IMPROVE STREERING COMMITTEE Meeting
Okeefenokee NWR, Georgia
Oct. 28-29, 2008

Summary for MARAMA Monitoring Committee, Nov. 19, 2008
IMPROVE
Particle Monitoring Network:
Status Report to
IMPROVE Steering Committee

Chuck McDade
Crocker Nuclear Laboratory
University of California, Davis
Okefenokee, Georgia
October 2008
Pack Monadnock, NH
Installed October 2007

PACK1
Elevation 695 m
Pack Monadnock, NH
Installed October 2007
New Breton, Louisiana, Site
New Breton, Louisiana, Site
Marsh grass, poisonous snakes, & downed power lines
Gates of the Arctic:
Being installed this week

[Map of Alaska with Gates of the Arctic highlighted]
Sites with secondary quartz filters
New protocol for secondary quartz filters

- Secondary sites increased from 6 to 12
- Field blanks are collected only at secondary filter sites, discontinued elsewhere
- Field blanks are also double quartz
- Field blanks and secondary filters are collected every sampling day, analyzed in 2 of 3 weeks (5 out of 7 filters)
- All front filters are analyzed
- Non-analyzed filters are archived
NETWORK PERFORMANCE:
CALENDAR YEAR 2007
2007 Sample Recovery (A Channel, PM$_{2.5}$ Teflon)

- 94%  Q1
- 95%  Q2
- 94%  Q3
- 93%  Q4
- 94%  Annual A Channel
  2006 was 94%
2007 Sample Recovery (All channels, ABCD)

- 92% Q1
- 94% Q2
- 91% Q3
- 91% Q4
- 92% Annual ABCD

2006 was 92%
Reasons for Sample Losses

Of the 8% of lost samples (ABCD):

- 32%  Equipment problems
- 26%  Operator no-show
- 18%  Power outages
- 12%  Incorrect filter cassette installation
- 12%  Torn or damaged filter
Regional Haze Rule Requirements

A “complete” site has, for ABCD:

- >75% annual recovery
- >50% recovery in each quarter
- <11 consecutive missed samples

7 sites failed in 2007
(8 in ’03, 5 in ‘04, 6 in ’05, 4 in ‘06)
Sites Failing Regional Haze Rule Requirements

- Cohutta, GA (IMPROVE): Failed in 2006
  - Failed annual criterion by 1 sample (74%)
  - Combination of equipment problems and late sample changes
  - Working with supervisor to improve operator performance and hire additional staff. 2008 is improved.
  - Power problems from 2006 have been resolved

- Douglas, AZ (Protocol)
  - Failed 1st quarter (43%) and consecutive lost samples (15)
  - D-module pump failure, replaced by the operator but installed incorrectly.
  - Difficult to contact operator so we didn’t get prompt feedback.
  - We now use email for better communications.
Sites Failing Regional Haze Rule Requirements (cont.)

- North Absaroka, WY (IMPROVE)
  - Destroyed in November 2007 windstorm
  - Rebuilt in time to preserve data capture for 2008

- Phoenix, AZ (Protocol)
  - Failed 1st quarter (43%) and consecutive lost samples (11)
  - B-module pump failure. Many pump failures at this site, due to poor pumphouse ventilation
  - Vent fans installed in March 2007
  - Data analysts can use data from collocated sampler (POC 2)
Sites Failing Regional Haze Rule Requirements (cont.)

