DR4 design



~4-5k USD; has chamber T/RH data, option for RH “correction”

Speciation

- Cooper XACT XRF
 - “Xact 620 ambient metals monitor”
 - shipping but still emerging
 - limited independent evaluation
 - not user friendly

Some info:

Washington U. at St. Louis 2010 AAAR presentation:

http://cooperenvironmental.com/wp-content/uploads/2010/11/AAAR_Yadav_2010.pdf

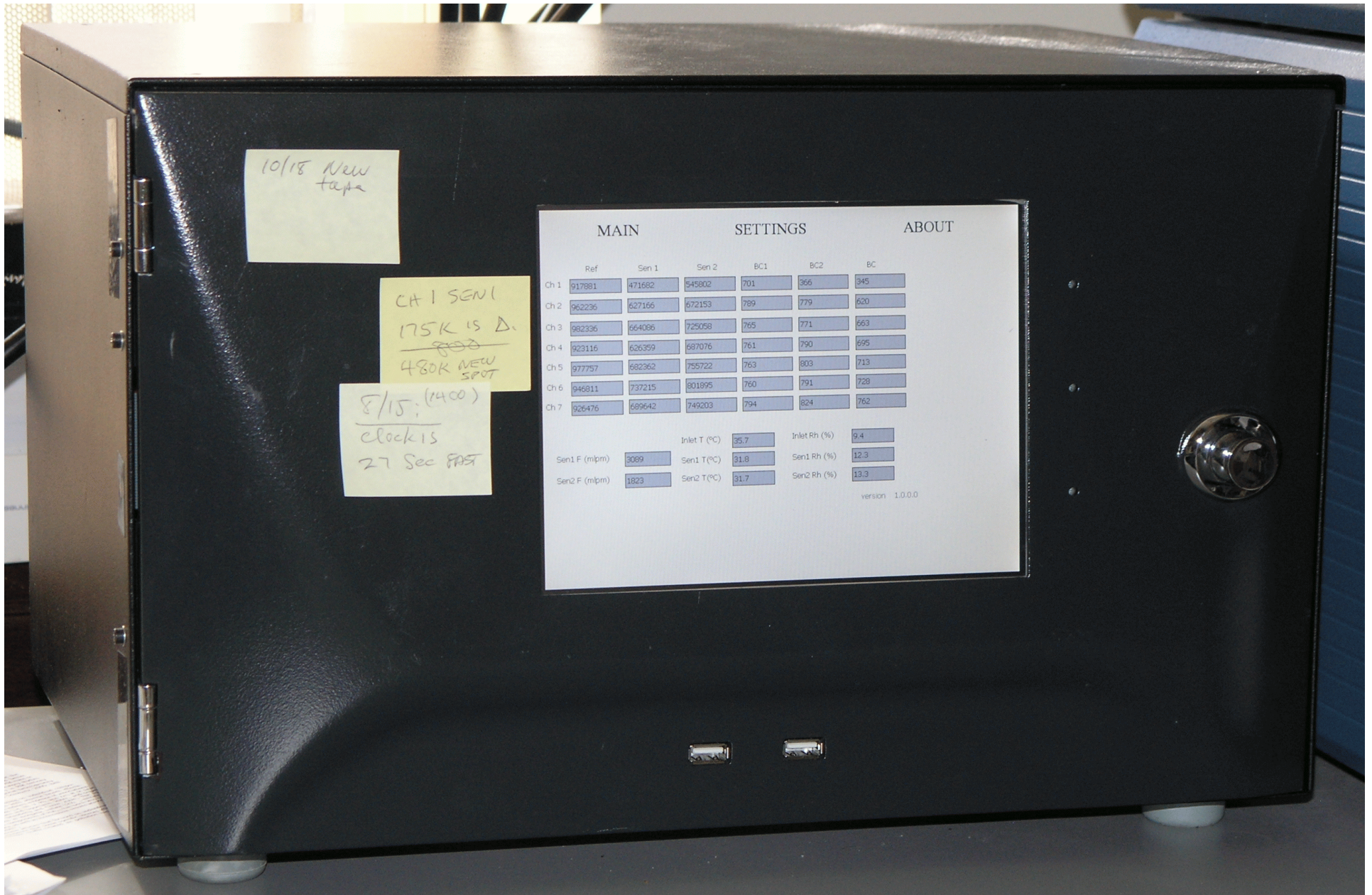
Cooper/EPA-OAQPA 2010 presentation:

