Summary of Emissions Management Strategy Policy Relevant Findings from EPA's PM Supersites Program

Paul Solomon, US EPA, Las Vegas, NV;

Philip Hopke, Clarkson University, Potsdam, NY

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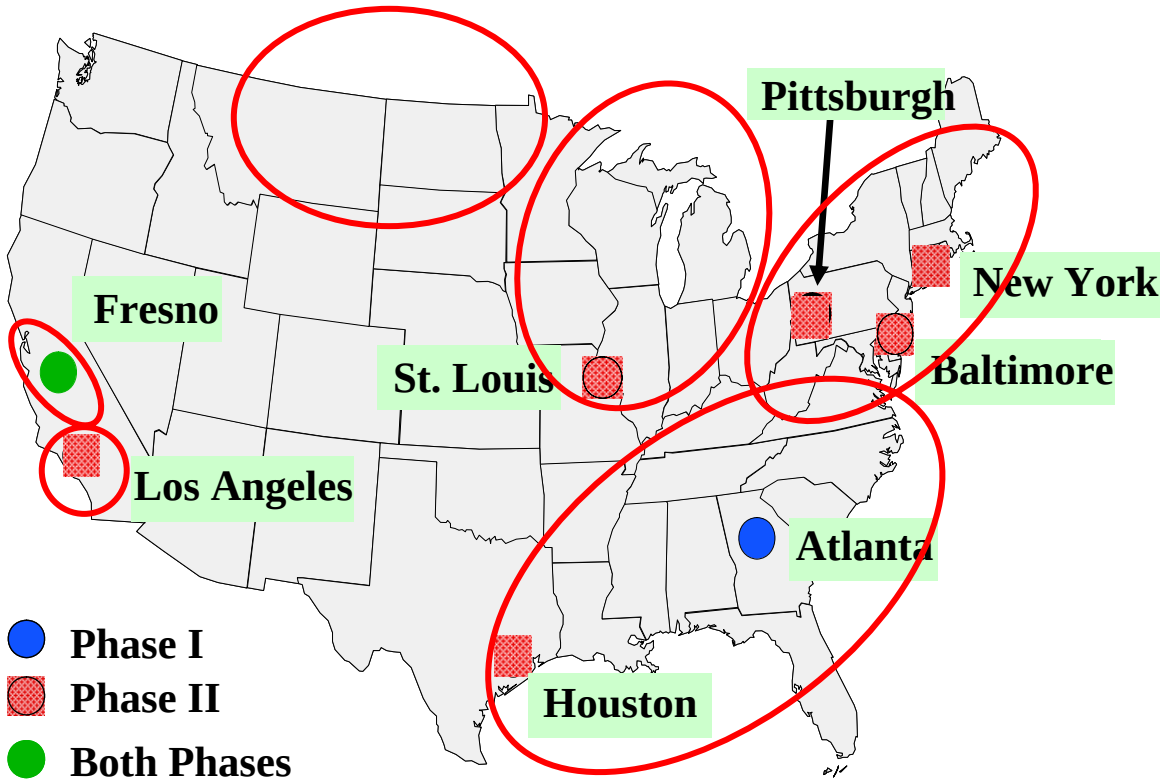
EPA's PM Supersites Program

- **Program Objectives**
  - ✓ Developing Information that Will Reduce Uncertainties In Our Understanding Of PM Accumulation In Air On Urban and Regional Scales
  - ✓ Advancing and Evaluating PM and Related Species Measurement Methods
  - ✓ Supporting Health Effects and Exposure Studies

Supersites Program Locations

- Locations Chosen Based on Diversity In PM Composition and Meteorology
- Consider As Regional Programs Including Initial Coordination With Other Studies In Most Locations and National Networks

