

# Southern Company Air Quality Research

**ARIES, SEARCH, ASACA, etc.**

## VISTAS Data Workshop

**January 15, 2002**

**SEARCH & ARIES**

Web Address: [www.atmospheric-research.com](http://www.atmospheric-research.com)

**ARIES ASACA**  
**SEARCH MERCURY**

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# OUTLINE

- ◆ Overview of **SEARCH**
- ◆ Semi-Continuous Speciation Monitors
- ◆ Primary Organic Carbon Sources
- ◆ Related Research Overview

# Jefferson Street (JST) Atlanta, GA



**ARIES**  
**SEARCH**  
**ASACA**  
**MERCURY**

**SEARCH** - Jun. 1998 to Dec. 2005  
**ARIES** - Aug. 1998 to Aug. 2003  
**ASACA** - April 1999 to Dec. 2005  
**MERCURY** - 1-yr 2002  
Atlanta Supersite - August 1999  
ESP01, ESP02 - July 2001, Jan. 2002  
U Minn - August 2002

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# SEARCH

## SouthEastern Aerosol Research and CHaracterization Study



Yorkville Site (YRK)  
Yorkville, GA

**SEARCH**

# SEARCH -- Sponsors

- ◆ Alabama Electric Cooperative
- ◆ Allegheny Power
- ◆ Detroit Edison
- ◆ EPRI
- ◆ Louisville Gas & Electric
- ◆ Oglethorpe Power
- ◆ Southern Company

# SEARCH -- Principal Investigators And Contractors

## Principal Investigators

- ◆ Eric Edgerton - ARA
- ◆ Ben Hartsell - ARA
- ◆ Alan Hansen - EPRI

## Contractors

- ◆ Atmospheric Research & Analysis, Inc.
- ◆ Chester Labnet
- ◆ Desert Research Institute
- ◆ GIT - Dr. Cass
- ◆ Harding - ESE
- ◆ UAH

**SEARCH**

# SEARCH -- Collaborators

- ◆ **ARIES**
- ◆ **ASACA** (Dr. Russell - GIT)
- ◆ EPA SuperSites
  - ◆ August 1999 Atlanta SuperSite Experiment
  - ◆ July 2001 Integrated SuperSite Experiment
  - ◆ January 2002 Integrated SuperSite Experiment
- ◆ Southern Oxidant Study
- ◆ Southern Center for the Integrated Study of Secondary Poll. (GIT)
- ◆ Southern Fine Particulate Mon. Project (Dr. Williamson - SRI)
- ◆ Alabama Department of Environmental Management
- ◆ Florida Department of Environmental Protection
- ◆ Georgia Environmental Protection Division
- ◆ Jefferson County (AL) Department of Health
- ◆ Mississippi Department of Environmental Quality
- ◆ Environmental Protection Agency

**SEARCH**

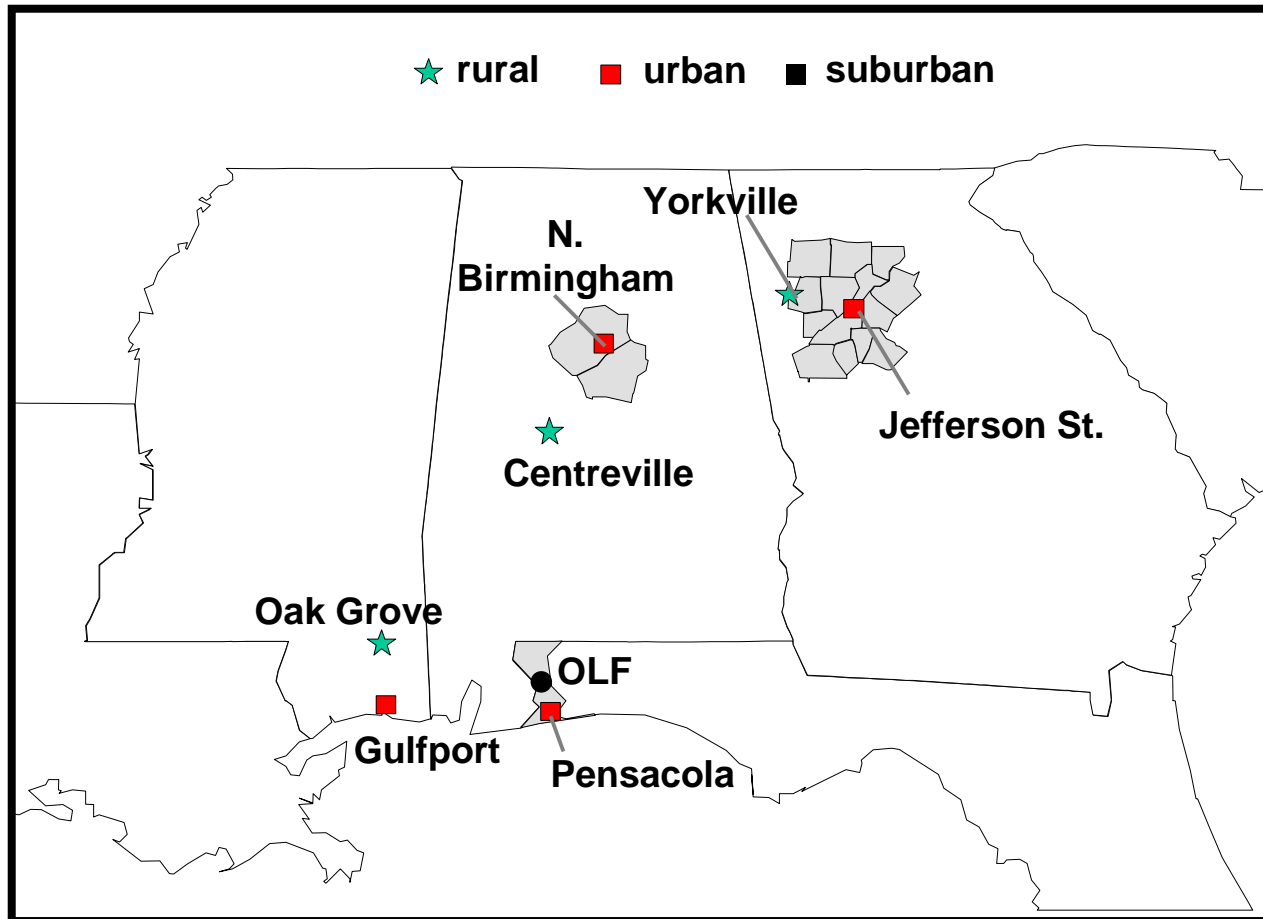
# SEARCH Objectives

- ◆ Develop a PM<sub>2.5</sub> Climatology for 8 Sites
- ◆ Understand Composition and its Variability
  - Year to Year, Season to Season (1999-2005)
  - Rural vs. Urban
  - Coastal vs. Inland
- ◆ Estimate Source Contributions
- ◆ Test and Improve Methods
- ◆ Collaborate with States and Others

