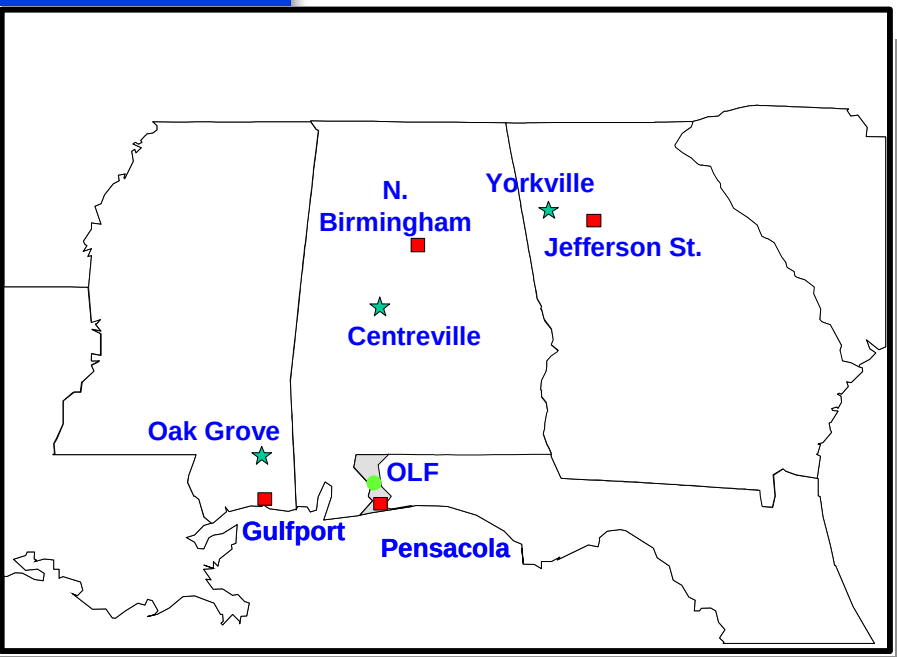


SEARCH: FourYears and Counting

D. Alan Hansen
Environment Group

EPRI

Outline

- History
- Objectives
- Network description
- Some findings
- Related research
- Overview of session

