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

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MANE-VU Modeling & Data Analysis/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
AWMA October 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

[G. Allen, B. Goodwin, J. Turner]

Covers the material presented here, and will be finalized this week.

Available on request.
RAIN and Friends (● = Summer 2004 Sulfate)

- Acadia NP
- Miller SP
- Pinnacle SP
- Mohawk Mtn.
- Frostburg (Piney Run)

? 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

Acadia NP July 6-Aug 26 2004
2-hour Reconstructed PM vs. TEOM PM2.5

$R^2 = 0.91$
Reconstructed and measured PM, Mohawk Mt.
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, µg/m³ (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.
Acadia NP Sulfur Phase, Summer 2004

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

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

Preliminary data.

Black = SO2
Red   = SO4

June-Aug 2004
0 20 40 60 80 100

0 4.8 9.6 14.4 19.2 24.0

0 1.2 2.4 3.7 4.9 6.1

0 50 100 150 200 250

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

SO2 and SO4, nm/m³ STP

% S converted

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

June-Aug 2004

Preliminary data.
Frostburg MD SO2 and Sulfate hourly means, Summer 2004.

Preliminary data.

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

Black = SO2
Red = SO4
Frostburg MD SO2 and sulfate detail, August 13-25, 2004

Black = SO2
Red   = SO4

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

Preliminary data.
Piney Run (Frostburg) MD SO2 and SO4, August 2004

Preliminary data.