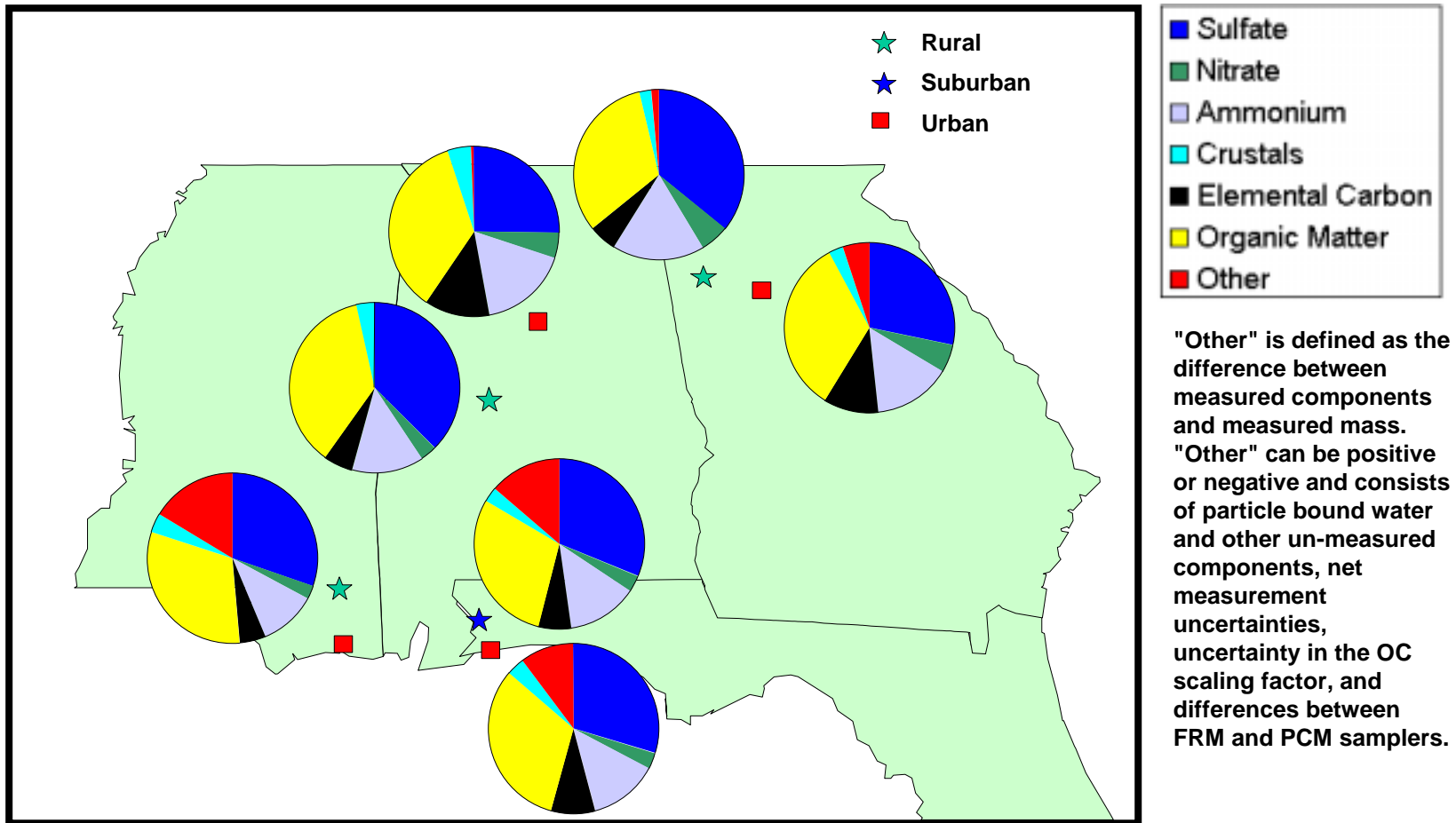
# SEARCH Measurements

- ◆ Discrete Particles (24-hour)
  - FRM: PM2.5
  - PCM and Dichot: PM2.5, PM10 and Speciation
- ◆ Continuous Particles (1-min to 1-hr)
  - TEOM: mass
  - R&P 5400: OC/EC
  - Ammonium/Nitrate
  - Sulfate
- ◆ Trace Gases (1-min)
  - O<sub>3</sub>, NO, NO<sub>2</sub>, NO<sub>y</sub>, HNO<sub>3</sub>, SO<sub>2</sub>, CO
- ◆ Meteorology (1-min)
  - WS, WD, T, RH, BP, SR, rainfall
- ◆ Visibility

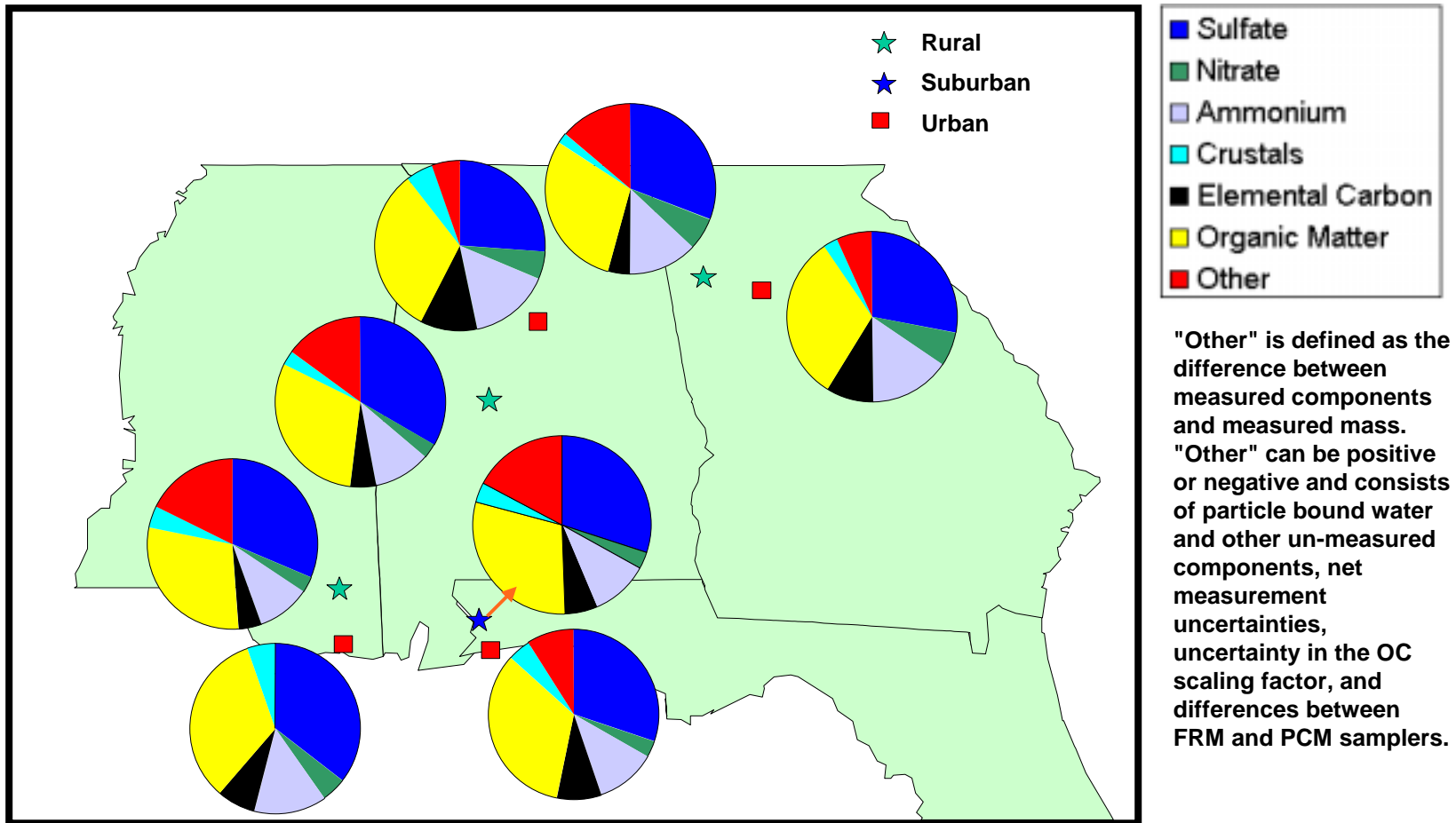
# SEARCH Enhanced PM<sub>2.5</sub> Network



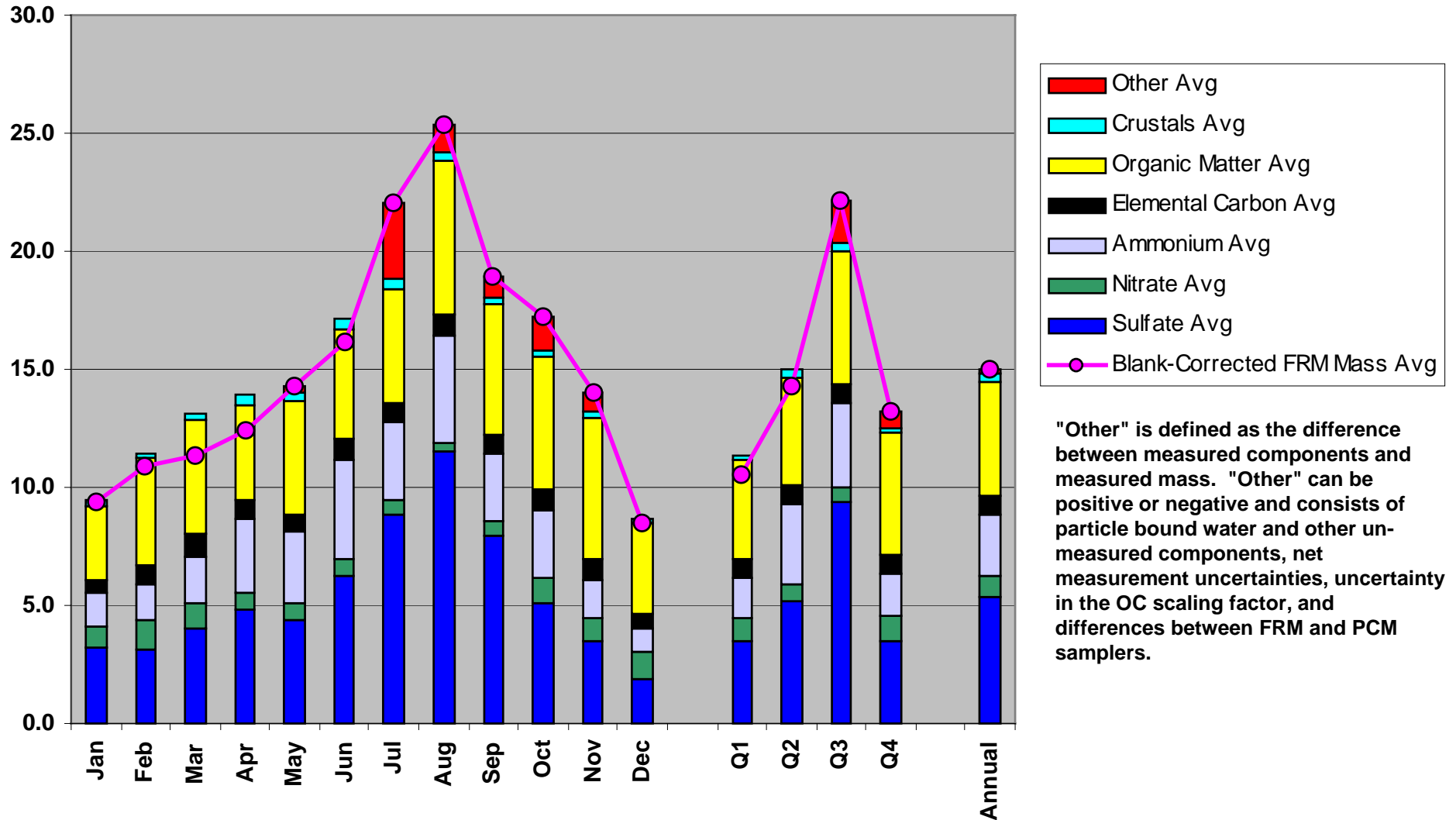
# PM<sub>2.5</sub> Composition at SEARCH Sites (ug/m<sup>3</sup>) 1999