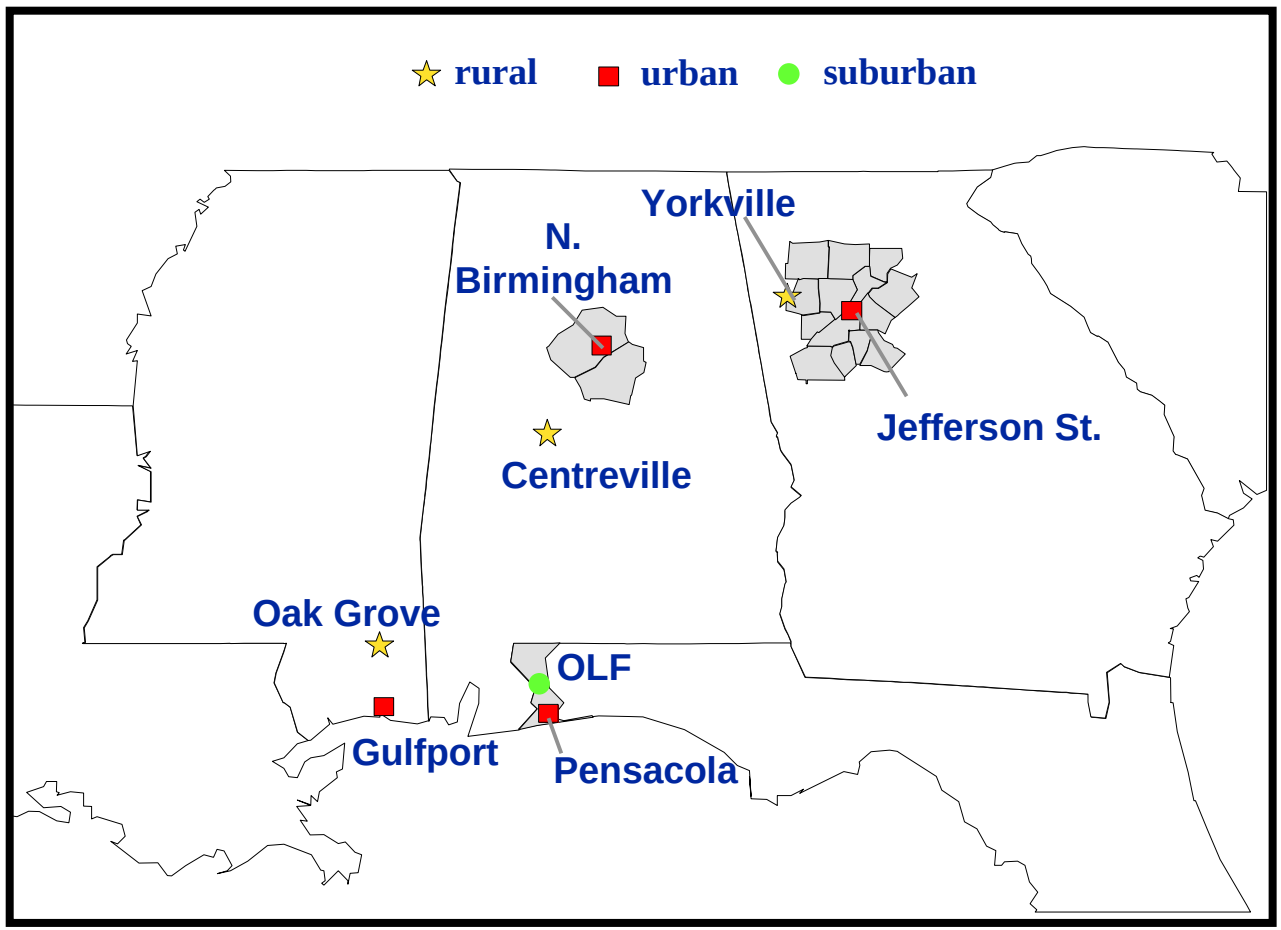
History

- 1992: 3-station component (YRK, CTR, OAK) of Southern Oxidants Study's Southeastern Consortium Intermediate Oxidants Network
  - Focused on ozone and precursors at regionally representative sites
- 1998: Expanded to 8 stations as Southeastern Aerosol Research and Characterization Study (SEARCH)
  - Focused on PM, precursors, co-pollutants
- 2001: SEARCH II
  - Extend monitoring through 2005 and complete installation of continuous monitors.

Objectives

- Develop a multivariate aerometric climatology for the region.
- Contrast and understand aerosol compositional differences on a large range of temporal and spatial scales.
- Test and improve measurement (especially continuous) methods.
- Identify sources of aerosol components.
- Elucidate amospheric processing of materials.
- Collaborate with host states and others in meeting regulatory obligations.

