

Analysis of Preliminary Data from the Regional Aerosol Intensive Network (RAIN)

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Regional Aerosol Intensive Network (RAIN) Overview:

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

- Multiple sites with detailed PM and visibility-related measurements
 - 3 sites, deployed Summer 2004
 - 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:
 - source area characterization and attribution
 - factors that drive short-term visibility
 - aerosol model performance and evaluation (SIPS!)
- Tech Transfer of new measurement methods into routine S/L agency use
 - Sunset Model 3 real-time aerosol carbon (EC/OC)
 - Thermo Model 5020 real-time sulfate
 - NGN2a “wet” IMPROVE Nephelometer (b-scat visual range)

RAIN Sites (● = potential additions to network)

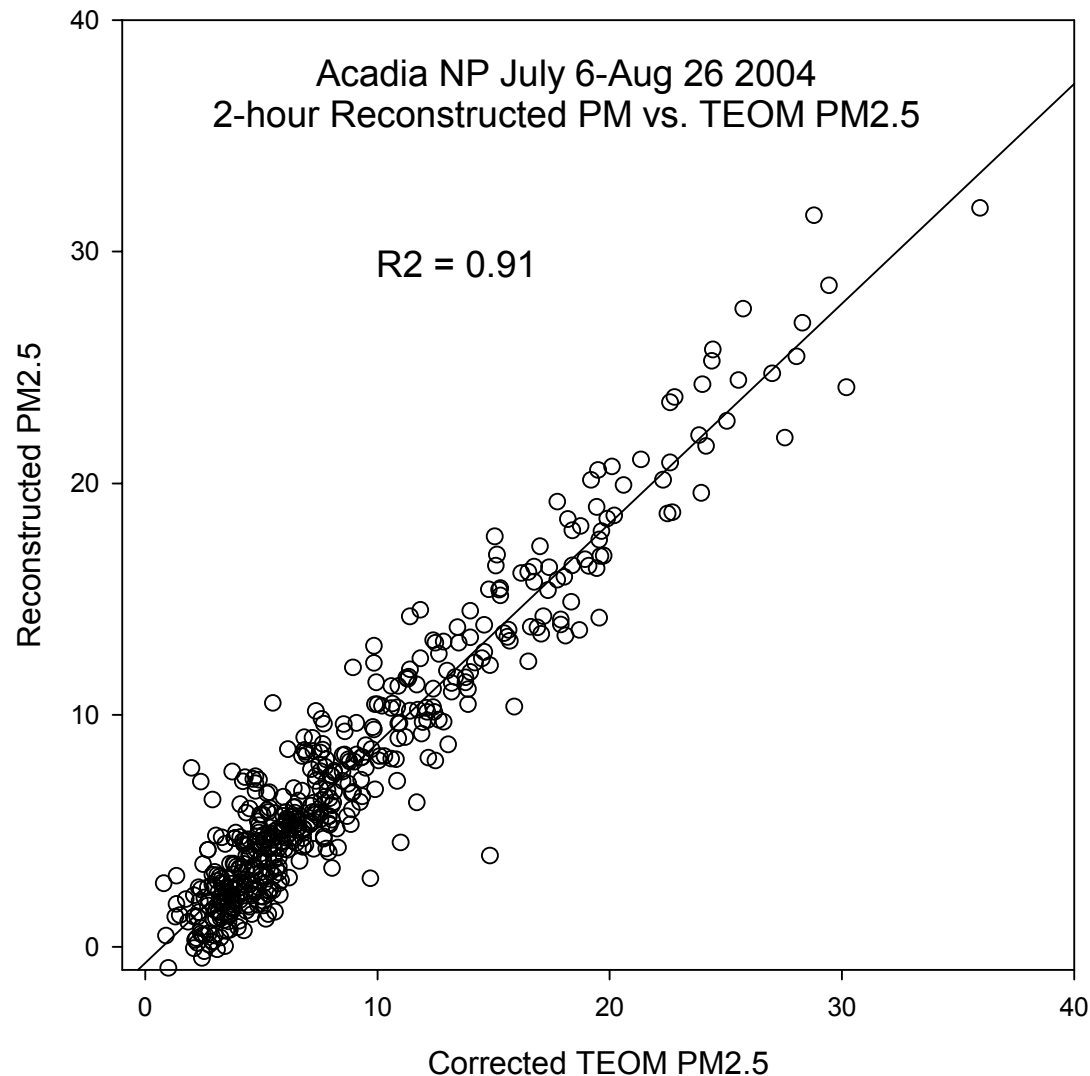


RAIN Parameters

- Core components
 - Continuous [hourly] PM_{2.5}, trace SO₂, O₃
 - Surface Met [wind, temp, RH or dew point,]
 - IMPROVE measurements for carbon, ions, elements, and PM_{2.5}
 - Continuous sulfate
 - 2-hour EC/OC
 - wet IMPROVE nephelometer for b-scat visual range
 - Hazecam (Camnet) automated digital scene photos
- Additional Measurements at some sites:
 - NO/NO_y, “true” trace level CO, Profiler
- Wish-list
 - ASOS, NH₃, continuous NO₃, HNO₃, strong aerosol acidity

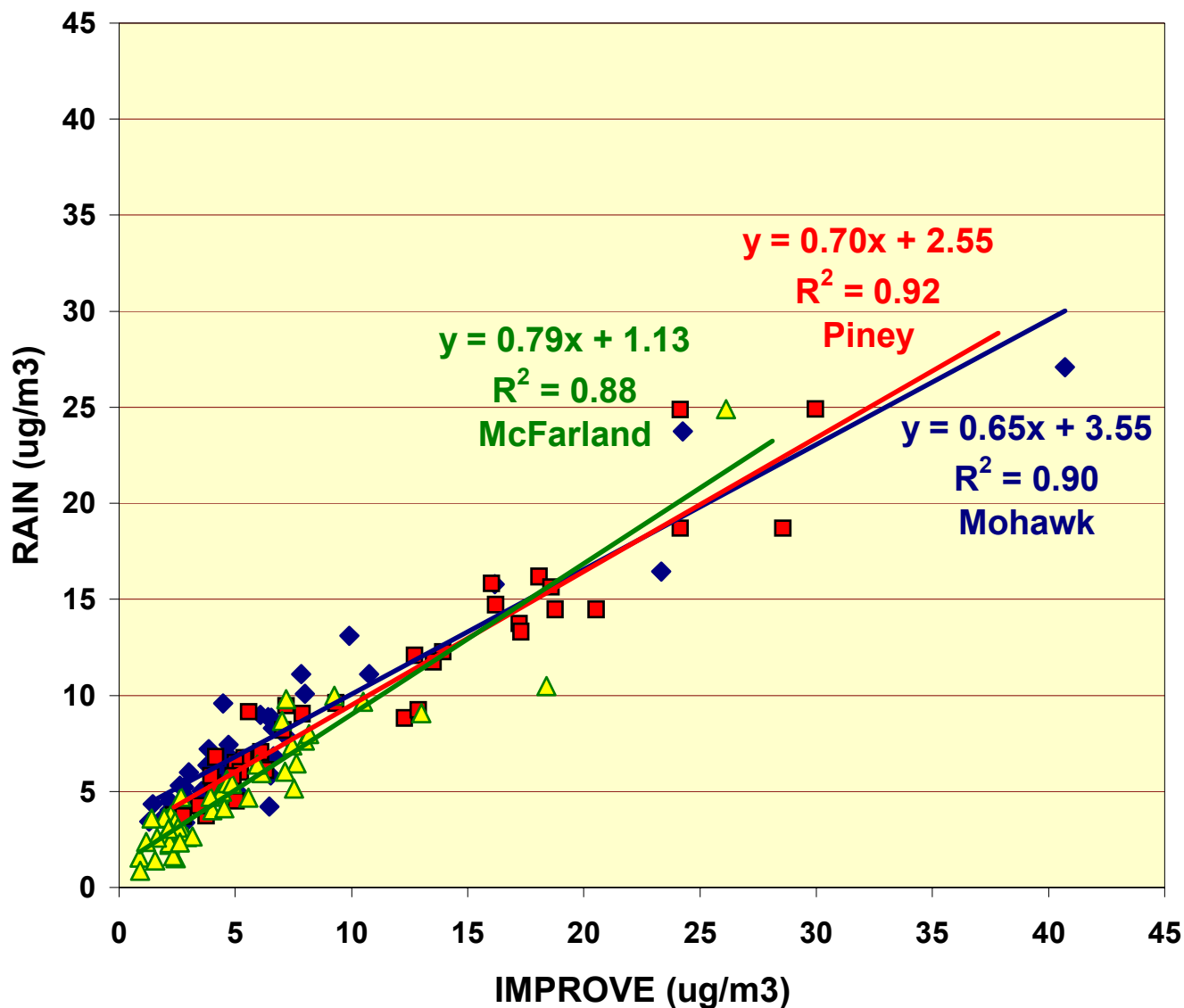
- Recent Nescaum report on initial RAIN data analysis (May 2006):
 - ==> Summarizes several aspects of the first 3 quarters of data
 - ==> Reviews data quality and consistency [Improve comparisons]
 - ==> Investigates increased summer OC aerosol at Acadia
- Available on Nescaum web site at:
<http://www.nescaum.org/documents/2006-05-memo8-rain.pdf/>
or
tinyurl.com/lvdm4
- This presentation highlights some of the major findings of this report