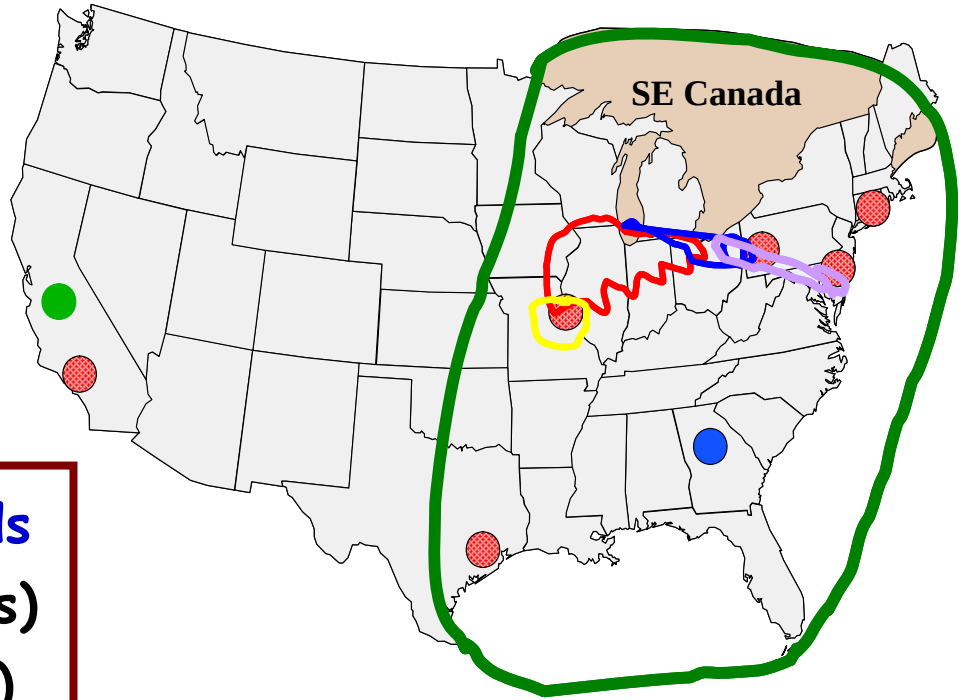


NARSTO Conceptual Models Locations Within US (5 of 6)

PM Supersites Program Is Enhanced and Enhances Air Quality and Meteorological Data Collection Activities Across the Country

Eastern Supersites Program (ESP)

- Coordinating and Collaborating With Related Air Quality Studies In the Eastern United States (Over 30 Programs & Studies Involved)

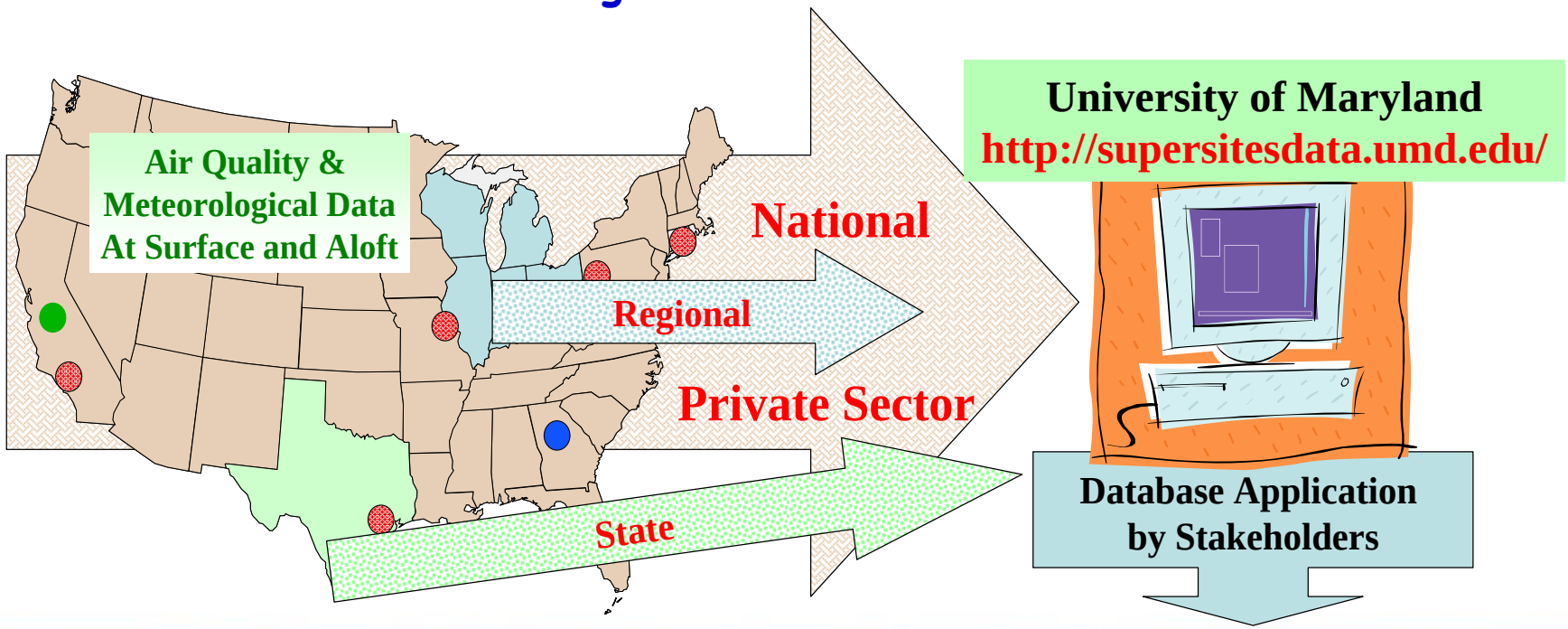


Intensive Monitoring Periods

- August 2001 (4.5 weeks)
- January 2002 (4 weeks)
- July 2002 (4 weeks)

