PAMS
Re-Engineering

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Outline

• Background of PAMS
• Need for Re-Engineering
• Reconsidering Objectives
• Network Design
• Target compound list
• VOC Measurements
• Nitrogen Measurements
• Meteorological Measurements
• Next steps
Background

• Enhanced ozone monitoring required by Clean Air Act
  – Section 182(c)(1) of the 1990 Clean Air Act Amendments (CAAA) required the EPA to promulgate rules for enhanced monitoring to obtain more comprehensive and representative data on ozone air pollution.
  – Section 185(b) of the CAA required EPA to work with the National Academy of Sciences (NAS) to conduct a study on the role of ozone precursors in tropospheric ozone formation and control.

• On February 12, 1993, the EPA promulgated the first PAMS requirements with the following objectives:
  – Build database of speciated VOCs for evaluation of control strategies and local modeling efforts
  – Provide data for model evaluation
  – Support emission inventory improvements
  – Track trends and progress in precursor reductions

• In 2006, the PAMS requirements were revised to lower the minimum requirements for PAMS.
Current PAMS Sites

Site Types
- Type 4
- Type 3
- Type 2
- Type 1
Need for Re-Engineering

• Changes have occurred since PAMS program first started
  – Ozone standard has been revised to a level of 0.075 ppm based on 3-year average of the annual 4th highest 8-hour average
  – Ozone concentrations have decreased in many areas of the country
• Equipment is old and in need of replacement
  – New technologies available that should be considered
• Concerns about data not being used enough
  – Improvements may make data more useful
Status of Re-engineering

- Team of EPA and state and local monitoring agency members formed
- Engaged CASAC for recommendations on improving PAMS network
  - Final report completed in September 2011
- Finalizing team recommendations on most aspects
- Beginning to brief management and other stakeholders on recommendations
Reconsidering Objectives

• CASAC Recommendations
  – All current objectives are valid and appropriate going forward
  – Objectives should be revised to include a national and regional focus
  – Recommended the following additional objectives:
    • Provide compound-specific diurnal patterns to evaluate emission profiles and for evaluation of the air quality modeling system overall
    • Secondary Objective: Measurement of secondary organic aerosol precursors (SOAP) with an emphasis on gathering data to support development of effective strategies for the reduction of SOAP

• Team Recommendations
  – Revise objectives to represent national (model development/evaluation, trends) and regional objectives (data for evaluation of control strategies, local modeling efforts)
  – Include measurement of priority organic air toxics and SOAP as sub-objectives
Network Design

• Current design calls for up to 5 sites in each serious and above ozone non-attainment area
  – Type 1 Upwind
  – Type 2 Max emissions
  – Type 3 Max ozone
  – Type 4 Extreme Downwind
• PAMS Season June-August
• 75 current PAMS sites
  – Not counting met sites
Network Design Recommendations

• CASAC Recommendations
  – Current requirements too inflexible to meet state needs
  – Should consider areas beyond those in serious and above nonattainment areas
  – PAMS season should be extended

• ORD Model Developer/Evaluators Recommendations
  – Add more areas for better spatial coverage of the US at the expense of multiple sites per area

• Team Recommendations
  – Reduce minimum PAMS requirements to free up resources for states to implement alternative enhanced ozone measurements
  – Remove ties to 1 hour ozone designations
  – Add PAMS measurements to NCore sites in ozone non-attainment areas instead of current multi-site design
  – Extend PAMS season to coincide with ozone seasons
  – Provide remaining funds to monitoring agencies in non-attainment areas for regional and local enhanced ozone monitoring strategies
Two Components of Proposed Design

• **Required PAMS**
  – Small core set of sites leveraging NCore infrastructure in ozone non-attainment areas
  – Consistent sampling schedule and methods
  – Primary objectives would be to gather data for model evaluation and development, tracking trends, and accountability

• **Flexible PAMS**
  – Monitoring agencies with ozone non-attainment areas would be required to develop and implement an enhanced ozone monitoring plan
  – Details of what, where, when and how to measure would generally be left up to monitoring agencies
  – Primary objectives would be to gather data to understand and solve local ozone problem
## Impact on Number of Required Sites

<table>
<thead>
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<th>Number of Sites</th>
<th>Currently Required</th>
<th>PAMS at NACore</th>
<th>Change</th>
</tr>
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<td>52</td>
<td>26</td>
<td>- 26</td>
</tr>
<tr>
<td>- New</td>
<td></td>
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Proposed PAMS Network
VOC Target List

• Currently 54 VOC compounds (plus 3 carbonyls) are identified through guidance for measurement at PAMS
  – Complete list can be found at:
    • http://www.epa.gov/ttn/amtic/files/ambient/pams/pams54.pdf

• Minor modifications have been made to the list over the years
VOC Target List Recommendations

• CASAC Recommendations
  – Provided guidance on how to prioritize current list
  – Recommended more biogenic species (such as terpenes), tracers for biofuels (such as ethanol)
  – Recommended additional carbonyl compounds