# PM<sub>2.5</sub> Composition at SEARCH Sites (ug/m<sup>3</sup>) 2000



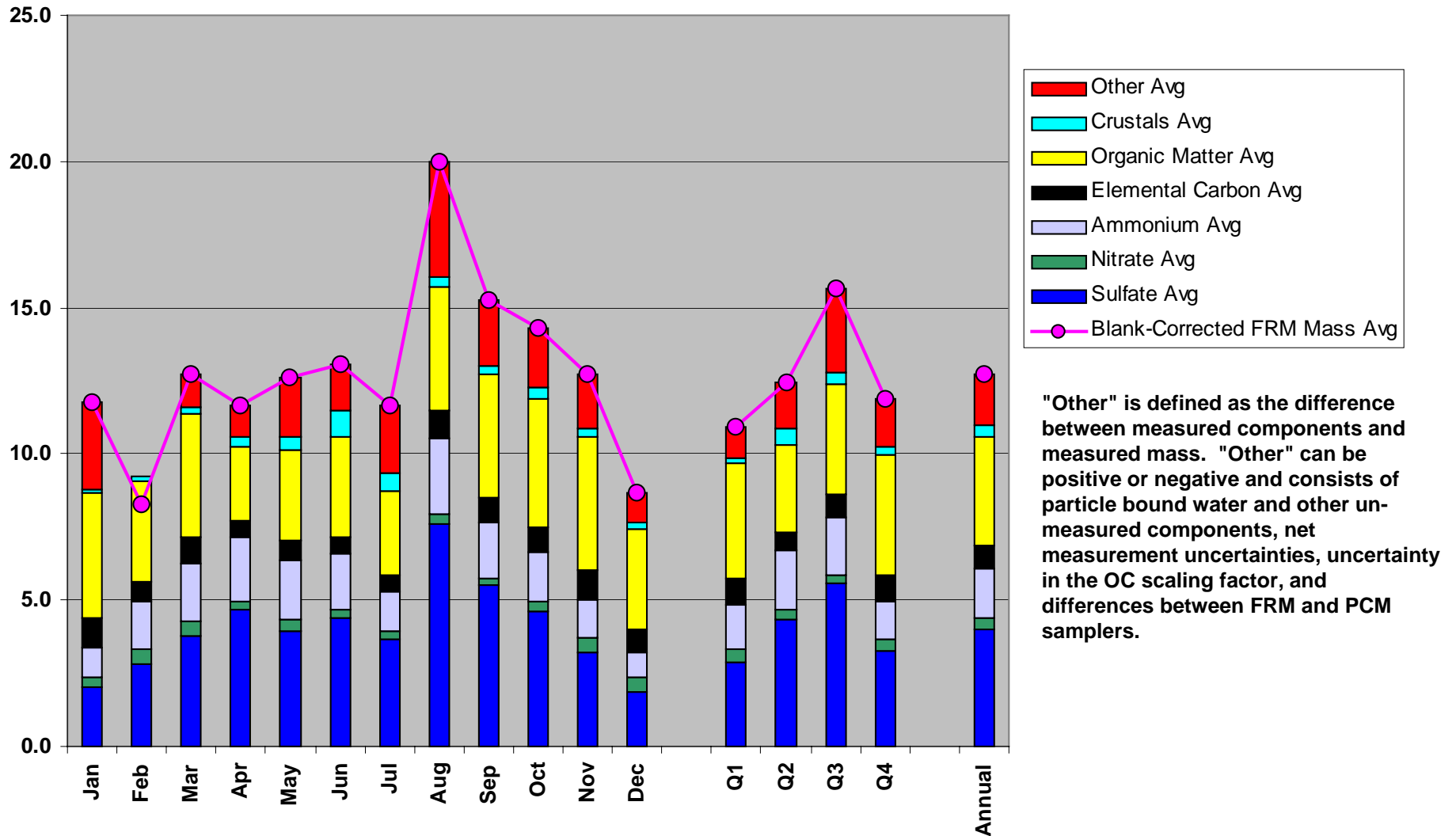
# PM<sub>2.5</sub> Composition (ug/m<sup>3</sup>) Yorkville, GA 1999



"Other" is defined as the difference between measured components and measured mass. "Other" can be positive or negative and consists of particle bound water and other unmeasured components, net measurement uncertainties, uncertainty in the OC scaling factor, and differences between FRM and PCM samplers.

Monthly pattern similar across network within a given year, but a different pattern in 1999 vs. 2000

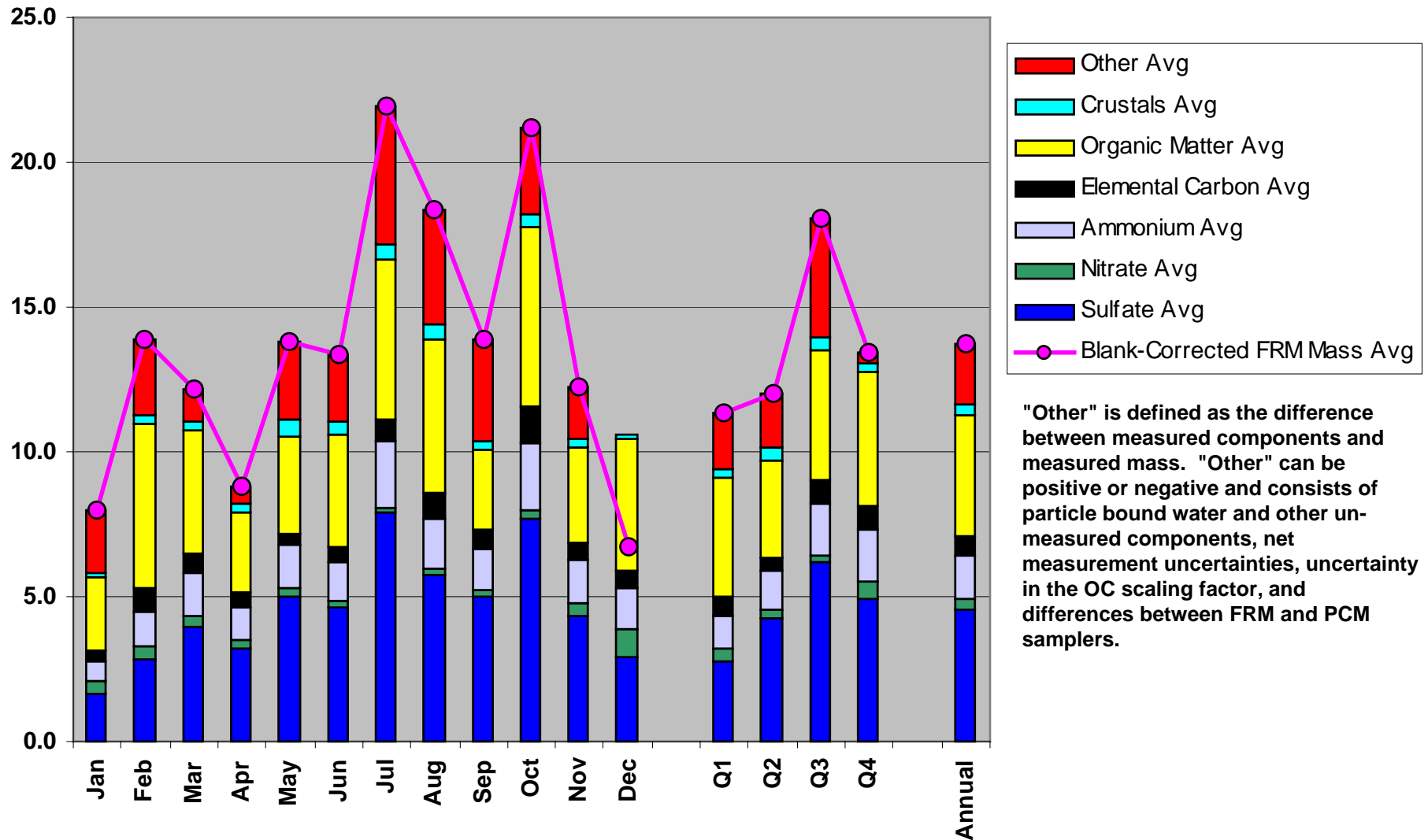
# PM<sub>2.5</sub> Composition (ug/m<sup>3</sup>) OLF, FL 1999