- Queen Valley, AZ (Protocol)
  - Failed consecutive lost samples (11)
  - Electrical problems with D-module ebox
  - Shipped several replacements before problem was solved, including visits by Mike Sundblom
  - Problems contacting operator; much better now

- Sierra Ancha, AZ (IMPROVE): Failed in 2006
  - Failed 3rd quarter (42%) and annual (60%)
  - Firefighters often called away, plus equipment problems
  - USFS is attempting to get non-firefighters assigned, but problems persist in 2008 (staff now available, but backup operator did not perform)
Virgin Islands, USVI (IMPROVE)

- Failed annual (67%) and consecutive lost samples (11)
- Many power outages due to breaker and surge protector tripping. Multiple attempts to resolve power issues failed.
- Rewiring repairs done on UCD’s 5/14/08 maintenance visit seem to have solved the problems.
25 IMPROVE samplers are currently in inventory at UC Davis
NEW SAMPLER PROGRAM
New Sampler Program
Features & Advantages

- Took advantage of work done by ARS in programming the URG 3000N for STN
- Code rewritten from scratch; cleaner code will provide fewer compromised flashcard files
- Diagnostics should improve data capture
- Unlimited flexibility in sampling schedules for special studies
- Final testing underway; deployment to follow
DATA MANAGEMENT AND DELIVERY
Data Status and Schedule

- Data soon to be delivered for January 2007 through June 2008
- 2007 data were held awaiting XRF calibration protocol; to be delivered now as a block
- Nearing desired 6 month lag in delivery; dual Cu XRF systems have allowed us to catch up
DATA ADVISORIES
Data advisories alert data users to changes in systems or procedures that may be apparent in the data.

Address deviations that are not incorporated into our reported statistical uncertainties.

Posted on the VIEWS website, linked below the Query Wizard to alert data users.

8 advisories posted since summer 2007.
Eight new data advisories posted since summer 2007

- Shifts in Mo-anode XRF calibration factors (Fall 2005)
- Change in definition of flowrate native flags
- Shift in EC/OC split with 1 January 2005 TOR hardware upgrade
- Changes in sodium data quality (XRF, 12/01)
- Positive interference in PIXE titanium determinations
- Bias between masked and unmasked elemental measurements (unmasked gives elevated S/\text{SO}_4^{2-})
- Invalid data for some collocated samples in 2005
- Mis-reporting of light absorption on masked filters
<table>
<thead>
<tr>
<th><strong>Posting type</strong></th>
<th>Advisory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject</strong></td>
<td>Missing mass and elemental data for episodes of heavy smoke</td>
</tr>
<tr>
<td><strong>Module/Species</strong></td>
<td>A/ MF, elements, $r_{abs}$</td>
</tr>
<tr>
<td><strong>Sites</strong></td>
<td>All</td>
</tr>
<tr>
<td><strong>Period</strong></td>
<td>All</td>
</tr>
<tr>
<td><strong>Recommendation</strong></td>
<td>Use carbon and ion data to bound MF from below</td>
</tr>
<tr>
<td><strong>Submitter</strong></td>
<td>W.H. White, <a href="mailto:white@crocker.ucdavis.edu">white@crocker.ucdavis.edu</a></td>
</tr>
</tbody>
</table>

**Supporting information**

The Teflon filters used in modules A and D often clog and rupture at the high OC concentrations associated with some regional fire events. These episodes of intense smoke are consequently under-represented among days with complete data sets. Failure to account for such non-random data losses can bias extreme-value statistics.
Optical and Scene Networks

Okefenokee NWR, GA
October 28, 2008

John V. Molenar
Air Resource Specialists, Inc.
<table>
<thead>
<tr>
<th>Network</th>
<th>Transmissometers</th>
<th>Nephelometers</th>
<th>Webcams</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Remote</td>
<td>Urban</td>
<td>Remote</td>
</tr>
<tr>
<td>Arizona</td>
<td>(19)</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>NPS</td>
<td>(13)</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Wyoming</td>
<td>(5)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Colorado</td>
<td>(4)</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>USFS</td>
<td>(3)</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Nevada</td>
<td>(2)</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>CENRAP</td>
<td>(1)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>VISTAS</td>
<td>(1)</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>LADCO</td>
<td>(0)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CAMNET</td>
<td>(0)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Totals</td>
<td>(48)</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>
Optical Data