SEARCH Network



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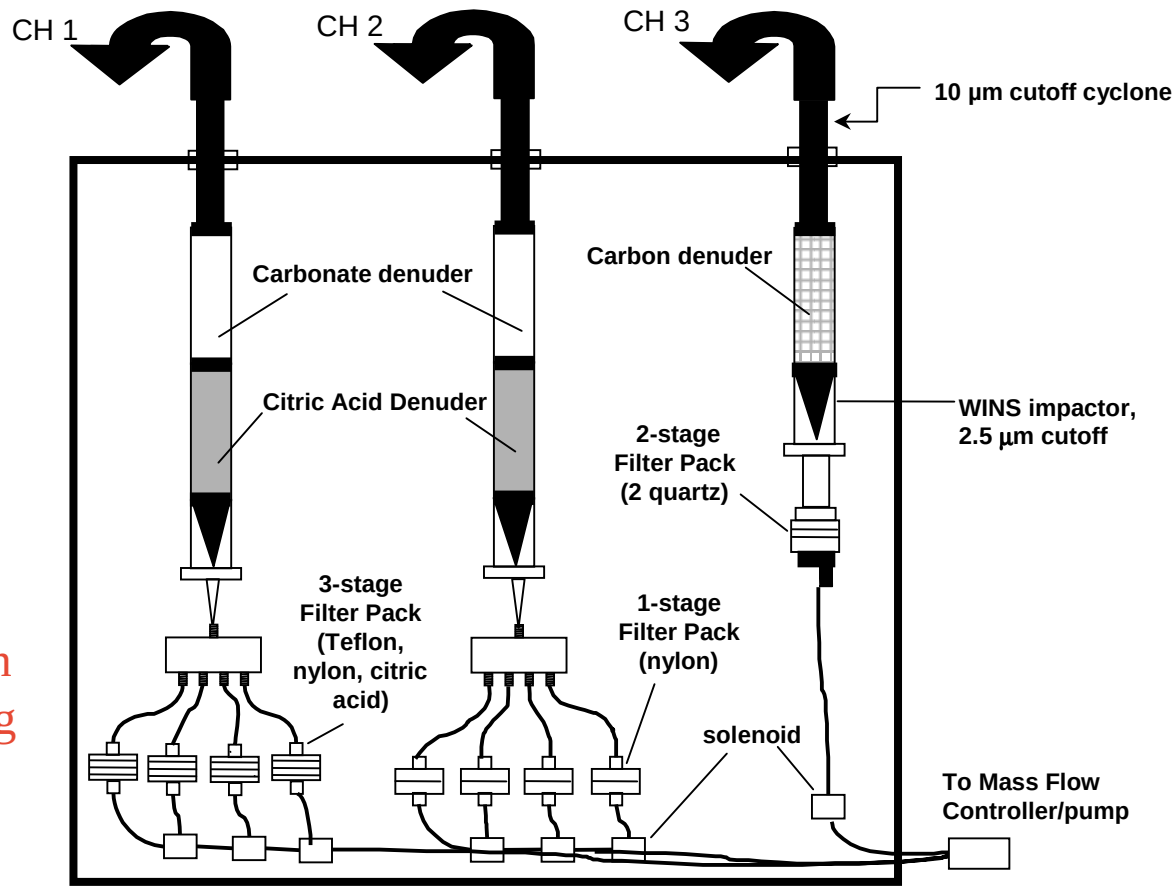
Particle Composition Monitor (PCM)

- Minimize sampling artifacts
- Provide redundancy



Eric Edgerton will describe what we have learned about $PM_{2.5}$ mass and composition in the SEARCH region using this system in this session's fifth presentation.

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Daily Average Measurements: $PM_{2.5}$

Analyte	Sampler	Filter	Frequency	Analysis	MDL, μg/m³
Mass	FRM	Teflon	Daily	Gravimetry	0.2
$SO_4^=$	PCM (CH1)	Teflon	3rd, 6th, 12th d	IC	0.03
NO_3^-	PCM (CH1)	Teflon	3rd, 6th, 12th d	IC	0.01
NH_4^+	PCM (CH1)	Teflon	3rd, 6th, 12th d	AC	0.03
Vol. NO_3^-	PCM (CH1)	Nylon	3rd, 6th, 12th d	IC	0.02
Vol. NH_4^+	PCM (CH1)	Citric acid	3rd, 6th, 12th d	AC	0.04
Organic C	PCM (CH3)	Quartz	3rd, 6th, 12th d	TOR	0.08
Black C	PCM (CH3)	Quartz	3rd, 6th, 12th d	TOR	0.05
Trace Elem.	FRM	Teflon	3rd day	XRF	0.0005-0.003

EPRI

Daily Average Measurements: PM_{coarse} from Dichotomous Sampler

Analyte	Sampler	Filter	Frequency	Analysis	MDL, μg/m³
Mass	PCM (CH1)	Teflon	Daily	Gravimetry	0.1
$SO_4^=$	PCM (CH1)	Teflon	3rd, 6th, 12th d	IC	0.05
NO_3^-	PCM (CH1)	Teflon	3rd, 6th, 12th d	IC	0.02
NH_4^+	PCM (CH1)	Teflon	3rd, 6th, 12th d	AC	0.04
Trace Elem.	FRM	Teflon	3rd day	XRF	0.0003-0.003

EPRI

Continuous Measurements: Trace Gases

Observable	Technique	Resolution	MDL, ppb
O_3	**UV absorption**	1 minute	1
NO	**Chemiluminescence (CL)**	1 minute	0.05
NO_2	**photolysis/CL**	1 minute	0.1
HNO_3	**denuder diff./Mo red./CL**	1 minute	0.1
NOy	**Mo red./CL**	1 minute	0.1
SO_2	**UV pulsed fluorescence**	1 minute	0.2
CO	**NDIR**	1 minute	5
NH_3 **or TRN**	**Denuder diff./Pt oxid./CL**	5 minutes	0.2

Further details on these measurements and source inferences enabled by them will be given by Eric Edgerton in this session's second presentation.