"Other" is defined as the difference between measured components and measured mass. "Other" can be positive or negative and consists of particle bound water and other unmeasured components, net measurement uncertainties, uncertainty in the OC scaling factor, and differences between FRM and PCM samplers.

Monthly pattern similar across network within a given year, but a different pattern in 1999 vs. 2000

# PM<sub>2.5</sub> Composition (ug/m<sup>3</sup>) Centreville, AL 2000



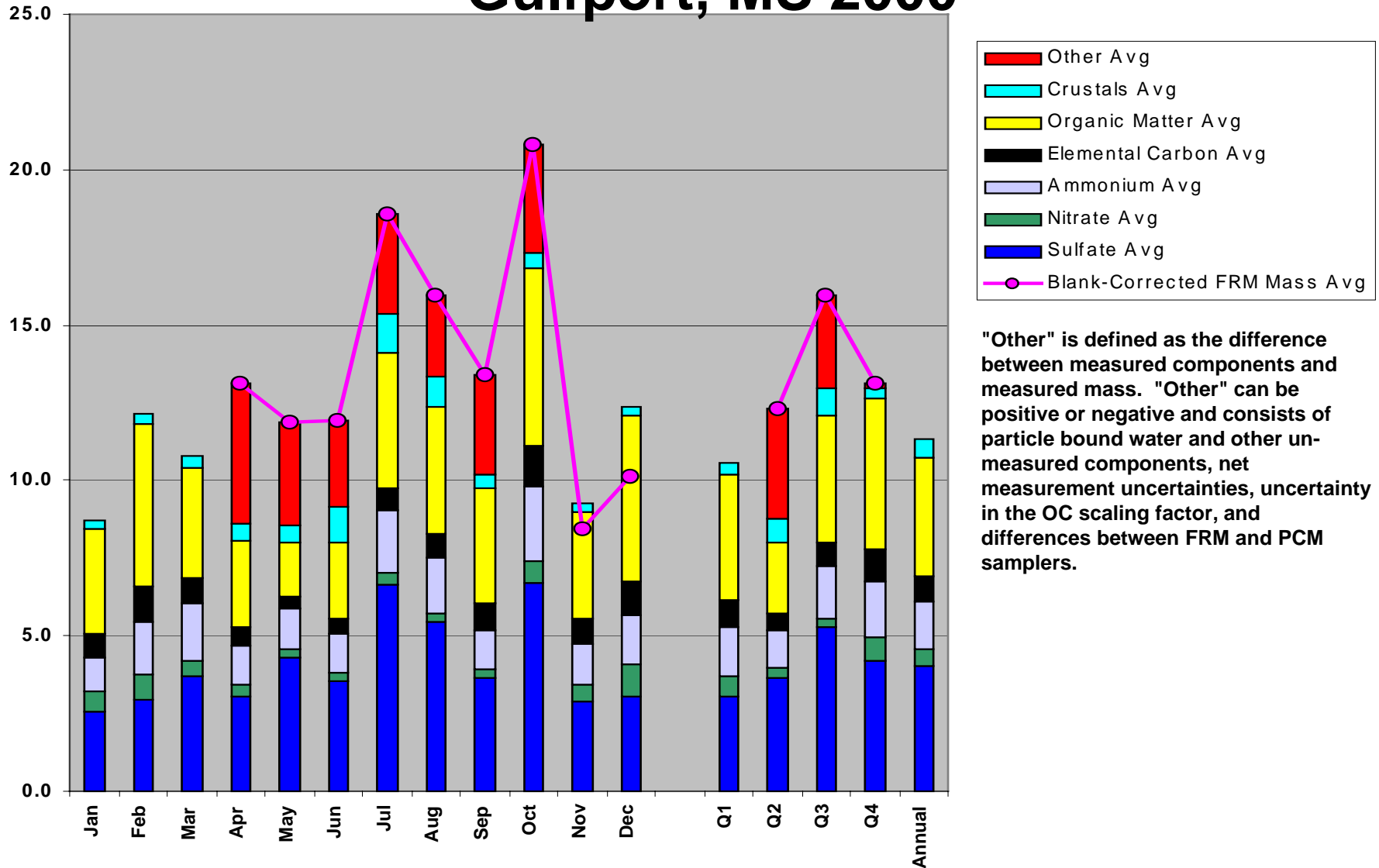
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Monthly pattern similar across network within a given year, but a different pattern in 1999 vs. 2000



# PM<sub>2.5</sub> Composition (ug/m<sup>3</sup>) Gulfport, MS 2000



"Other" is defined as the difference between measured components and measured mass. "Other" can be positive or negative and consists of particle bound water and other unmeasured components, net measurement uncertainties, uncertainty in the OC scaling factor, and differences between FRM and PCM samplers.

Monthly pattern similar across network within a given year, but a different pattern in 1999 vs. 2000

# Urban-Rural Annual Average Differences 1999 (ug/m<sup>3</sup> )

Site Pair	Delta PM2.5	Delta SO4	Delta NH4	Delta OM	Delta EC	Delta NO3	Delta Total
JST/YRK (GA)	4.82	0.24	0.29	1.81	1.25	0.23	3.82
BHM/CTR (AL)	7.80	0.64	1.88	2.86	1.93	0.57	7.88
PNS/OLF (FL)	1.45	0.20	0.15	0.87	0.37	0.08	1.66
GFP/OAK (MS)	NA	NA	NA	NA	NA	NA	NA