- How do we know it's working? ==> Mass reconstruction to continuous PM
 - use only EC/OC and sulfate 2-hour data
 - subtract $0.5 \mu\text{g}/\text{m}^3$ for OC blank; then assume $\text{OC} \times 1.8$
 - $\text{sulfate} \times 1.3$ (for ammonium) $\times 1.2$ (for water in measured PM)
 - add generic 10% for nitrate and crustal PM components

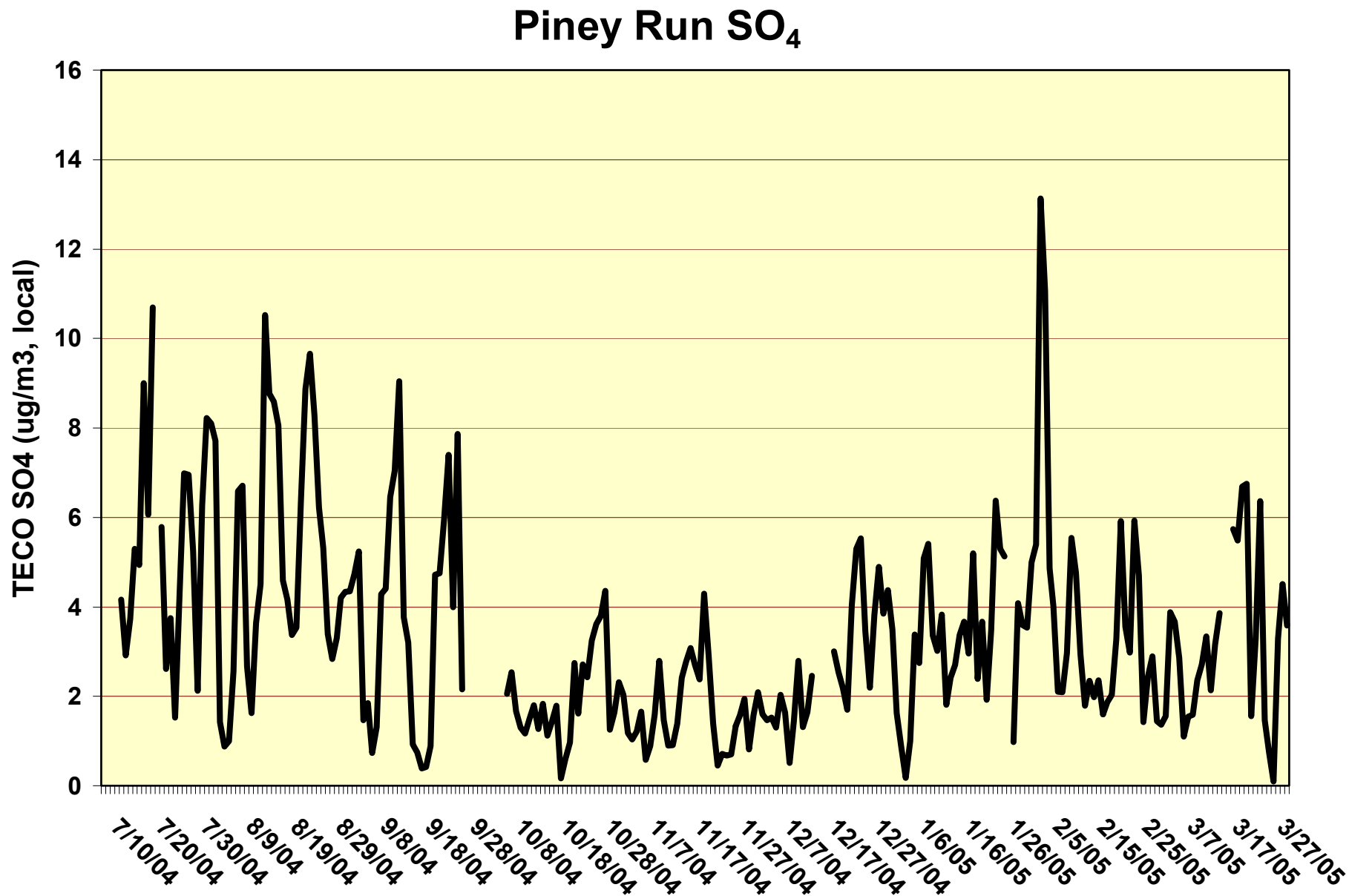


IMPROVE PM-fine from 3 sites versus reconstructed RAIN mass, Q3-4 2004
(uncorrected sulfate)

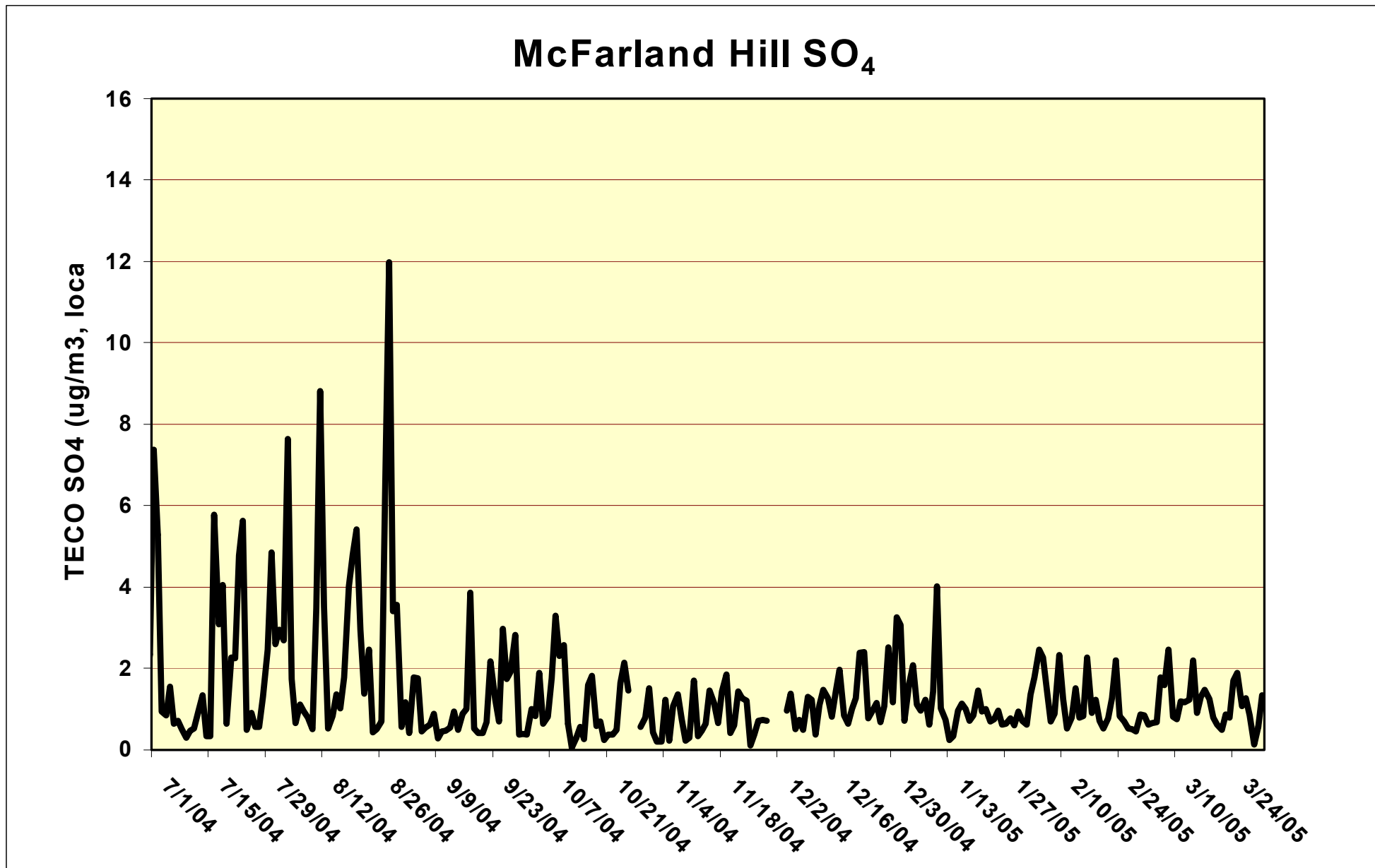
IMPROVE Fine Mass vs Reconstructed RAIN Mass