EPRI

Continuous Measurements, $PM_{2.5}$

Observable	Technique	Resolution	MDL, μg/m³
Mass	**TEOM**	**10 minutes**	**1**
$SO_4^=$	**Fe red./UV fluorescence**	**5 minutes**	**0.4**
NO_3^-	**Filter diff./Mo red./CL**	**5 minutes**	**0.2**
NH_4^-	**Filter diff./Pt oxid./CL**	**5 minutes**	**0.1**
OC	**Temp. ramp combustion** (R&P 5400)	**60 minutes**	**0.5**
BC	**Temp. ramp combustion** (R&P 5400)	**60 minutes**	**0.5**
BC(~B_{ap})	**Light absorption** (aethalometer)	**5 minutes**	**0.1(na)**
B_{sp} (dry)	**Nephelometry** (RR M903)	**1 minute**	**na**

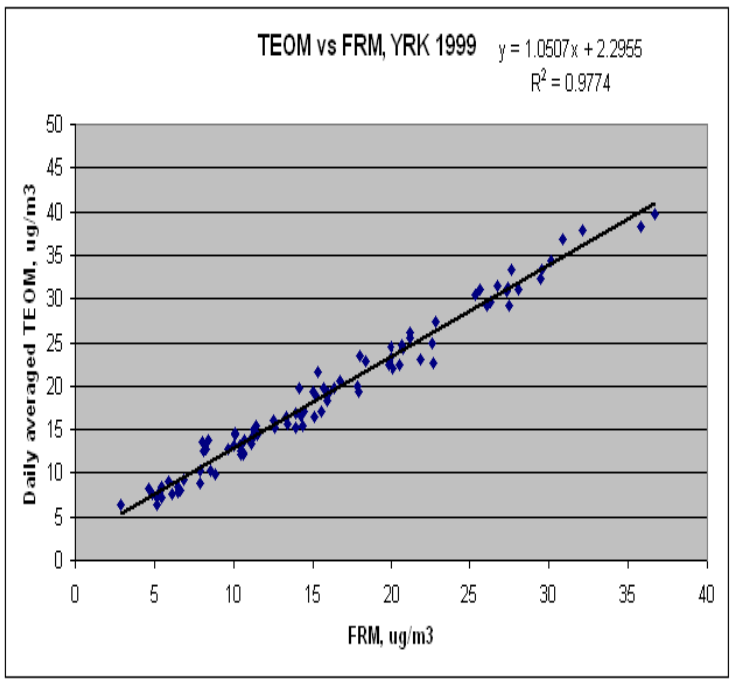
EPRI

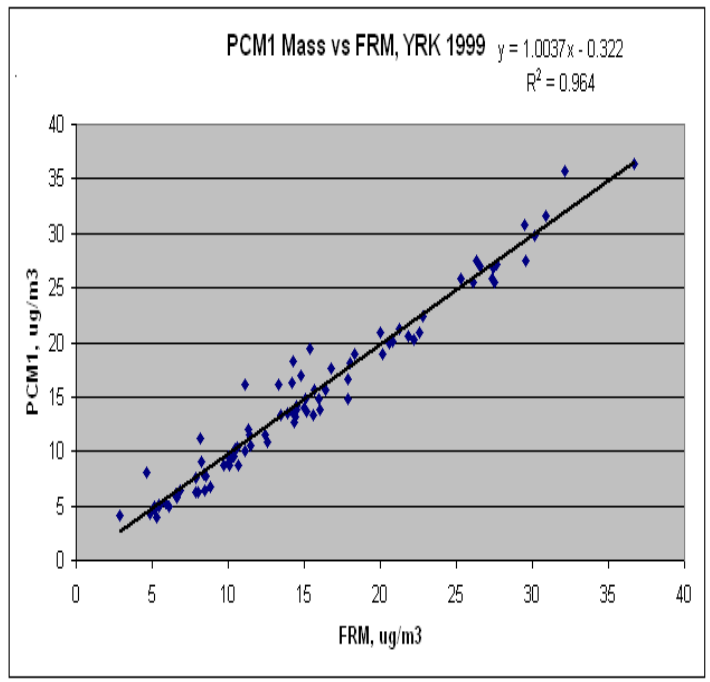
Continuous Measurements, PM_{10} and Meteorology