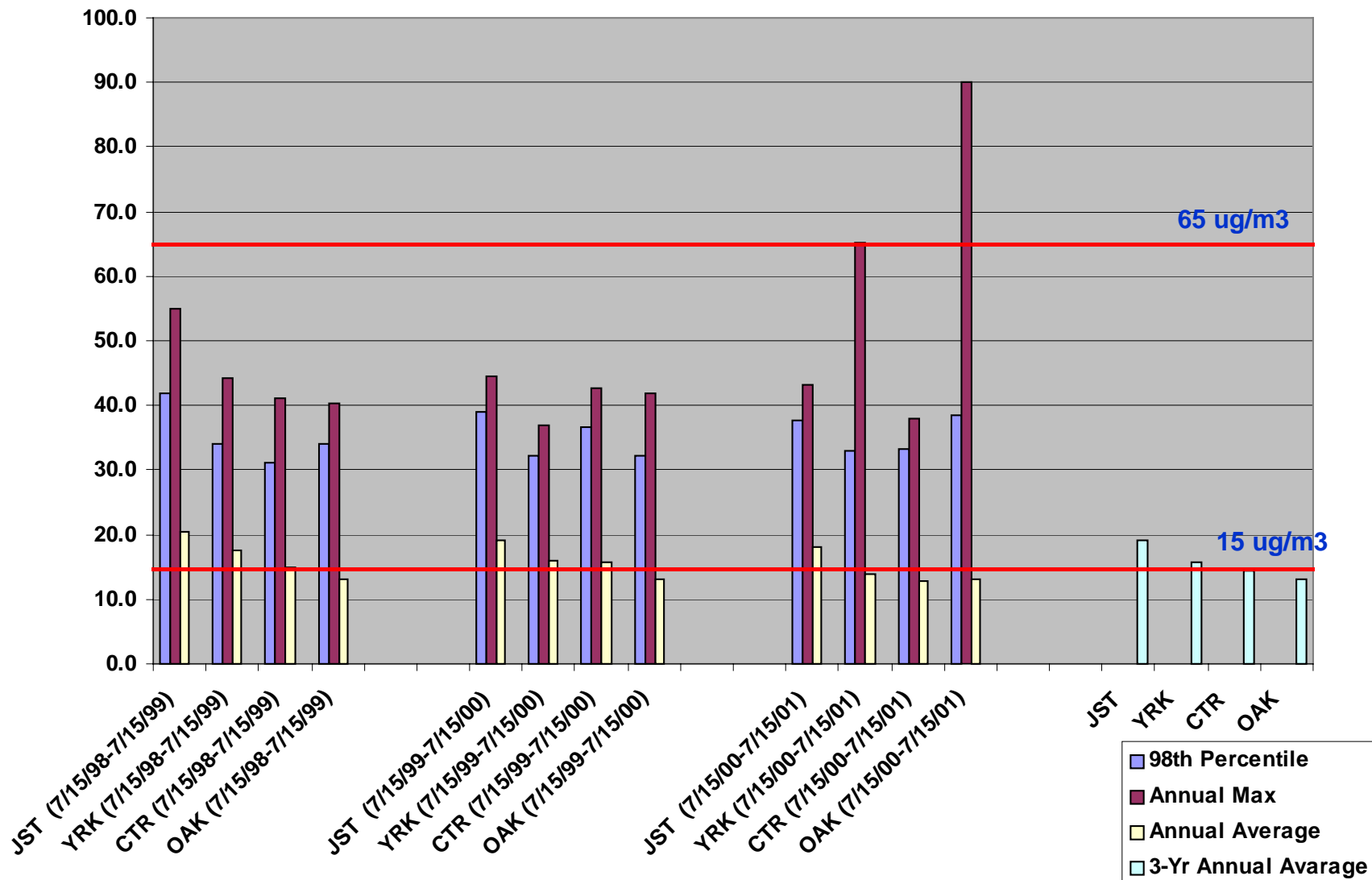
**SEARCH** Most of the urban-rural difference in PM2.5 is explained by differences in carbon.

## Urban-Rural Annual Average Differences 2000 (ug/m<sup>3</sup> )

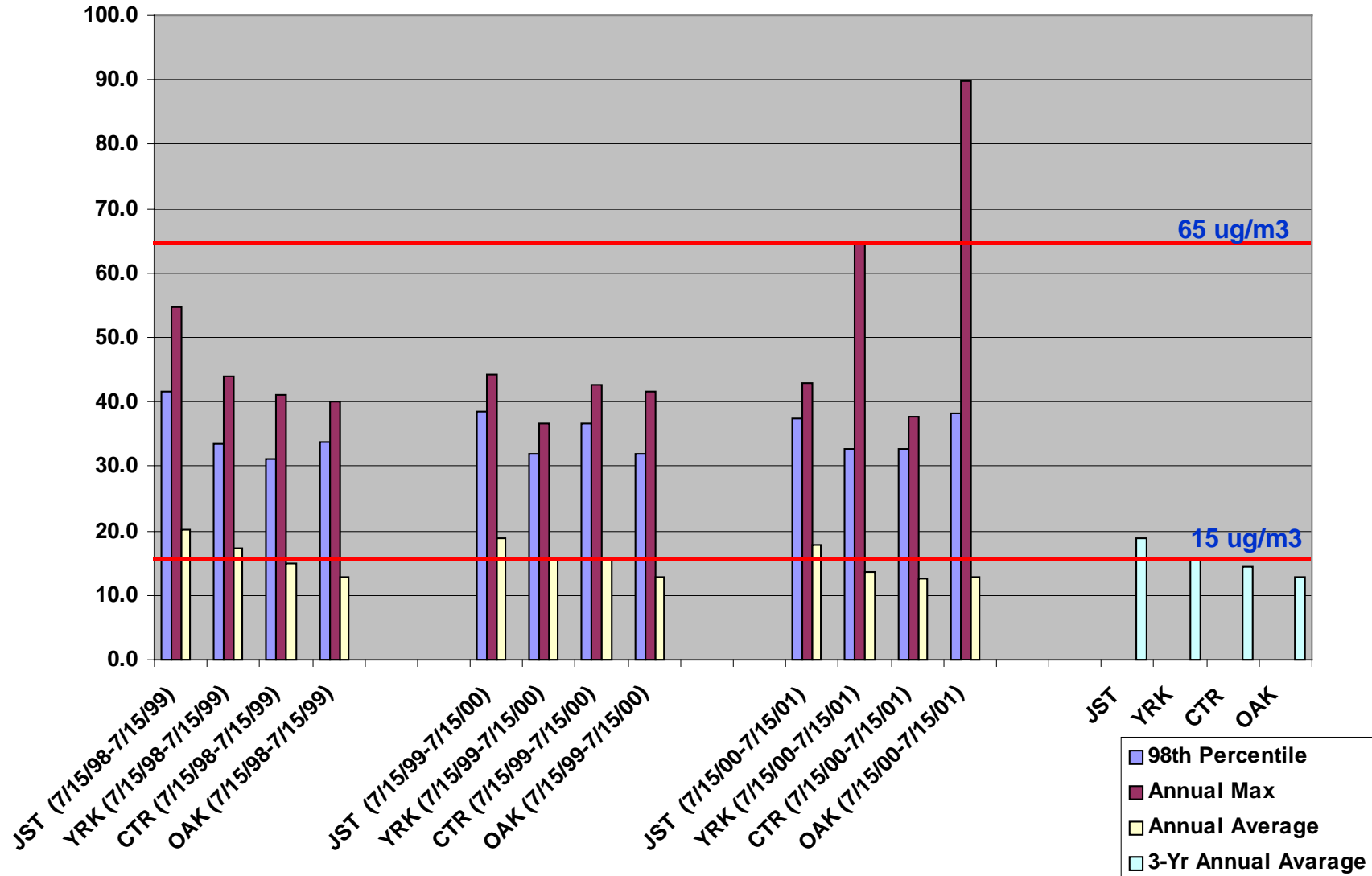
Site Pair	Delta PM2.5	Delta SO4	Delta NH4	Delta OM	Delta EC	Delta NO3	Delta Total
JST/YRK (GA)	2.55	0.28	0.74	1.15	0.92	0.21	3.31
BHM/CTR (AL)	6.25	0.64	1.53	2.19	1.51	0.69	6.56
PNS/OLF (FL)	1.32	0.44	0.28	3.66	0.37	0.04	4.79
GFP/OAK (MS)	NA	0.09	0.30	0.14	0.28	0.30	1.11