• Nephelometer data through 06/30/2008 delivered to NPS/CIRA on 9/30/2008

• Transmissometer data (2 USFS sites - Bridger & San Gorgonio) through 12/31/2007 delivered to NPS/CIRA on 7/31/2008
<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006</td>
<td>Budget cuts push NPS into looking at private partnerships to fund NPS camera network.</td>
</tr>
<tr>
<td>2007</td>
<td>ARS provides NPS with information on suppliers of NPS camera system hardware.</td>
</tr>
<tr>
<td>Early 2008</td>
<td>NPS approaches Olympus, Canon and others on the partnership concept. Olympus responds favorably.</td>
</tr>
<tr>
<td>March 2008</td>
<td>ARS provides technical and cost proposal to Olympus.</td>
</tr>
<tr>
<td>April 2008</td>
<td>Meeting with NPS, Olympus marketing and technical staff, and ARS to review ARS proposal and get the partnership process started.</td>
</tr>
<tr>
<td>Summer 2008</td>
<td>NPS and Olympus lawyers hash out partnership details and funding levels.</td>
</tr>
</tbody>
</table>
NPS – Olympus USA Partnership

September 2008  Partnership agreement signed by NPS and Olympus.

November 2008  Olympus funding of NPS camera network operations scheduled to begin.

Olympus funding of NPS camera network operations includes two major tasks:

**Network Operations**
- Technical support, backup equipment, communications, archive
- One year, then renewable for two additional years

**System Upgrades**
- Several sites per year, first four by April 2009
- New digital SLRs (E420) and backups supplied by Olympus
- Hardware upgrades and replacements (site dependent)
- New computers and many sites

**Optional New Sites**
- Mesa Verde, Hawaii Volcanoes, Cape Cod
IMPROVE Carbon Analysis

Judith C. Chow (judy.chow@dri.edu)
John G. Watson
Mark Green
Desert Research Institute, Reno, NV

Presented at
the IMPROVE Steering Committee Meeting
Okefenokee, FL
October 28, 2008
Objectives

- Report progress on IMPROVE carbon analysis
- Evaluate precision of carbon fractions for DRI Model 2001 analyzers
## Progress on IMPROVE Sample Carbon Analyses

**(7/07 – 6/08)**

<table>
<thead>
<tr>
<th>Sampling Period</th>
<th>Samples Received</th>
<th>Analysis Completion Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/1/07-12/31/07</td>
<td>11,056</td>
<td>6/30/08</td>
</tr>
<tr>
<td>1/1/08-3/31/08</td>
<td>5,276</td>
<td>9/26/08</td>
</tr>
<tr>
<td>4/1/08-6/30/08</td>
<td>5,186</td>
<td>12/31/08*</td>
</tr>
</tbody>
</table>

* Expected completion date
Laboratory Enhancements

- Recruited two additional full-time technicians
  - Three full-time technicians and two part-time college students, 24-hr/day, ~7 day/week operation

- Hired a part-time maintenance technician

- Procured two additional Model 2001 analyzers (delivery in September and November 2008)

- Upgraded SQL Server software for data backup and retrieval
Model 2001 Replicate Analysis  
(Jan 2005 – April 2008)

1. Calculate absolute differences between original and replicate analyses
2. Average differences for all sites by each sampling date. (This maximizes precision estimates)
3. Divide daily average differences by the corresponding daily site-average filter loading
4. Plot time series of daily absolute and relative differences
Absolute differences are 2-4 μg/filter for TC and OC; 1-2 μg/filter for EC.
Relative differences are 5-10% for TC and OC; 10-30% for EC.
Median relative differences are 5% for OC and TC and 10% for EC. Higher for other fractions.
Conclusions

- Model 2001 replicate differences and relative differences are consistent from 2005 through April, 2008
- OC and TC median relative differences are 5%; EC median relative differences are 10%
- Median relative differences for OC and EC fractions are 10-15%, except for OC1 (35%) and EC2 (20%)
- Low loadings for OC1, EC2 and EC3 result in higher relative differences
IMPROVE – CSN
Carbon Monitoring Workshop
UCD 1/22/08 to 1/23/08
Attendees

