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Continuous Methods

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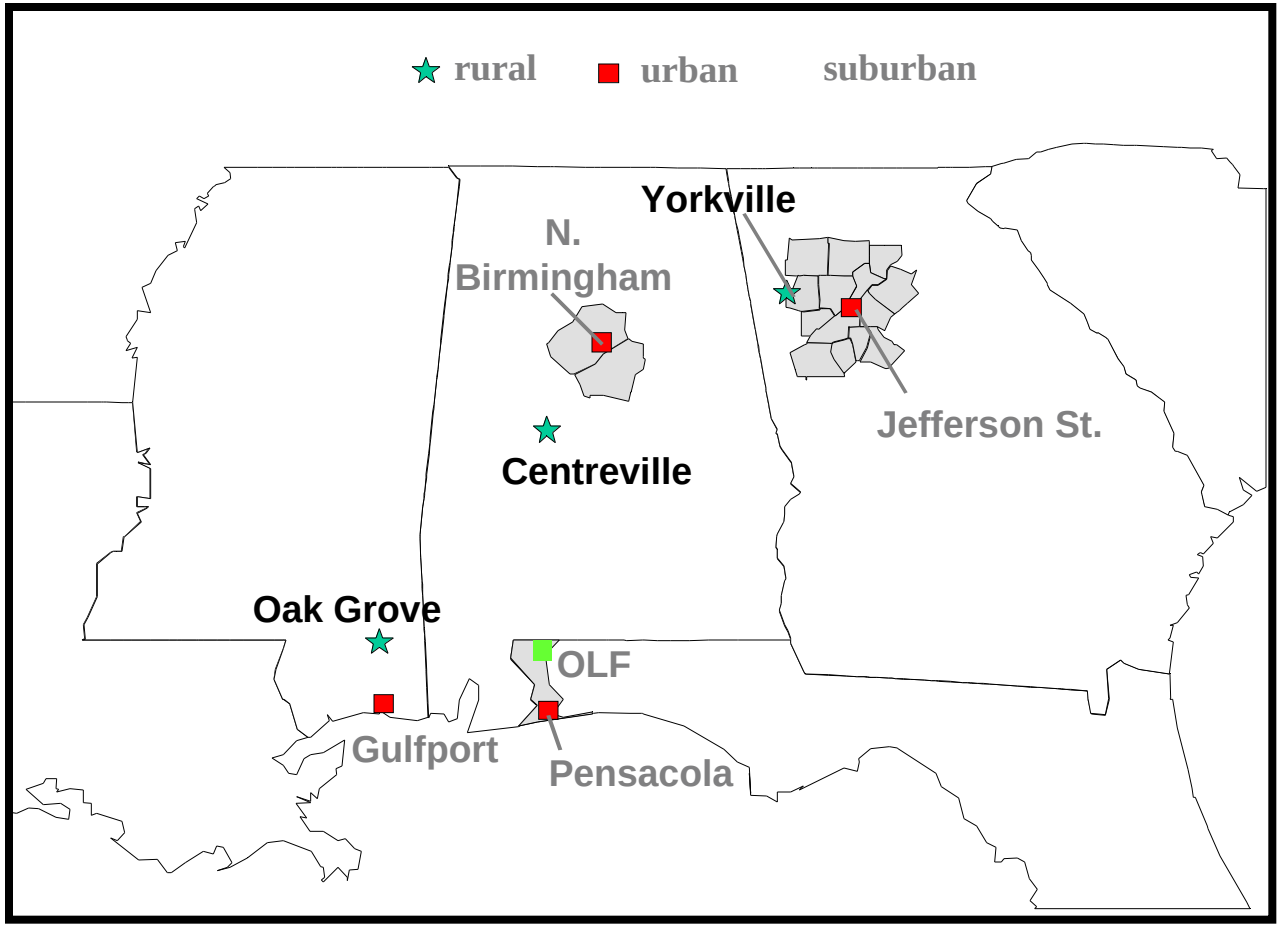

Applications of Continuous Gas and PM Data

- Hourly Reconstructed Mass
- Formation Processes
- Emissions Estimates/Confirmation
- Diagnosis of Extreme Events
- Model Evaluation

SEARCH Continuous Trace Gas and Particle Measurements

Species	Method	Time Resolution	Status
O3, NO, NOy, SO2, NO2, CO	various	1-minute	commercialized
HNO3	denuder diff.	1-minute, 60-minute	routine
NH3/TRN	cat. oxid. To NO	< 60-minute	drawing board
PM2.5 Mass	TEOM, dry, 30C	5-minute	commercialized
PMcoarse Mass	TEOM, dry, 30C	5-minute	developmental
Part. Black Carbon	optical absorption	5-minute	commercialized (aethalometer))
Part. Carbon	combustion to CO2	60-minute	commercialized
Part. SO4	reduction to SO2	5-minute	modified Harvard approach
Part. NO3/NH4	cat. red./ox. to NO	5-minute	ARA

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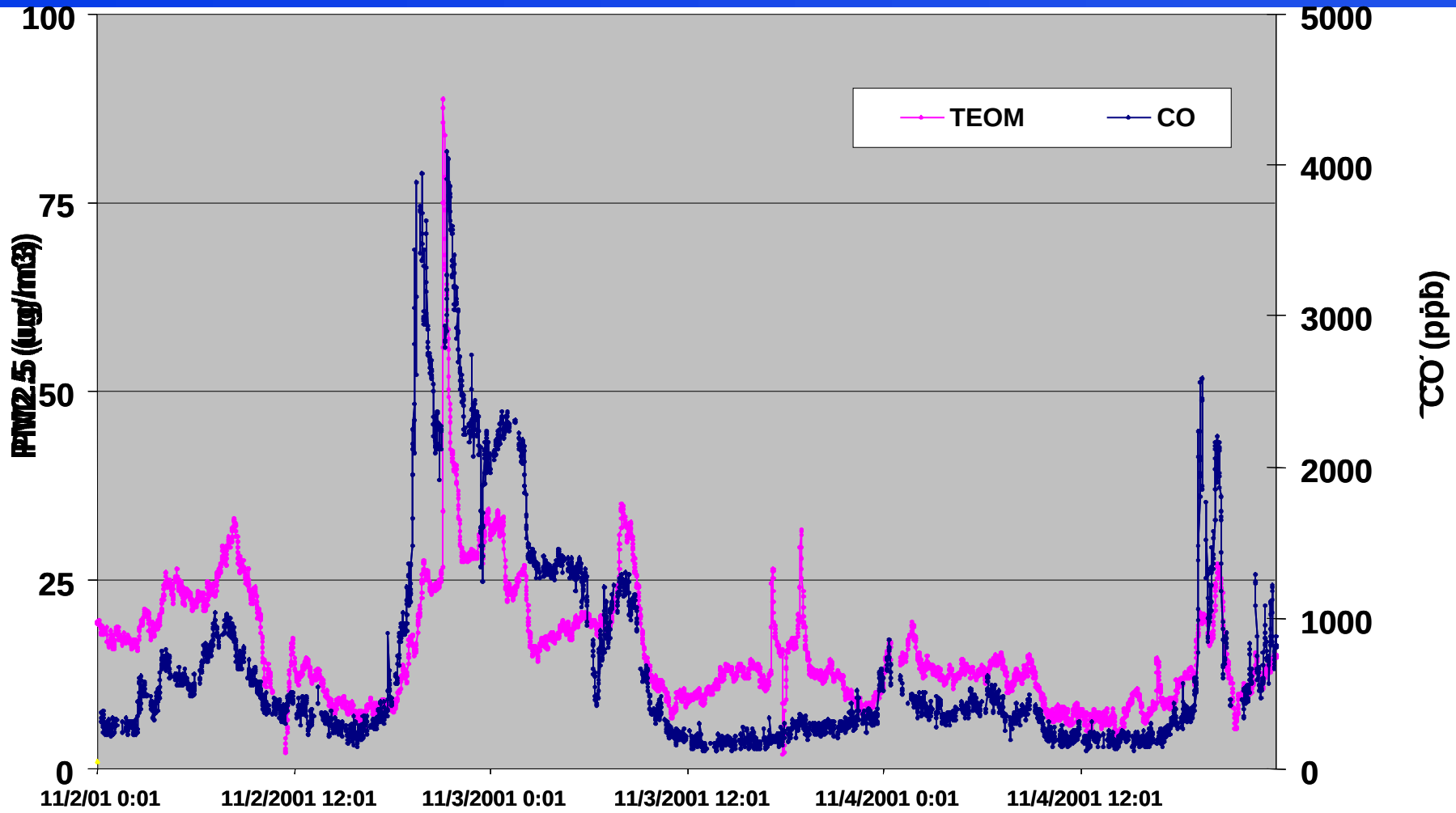
Reconstructed Mass