Supersites Integrated Relational Database (SIRD)

- **An Outcome Of ESP**
  - ✓ Development Of SIRD
    - ❖ **Includes Most Air Quality and Meteorological Data (Surface and Aloft) Collected In the Continental US From June 2001 – August 2002, A Period that Encompasses the Three ESP Intensive Monitoring Periods**



SIRD Outcomes

- **Used by Stakeholders for:**
  - ✓ **SIP Development:**
    - ❖ Model Performance Evaluation
    - ❖ Model Application
    - ❖ Data Analysis
- **Yielding Improved:**
  - ✓ **Understanding of the Accumulation Of PM On Urban and Regional Scales**
  - ✓ **Source-Receptor Relationships**
- **Resulting In:**
  - ✓ **More Efficient and Cost Effective Approaches To Reducing Ambient PM Levels and Related Species On Urban and Regional Scales**
  - ✓ **Resulting in Better Protection of Public Health and Welfare**

PM Supersites Program and Related Studies Synthesis of Key and Policy Relevant Findings

Purpose

- ✓ Provide Stakeholders and Relevant Scientific Communities With Information To:
  - ❖ **Improve Our Understanding Of Differences In PM Accumulation Across Multiple Regions Of the Country**
  - ❖ **Better Define Uncertainties In Our Understanding Of PM Accumulation On Urban and Regional Scales**
  - ❖ **Support SIP Development**
  - ❖ **Support Planning for Future Air Quality and Health Effects and Exposure Studies**
    - What is out there, how does it vary, what can we measure, and to what time resolution?

Synthesis of Key and Policy Relevant Findings

➢ Approach

- ✓ Integrate Findings From the Supersites Program and Related Studies:
  - ❖ **Focus On 17 Science/Policy Relevant Questions**
    - Developed With State And Federal Agencies, Multi-state Organizations, and Private Sector
    - Providing Technical Basis for Integrated Synthesis
  - ❖ **Key Inputs Include**
    - Published Results From Air Quality Studies During The Last 5-7 Years
    - February 2005 AAAR PM Supersites and Related Studies International Specialty Conf., Atlanta, GA

Synthesis of Key and Policy Relevant Findings

- **Science/Policy Relevant Questions**
  - ✓ Methods (Qs 1-3)
  - ✓ Characterization (Qs 4- 8)
  - ✓ Source Apportionment – Receptor and Emissions Based Chemical Transport Models (Qs 9-11)
  - ✓ Atmospheric Processes (Qs 12 – 15)
  - ✓ Emissions Estimates (Q 16)
  - ✓ Conceptual Models (Q17)
- **Questions Divided Among Supersites Program PIs (2 Each)**

Synthesis of Key and Policy Relevant Findings

- **Outputs**
  - ✓ Technical Papers in JAWMA Special Issue
  - ✓ Integrated Synthesis of Key Atmospheric Sciences Findings
  - ✓ Policy Relevant Implications Based on Atmospheric Sciences Findings
  - ✓ Health Relevant Implications Based on Atmospheric Sciences Findings
  - ✓ Executive Summary
  - ✓ Policy Relevant One Page Statements
- **Schedule**
  - ✓ Technical Papers Due August 2006
  - ✓ Final Drafts of Technical Papers Due Nov. 2006
  - ✓ Synthesis Draft Dec. 2006

Example Insights Looking Back 5+ Years

- **General Categories Include:**
  - ✓ Methods Development and Evaluation
  - ✓ Characterization of PM In Space (Urban, Regional, Intercontinental) and Time, Especially At High Time Resolution, Including UF, Fine, and Coarse PM
  - ✓ Atmospheric Processes
  - ✓ Atmospheric Modeling, Performance Evaluation, and Application
  - ✓ Source Apportionment by Receptor and Emissions Based Modeling
  - ✓ Insights Into Emissions Control Strategies

Example Insights Looking Back 5+Years

Today's Example
Method to Application

Development Of A Continuous Method
for
Particle Bound Water
and
Application To FRM Mass Closure