Daily (24-h) Sulfate, Western MD site (near-source)
Uncorrected data; Q3-4 2004 and Q1 2005



Daily (24-h) Sulfate, Acadia NP (Maine, far-source)
Uncorrected data; Q3-4 2004 and Q1 2005



RAIN daily SO₄ statistics June 2004-March 2005:
Uncorrected data (local t/p)

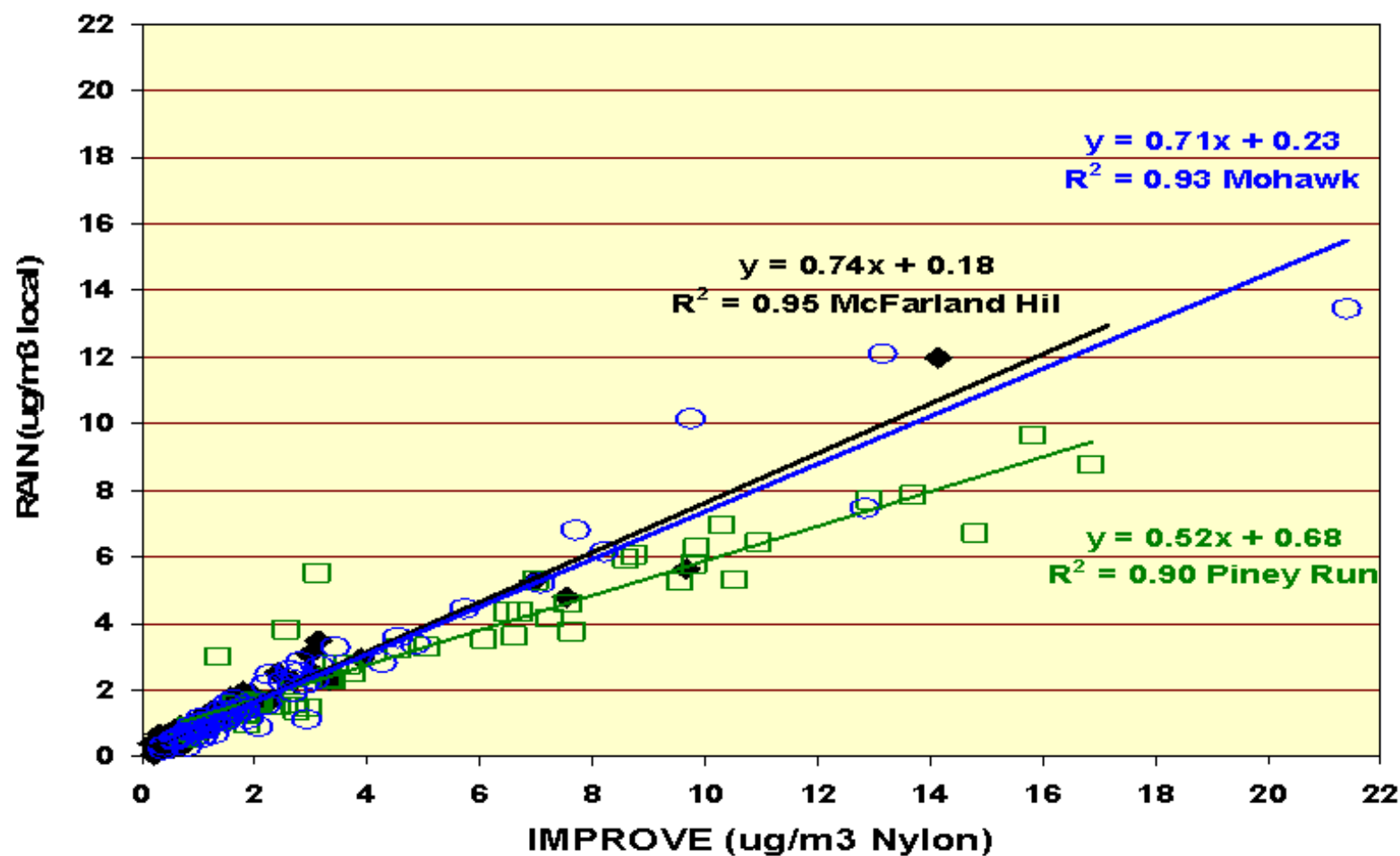
	Piney Run TECO SO₄	Mohawk Mtn. TECO SO₄	McFarland Hill TECO SO₄
Max. (ug/m3)	13.1	14.1	12.0
2nd high (ug/m3)	11.1	13.5	8.8
Mean (ug/m3)	3.38	2.13	1.41
Median (ug/m3)	2.90	1.37	0.95
Num. of Obs.	245	266	272

Continuous method bias... 15 to 35% low (but highly correlated with filters)