**SEARCH** Most of the urban-rural difference in PM2.5 is explained by differences in carbon.

# Annual Max, Average and 98<sup>th</sup> Percentile FRM Mass Concentrations (ug/m<sup>3</sup>) 07/15/98 -07/15/01



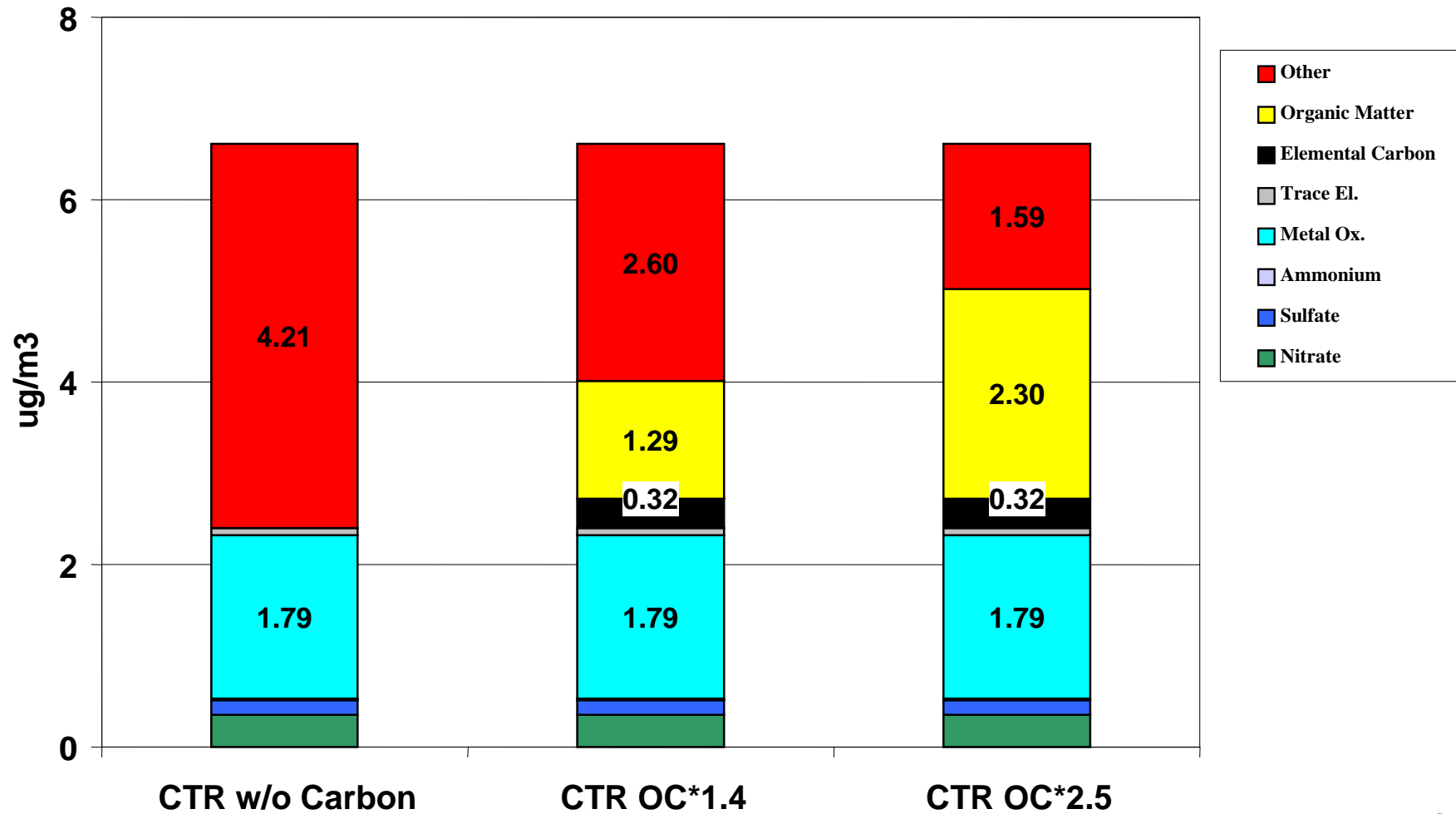
# Annual Max, Average and 98<sup>th</sup> Percentile **Blank-Corrected** FRM Mass Concentrations (ug/m<sup>3</sup>) 07/15/98 -07/15/01



# PMcoarse Speciation at Centreville, AL

August 2000-April 2001

PMcoarse Mass = 6.6 ug/m<sup>3</sup>

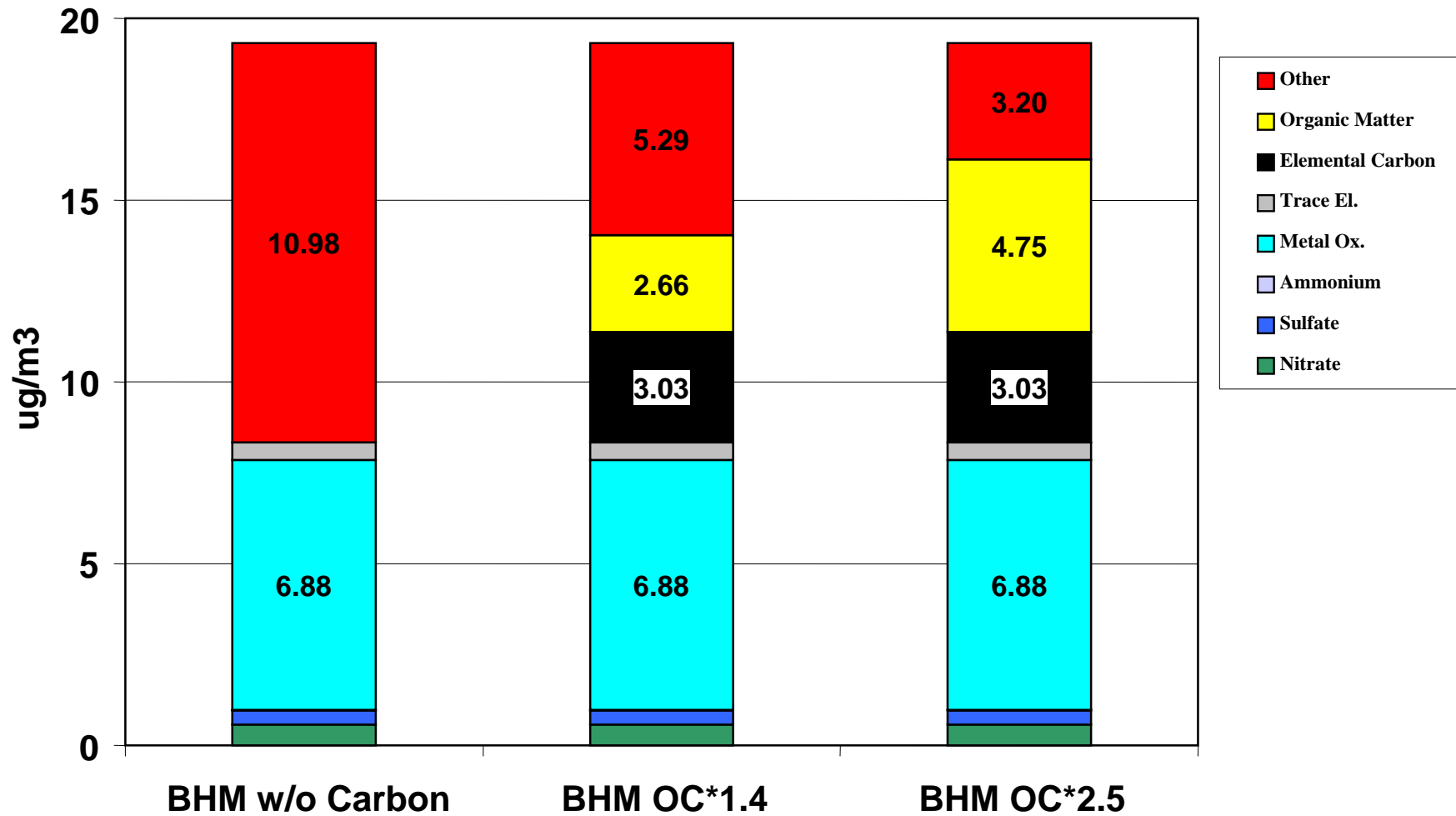


**Carbon is an Important Component of PMcoarse**

# PMcoarse Speciation at Birmingham, AL

August 2000-April 2001

PMcoarse Mass = 19.3 ug/m<sup>3</sup>



**Carbon is an Important Component  
of PMcoarse**

# Semi-Continuous Speciation Monitors

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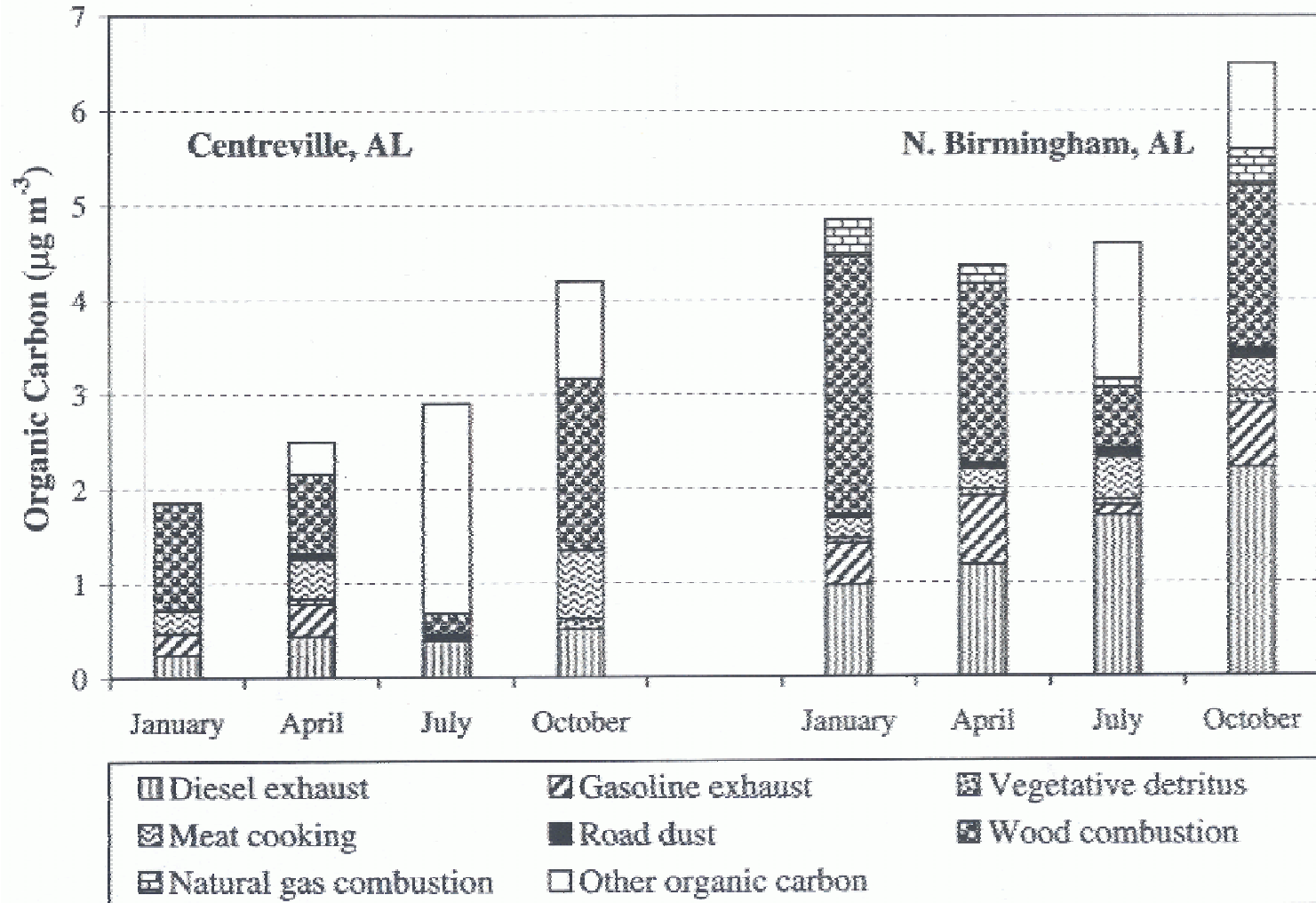
# Primary Organic Carbon Sources