Hourly Reconstructed Mass
Jefferson St., GA - 8/16/01

$PM_{2.5}$ and CO
Jefferson Street, Atlanta



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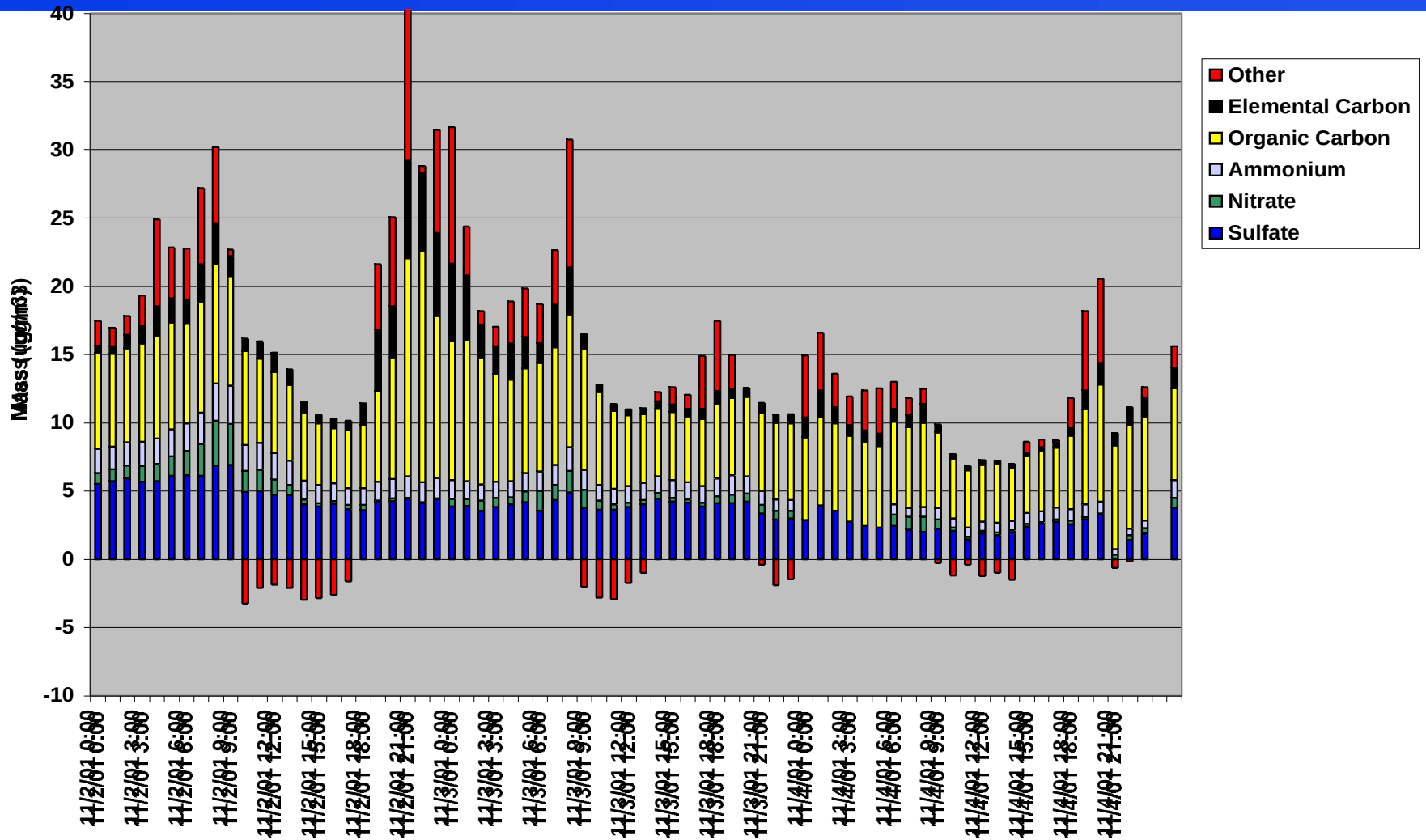
Other
Elemental Carbon
Organic Carbon
Ammonium
Nitrate
Sulfate
Mass (ug/m3)
40
35
30
25
20
15
10
5
0
-5
-10
11/2/01 0:00
11/2/01 3:00
11/2/01 6:00
11/2/01 9:00
11/2/01 12:00
11/2/01 15:00
11/2/01 18:00
11/2/01 21:00
11/3/01 0:00
11/3/01 3:00
11/3/01 6:00
11/3/01 9:00
11/3/01 12:00
11/3/01 15:00
11/3/01 18:00
11/3/01 21:00
11/4/01 0:00
11/4/01 3:00
11/4/01 6:00
11/4/01 9:00
11/4/01 12:00
11/4/01 15:00
11/4/01 18:00
11/4/01 21:00

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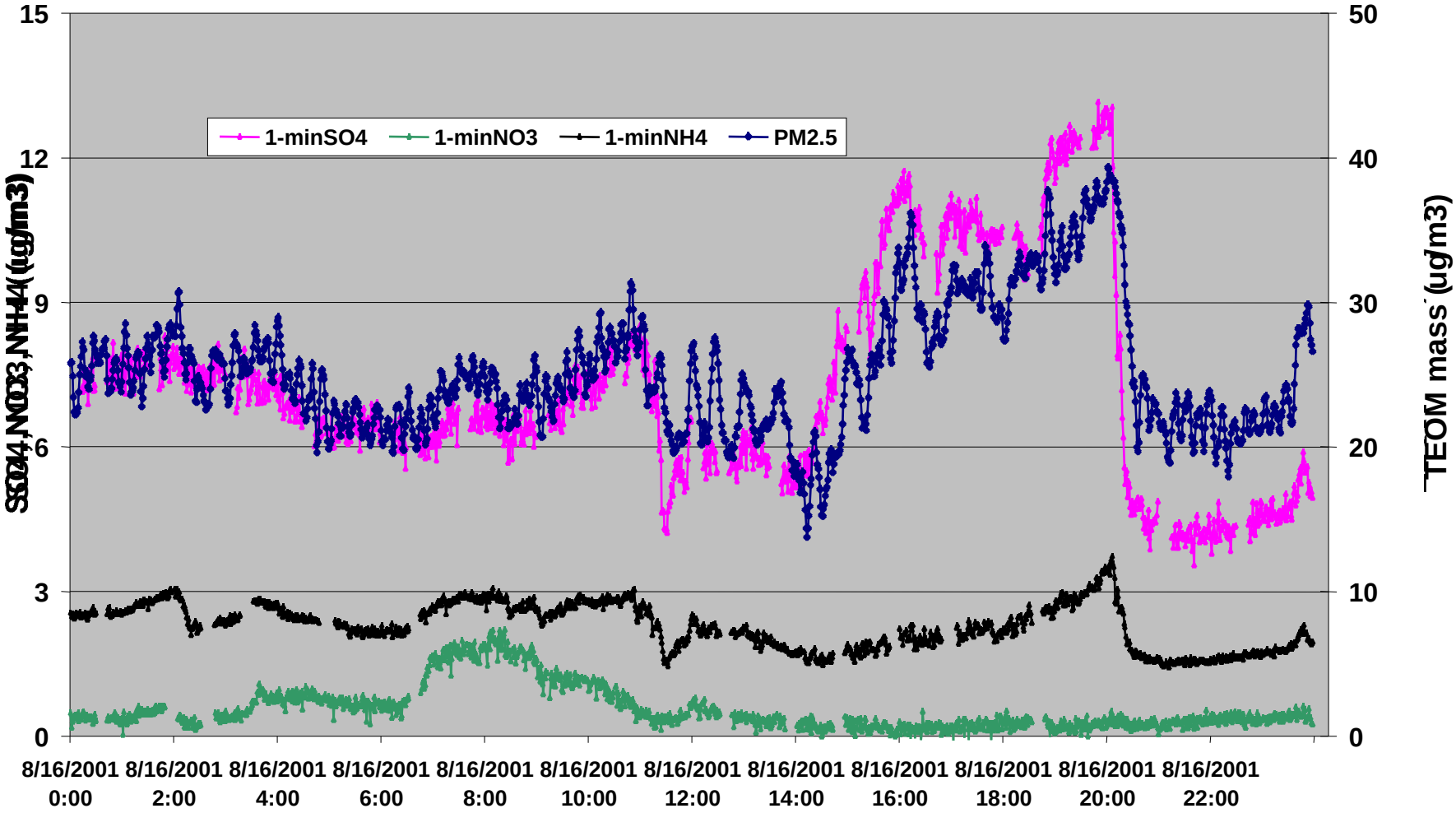
Formation Processes

