Status Update and Early Data from the MANE-VU Rural Aerosol Intensive Network (RAIN)

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MARAMA/NESCAUM Joint Monitoring Meeting

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PM/Haze Rural “Transport Supersites” in MANE-VU domain

The network has a name: RAIN

- Multiple sites (3 or more) with detailed PM and visibility-related measurements
  - high-elevation (500 - 2500 ft), rural, transport characterization
  - contrast “Fresh” vs. Aged secondary aerosols
  - highly time-resolved (1-2 h) aerosol composition measurements

- Hourly aerosol composition data provide enhanced insight into:
  - regional aerosol generation and source characterization
  - factors that drive short-term visibility
  - aerosol model performance and evaluation

- 1Q 2004 IMPROVE newsletter Feature Article on RAIN:
Status of RAIN Site Implementation

• Core year-round components are in place at all 3 sites as of July 1:
  → Continuous [hourly] PM2.5, Ozone
  → Surface Met [wind, temp, RH or dew point,]
  → IMPROVE measurements for carbon, ions and PM2.5

  Still needed: HazeCam for CT and MD

• New real-time methods in place at all 3 sites as of July 1:
  → Continuous sulfate (Thermo 5020 method): all sites
  → 2-hour EC/OC (Sunset Lab NDIR method): all sites
  → NGN-2 (wet) nephelometer [not MD?], trace SO2, ozone

Notes: MD Sulfate starts July 10.
  MD carbon and PM data quality uncertain for some of summer
Additional Measurements

- The following non-core measurements are operational:
  - NO/NOy, trace level CO at Acadia NP
  - NOy at Frostburg

- Still to come:
  - Trace CO, wet neph, and Profiler at Frostburg MD
  - Solar Rad and Rain, dry neph at CT

- Still on the wish-list:
  - trace CO, NOy at CT
  - ASOS [CT?]
  - NH3, continuous NO3, strong aerosol acidity [MD and/or CT?]
• **Current Issues**

  → RAIN QA Project Plan [NESCAUM]

  → RAIN SOPs for carbon, sulfate, and wet neph
    [States and NESCAUM]

  → Data Quality Issues [carbon, trace SO2/CO/NOy, neph]
    Not your mother’s compliance network anymore...
    [States and NESCAUM]

  → Realtime reporting of carbon, sulfate, neph, etc. to AIRNow/FASTNET [State data logger issues; AIRNow is ready]

  → Plans for routine ongoing data reduction and validation
    [States]

  → Plans for common database construction, future data analysis
    [NESCAUM]
Methods Update

- Continuous Sulfate: Thermo Electron model 5020
  - reasonably simple method; working well
  - 2 extra sites summer 2004 (Miller SP NH, Pinnacle SP NY)
    enhanced spatial resolution late July-October
  - Miller SP moves to AIRMAP Thomson Farm winter 2004/5
    [CT DEP and EPA-01 resources]

- Semi-continuous Carbon: Sunset NIOSH Method (2-hour cycle)
  - “Improve-like” method configuration not yet implemented
  - method is more complex; some problems in MD
  - “appears” to be working well at CT and Acadia
  - How do we know it’s working??

- Must have a way to assess performance in near real-time
  - can not wait for IMPROVE samples 9 months later
  - IMPROVE C and S can be used for final validation
• Mass reconstruction to continuous PM approach
  → use EC/OC and sulfate
  → subtract 0.5 µg/m³ for OC blank; then assume OC*1.8 or 2.0
  → sulfate*1.3 (for ammonium)*1.2 (for water in measured PM)
  → add generic 10% for nitrate and crustal PM components

• “Dynamic” blanks for both methods
  → detects many but not all problems
  → “one tool in the kit”

• Aethalometer for EC?
  → simple method that should be well correlated with Sunset optical and thermal EC (not OC or TC)
  → can also provide a wood smoke signature signal
RAIN and Friends (● = Summer 2004 Sulfate)

? Delaware Water Gap, Kejimkujik NP NS, Athens OH, Shenandoah NP
Thermo continuous sulfate vs. filter IC sulfate, St. Louis Supersite, July-Sept 2004

6-hour samples

Without 2 outliers (squares):

\[ b[0] = 0.4 \]
\[ b[1] = 0.929 \]
\[ r^2 = 0.965 \]
\[ N = 40 \]

Mean 5020 = 5.2 µg/m³
Mean Filter IC = 5.2 µg/m³
Reconstructed and measured PM, Acadia NP
Reconstructed and measured PM, Mohawk Mt.

R2 = 0.88
Mohawk Mt. CT PM reconstruction components:
2-hour sulfate and organic carbon-related PM, and measured PM2.5
Five-site Thermo 5020 Hourly Sulfate, July 30 - August 13, 2004

Sulfate, $\mu g/m^3$ (STP)

Acadia NP, ME
Mohawk Mt, CT
Pinnacle SP, NY
Frostburg, MD
Miller SP, NH

Pinnacle data courtesy SUNY-A/Schwab
Five-Site Thermo 5020 Hourly Sulfate, August 14-31 2004.

Pinnacle data courtesy SUNY-A/Schwab
Acadia NP Sulfur Phase, Summer 2004

Acadia NP, Maine: SO2 and SO4, June 25 - August 31, 2004

SO2 and SO4, µg/m³

SO2 and SO4, nm/m³ STP

% S converted

SO4, µg/m³

SO2, PPB

Black = SO2
Red = SO4

Preliminary data.

Plot is limited to hours where S is > 20 nmole/m³

June-Aug 2004
Preliminary data.

% S converted plot is limited to hours where total S is > 20 nmole/m$^3$
Preliminary data.

%S converted plot is limited to hours where total S is > 20 nmole/m³
Piney Run (Frostburg) MD SO2 and SO4, August 2004

SO2 and SO4, nm/m³ (STP)

SO4, µg/m³

SO2, PPB

Black = SO2
Red = SO4 * 10x

% S converted plot is limited to hours where total S is > 20 nmole/m³

Preliminary data.
For more info:

AWMA October 2004 Haze Conference Proceedings Paper #18:

“Real-time Carbon and Sulfate Measurements from the MANE-VU Rural Aerosol Intensive Network (RAIN): Design, Methods and Early Data”

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Covers the material presented here in more detail; available on request.