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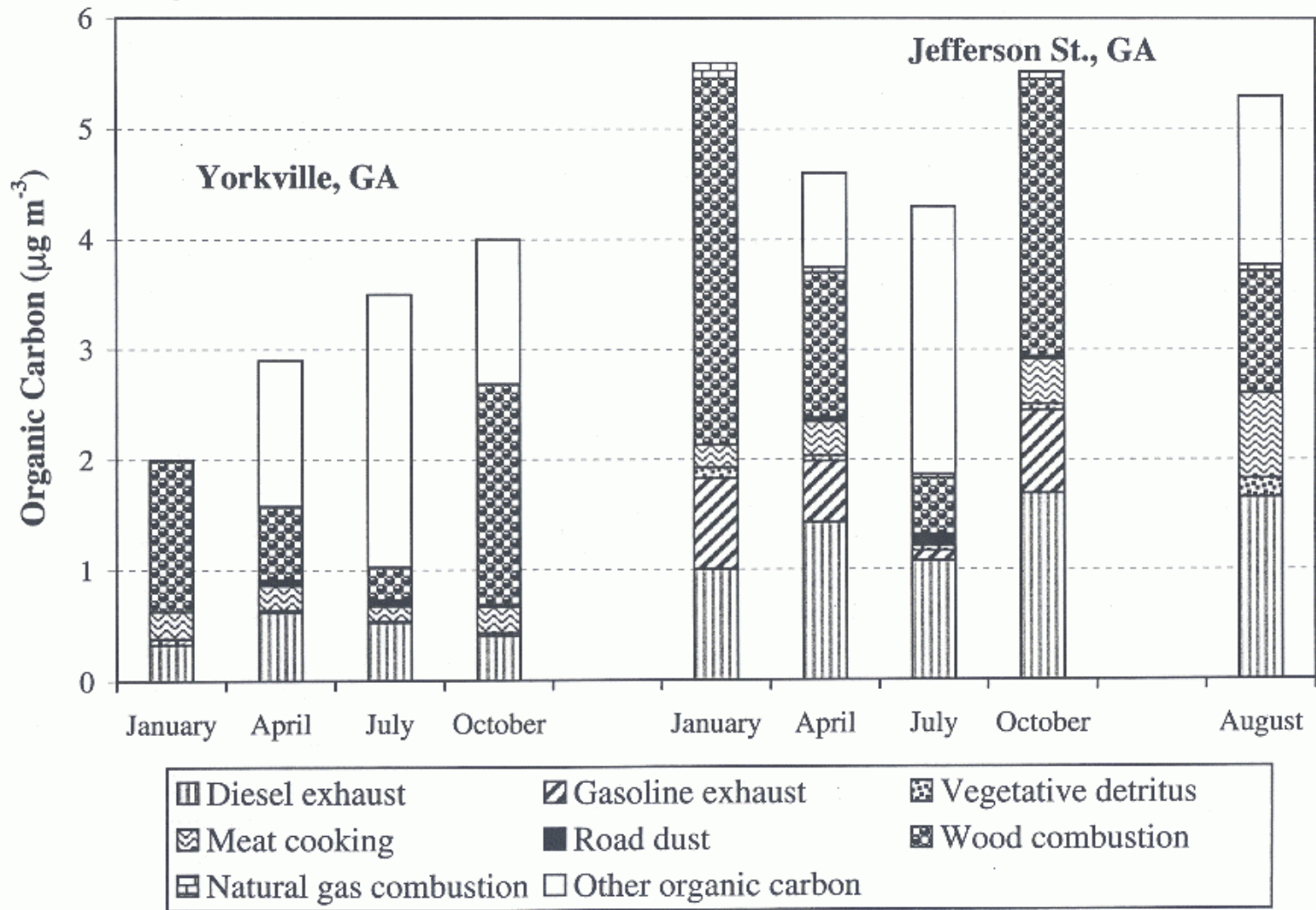
# Source Contributions to Organic Carbon in Fine Particles

Figure 3a



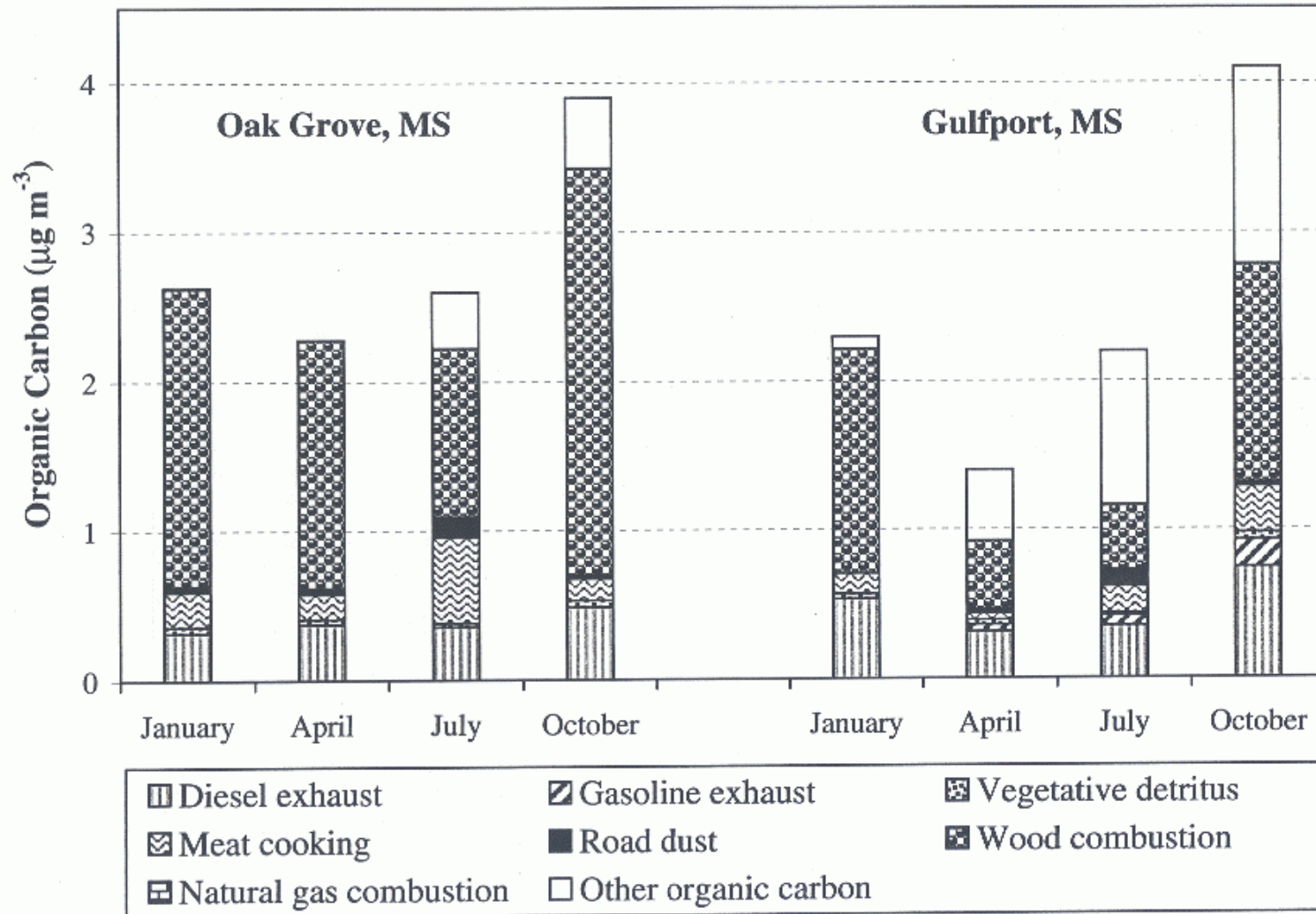
# Source Contributions to Organic Carbon in Fine Particles