<http://cooperenvironmental.com/wp-content/uploads/2010/03/U.S.-EPA-Xact-620-FLM-Phase-III-2010-Presentation.pdf>

TAPI model 633 Aethalometer:

- Complete rebuild/redesign of classic Aethalometer by Magee Scientific
- TAPI now sole-source of Magee products
- Dual-sensor, multi-wavelength design
 - 2 simultaneous measurements [2 spots] at different flows
 - ==> different spot loading rates
- Near-realtime correction for spot loading artifact
 - in theory - US patent app. # 20100027013
 - correction approach still evolving
 - not yet demonstrated on ambient air
- Should ship late 2011

Magee/TAPI "Next-Gen" Model 633 Aethelometer - beta instrument



Model 633 Main Screen [v 1.0.0.0]

	MAIN	SETTINGS	ABOUT			
	Ref	Sen 1	Sen 2	BC1	BC2	BC
Ch 1	917881	471682	545802	701	366	345
Ch 2	962236	627166	672153	789	779	620
Ch 3	982336	664086	725058	765	771	663
Ch 4	923116	626359	687076	761	790	695
Ch 5	977757	682362	755722	763	803	713
Ch 6	946811	737215	801895	760	791	728
Ch 7	926476	689642	749203	794	824	762
		Inlet T (°C)	35.7	Inlet Rh (%)	9.4	
Sen1 F (mlpm)	3089	Sen1 T(°C)	31.8	Sen1 Rh (%)	12.3	
Sen2 F (mlpm)	1823	Sen2 T(°C)	31.7	Sen2 Rh (%)	13.3	
				version	1.0.0.0	

UFP (particle # concentration down to 7 nm, up to $10^6/\text{cc}$):
TAPI Model 651 Ultrafine Particle Monitor
aka TSI 3783 water CPC



Best current commercial option for ambient particle # conc.
several bumps in the road; some still not resolved
SQAQMD (LA) / Phil Fine still not happy with it...