Sulfate Plume
Jefferson Street - 8/16/0



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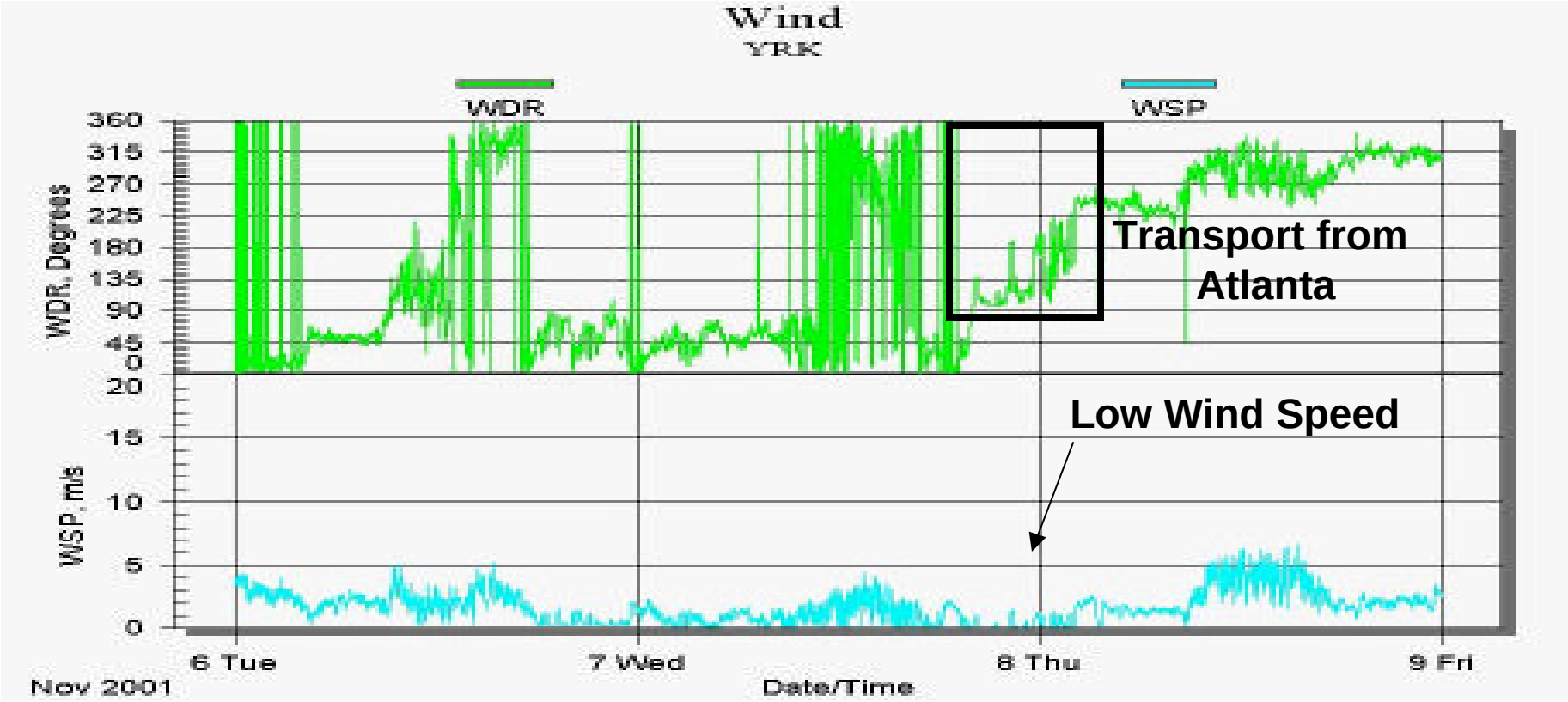
WS and WD
Yorkville, GA 11/6-8/01



Wind Data from Yorkville show Frequent Transport from the SE (Atlanta)

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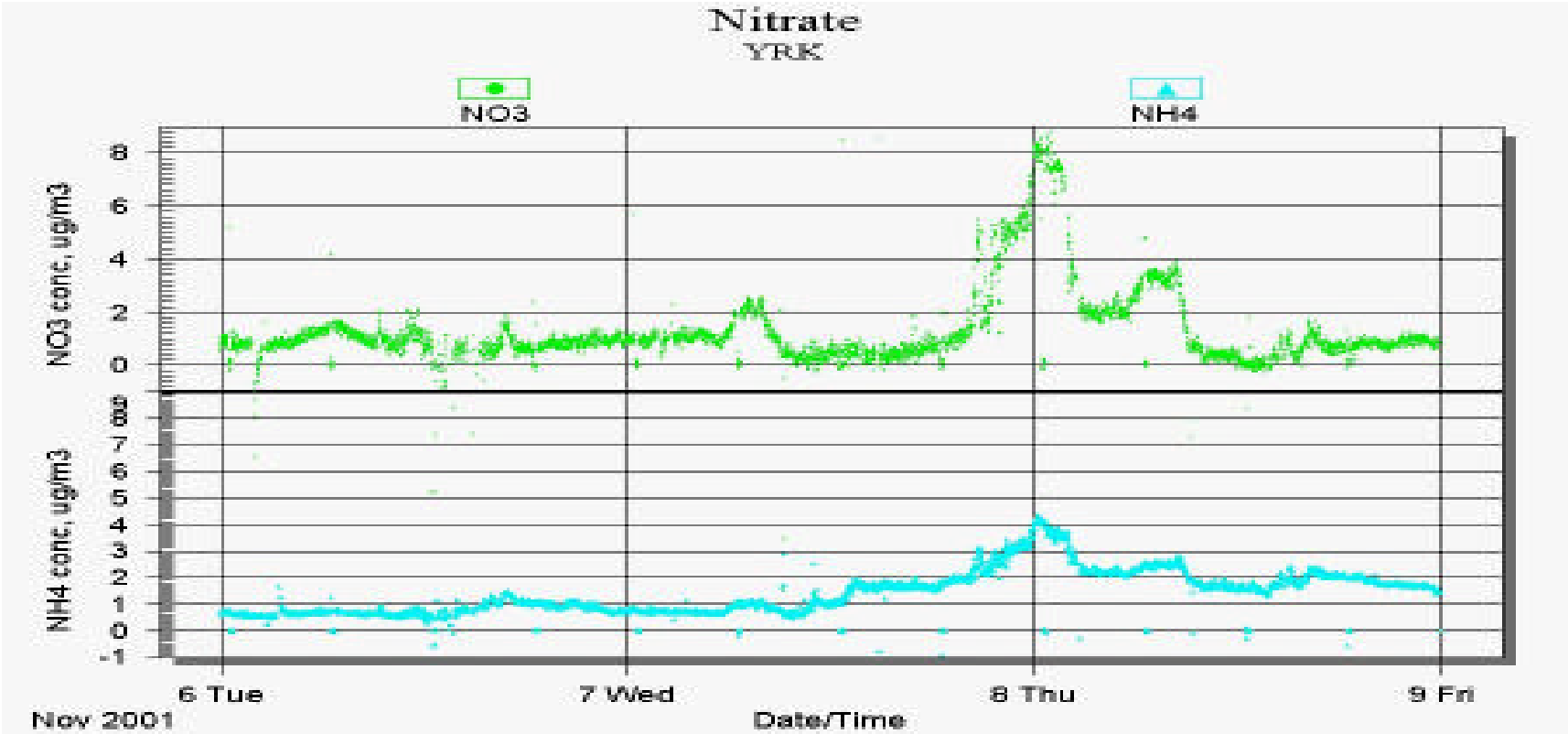
Particulate NO_3 and NH_4 Yorkville, GA 11/6-8/01