Figure 3b



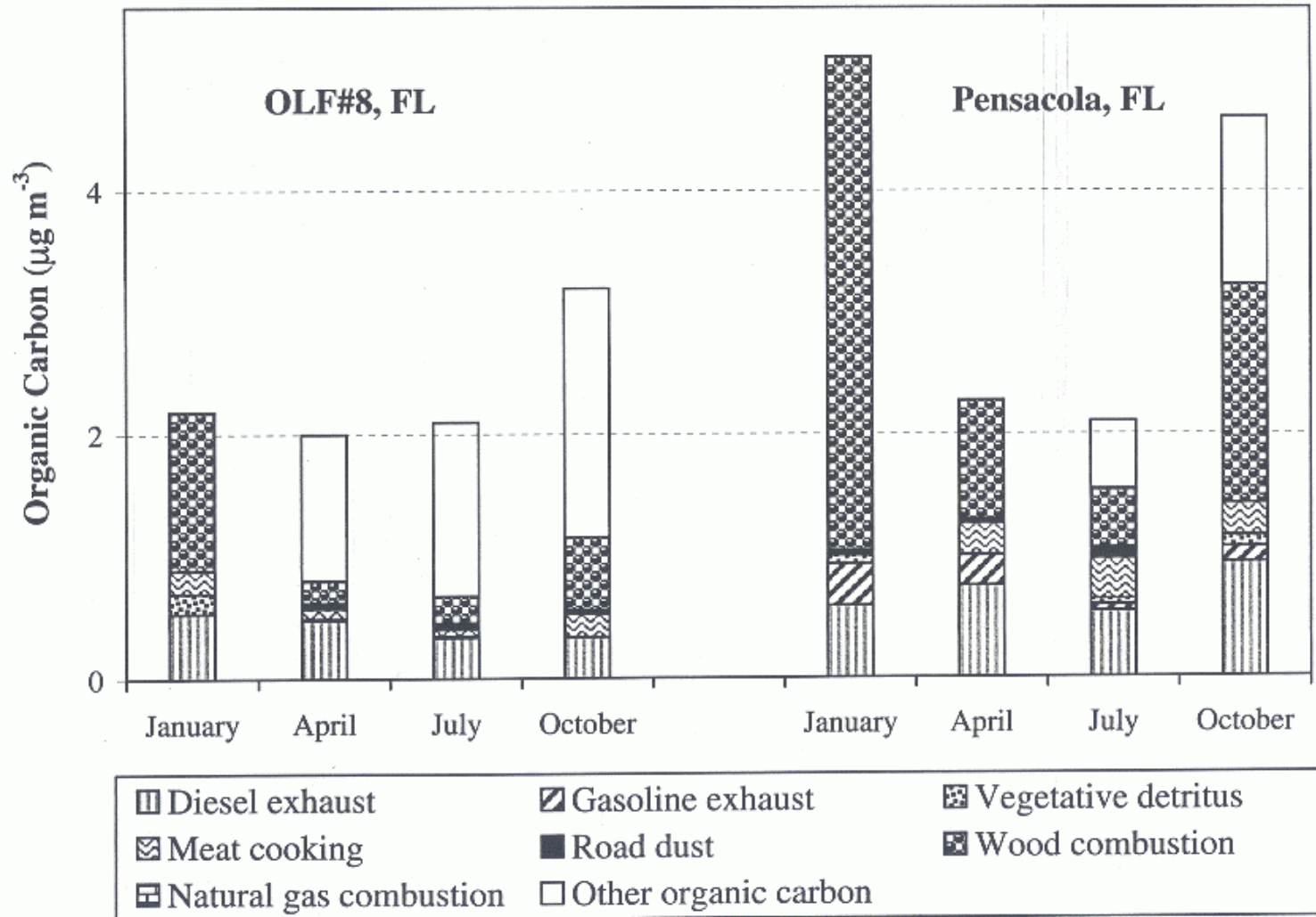
# Source Contributions to Organic Carbon in Fine Particles

Figure 3c



# Source Contributions to Organic Carbon in Fine Particles

Figure 3d



# Future Work

- Extend Spatially (ASACA, FAQs, EUS)
- Extend Temporally (Daily, July 2001)
- Extend to  $Pm_{\text{coarse}}$ , if possible
- EUS Work to be Done in Cooperation with EPA ESP01 and ESP 02 (July 2001, January 2002)

# SEARCH Timeline and Initiatives

- ◆ Continue **SEARCH** operations through December 2005
- ◆ 1992 to 2000 Data Base Release in January 2002
- ◆ Test/Deploy Continuous Speciation (all, except TRN, to 8 sites by 2<sup>nd</sup> quarter 2002)
  - SO<sub>4</sub> testing underway (2 sites)
  - NH<sub>4</sub>/NO<sub>3</sub> deployment underway (2 sites)
  - B<sub>scat</sub>/B<sub>abs</sub> deployment underway (2 sites)
  - OC/EC deployed (8 sites)
  - TRN development underway
- ◆ Special Studies
  - Continue daily sampling in Atlanta (support **ARIES**/health studies)
  - PM<sub>coarse</sub> investigations (missing mass): microscopy, INAA, OC/EC
  - Continuous PM<sub>coarse</sub> : mass and OC/EC (Atlanta and Birmingham)
  - Comparisons with State & Local mass and speciation monitors
  - Carbon-14 (wood smoke, fall stagnation, winter inversions)
  - SO<sub>4</sub> size fractionation (homogeneous vs. heterogeneous formation)
  - Carbon fractionation (primary vs. secondary sources)
  - Carbon monolith efficiency and capacity (Rasmussen)
- ◆ Publications (AWMA, JGR) and Presentations (AWMA, EUEC, NETL, States)

**SEARCH**

# Southern Company Air Quality Research

**ARIES, SEARCH, ASACA,  
MERCURY & Related Research**

**ARIES ASACA  
SEARCH MERCURY**

# Related Research

- ◆ **ARIES**
- ◆ **SEARCH**
- ◆ Assessment of Spatial Aerosol Composition in Atlanta -- **ASACA** (Dr. T. Russell - GIT)
- ◆ EPA SuperSites
  - August 1999 Atlanta SuperSite Experiment
  - July 2001 Integrated SuperSite Experiment
  - January 2002 Winter Integrated Supersite Experiment
- ◆ Wind Profiler Data Collection (UAH)
- ◆ Primary Carbon Source Identification (Dr. T. Russell - GIT)
- ◆ Organic Compound Speciation (DRI)
- ◆ Carbon Scaling Factor (Dr. B. Turpin - Rutgers)

**ARIES ASACA**  
**SEARCH MERCURY**

# Related Research (cont'd)

- ◆ Comparison of Continuous Mass Indicators (Dr. P. Hopke – Clarkson)
- ◆ Physico-Chemical Characteristics of Individual Particles: Electrical Mobility, Hygroscopicity, Volatility, and Mass (Dr. P. McMurry - U Minnesota)
- ◆ Baltimore Supersite - (Dr. J. Ondov - U. Maryland)
- ◆ Atmospheric Mercury Research - (ARA)
- ◆ Visibility Studies (Dr. I. Tombach)
- ◆ Episode Selection -- PM and O<sub>3</sub> (SAI)
- ◆ Exploratory Analyses of network intercomparison, nitrate response, and OC/photochemical activity relationships (Dr. G. Hidy)

# Related Research (cont'd)

- ◆ Emissions Inventory Enhancements (Dr. T. Russell - GIT)
- ◆ Ozone Modeling, GCOS - (SAI, in-house)
- ◆ Exploratory PM Modeling (AER, SAI, GIT)
- ◆ Mercury Plume Modeling - (Dr. C. Seigneur - AER)
- ◆ Receptor Modeling (Dr. P. Hopke)
- ◆ Fire Related PM Effects on Alveolar Cells (UGA)

# Jefferson Street, Atlanta, GA - Supporting **ARIES**, EPA-Atlanta SuperSite, EPA Integrated SuperSite Experiments (ISSE), and **SEARCH**



**ARIES ASACA**  
**SEARCH**

EPA Atlanta SUPERSITE  
August 1999

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