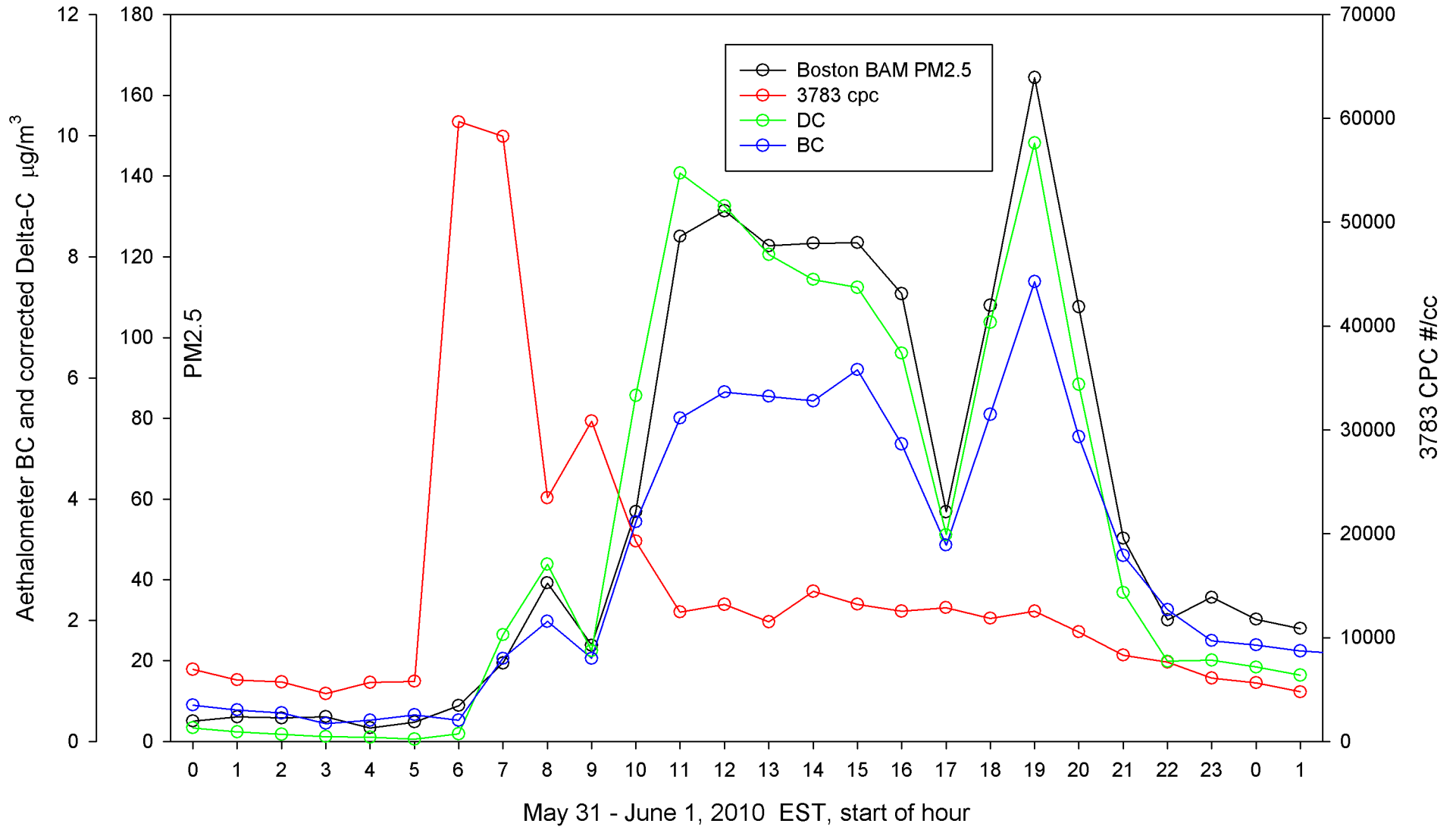
Realtime Woodsmoke Monitor

- Aethalometer “Delta-C”
 - 2-channel model AE21
 - new application for existing instrument
 - UVC minus BC = “DC”
- DC: very specific, semi-quantitative woodsmoke PM measurement
 - Original work: 2004 Rutland, VT -- Unmix analysis
 - shows ambient air DC response is only from WS
 - Allen et al. <http://tinyurl.com/gqct6>
- $DC * 10 = WS \text{ PM } (\mu\text{g}/\text{m}^3)$ - generic scaling factor
 - factor varies depending on source and age; 5 to infinity
 - no DC response for photochemically aged aerosol
 - same for levoglucosan!
 - Ref: Evolution of Organic Aerosols in the Atmosphere,
Jimenez, et al. *Science* (2009) DOI: 10.1126/science.1180353

BAM PM2.5, UFP, BC, DC-WS

May31-June 1, 2010 WS event, Boston

Quebec Fire Event -- Boston Hourly PM2.5, Aeth Delta-C (WS), and Particle # conc.
PM2.5 is average of N.End and Roxbury MA-DEP sites