Results may Suggest Mixing of Rural (NH_3)and Urban Pollutants (HNO_3) can Produce High Concentrations of Particulate Nitrate and Ammonium

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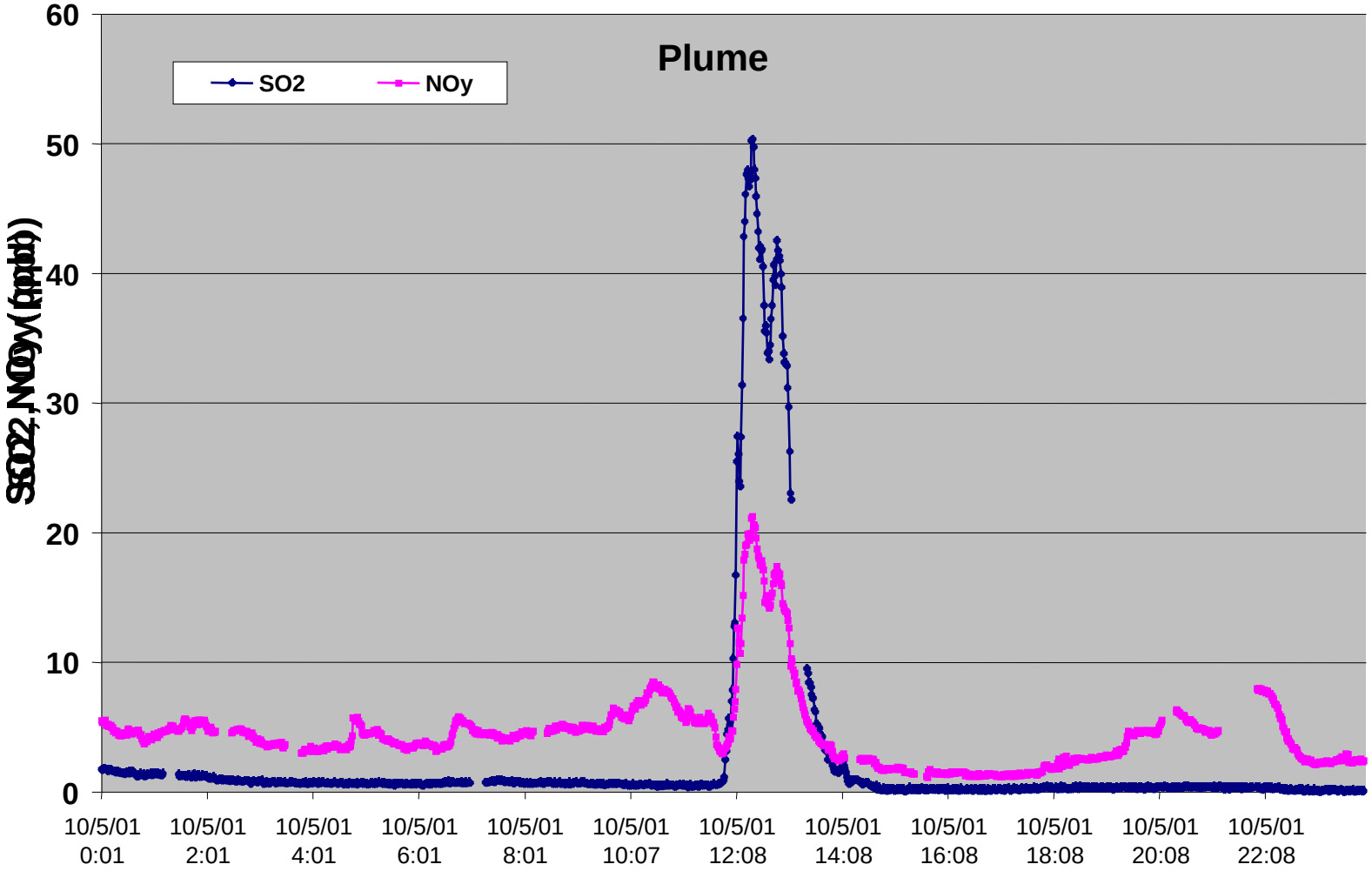
Sulfate Production in a Point Source Plume
Yorkville, GA 10/5/01



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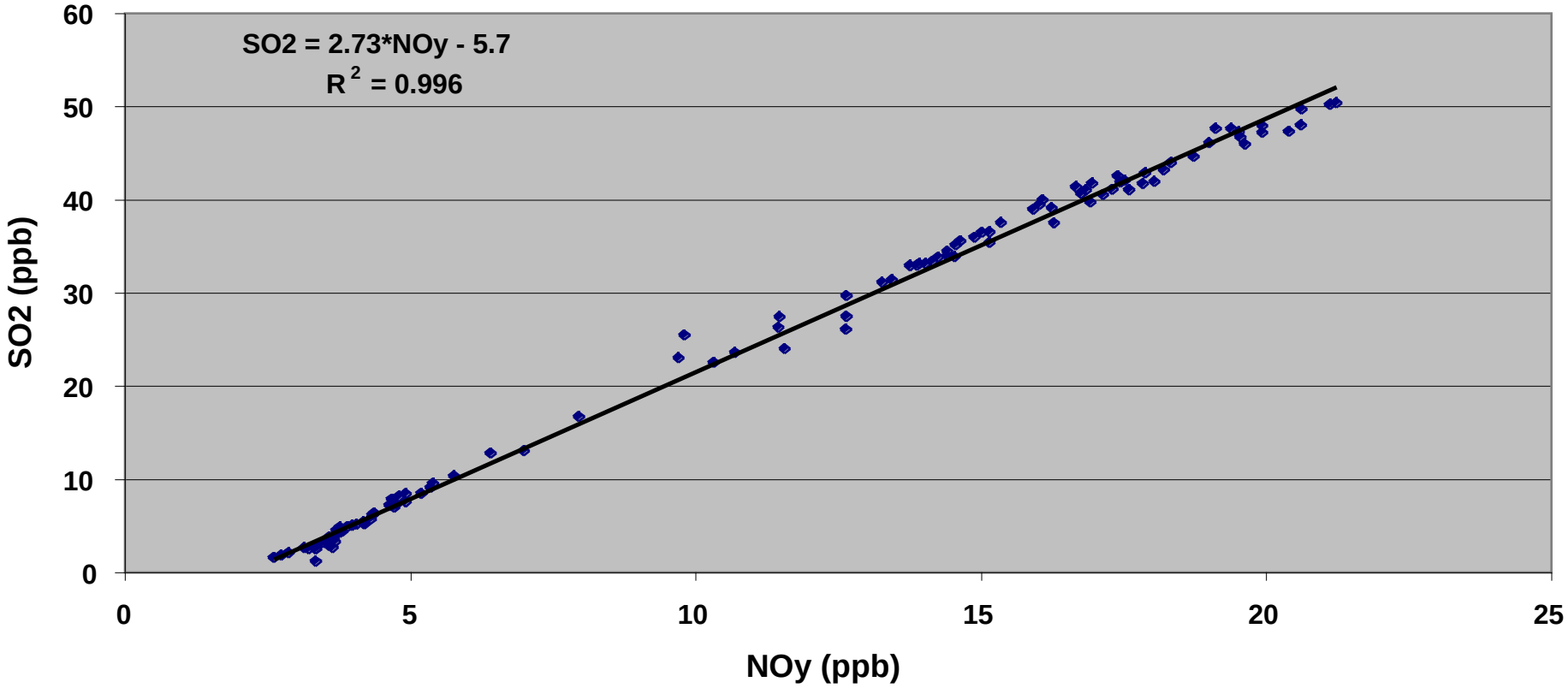
SO_2 vs. NOy
10/5/01 Event, Yorkville, GA



