VT & CT FDMS Experiences

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Joint MARAMA/NESCAUM Continuous Monitor Training Workshop
Philadelphia, PA
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VT FDMS Network

**Burlington - Zampieri State Office Building**
- FDMS-A
- Outdoor installation
- Start: 1/24/03
- Stop: 1/7/04

**Burlington - So. Winooski & Main Street**
- FDMS-B
- Indoor installation
- Start: 1/20/04

*Switch out w/ Bennington to FDMS-A in March '04.*

**Rutland**
- FDMS-A
- Indoor installation
- Start: 12/10/02

**Bennington**
- FDMS A
- Indoor installation
- Start: 6/18/03

*Switch out w/ Burlington to FDMS-B in March '04.*

**Brattleboro - Route 5**

**Underhill - Proctor Maple Research Center**
Vermont FRM vs FDMS TEOM 24hr PM$_{2.5}$ Averages
3 sites; December 2002 through June 2004

<table>
<thead>
<tr>
<th>Location</th>
<th>N</th>
<th>slope</th>
<th>intercept</th>
<th>r</th>
<th>r$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutland</td>
<td>124</td>
<td>1.06</td>
<td>-0.24</td>
<td>0.98</td>
<td>0.97</td>
</tr>
<tr>
<td>Bennington</td>
<td>94</td>
<td>1.05</td>
<td>0.05</td>
<td>0.99</td>
<td>0.97</td>
</tr>
<tr>
<td>Burlington</td>
<td>86</td>
<td>1.09</td>
<td>0.40</td>
<td>0.98</td>
<td>0.96</td>
</tr>
<tr>
<td>Burlington (w/o High Nitrate)</td>
<td>85</td>
<td>1.06</td>
<td>0.67</td>
<td>0.98</td>
<td>0.96</td>
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<tr>
<td>All sites</td>
<td>303</td>
<td>1.06</td>
<td>0.20</td>
<td>0.983</td>
<td>0.97</td>
</tr>
</tbody>
</table>

High Nitrate Event (3/1/2004)

Proposed PM$_{2.5}$ National Equivalency Criteria
Workgroup Draft of PM$_{2.5}$ National Equivalency Criteria
For illustrative purposes only, do not cite or quote
Connecticut FRM vs BAM 24hr PM$_{2.5}$ Averages
4 sites; June 2003 through September 2004

<table>
<thead>
<tr>
<th>Site</th>
<th>N</th>
<th>slope</th>
<th>intercept</th>
<th>r</th>
<th>r$^2$</th>
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</thead>
<tbody>
<tr>
<td>Bridgeport</td>
<td>105</td>
<td>0.95</td>
<td>3.25</td>
<td>0.94</td>
<td>0.88</td>
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<tr>
<td>Hartford</td>
<td>96</td>
<td>1.11</td>
<td>1.87</td>
<td>0.99</td>
<td>0.97</td>
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<tr>
<td>New Haven</td>
<td>171</td>
<td>1.29</td>
<td>0.30</td>
<td>0.96</td>
<td>0.92</td>
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<tr>
<td>Waterbury</td>
<td>143</td>
<td>1.08</td>
<td>-1.15</td>
<td>0.97</td>
<td>0.95</td>
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<tr>
<td>All sites</td>
<td>514</td>
<td>1.10</td>
<td>1.07</td>
<td>0.94</td>
<td>0.89</td>
</tr>
</tbody>
</table>

Proposed PM$_{2.5}$ National Equivalency Criteria
Workgroup Draft of PM$_{2.5}$ National Equivalency Criteria
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FDMS Routine Maintenance

**Weekly:**

- Site
  - Check “Status” and “Filter %”
- ESC/Data Acquisition
  - Check “Total PM,” “Non-Volatile PM” and “Volatile PM”
    - Usually best way is to graph all sites at once
- RPComm
  - If any issues observed above, call remotely and download data/troubleshoot.
- Other
  - Also keep an eye on shelter temp (whether indoor or outdoor installation).