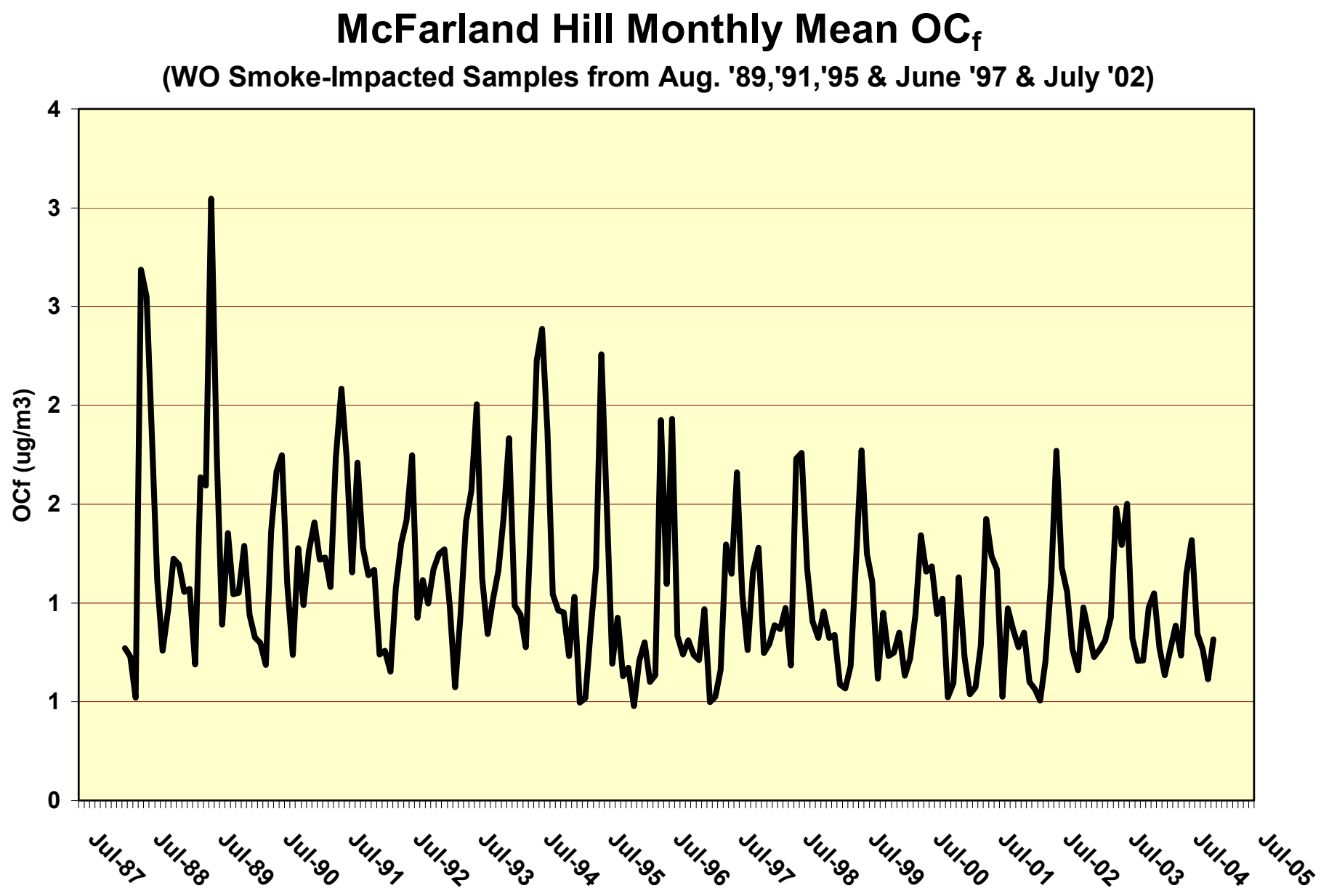
With corrections based on Improve Sulfate, Piney Run would be highest Max and 2nd highest, and higher mean/median.

IMPROVE vs RAIN SO₄

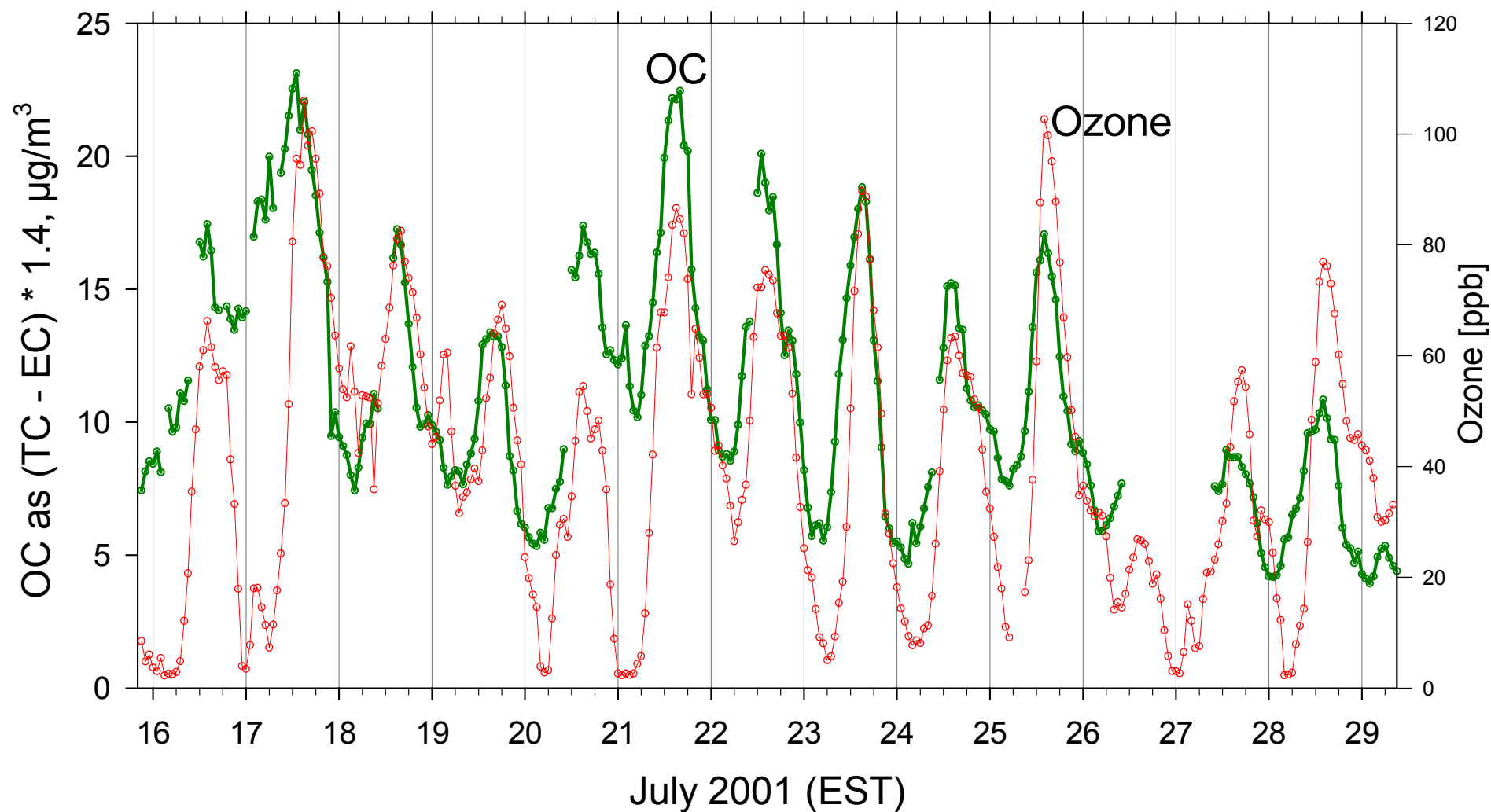
(Data Spans 6/26/04 - 12/29/04)