Method Development: Particle Bound Water (PBW)*

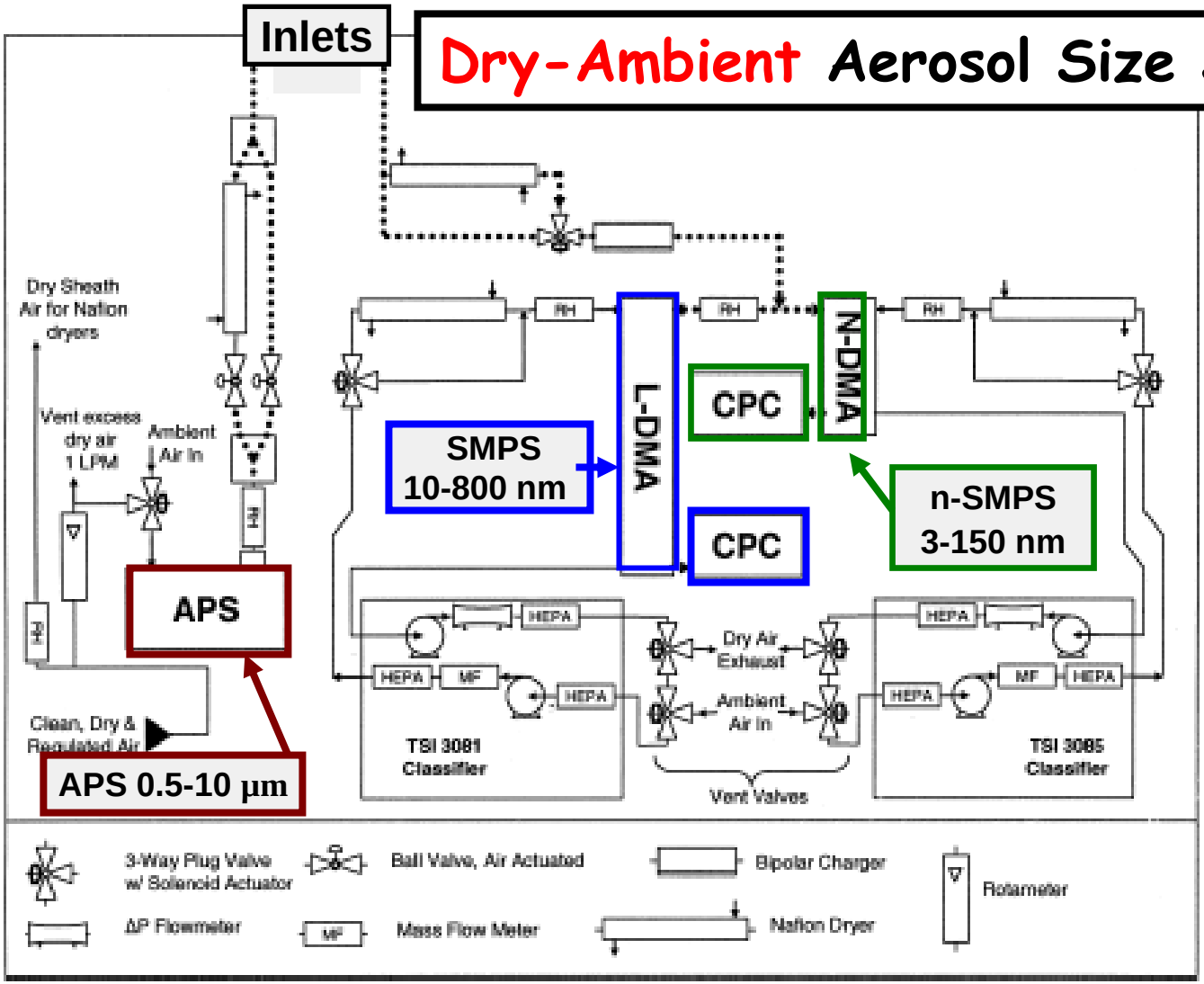


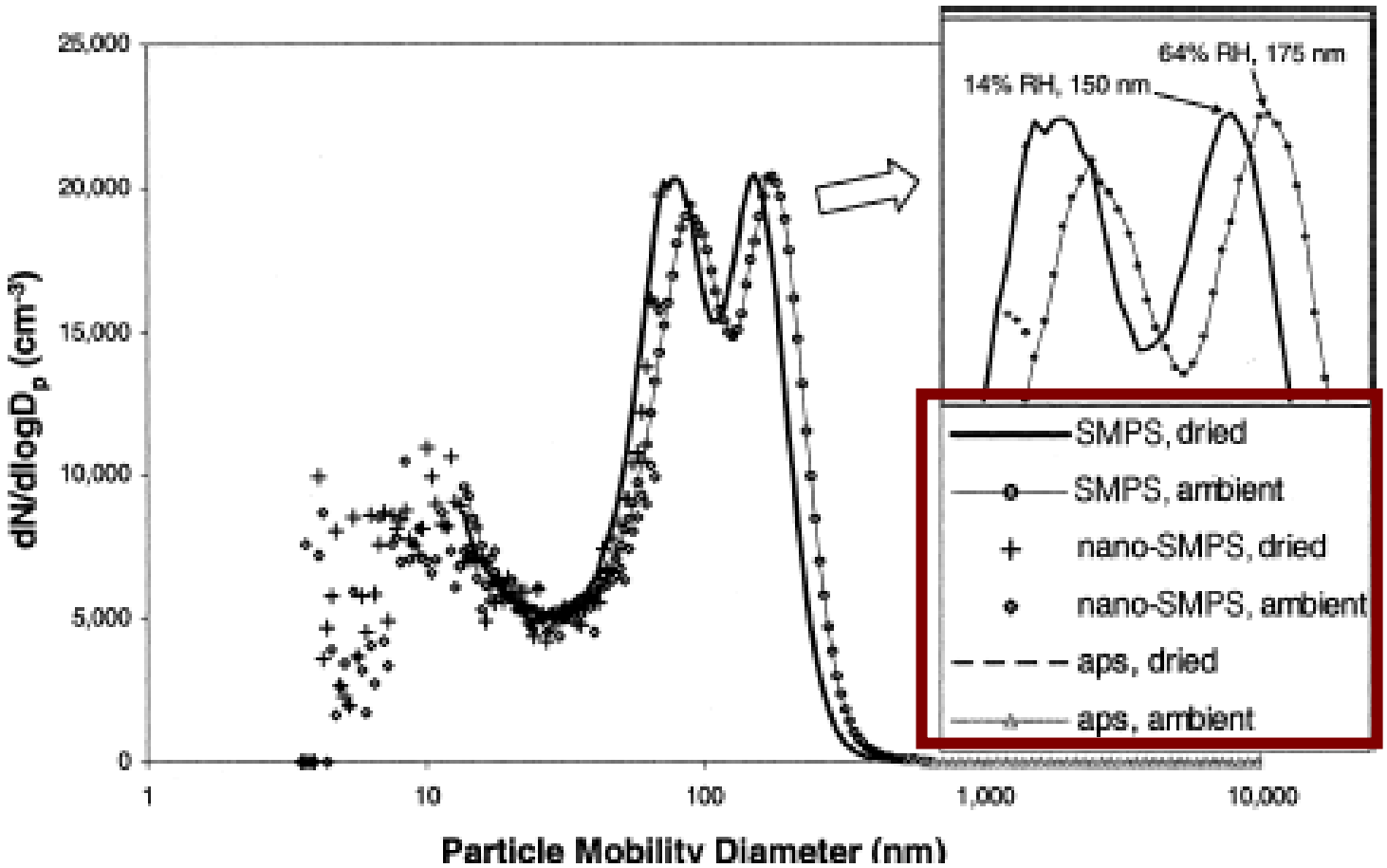
Figure 1. Flow diagram of DAASS. Aerosol streams are shown by dotted lines and other flows are indicated by solid lines.