SO_2/NOy Relationship Bears Signature of Known Point Sources SW of Yorkville

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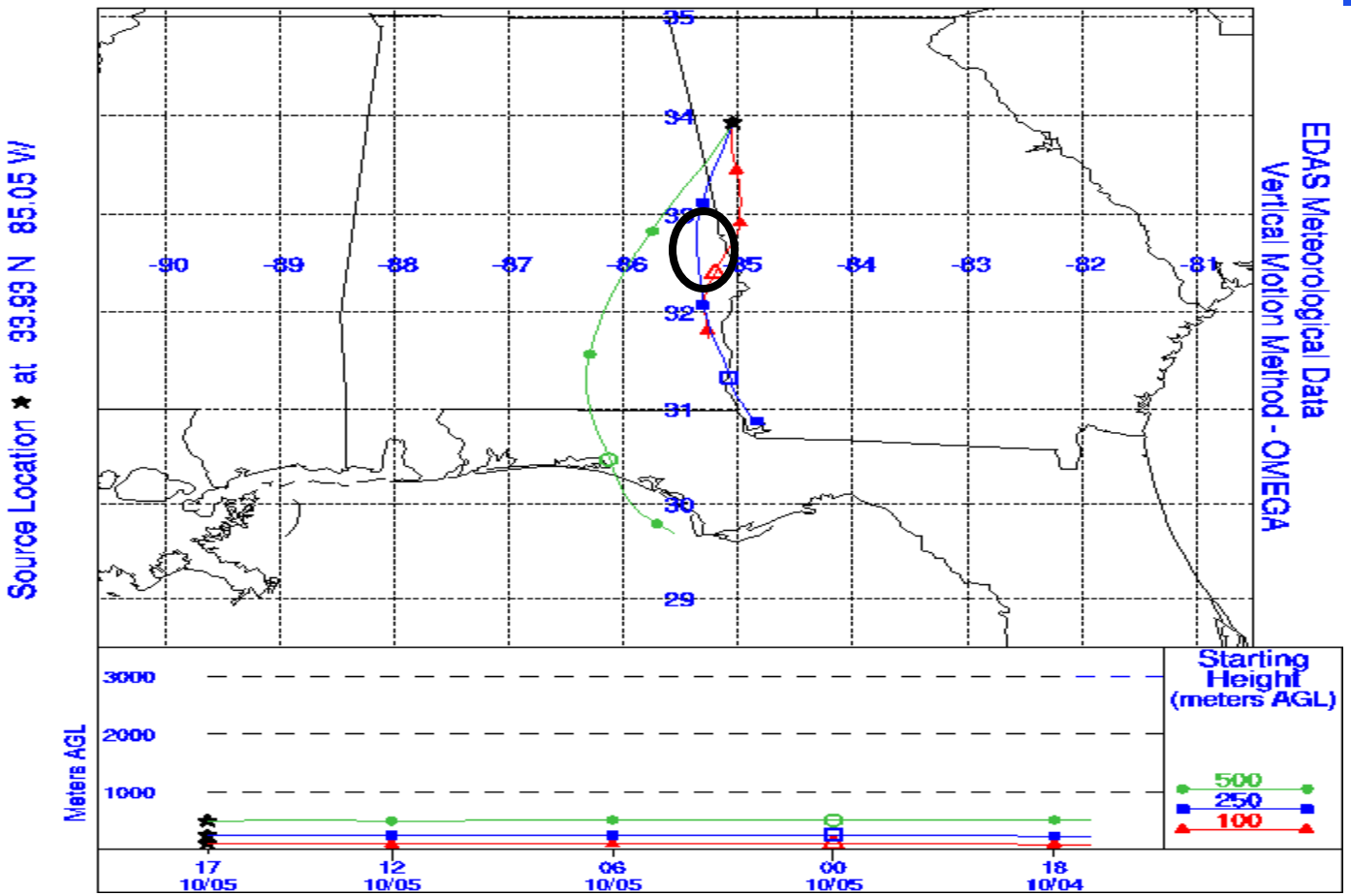
Backward Trajectories Ending- 17 UTC 05 OCT 01



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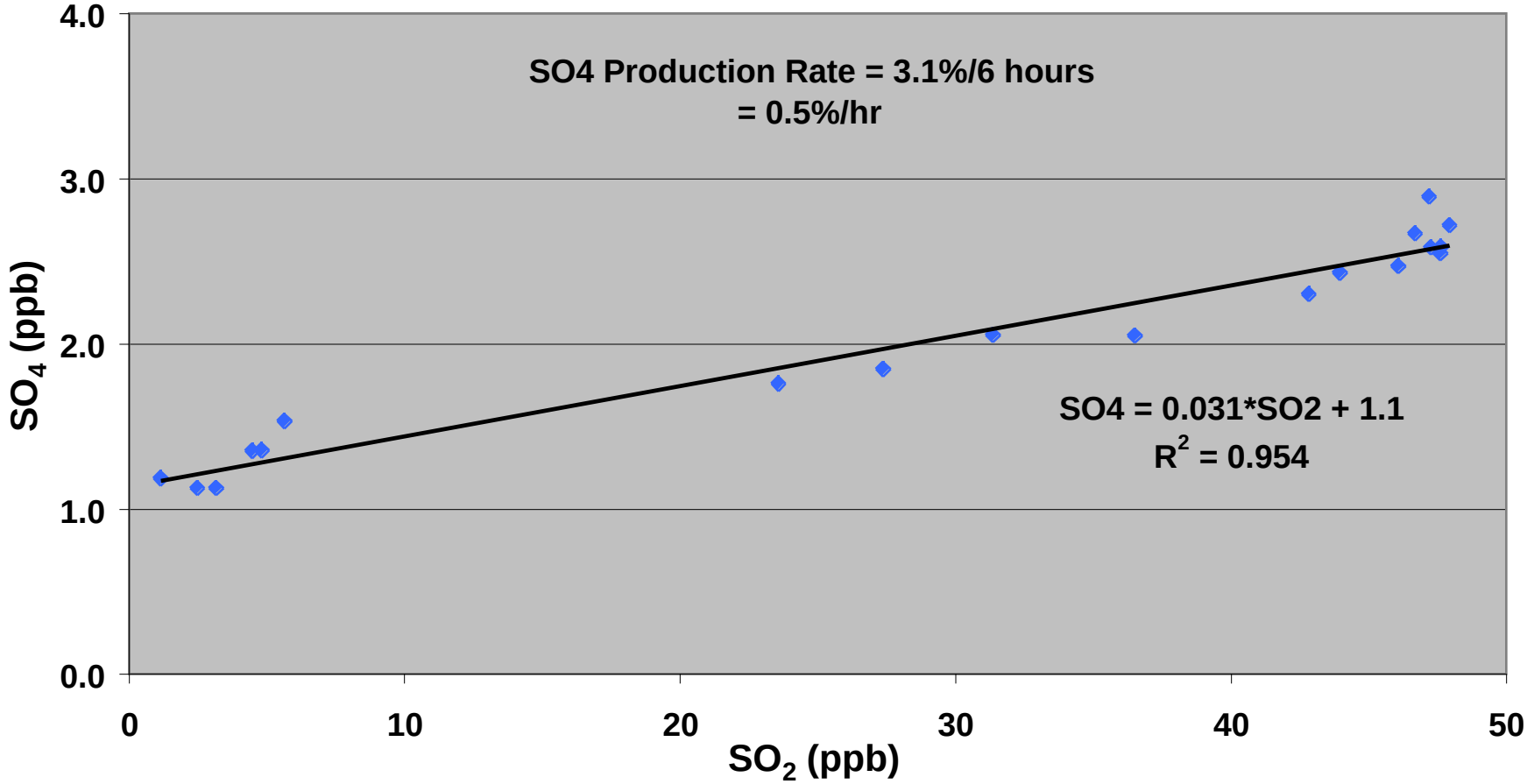
Sulfate Production Based on Relationship With SO_2 and Transit Time