- Chuck McDade, UCD
- Max Peterson, RTI
- Neil, Frank, EPA
- Sherri Hunt, EPA
- Judith Chow, DRI
- Warren White, UCD
- Lowell Ashbaugh, UCD
- James Flanagan, RTI
- John Watson, DRI
- Mike Kleeman, UCD
- Ashley, Mefferd, UCD
- William Malm, NPS
- Joann Rice, EPA
- Bret Schichtel, NPS
- Phil Lorang, EPA
- Antony Chen, DRI
- Jay Turner, Wash. U.
- Marc Pitchford, NOAA
Motivation

- Carbon is an abundant and critically important PM species for health and visibility effects
- PM carbon monitoring data has greater uncertainties than the other PM species
  - Artifact uncertainty contributes to overall uncertainty
  - OC/EC split and determination of thermal subspecies are sensitive to small differences in analytical protocol and sample matrix effects
- Recent transitions in the IMPROVE and CSN monitoring methodologies for PM carbon affect the data
  - IMPROVE changed carbon analyzers
  - CSN is transitioning to IMPROVE-like samplers and analysis
- Available information are not sufficient to adequately understand and reduce uncertainties
Goals

• Develop an action plan (12 to 24 months) to generate the information to support the following needs
  – Consistent approach to adjust for organic PM monitoring artifacts
  – Algorithms that relate carbon PM data from IMPROVE and CSN
  – Algorithms that relate old and new analyzer generated IMPROVE carbon PM data

• Make recommendations for interim approaches to address to the same three needs until better approaches are developed
Approach

• **For each of the three needs**
  - Review available pertinent information
  - Identify and discuss information gaps
  - Develop action plans to generate the new information to improve our understanding
  - Discuss interim approaches for coping until better methods can be developed

• **Challenges**
  - No new resources have been identified to conduct additional measurements or studies
  - Both networks need to continue operations while working on this issue
  - Both networks are unlikely to radically change monitoring approaches in the foreseeable future
Overview of Action Plan

- Re-analysis of archived filters
  - Use new IMPROVE method to investigate historic variations in IMPROVE network median EC/OC trends (2004/2005, 96 filter; late 1994, 48 filters; pre-2005 sites with collocated CSN, 72 filters); ~$11.3k – status, recently authorized.
  - Use new IMPROVE method to analyze CSN filters at 6 IMPROVE/CSN collocated urban sites (60 filters per site); ~$26k – status, decision pending but high priority
  - Recalculate OC/EC for CSN filters collected prior to July 8, 2003 using new Sunset Labs software on raw thermal dataset (all filters); ~$20k – status, decision pending but high priority

- Information exchange consistency
  - CSN distribution of site metadata and data advisories similar to IMPROVE; status, decision pending but low priority
  - IMPROVE distribution of blank datasets similar to CSN; status, underway
Overview of Action Plan (continued)

- **Data analysis**
  - Further regression analysis to related IMPROVE and CSN; no additional cost – status, underway (Warren White)

- **Special Studies**
  - Additional artifact literature review*
  - Source-specific sample tests for artifacts*
  - Effects of face velocity on artifacts*
  - Laboratory study of negative artifact*
  - Laboratory studies of vapor absorption on quartz filters (e.g. accumulation rate and stability of as a function of chemical and physical conditions); ~$50k – status, decision pending
  - Study longer exposures of field blanks and secondary filters for CSN network for the pre-conversion to IMPROVE methodology; ~$60k – status, being discussed (see next bullet)

* Proposal not received and no longer being solicited
Overview of Action Plan (continued)