Alternating 7 min Cycles: Dry – Ambient

Continuous (hr avg.) PBW from 3 nm – 10 µm

*Stanier et al. AS&T, 38 (S1), 215-228, 2004, Figure 1

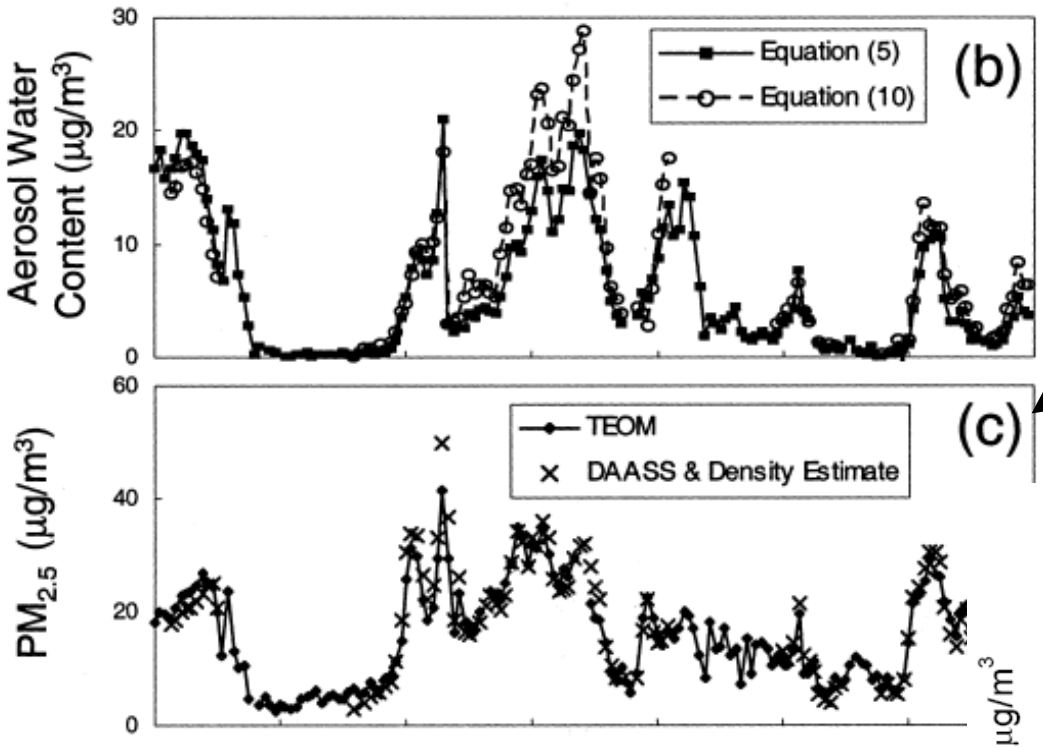
Measurement of Particle Bound Water (Cont)*



Dried and Ambient Number Size Distributions Measured During the PAQS. One Hour Averages for 22:00–23:00 EST On 3 July 2001. Each Distribution Is the Average Of 4 Ambient and 4 Dried Distributions.

*Stanier et al. AS&T, 38 (S1), 215-228, 2004, Figure 5

Evaluation & Validation of PBW Method

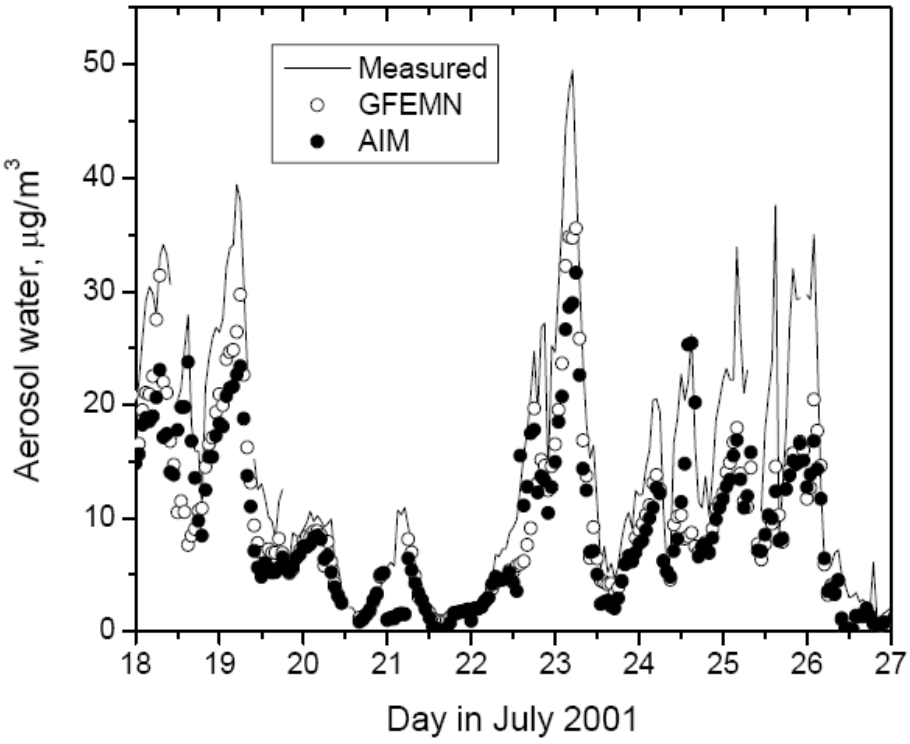


(b) Example Of Aerosol Water Content Measurement for A 7-day Period

(c) Validation Of Density Estimate Against SES TEOM.