Observable	Technique	Resolution	MDL, μg/m³
PM_{10} Mass	**TEOM**	**10 minutes**	**2**
PM_{10} OC	**Temp. ramp combustion**	**60 minutes**	**0.5**
PM_{10} BC	**Temp. ramp combustion**	**60 minutes**	**0.5**
10-meter temperature, relative humidity, solar radiation, barometric pressure, wind speed, wind direction, precipitation	**various**	**1 minute**	**na**

EPRI

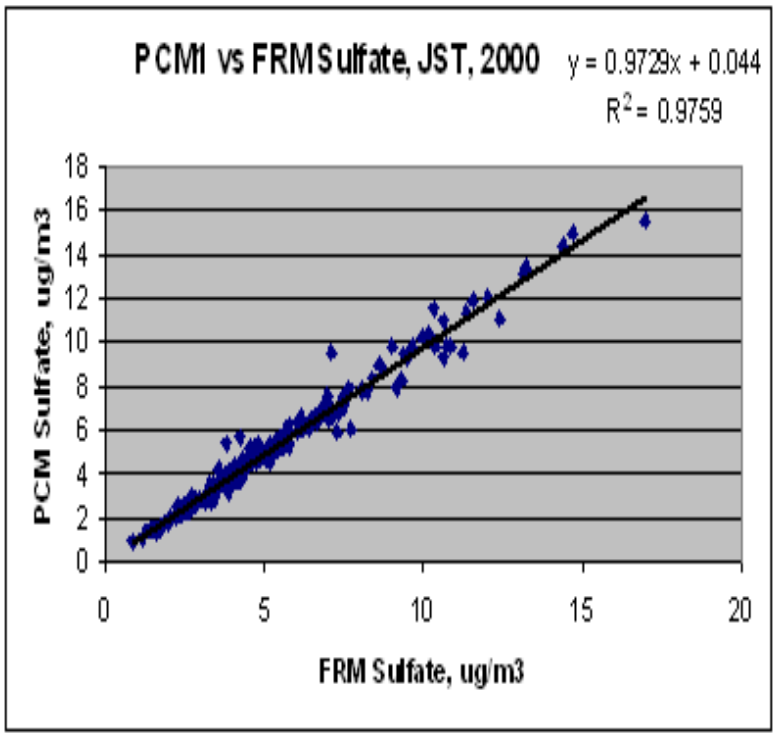
Comparability of Mass Measurements

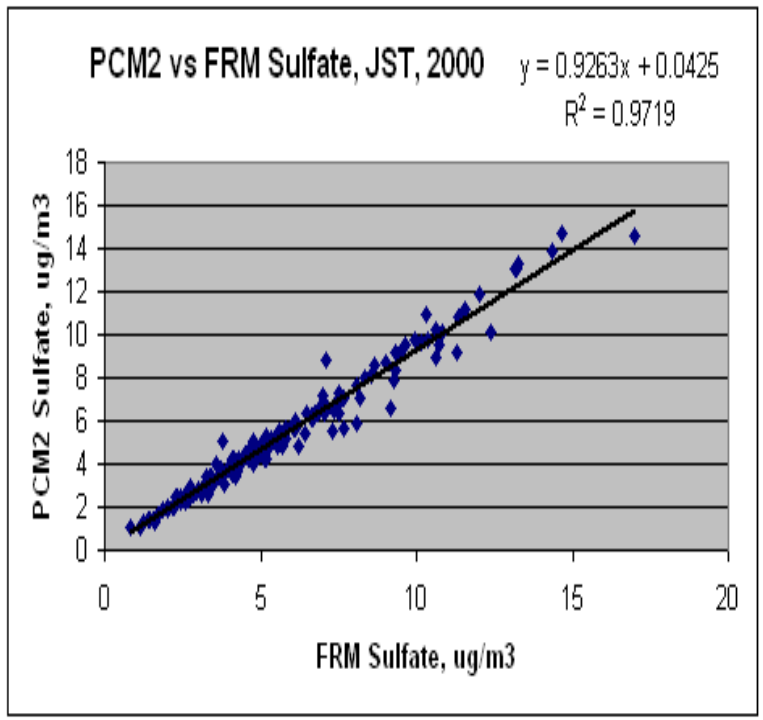




EPRI