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Important for Understanding Hygroscopicity and Light Scattering

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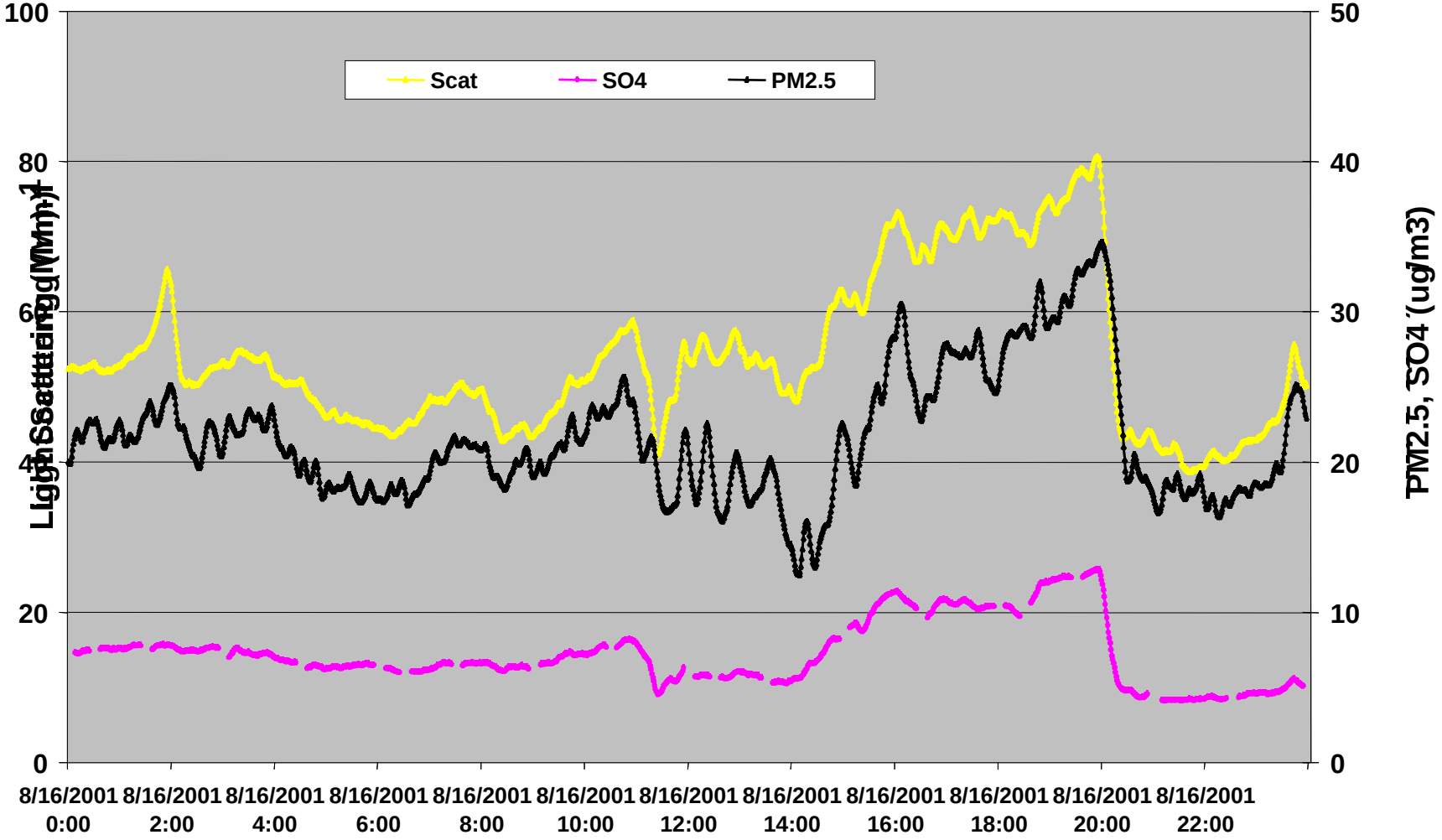
Light Scattering, PM2.5 and Sulfate Jefferson Street - 8/16/01



