2005 Update: Delaware’s Experience with a Continuous PM2.5 Monitor: The Andersen BAM

In Search of FRM-Like Data – The search goes on . . .

Betsy Frey, Delaware Air Quality Mgmt
MARAMA Monitoring Meeting
November 16, 2005
Andersen Series FH62 C14 Continuous Ambient Particulate Monitor, aka BAM

- Beta Attenuation Monitor
- Configuration:
  - SSC PM2.5 inlet
  - 35° C temp
  - No correction factor
BAM at two sites

- MLK site began November 2002
  - Collocated with:
    - two FRMS (daily and 1-in-6 days)
    - TEOM PM10 (converted back from PM2.5)
  - Located on top of shelter platform

- Killens Pond site began April 2003
  - Collocated with one 1-in-3 day FRM
  - Inlet on top, sampler inside station shelter
MLK PM2.5 FRM vs BAMS
November 2002 - March 2003

\[ y = 1.1555x - 1.1184 \]

\[ R^2 = 0.9371 \]

1 to 1 line
MLK PM2.5 FRM vs BAMS
April 1, 2003 - October 15, 2003

\[ y = 0.9342x - 3.2829 \]

\[ R^2 = 0.9579 \]

1 to 1 line
BAM Since 2003

- Continued operation at MLK, Killens
- Added Newark, Seaford
- Tried to add collocated BAM at MLK
  - Never stabilized
  - Returned to Thermo for repair or replacement
- Modified procedures for audit and operator checks
MLK Difference in ug BAMS - FRM
Nov. 2002 through September 2005
MLK PM2.5 Winter FRM vs BAM
Dec. 03 - Feb 04, Nov 04 - Feb 05

$y = 1.1483x - 5.9444$

$R^2 = 0.8999$
MLK PM2.5 FRM vs BAM
Mar - Oct 03, Mar - Nov 04, Mar - Oct 05

\[ y = 0.9052x - 3.4315 \]
\[ R^2 = 0.9106 \]
MLK Difference in ug BAMS (corrected) - FRM
Nov 02 - Sep 05
2003 - 2005 MLK FRM vs BAM corrected using multi-year seasonal averages excludes winter 2002

\[ y = 0.9969x + 0.1217 \]

\[ R^2 = 0.9098 \]
Problem in July 2005

- Very high humidity - BAM spikes/drops, poor correlation with FRM
- Consult with Thermo – Kevin Goohs
- Recommendation – use seasonal heater tube temperature settings
  - Summer – 50 deg C
  - Spring and Fall – 35 deg C
  - Winter – 25 deg C
- These are temps for the inlet tube, not the aerosol
How is it going?

- Made adjustments last week of July 2005
- Improved stability (fewer spikes/drops)
- Slightly improved correlation with FRM
- Will run for one year and re-evaluate
MLK BAMS - FRM Difference
Nov. 2002 through September 2005

Avg diff = 4.1 ug/m3
Std dev = 3.4 ug/m3
MLK Adjusted BAMS - FRM Difference
Nov 02 - Sep 05

Avg diff = 0.0 ug/m³
Std dev = 2.4 ug/m³
Killens BAMS - FRM Difference
2003 - 2005

Avg diff = 0.7 ug/m3
Std dev = 2.7 ug/m3
Killens Adjusted BAMS - FRM Difference
2003 - 2005

Avg diff = -0.1 ug/m³
Where are we now?

- Is the BAM data similar enough to the FRM data to replace an FRM?
Compare annual average NAAQS

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<th>BAM</th>
<th>FRM</th>
<th>Adj BAM</th>
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<tr>
<td>3-yr Avg</td>
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Compare 24-hour NAAQS

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<th>Adj BAM</th>
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Conclusion

- Andersen BAM –
  - Good for diurnal patterns
  - Generally consistent with FRM, especially for longer term averages, but not close enough for areas near the NAAQS
- May be affected by high ambient humidity; can compensate with heater tube temperature adjustment
- Current focus – precision (collocated BAM) and seasonal temperature adjustments
The Night Before Thanksgiving