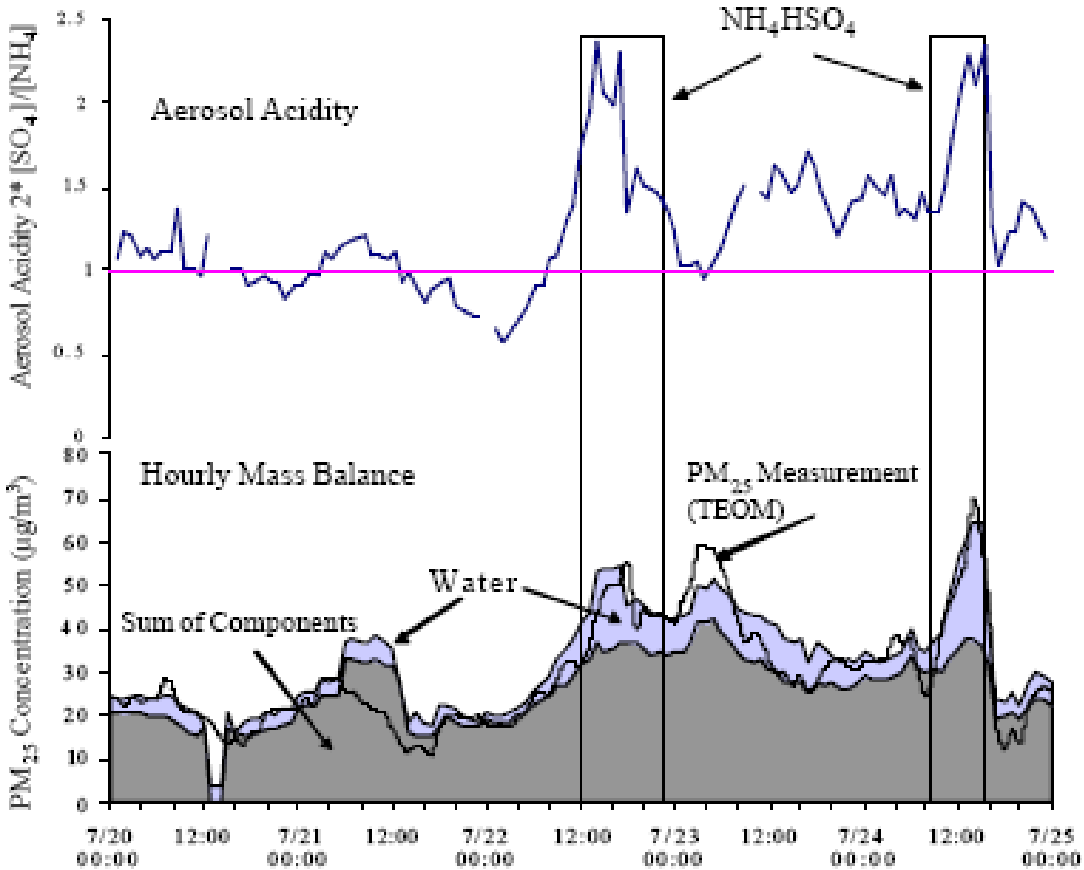
Stanier et al. AS&T, 38 (S1), 215-228, 2004, Figure 9b, 9c.

Example Of Time Series Of the Observed and Modeled Aerosol Water Content During A Period In July 2001.



Khlystov et al. JGR, 110, D07S10, 2005, Figure 6.

Measurement of Particle Bound Water (Cont)