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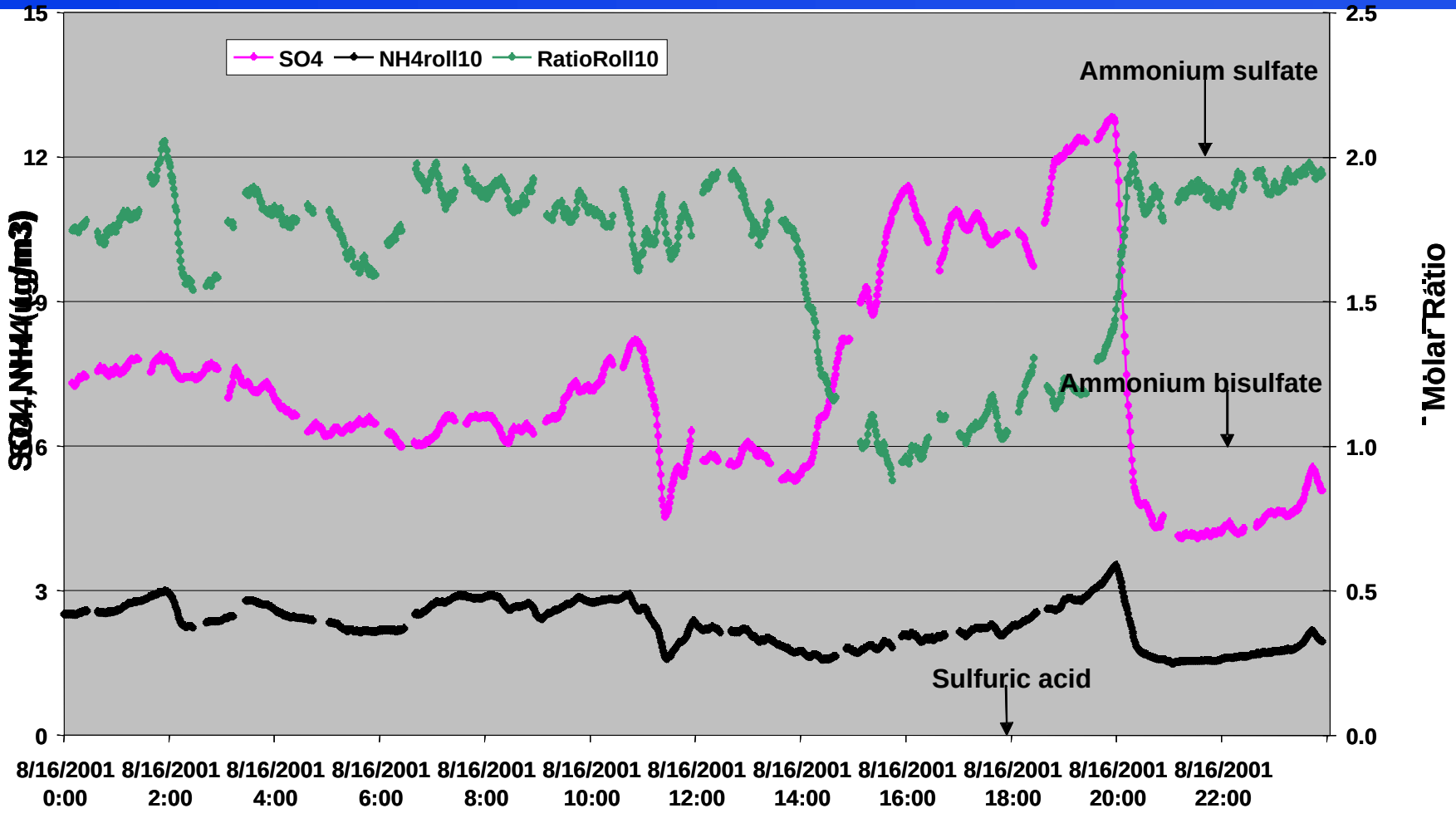
Molar Ratio of NH4 to SO4
Jefferson St., GA - 8/16/01



Molar ratio of NH4 to SO4 is not necessarily constant.

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Emission Factor Estimates

Emission Factor Calculations

$$EF = \frac{[x]_{event} - [x]_{background}}{[tracer]_{event} - [tracer]_{background}}$$

where tracer is abundant and stable (e.g., CO). EF expressed in units of ppb/ppm for gases and ug-m^{-3}/ppm for particulate species

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Urban (Atlanta) vs. Biomass EFs (Relative to CO)

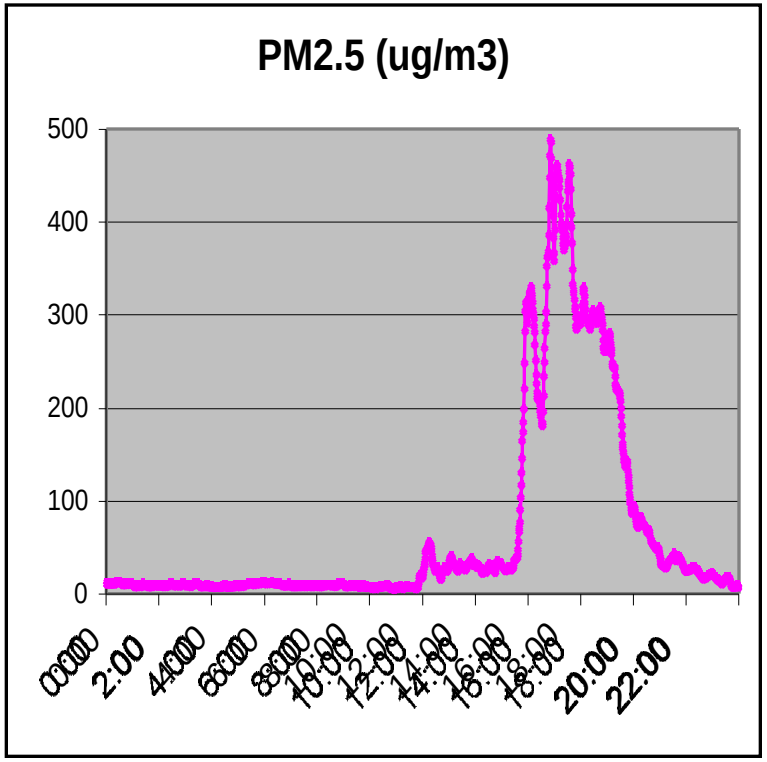
Uncertainties in parentheses

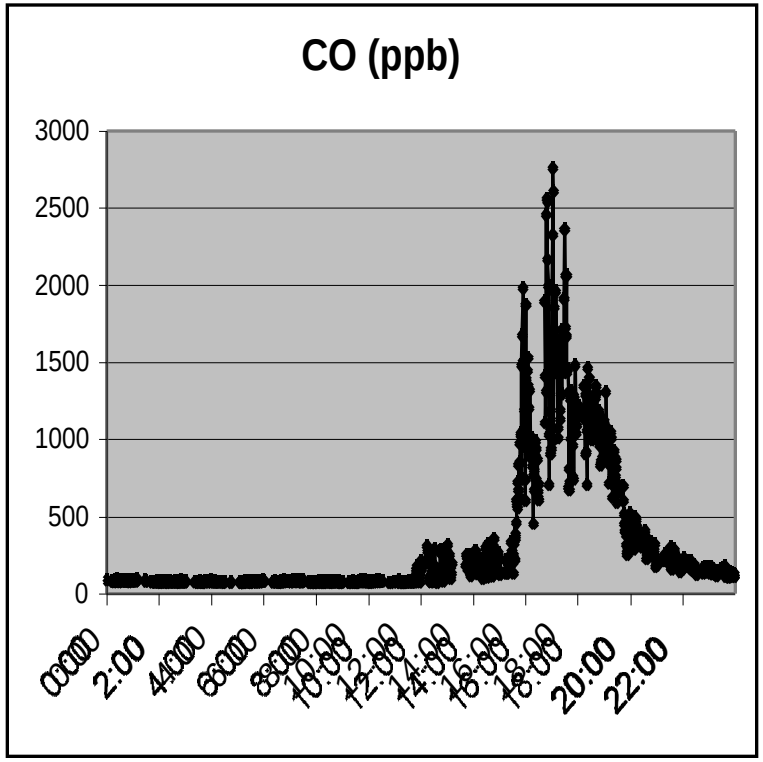
	NOy (ppb/ppm)	$PM_{2.5}$ (ug/m3/ppm)	Carbon (ug/m3/ppm)
Urban	**137 (12)**	38 (9)	11(2)
Biomass	23 (13)	**220 (60)**	**69 (19)**
Urban/Biomass	6.0	0.17	0.16

Extreme Events

- Oak Grove – January 31, 2002
- FRM Mass – 67.1 ug/m3
- 24-Hour TEOM Mass – 66.2 ug/m3
- Site Operator Reports Wood Smoke

Time Series of PM2.5 and CO
Oak Grove 1/31/02





PM2.5 increases dramatically at 1600. CO tracks PM2.5, suggesting a combustion source.