• Network Changes
  – Design and implement changes to CSN collection of various blanks (increase field blank exposure, reduce number of trip blanks); ~$20k, status, under discussion (progress is slow)
  – Continue collocation of old CSN & new CSN, and CSN & IMPROVE during transition to new CSN; status, anticipate doing this, but details not yet determined
  – Increase spatial coverage of IMPROVE backup filters (double the number of backup filter sites to 12, reduce the number of field blanks for cost-neutral change); $0 – status, implemented
Follow-on Activities

• Continue to track implementation and assess results of the action plans
• As more data becomes available, assess the comparability of the IMPROVE and new CSN (i.e. IMPROVE-like) carbon data from collocated sampling sites
• Determine if another joint network workshop would be helpful to plan additional activities and/or operational changes (~1 year from now)
• Disseminate results of assessments (e.g. IMPROVE data advisories, papers, journal articles, etc.)
IMPROVE
Sampling & Analysis:
Evaluation & Development

Chuck McDade
Crocker Nuclear Laboratory
University of California, Davis
Okefenokee, Georgia
October 2008
CARBON SAMPLING AND ANALYSIS
CARBON ARTIFACT TESTING
Four PM$_{2.5}$ IMPROVE Modules

One cassette in each module will have Q and Q (XAD) field blanks.
- IMPROVE sampling method
- Use daily Secondary to correct daily Primary (not monthly medians)
- Particulate OC = Primary - Secondary
Configuration B – Denuded OC (no gases)

- Denuder removes gas phase
- Quartz = particulate OC + denuder breakthrough
- Quartz (XAD) = volatilized OC (negative artifact) + denuder breakthrough
Configuration C – Denuder Breakthrough

- Teflon removes particles
- Quartz = gas phase denuder breakthrough
- Quartz (XAD) = highly sorptive filter for additional gas phase breakthrough
- Denuder breakthrough = Quartz + Quartz (XAD)
**Configuration D – Undenuded to Determine Denuder Efficiency (compare to config C)**

- Teflon removes particles
- Quartz + Quartz (XAD) = Total Gases
- **ESTIMATE of Denuder Efficiency** =
  - 1 – denuder breakthrough/total gases
  - 1 – config C/config D
Best Estimate of Particulate OC

- If denuder 100% efficient
  - POC = collected particles + negative artifact
  - POC determined from Config B (denuded)
- If denuder < 100% efficient (real world)
  - POC = collected particles + negative artifact – denuder breakthrough
  - POC determined from Config B – Config C
Upcoming Work

- Sampling conducted this summer, to continue in 2008-09
- Analyses will be conducted on the Sunset Labs analyzer at UC Davis
- Work to be completed by Fall 2009
- Results will illuminate biases in our current sampling approach
EPA PM NAAQS Review
“Urban Visibility-Based Secondary Standard?”
Overview by Marc Pitchford for the IMPROVE Steering Committee Meeting, October 27 to 29, 2008
# Schedule for the Current Review

<table>
<thead>
<tr>
<th>Major Milestones</th>
<th>Projected Completion Date</th>
<th>Projected CASAC Review Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workshops to Discuss Key Policy-Relevant Issues</td>
<td>July 2007 (complete)</td>
<td></td>
</tr>
<tr>
<td>Integrated Review Plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft</td>
<td>October 2007 (complete)</td>
<td>November 30, 2007 (complete)</td>
</tr>
<tr>
<td>Final</td>
<td>January 2009</td>
<td></td>
</tr>
<tr>
<td>Integrated Science Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Draft</td>
<td>August 2008</td>
<td>October 2008</td>
</tr>
<tr>
<td>Second Draft</td>
<td>March 2009</td>
<td>May 2009</td>
</tr>
<tr>
<td>Final</td>
<td>September 2009</td>
<td></td>
</tr>
<tr>
<td>Risk/Exposure Assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan</td>
<td>September 2008</td>
<td>October 2008</td>
</tr>
<tr>
<td>First Draft</td>
<td>April 2009</td>
<td>May 2009</td>
</tr>
<tr>
<td>Second Draft</td>
<td>November 2009</td>
<td>January 2010</td>
</tr>
<tr>
<td>Final</td>
<td>March 2010</td>
<td></td>
</tr>
<tr>
<td>Policy Assessment/Rulemaking</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANPR</td>
<td>June 2010</td>
<td>August 2010</td>
</tr>
<tr>
<td>Proposed</td>
<td>January 2011</td>
<td></td>
</tr>
<tr>
<td>Final</td>
<td>October 2011</td>
<td></td>
</tr>
</tbody>
</table>