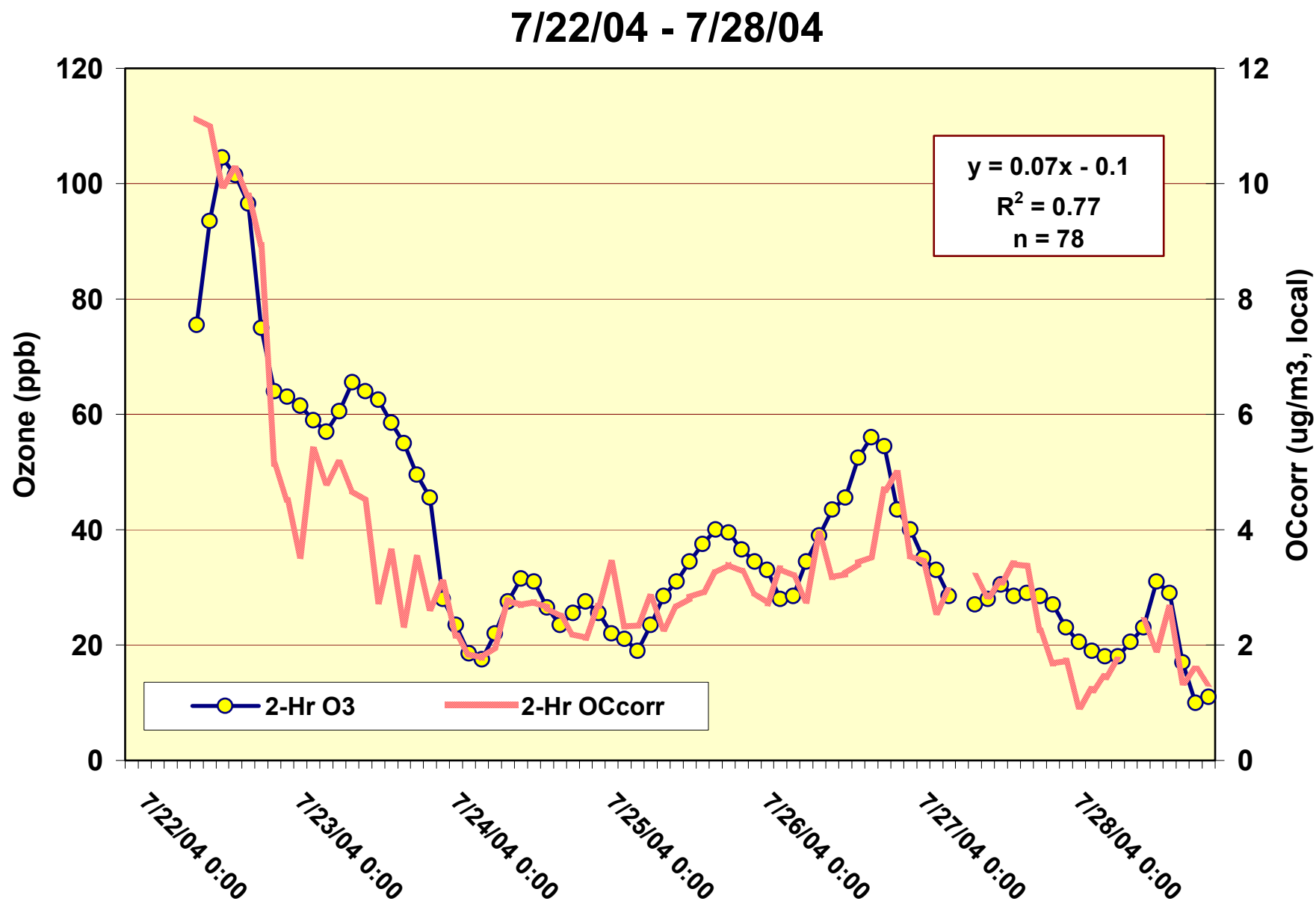
IMPROVE OC, Acadia National Park, Maine: 18 year record.



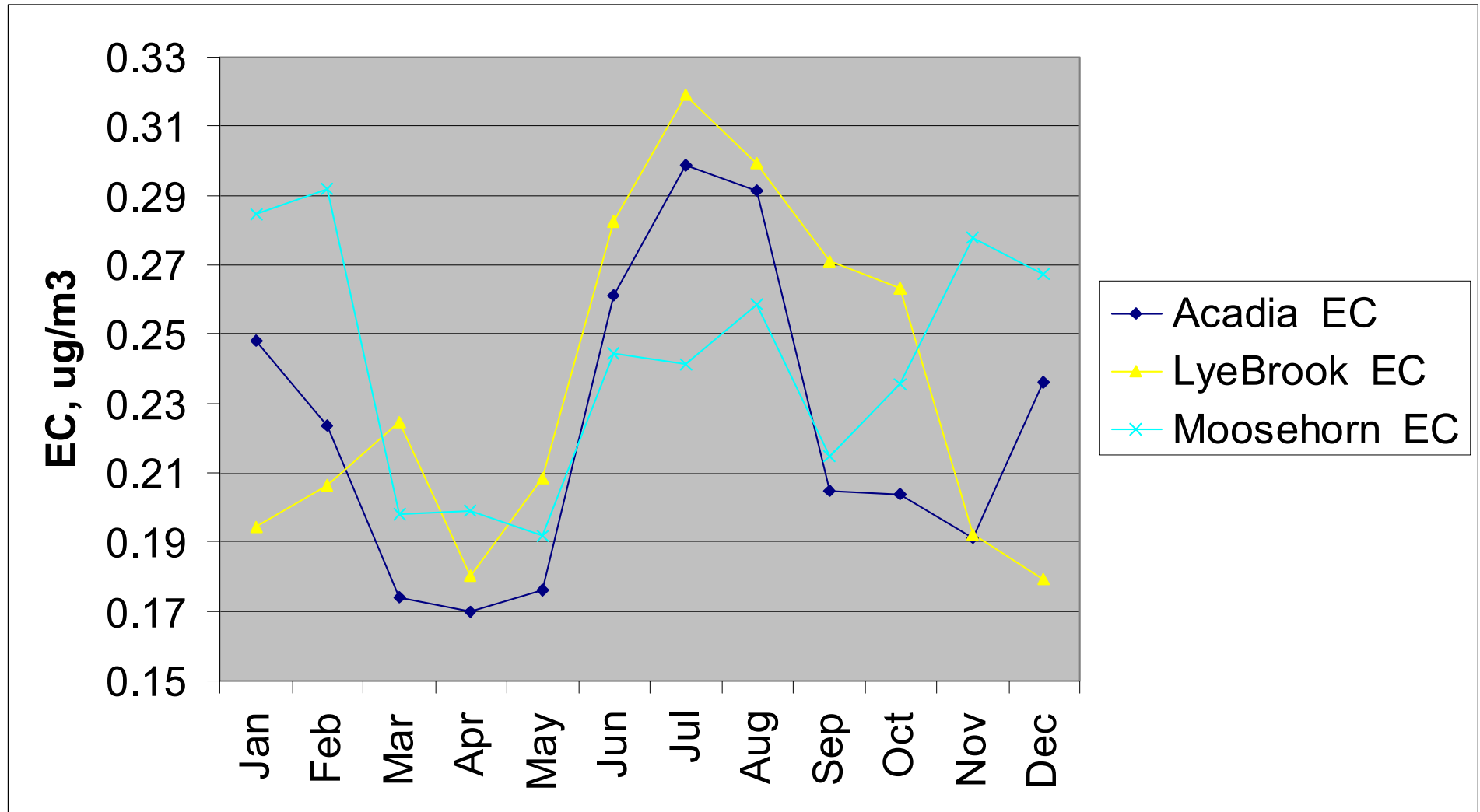
Sunset Labs 1-Hour Organic Carbon and Ozone Philadelphia-Baxter (NEOPS)