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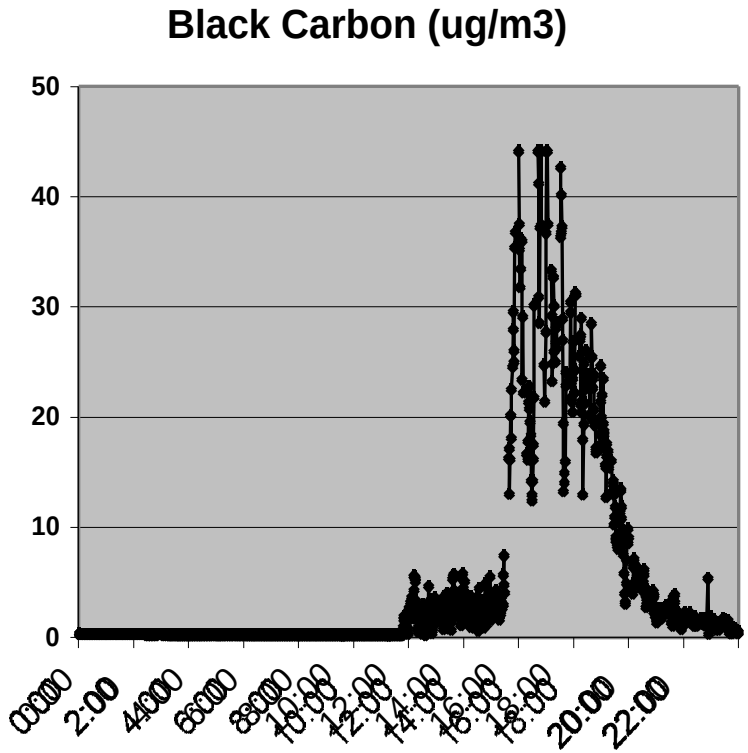
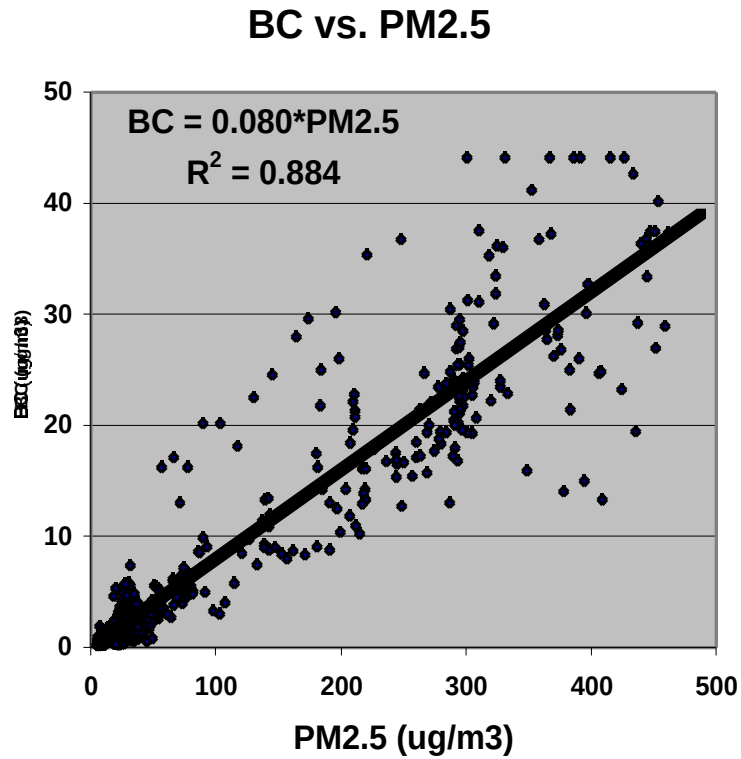
Continuous Black Carbon
Oak Grove 1/31/02





Black Carbon tracks with PM2.5 and represents about 8% of Incremental mass, also indicative of a combustion source.

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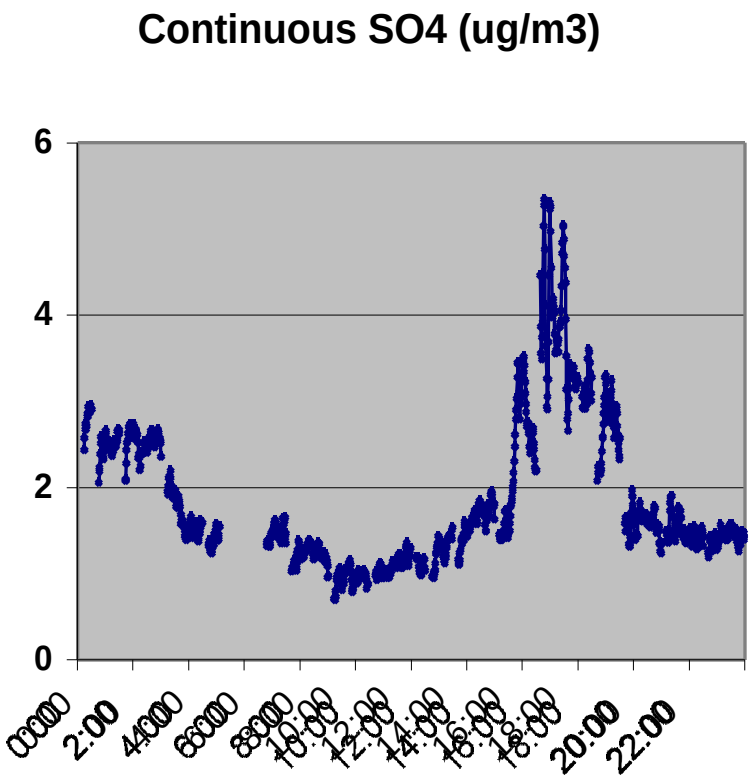
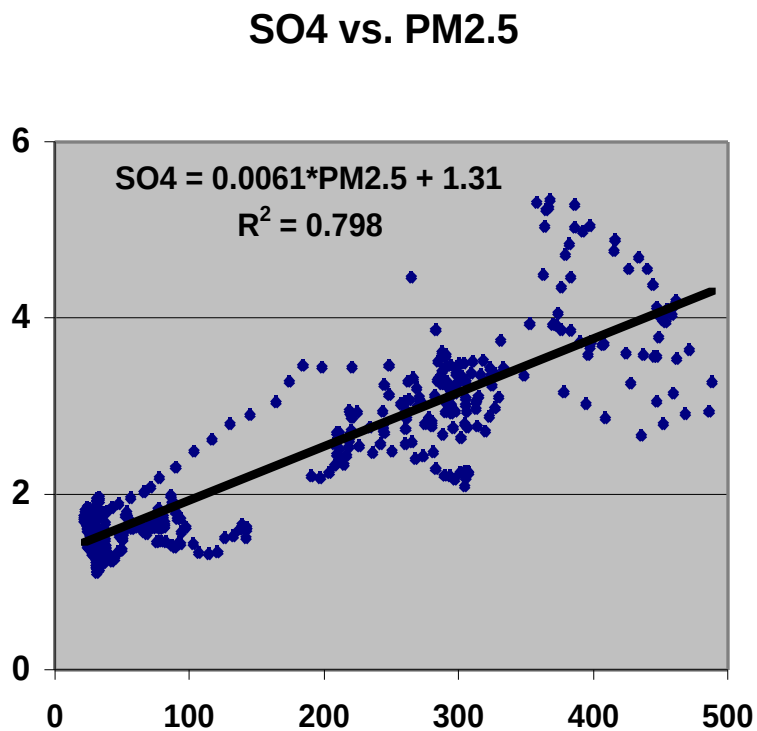
Continuous SO4
Oak Grove 1/31/02





SO4 also tracks with PM2.5, but represents less than 1% of incremental mass.

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Oak Grove Event

- Gas and Particle data together are diagnostic of biomass burning
- Continuous Speciation Data Suggest
  - 8% Black Carbon
  - <1% SO4
  - <1 % NO3
  - 2% NH4
  - >85% Organic Matter, Water and Trace Elements

Continuous Measurements Summary

- Methods Deployed for Mass and Major Components.
- Significant (Real) Variability on all Time Scales
- Need Continuous Data to Understand Sources and Formation of $PM_{2.5}$.
- Data can be used to evaluate models at less than daily time scales.