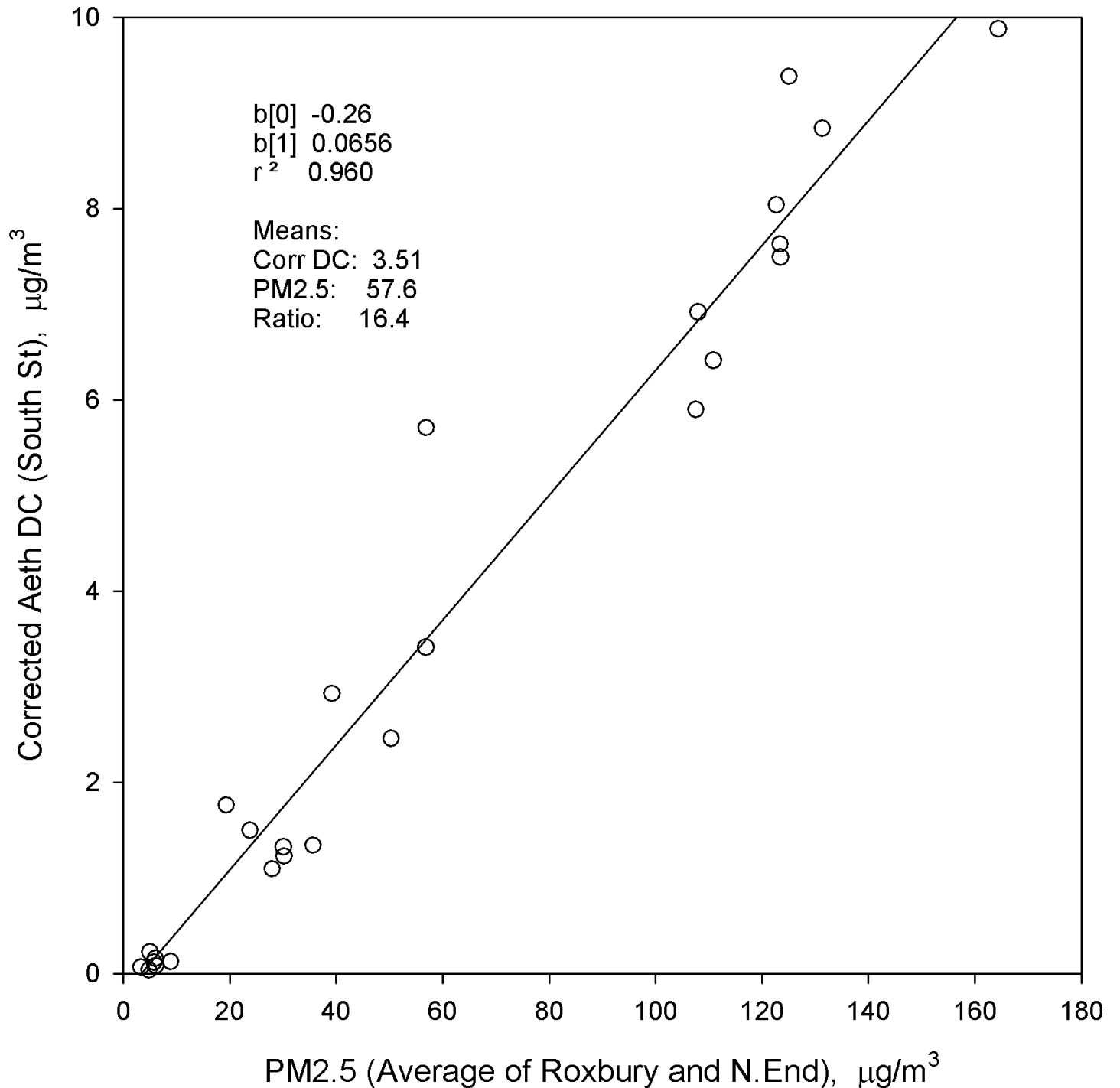


Boston wildfire
WS event:
1-hour unscaled
DC vs. BAM
PM2.5

May 31-June 1,
2010

R2 = 0.96
PM/DC=16.4

Not collocated;
PM2.5: avg. of 2
Boston sites
DC: my office



- WS DC caveats:
 - must correct for spot loading saturation effect (masher tools)
 - may not work well with model AE22 Aethalometer
 - original work done with AE21
 - AE22 must be run with 3 spots/advance for DC measurement

- Other DC woodsmoke references:

CT DEP WS report:

http://www.ct.gov/dep/lib/dep/air/wood_stove_furnaces/ctdep_woodsmokefinalreport.pdf

“Characterization of Valley Winter Woodsmoke Concentrations in Northern NY Using Highly Time-Resolved Measurements”