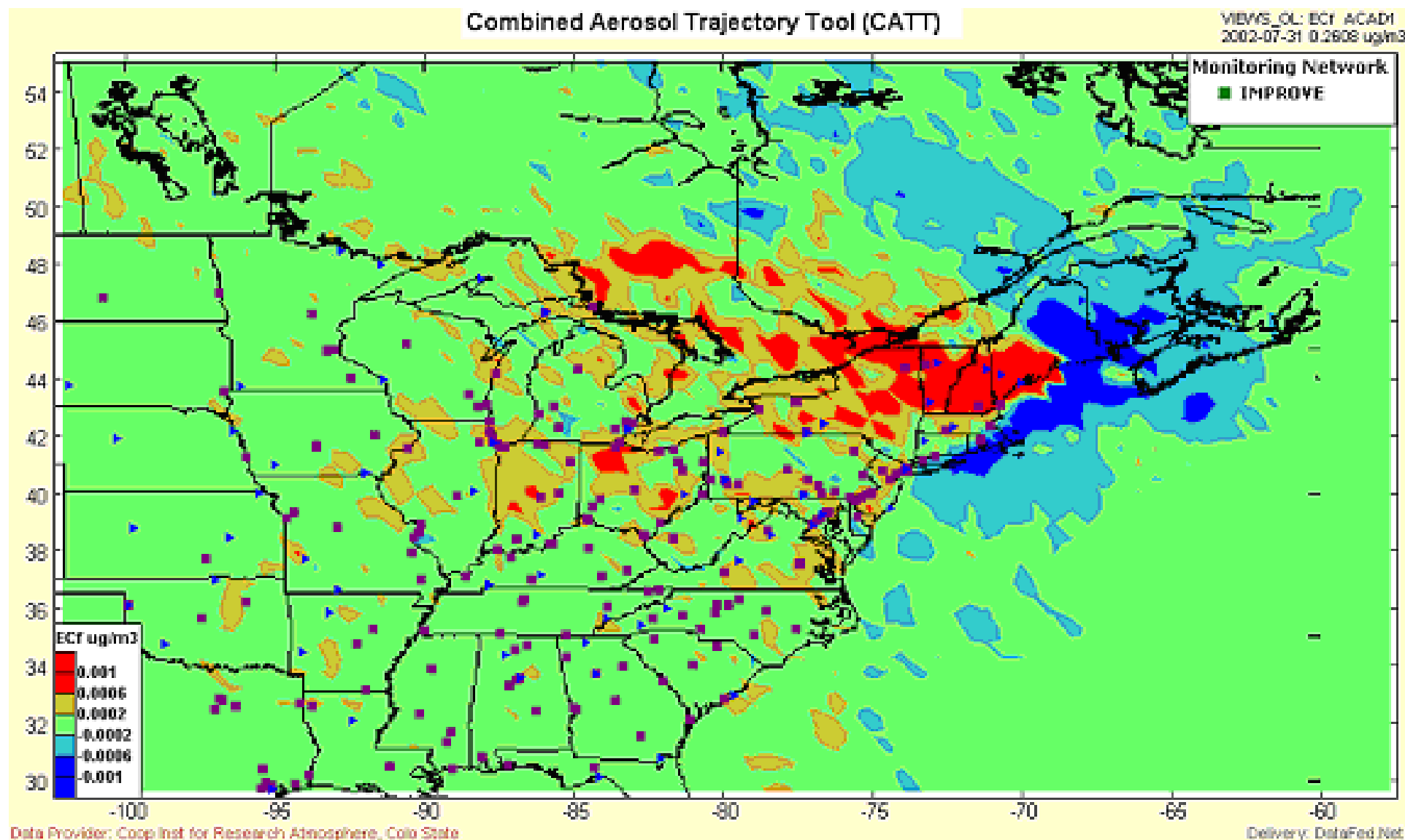
Example of episodic ozone vs. organic carbon - Mohawk Mtn. CT



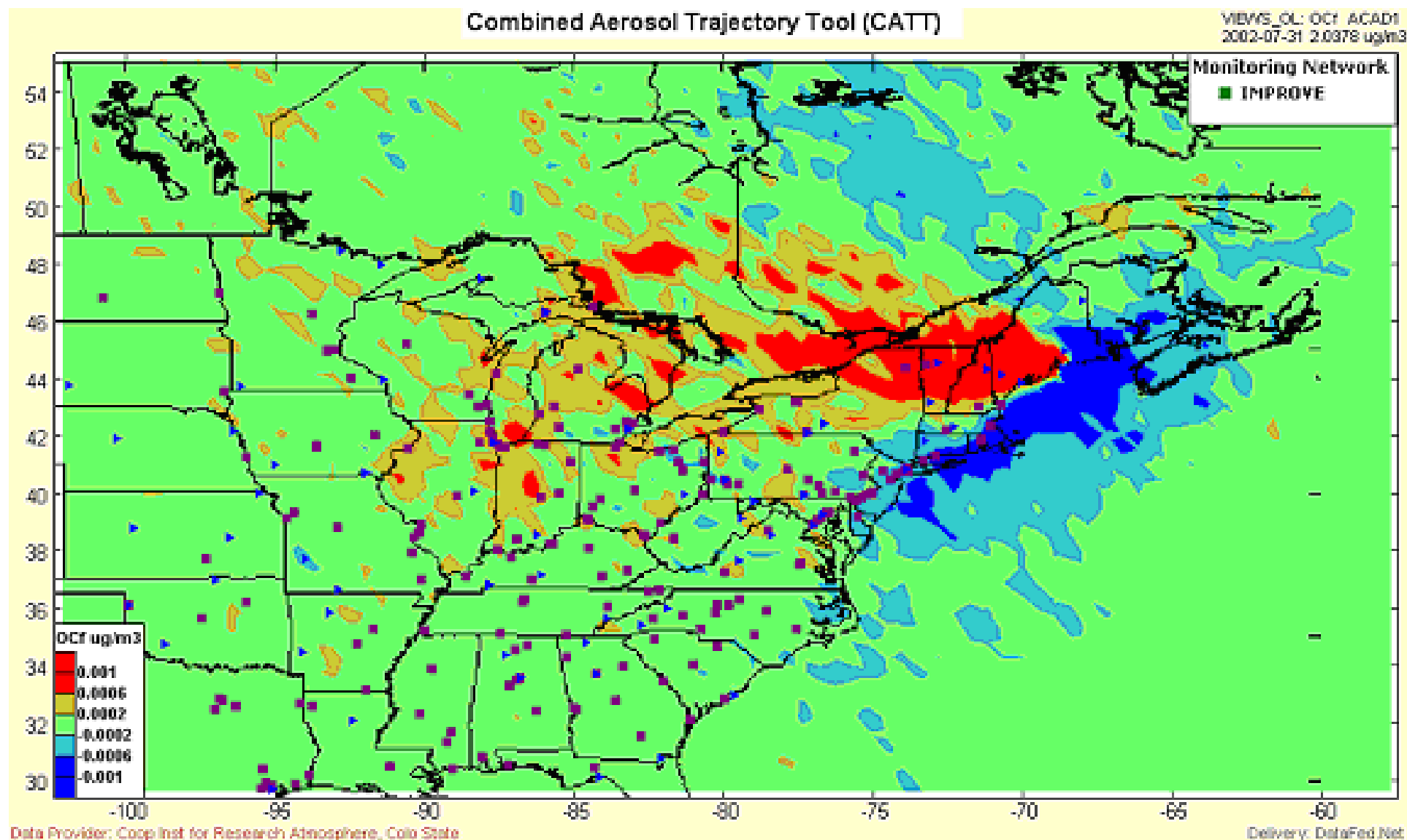
Mean monthly EC concentrations - Acadia, Lye Brook, and Moosehorn
IMPROVE sites (1995-2004):