*Indicates that a single CASAC meeting will address both documents*
Scope of Assessment for Review of Secondary Standards

Issue:
• Should the assessment continue to focus on urban visibility?

Planned approach:
• Quantitative assessments:
  – Visibility impairment as it relates to fine particles
  – Expand the characterization of public perceptions of visibility impairment in urban areas

• Qualitative assessments
  – climate,
  – effects on vegetation and ecosystems,
  – and materials damage
Current Status

• Integrated Science Assessment, Visibility Effects Chapter 7
  – features information developed by the RPO process and IMPROVE network
  – draft chapter is available

• Urban Visibility Preference/Valuation Workshop (10/6 to 10/8/08)
  – goal is to help plan a new round of urban visibility focus group and survey studies that EPA may fund
  – summary report will be available soon

• Other activities & issues
  – WinHaze modifications to improve sky color and cloud appearance as sensitive indicators of visibility impairment for urban scenes
  – Review/optimization of IMPROVE algorithm to estimate light extinction from PM speciation data will begin soon
  – EPA could choose a non-PM mass indicator for a proposed secondary standard (e.g. light extinction)
Visibility Regulation Planning in Canada

Prepared by Marc Pitchford for presentation at the IMPROVE Steering Committee Meeting Oct 27 to 29, 2008
Motivation & Interests

• **Canada-US Air Quality Accord**
  - Annex 1 of the 1991 accord recognizes “the importance of preventing significant air quality deterioration and protecting visibility, particularly for international parks, national, state, and provincial parks, and designated wilderness areas”.
  - Canada is required to “develop and implement means affording levels of prevention of significant air quality deterioration and protection of visibility…with respect to sources that could cause significant transboundary air pollution.”
  - Visibility issue has surfaced during the ongoing PM Annex discussions; next meeting Fall 2008

• **Canada Wide Standards**
  - Canada-Wide Standards for PM and Ozone contain provisions for *Continuous Improvement (CI)* and *Keeping Clean Areas Clean (KCAC)*.
  - In areas where ambient levels are lower than the Canada-Wide Standards for PM and Ozone, the CI and KCAC provisions require jurisdictions to establish pollution prevention and best management programs to further improve or maintain good AQ.
  - The CWS recognize that PM and Ozone play a role in visibility impairment, and the actions aimed at reducing these pollutants and their precursors can also help to improve visibility.
Process to Develop the Knowledge Needed to Support Policy Planning

• **Objectives:**
  – To update visibility science in Canada.
  – To scope requirements visibility monitoring in Canada.
  – To report on options for visibility monitoring in Canada.

• **Requirement**
  – Ensure data are comparable to those of the IMPROVE network in the US
Visibility Science Initiative Monitoring Activities

• Establish Visibility Pilot Site(s)
  – IMPROVE-like visibility site(s) to be established at one or two key location

• Monitoring Equipment Inter-comparison Study
  – Perform instrument inter-comparisons to determine optimal monitoring configuration for visibility measurements.

• Develop Image Metrics Technique
  – Develop image processing technique that will quantify visibility information directly from the digital images.
Other Topics/Special Studies

- Western Regional Issues Beyond Haze
- NASA including AERONET
- RHR Implementation Status
- Atmospheric Nitrogen Issues
- Hybrid Receptor Modeling
- NAAQS Exceptional Events
- CSN Carbon Measurement Changes
- IMPROVE/VIEWS website updates
Full Presentations Available at
http://vista.cira.colostate.edu/improve/