**Monthly:**

- Site
  - Change both filters – Sensor unit and FDMS
  - Do flow audit before and after filter change, partly to check for leaks
  - Temperature and pressure audits
  - Clean (V)SSC
  - Either perform leak checks monthly automatically or only if there’s a problem with the flows
- ESC
  - Scan monthly data and take note of any questionable periods
- RPComm
  - Download monthly data and investigate questionable periods; Check stored “Status” for entire period
FDMS Routine Maintenance (continued)

Quarterly:

- Site
  - Independent flow, temperature, pressure audit
  - Leak check
  - Mass transducer calibration verification
    - Never failed one, but have marginally passed (within 2.5%), also good way to make sure calibration factor (K0) is correctly set in control unit – this would be important if you had to change a mass transducer out.

Annually:

- Site
  - Change large in-line filters upstream of MFCs
  - Check pump vacuum
FDMS Non-Routine Maintenance Issues

- Outdoor enclosure installation in Burlington, VT
  - Data capture ≈ 30% over initial year
  - Shelter air-circulation has been addressed, although still had problems with Burlington unit after circulation improvements made; even after switching from FDMS-A to FDMS-B in October 2003.
  - Moved FDMS to new monitoring trailer in Burlington in January 2004 (Indoor installation).
  - Primary reason for move was that there seemed to be noise associated with abrupt changes in temperature (even between 20 to 15°C). Perhaps the cycling of the heater. Seemed to work best in fall when both AC and heater were on and maintaining constant temperature.

- Indoor installation
  - Initially leak problems associated with seating of FDMS filter.
  - Any other periods of invalidated data were due to AC breaker tripping and shelter temp being elevated. **Shelter temp should be part of validation process.**

- CT FDMS – on loan from EPA Region I
  - Summer ’04 – inexplicable positive and negative spikes in concentration for 1-8 hr periods although no status codes associated with these periods.
  - R&P replaced FDMS-A with FDMS-B in November 2004; haven’t seen any “spiking” problems since switchover.
FDMS Settings/Configurations

- Analog out channels
  - Can configure up to 3 analog out channels to ESC datalogger
    - PRC 57 – 1hr Mass Conc. (Total PM)
    - PRC 102 – Base MC (Non-volatile PM)
    - PRC 104 – Reference MC (Volatile PM)
  - Set-up a total of 6 channels on datalogger; 3 standard channels to take analog input and 3 math channels to post measurements to correct hour.
  - Storing these three channels properly aids in forecasting, data validation and AQS and web reporting.
  - With the channels setup in the above manner, there’s a 6-minute window to capture the right number on the right hour. Therefore, the **FDMS should be set 3 minutes ahead of the ESC logger** and this time difference should be part of the weekly checks.
  - Link to FDMS ESC 8816 Datalogger setup:

- Contact closure channels
  - Two channels used to indicate filter loading > 90% or status codes
  - May be prohibitive due to channel availability limitations (would be a total of 8 analog channels setup in the ESC datalogger dedicated to FDMS – another argument to go digital!!)
FDMS Settings/Configurations (continued)

- Internal data storage
  - Recommend utilizing all 8 possible parameters to be stored at 1 hr (3600s) intervals.
  - Setting up to store all 8 parameters requires data download every 5 weeks to prevent internal data being overwritten.
  - Data file is in a spreadsheet/database friendly comma-delimited file that aids in data validation and troubleshooting problems. When troubleshooting, may need to drop frequency down to 6-min (360s) to better diagnose issues.
  - Many possible parameter could be stored, I typically setup an FDMS to store the following parameters at a 1-hr interval: 1-hr MC (PRC 057), Base MC (102), Reference MC (104), Filter loading (35), Status (41), Noise (13), External Dew Point (114) and Sample Dew Point (99). For troubleshooting, R&P will typically request that the internal data storage settings are set to 99, 100, 110, 111, 112, 113, 114 and 123 at an interval of 360s.

- Other internal settings
  - May be old news to most, but if you want to report measurements in actual conditions, which I think we all do, make sure under the “Set Temp/Flows” menu that “T-A/S” and “P-A/S” are set to **99 for both average (A) and standard (S) temperature settings** and **9 for both average (A) and standard (S) pressure settings**.