• Team Recommendations
  – Evaluate list to determine if some compounds can be removed due to low concentration/importance in all PAMS areas
  – Add important biogenics, air toxics, “tracers”, and SOA precursors that can be measured with “standard” equipment
  – Allow states to further reduce list based on their concentrations
    • Maybe provide core list of compounds that can not be removed by states
Average Concentration of PAMS Compounds in 2010
Average MIR Adjusted Concentration of PAMS Compounds in 2010
VOC Measurements

• Current requirements
  – Speciated VOC measurements at 2 sites (a Type 2 and a Type 1 or Type 3)
  – Three options allowed
    • Hourly auto GC,
    • Eight 3-hour canisters, or
    • 1 morning and 1 afternoon canister with a 3-hour or less averaging time plus continuous Total Non-methane Hydrocarbon (TNMH) measurement
VOC Measurement Technologies

Canisters vs Auto-GCs

- Data averaged over sampling period
- Low capital cost
- Continuing lab/shipping costs
- Manually intensive
- Canister “artifacts”

- Hourly data
- Higher capital cost
- Higher skill level required to run and analyze data
- Difficulty resolving some compounds
VOC Recommendations

• CASAC Recommendations
  – No specific recommendation on autoGC vs. canister
    • CASAC did note that one objective of PAMS should be to gather data on diurnal patterns which can’t be done (well) with canisters
  – Noted advantages and disadvantages of both options
  – Recommended a thorough evaluation of commercial autoGCs

• Team Recommendations
  – Require use of autoGCs at required PAMS sites
  – Allow and support canisters for flexible portion of PAMS
  – Perform a “shootout” of available autoGCs to evaluate performance, field readiness, and costs
Carbonyl Measurement Requirements

• Carbonyl measurements are required at Type 2 sites in areas classified as serious or above for the 8-hour ozone standard
  – Formaldehyde,
  – Acetaldehyde, and
  – Acetone

• Carbonyl requirements were dramatically scaled back in 2006 monitoring revisions due to method concerns
  – EPA’s Office of Research and Development (ORD) has plans to develop improved carbonyl methods
Carbonyl Recommendations

• CASAC Recommendations
  – Noted that carbonyls are very important in ozone formation
  – Voiced continued concerns regarding method and need for improved QA protocols for field and laboratory analysis

• Team Recommendations
  – Follow ORD evaluation of carbonyl sampling methods
  – Require carbonyl sampling at required PAMS sites, but only after ORD has finalized a new and improved method
Nitrogen Measurements

• Current requirements
  – One NO/NO2/NOx site per area (at Type 2 Sites)
  – One NO/NOy site per area (at either Type 1 or Type 3 site)

• Issues
  – NO₂ plays a major role in ozone formation
  – Standard NOₓ measurement technology is known to have positive interferences from other non-NOₓ species (HNO₃, PAN, mPAN, etc.)
    • NO₂ measurement = NOwhat
  – NOᵧ measurements don’t give a NO₂ reading at all!
  – New technologies are coming out that will provide a “true NO₂“ measurement
    • Direct NO₂ measurements (e.g., cavity ringdown)
    • Photolytic converters
  – Existing NO2 NAAQS network provides useful data for O₃ modeling.
Nitrogen Measurements

• CASAC Recommendations
  – New NO2 technologies should be investigated for inclusion in the PAMS network

• Team Recommendations
  – Add a “true NO2” measurement at required PAMS NCore sites
    • NCore sites currently monitor NO/NOy
    • Could add just an NO2 instrument or a photolytic NOx box
Upper Air Meteorology Measurements

- Currently one representative upper air site is required in each PAMS area
  - Details on what upper air data is to be collected is not defined!
    - Mixing height
    - Wind direction and speed?
- Most upper air systems used in PAMS are radar profilers with RASS temperature profilers
  - The systems at PAMS sites are old and VERY expensive
- Inexpensive ceilometers can provide continuous mixing height data
  - NOAA has recently installed over 1000 ceilometers across the US but are not currently collecting mixing height data
Upper Air Meteorology

- **CASAC Recommendations**
  - Upper air wind speed and wind direction data should not be required at all PAMS areas
    - Upper air wind speed and direction data are useful but expensive
    - Utility of upper air wind speed and wind direction data depends on local or regional needs
  - EPA should explore other sources of upper air data (e.g., NOAA’s Aircraft Meteorological Data Relay program)

- **Team Recommendations**
  - Remove requirement to collect upper air data at PAMS sites
  - Work with NOAA to make NOAA upper air data available
    - Alternatively, require mixing height measurement at required PAMS sites
  - Continue to support use of profilers as part of flexible portion of PAMS
Next Steps

- Finish data analysis to finalize recommendations for revised target list
- Plan and initiate “shootout” of auto-GCs
- Work with NOAA to get access to upper air data
- Build management and external consensus on new network design plans
- Revise regulatory requirements as needed
  - Tie in to next ozone review which should be finalized in 2014
- Details, Details, Details…
  - Determine how best to implement “flexible” portion of PAMS
  - Work out funding details
  - Develop appropriate support materials (TAD, SOPs, etc.)
  - Develop national QA program