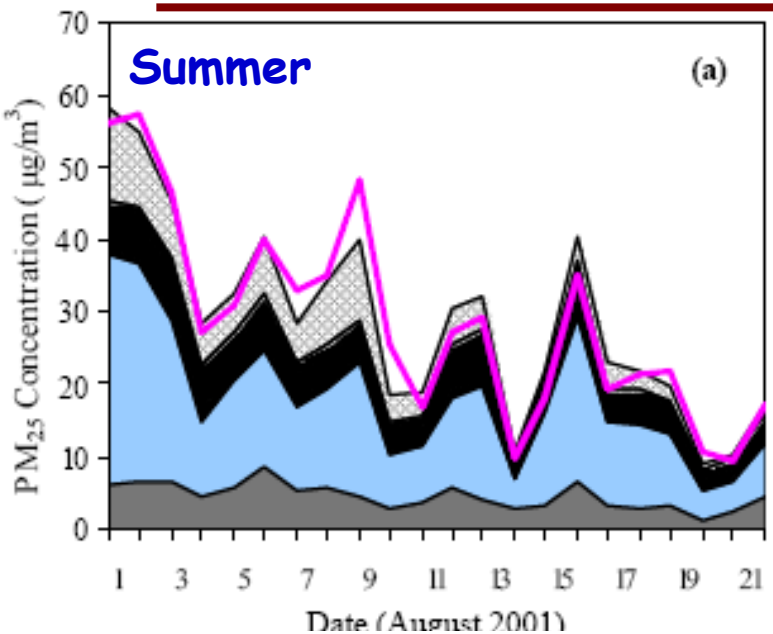


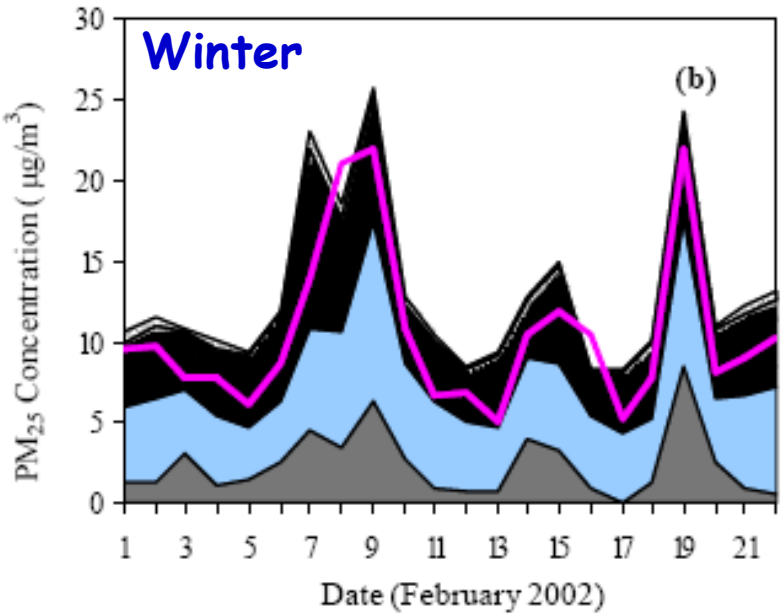
Pittsburgh: PBW Correlates With Acidic Periods,

NH_4HSO_4 Comprises Up To Half the Sulfate During Acidic Periods

Rees et al. AE 38(20), p3313, 2004, Figures 8

Application of Particle Bound Water*





Closing FRM Mass Balance
Using Composition Data Corrected for Volatilization and Water Content Based on DAASS

Water Content of FRM Mass:
Summer 16%, Winter 8%
Appears Responsible for Episodes Where FRM Mass > Sum of Species.

Aerosol Acidity
- **Highest During Summer;**
- **Winter is Neutral With Less Water**

Volatilization: **5% Summer,**
(Nitrate, SVOC) **9% Winter**

Rees et al. AE 38(20), p3313, 2004, Figures 9

Key Atmospheric Sciences Findings Related to Particle Bound Water (PBW)

- A New Semi-continuous Method Has Been Developed and Tested To Measure PBW
- In Pittsburgh, PBW Is Associated With Acidic Aerosols, Even At RH As Low As 30%
  - ✓ Aerosol Water Content Is Highest In Summer When Aerosol Is Acidic and Dominated By Ammonium Bisulfate
  - ✓ Neutral Aerosol In Winter Has A Much Lower Water Content
- PBW Ranged From 0-50% Of PM2.5 Mass Or Ranged From 0-20 $\mu g/m^3$, PM2.5 Ranged From 5-60 $\mu g/m^3$

PBW Policy and Health Relevant Implications

Policy Relevant Implications

- ✓ A Significant Fraction Of Aerosol Mass Can Consist Of PBW, Especially that Not Accounted for By Methods Used In EPA's Chemical Speciation Network
- ✓ Highest Amounts Of PBW Are Observed In the Summer When the Aerosol Appears To Be Acidic
- ✓ Accounting for Measured PBW and Volatilization Of Semi-volatile Species the FRM Mass Can Be Reproduced Within Uncertainties Of the Measurements By the Sum Of the Species

PBW Policy and Health Relevant Implications

➢ Policy Relevant Implications

- ✓ PBW Measurements Will Provide Important Information for Performance Evaluation Of Thermodynamic Modules, Where PBW Content Is Critical To The Distribution Of Semi-volatile Species Between the Gas, Aqueous, and Particle Phases

- ✓ Uncertainties In Control Strategy Development By Apportionment Might Be Reduced By Measurement Of PBW Helping To Account Effectively for A Significant Portion Of the Unidentified Aerosol Mass

PBW Policy and Health Relevant Implications

- **Health Relevant Implications**
  - ✓ Acidity Appears To Be Associated With Particles that Have The Highest PBW Levels and the Acidic Solution Maybe Capable Of Mobilizing Toxic Species that Would Otherwise Be Insoluble, Potentially Increasing Adverse Impacts On Human Health.
  - ✓ Greater Acidity Also May Result In An Increase In Acute Effects Associated With Low pH, Such As, Irritation, Possible Airway Constriction, Or Other Acute Effects.

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Questions???