Allen, et al. *Aerosol and Air Quality Research* (2011)

doi: 10.4209/aaqr.2011.03.0031; open access:

http://www.aaqr.org/Doi.php?id=6_AAQR-11-03-OA-0031

Nescaum WS kit:
stand-alone WS PM
monitoring field system

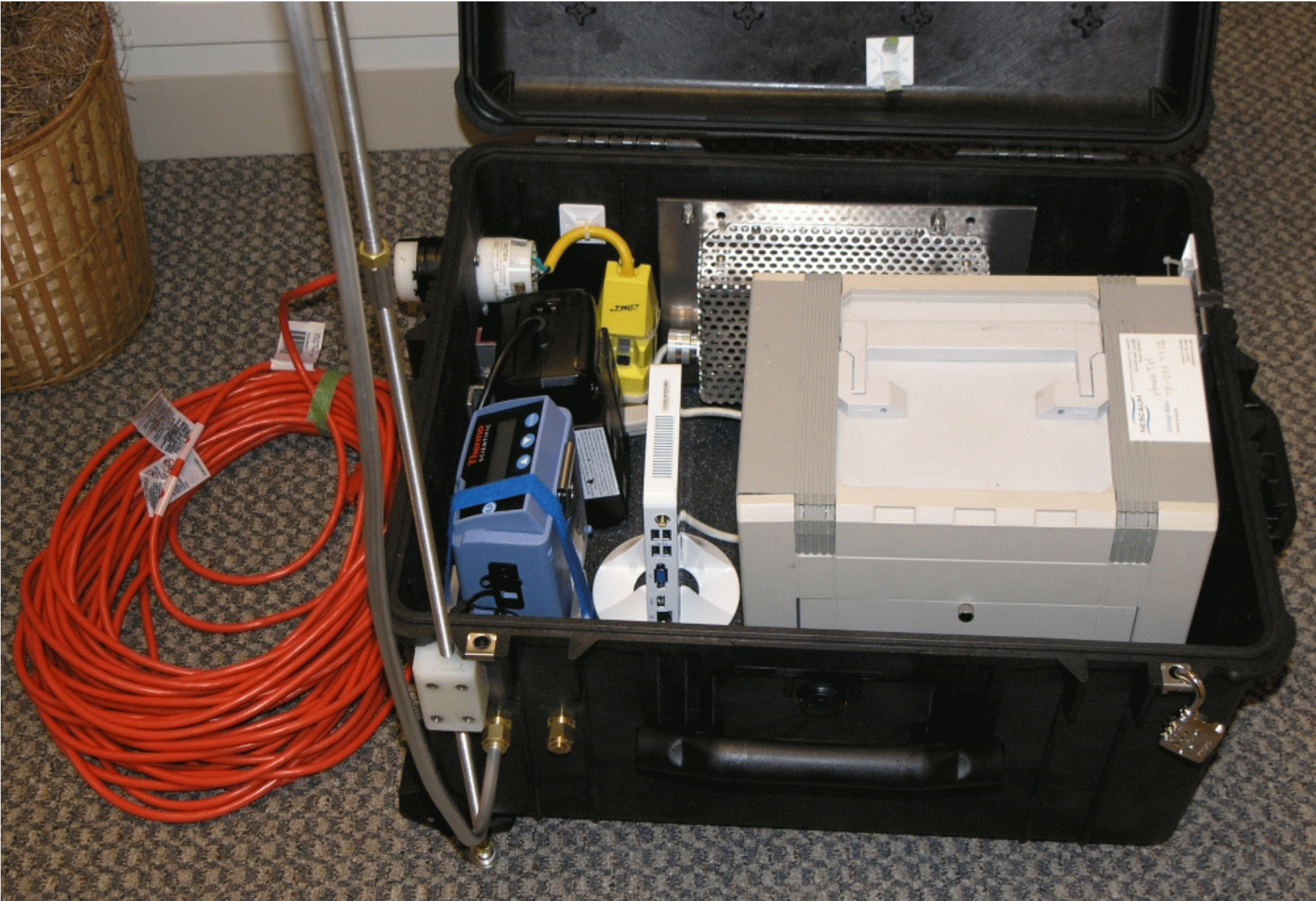
System housed in Pelican case

Self-contained, heated

Sonic wind option



Inside view:



Questions/discussion...