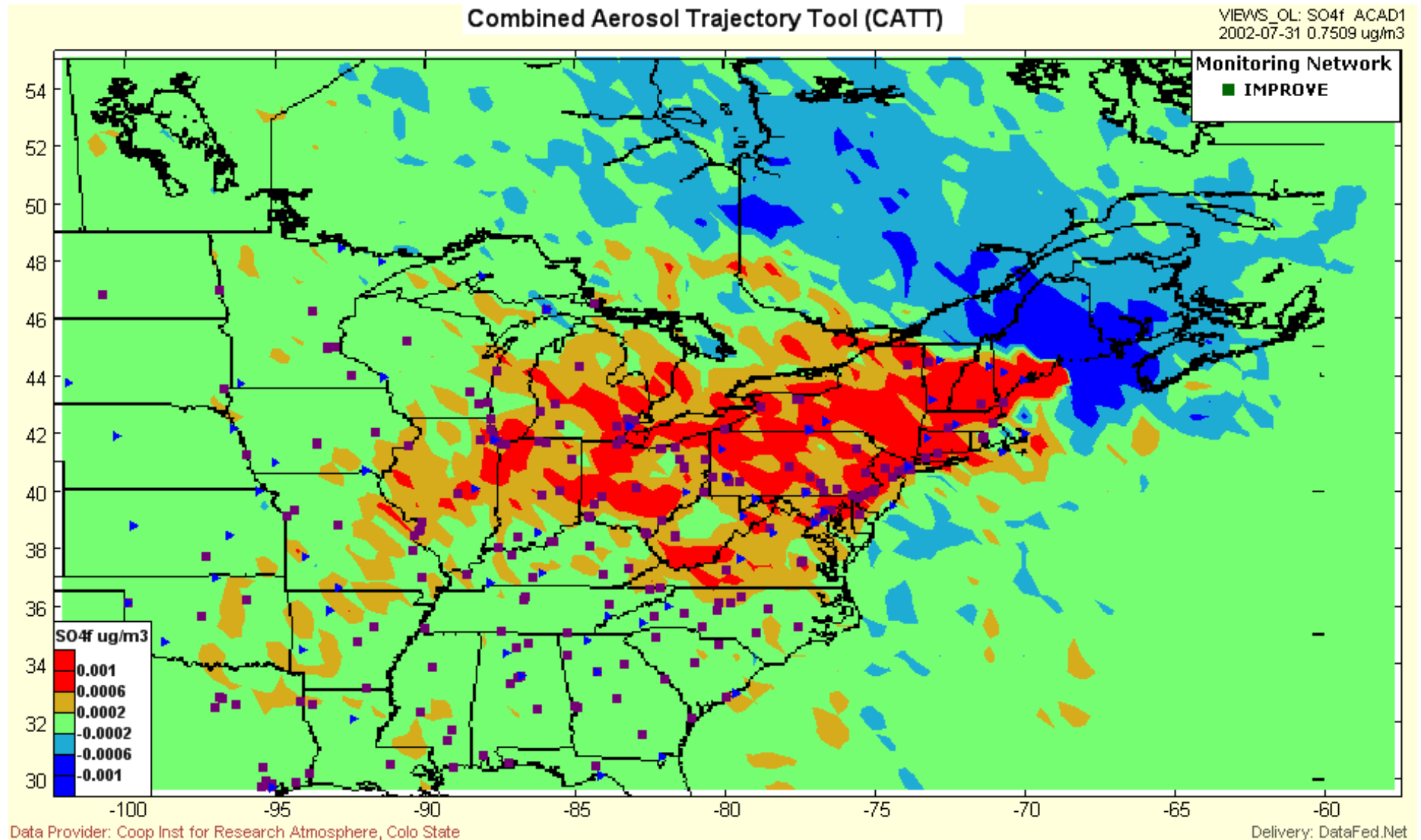
Potential Source Region for EC at Acadia National Park between 1995 and 2005 during June, July August (Courtesy of DataFed.net and CATT)



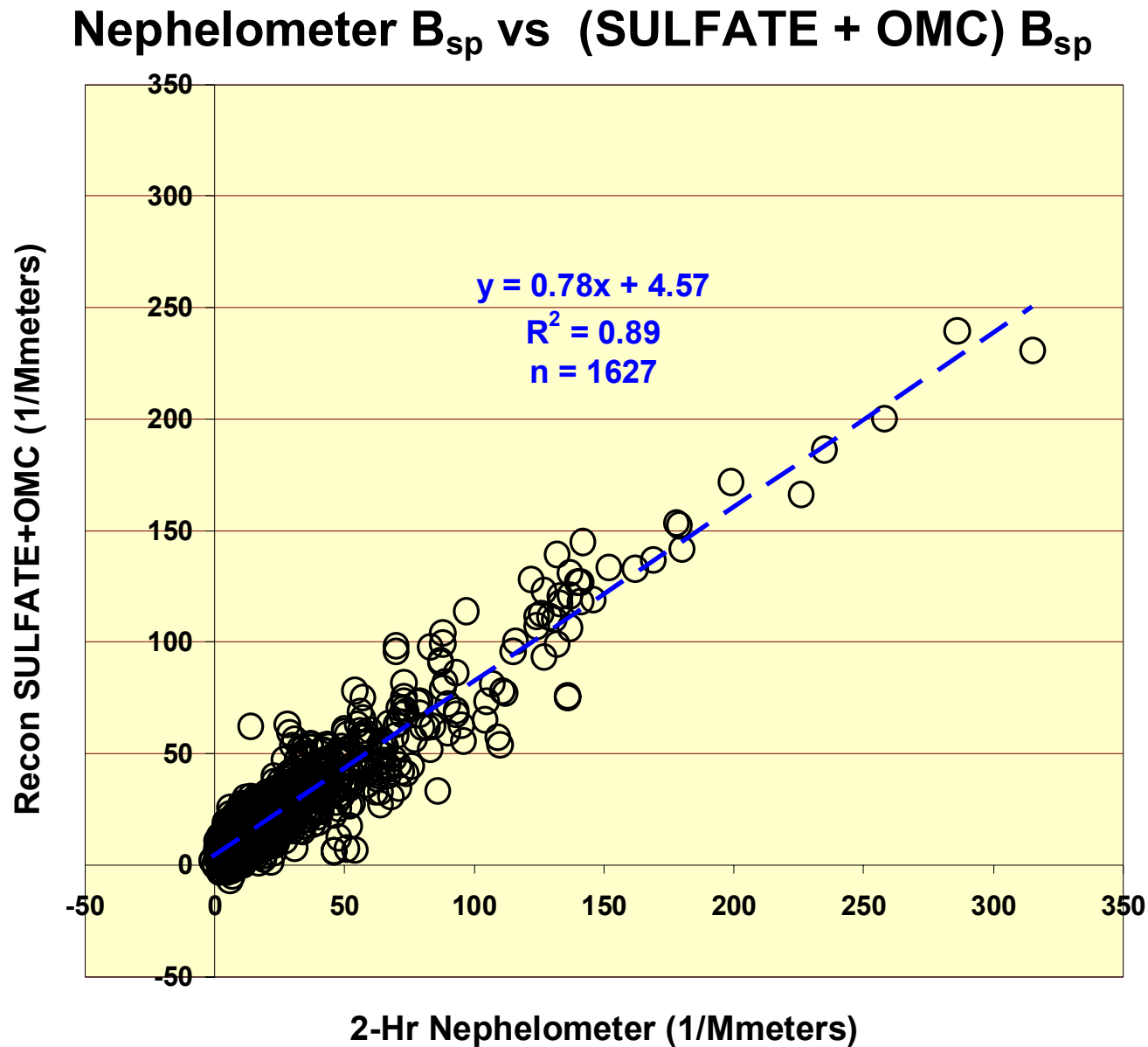
Potential Source Region for **OC** at Acadia National Park between 1995 and 2005 during June, July August (Courtesy of DataFed.net and CATT)