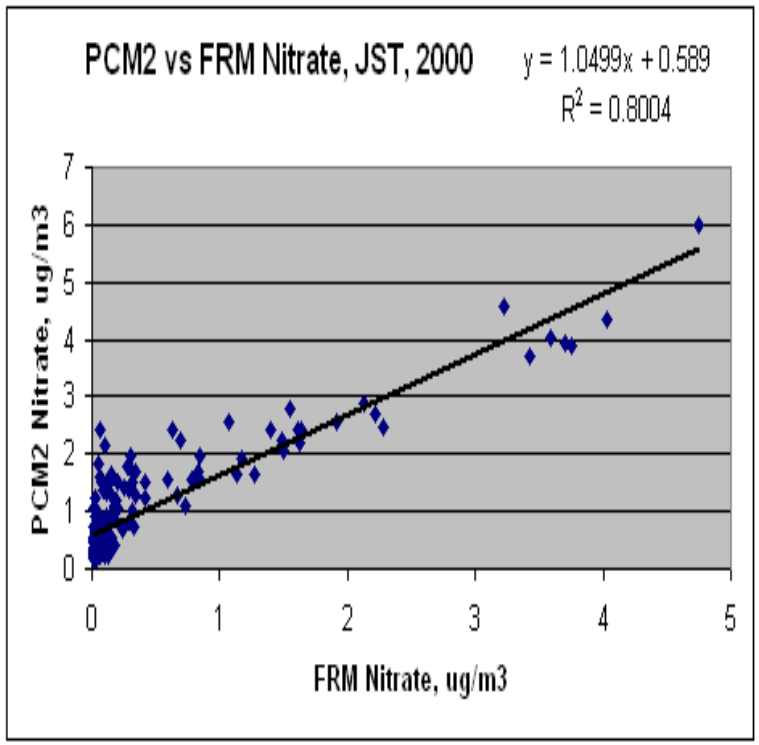
Comparability of $SO_4^=$ Measurements

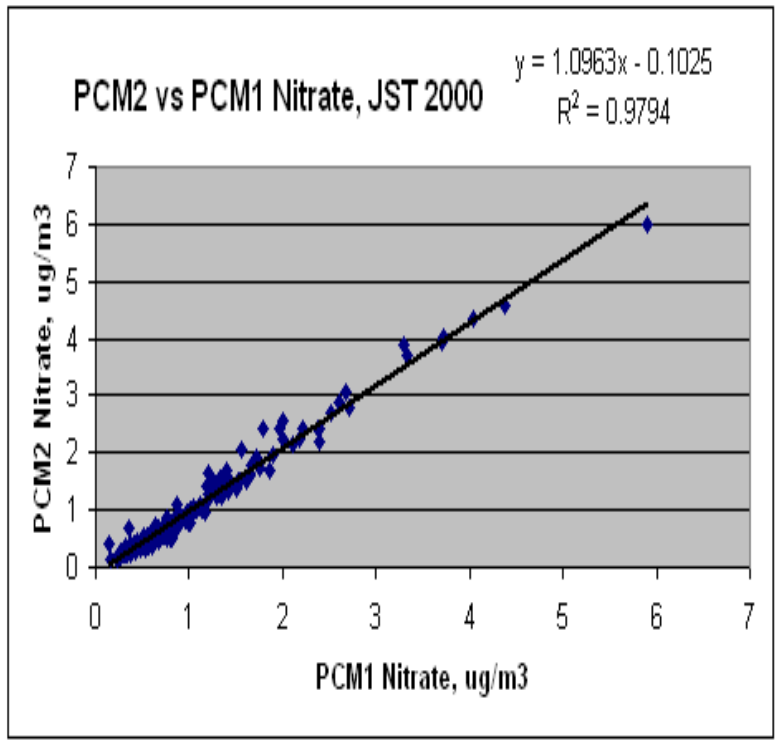




EPRI

Comparability of NO_3^- Measurements





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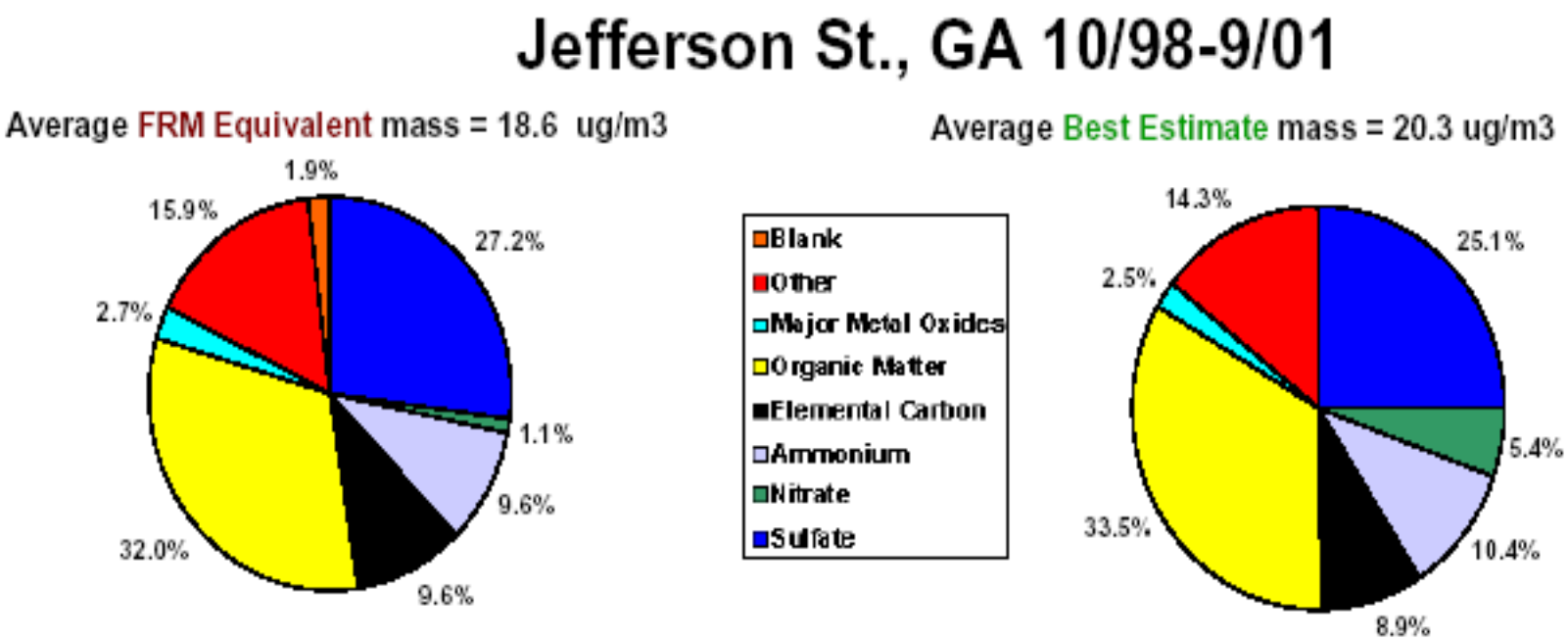
FRM Artifacts



Eric Edgerton will discuss this issue in more detail in this session's fourth paper.

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SEARCH Findings

- $PM_{2.5}$ annual standard exceedances at BHM, JST and YRK.
  - YRK would not exceed if blank corrected
- No daily standard exceedances
- Organic matter and $SO_4^=$ are the major components of $PM_{2.5}$, with OM > $SO_4^=$ at urban sites.
- Urban $PM_{2.5}$ > rural, with ΔC being the major factor.
- Methods for reconstructing mass should be clearly specified when presenting results.
- Carbonaceous material is an imporant component of PM_{coarse}
- Primary C > secondary C in SE
  - Diesel, wood smoke, meat cooking and gasoline sources predominate.