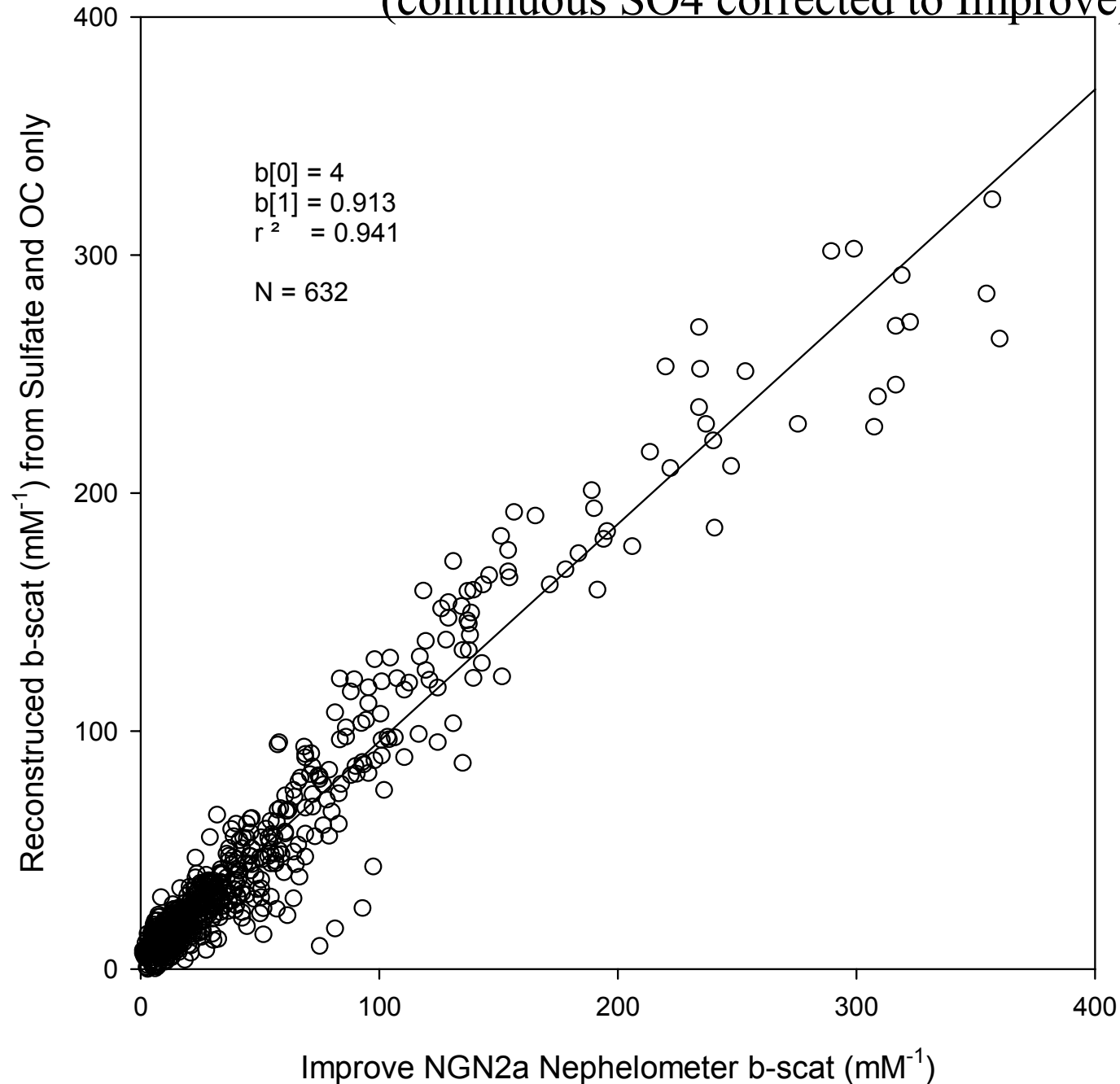
Potential Source Region for **SO₄** at Acadia National Park between 1995 and 2005 during June, July August (Courtesy of DataFed and CATT)



Acadia Improve nephelometer visibility data versus reconstructed visibility from both sulfate (uncorrected) and carbon - 2 hour intervals (Q3-4, 2004)



Acadia NP, July 6 - Sept 27, 2004 2-hour Reconstructed scattering
(continuous SO₄ corrected to Improve)



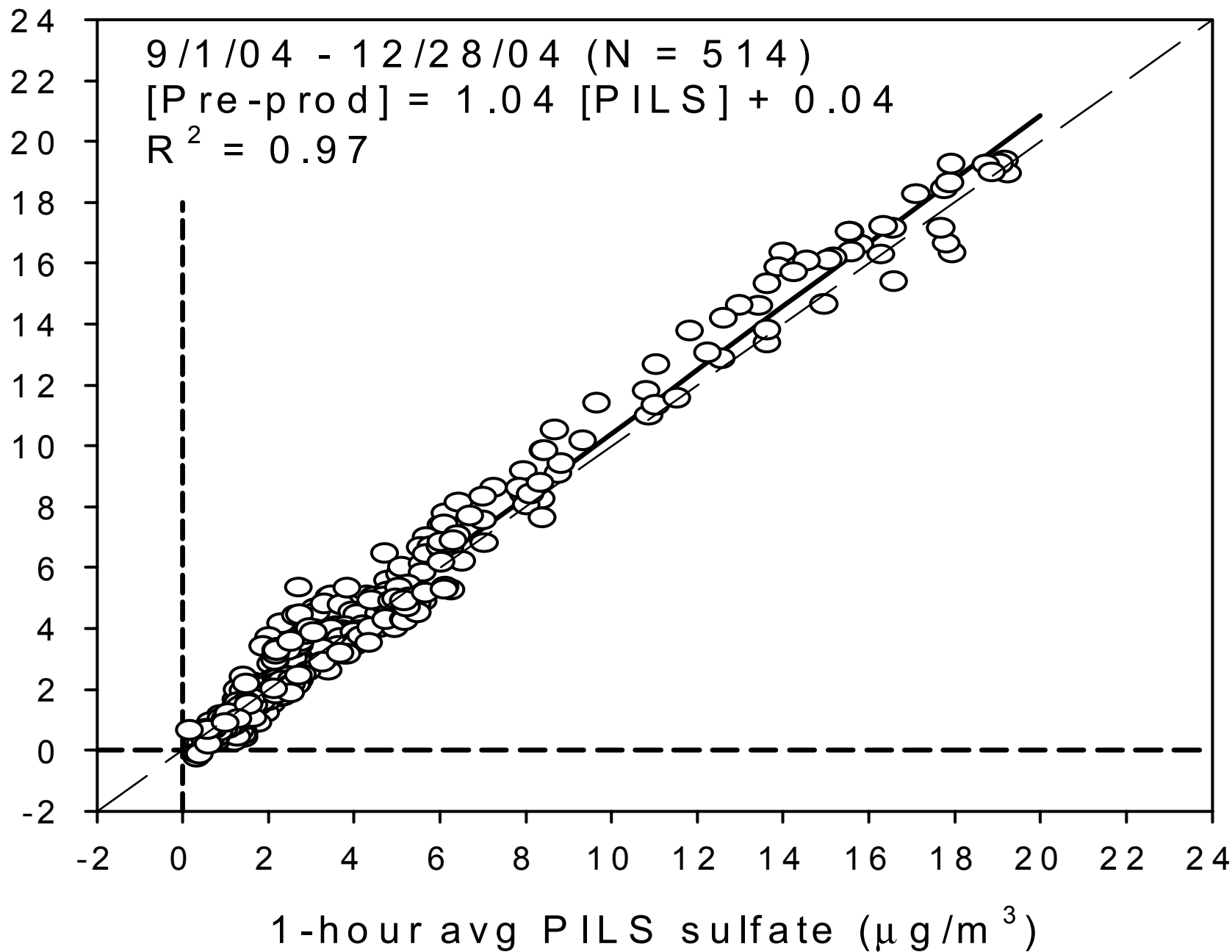
Using old Improve factors except 1.8 for OC-mass;

No NO₃ or crustal components included

Method performance issues and solutions

- Sunset Carbon:
 - OC Blanks, OC Blanks, OC blanks...
 - High and variable; current analysis assumes minimal blank value
 - Work in progress to lower blank levels and variability
shorter analysis time, hardware retrofits, better denuders?
 - Plans for a Sunset “data masher” for processing and validation
- NGN2a “wet” neph (b-scat visual range)
 - raw data are difficult to reduce and validate
 - ARS developed NGN2a Neph “data masher” tool for RAIN
 - Improve-like data processing approach
- Thermo Sulfate
 - under-measures 20-35% [but highly correlated with Improve SO₄]
 - correctable; work underway to determine cause
 - Goodwin/Turner and other work shows 100% efficiency
 - Jay Turner and NESCAUM developed a Thermo 5020 SO₄ “data masher” for automated data processing and validation

Response (1-hour) of Model 5020 vs. PILS (1-hour) results (St. Louis Supersite)



The Future...

- PSP/Addison NY becoming Rain-ey; just needs NGN2a wet neph
[Sunny-Albany/NY-DEC]
- Sunset Carbon at Airmap/TF and Pack Monadnock NH
Real-time SO₄?
- HSPH (Boston) Sunset carbon and Thermo SO₄ (EPA PM-Center)
- Future funding models for RAIN site and CAMNET operation?
→ MANE-VU EPA funds will be sharply decreasing FY07 and beyond
- Rain Technical Memo #8 available on Nescaum web site at:
<http://www.nescaum.org/documents/2006-05-memo8-rain.pdf/>
or
tinyurl.com/lvdm4

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MANE-VU