Related Research

- Continue daily sampling at JST through 2003 in support of ARIES.
- Study fire-related effects on alveolar cells (UGa)
- Continue Assessment of Spatial Aeorsol Composition in Atlanta (ASACA) through 2003 (GIT).
- Collaborate with EPA SuperSites
  - 8/99 Atlanta Supersite
  - 7/01, 1/02, 7/02 Integrated Eastern Supersite Experiments
- Study Physico-chemical characteristics of particles (U MN)
  - Electrical mobility, hygroscopicity, volatility, and mass

Related Research

- Investivate “missing” mass in PM_{coarse} using microscopy, INAA, EC/OC. (ARA)
- Conduct comparisons with state and local mass and speciation monitors. (ARA)
- Use PM ^{14}C to infer modern carbon in samples having broad range of airmass histories. (ARA)
- Use size fractionated $SO_4^=$ to distinguish homogeneous from heterogeneous formation. (ARA)
- Carry out further studies on sources of carbonaceous materials. (ARA)

Related Research

- Enhance emissions inventory for domain. (GIT)
- Develop optimal episode selection technique for ozone and PM modeling. (SAI)
- Conduct ozone modeling for GCOS domain (SAI, SCS)
- Conduct exploratory PM modeling for domain (AER, SAI, GIT)
- Characterize atmospheric Hg behavior. (ARA)
- Develop and apply Hg plume model. (AER)

Acknowledgements

Sponsors

- Alabama Electric Cooperative
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- Constellation Energy
- Detroit Edison
- Excel Energy
- EPRI
- Louisville Gas & Electric
- Municipal Electric Authority of Georgia
- NISOURCE
- Oglethorpe Power
- Southern Company
- TXU Electric

Principal Investigators

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

Contractors

- Atmospheric Research & Analysis, Inc.
- Chester Labnet
- Desert Research Institute
- Harding - ESE

EPRI

Collaborators

- ARIES
- ASACA (Russell – GIT)
- EPA PM SuperSites
  - August 1999 Atlanta SuperSite
  - July 2001 and January 2001, ESP01 and ESP02
- Southern Oxidants Study
- Southern Center for the Integrated Study of Secondary Pollutants (GIT)
- Southern Fine Particle Monitoring Project (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
- US Environmental Protection Agency
- US Department of Energy

Synopsis

- SEARCH is unique in that it combines
  - eight highly instrumented monitoring stations,
  - in both rural and urban environments,
  - over a large (4-state) geographic area,
  - with a large fraction of the measurements being made in “real time,”
  - with a level of redundancy, and
  - a planned operational lifetime of over seven years, with
  - Extensive related research.

Overview of Session

- 2nd Paper
  - "Measurement of Trace Gas Oxidants, Precursors and Tracers in SEARCH"
  - Eric Edgerton et al.
  - What source inferences can be made with continuous gaseous measruements.
- 3rd Paper
  - "Carbon in Southeastern Aerosol Particles"
  - George Hidy et al.
  - Methods for distinguishing primary from secondary carbonaceous materials

Overview of Session

- 4th Paper
  - Eric Edgerton et al.
  - "Investigation of Sampling Artifacts in the Federal Reference Method for $PM_{2.5}$"
  - Compare FRM with methods designed to minimize artifact
- 5th Paper
  - Eric Edgerton et al.
  - "Filter-Based Measurements of $PM_{2.5}$ Mass and Composition in SEARCH"
  - Describe $PM_{2.5}$ characteristics throughout the SEARCH domain

Overview of Session

- 6th Paper
  - Charles Blanchard and George Hidy
  - “Effects of Changes in Sulfate, Ammonia, and Nitric Acid on Particle Compostion in the Southeastern United States”
  - Use a gas-particle equilibrium model to explore how aerosol compositon responds to changes in precursors.
- 7th Paper
  - Eric Edgerton, et al.
  - “Real-time Measurements of $PM_{2.5}$ Mass and Composition in SEARCH”
  - Demonstrates the wealth of information that can be derived from measurements with high temporal resolution.