INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

4th Quarter 2004 | The IMPROVE Newsletter | Volume 13 / Number 4

Monitoring update

Feature Article: Collocated precision sampling in IMPROVE, Page 4

Network operation status

The IMPROVE (**I**nteragency **M**onitoring of **Pro**tected **V**isual **E**nvironments) Program consists of 110 aerosol visibility monitoring sites selected to provide regionally representative coverage and data for all 156 Class I federally protected areas. Additional instrumentation that operates according to IMPROVE protocol in support of the program includes:

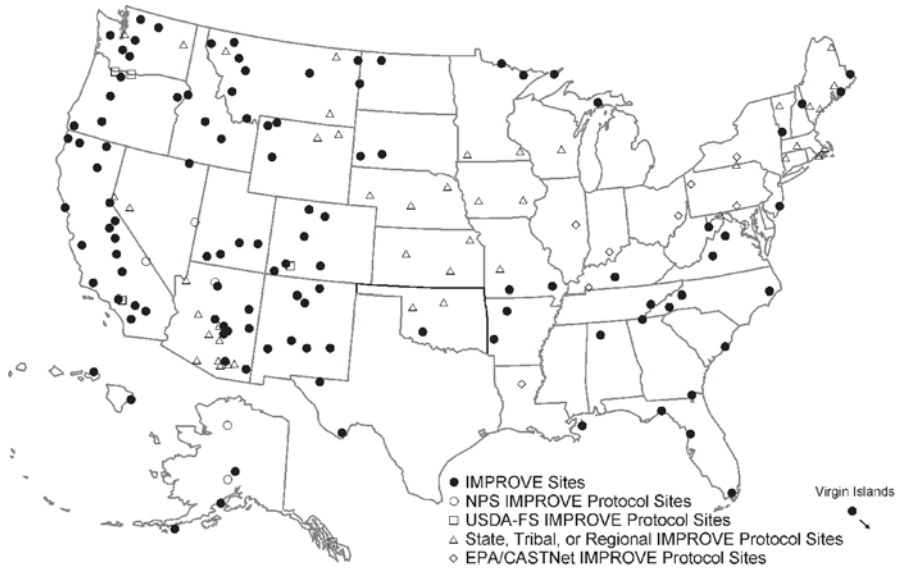
- 57 aerosol samplers
- 15 transmissometers
- 44 nephelometers
- 12 film or digital camera systems
- 52 Web camera systems
- 3 interpretive displays

IMPROVE Program participants are listed on page 8. Federal land managers, states, tribes, regional air partnerships, and other agencies operate supporting instrumentation at monitoring sites as presented in the map below. Preliminary data collection statistics for the 4th Quarter 2004 (October, November, and December) are:

- Aerosol (channel A only) 97% collection
- Aerosol (all modules) 96% completeness
- Optical (transmissometer) 87% collection
- Optical (nephelometer) 93% collection
- Scene (photographic) 93% collection

Instrumentation added to the networks this quarter include a Web camera at Blue Hill, MA, sponsored by CAMNET. A temporary aerosol sampler was also installed at Rubidoux, CA, for comparison with Speciation Trends Network samplers.

Instrumentation removed from the networks this quarter includes the transmissometer at Petrified Forest National Park, AZ, sponsored by the National Park Service. The instrument was one of the first transmissometer monitoring sites and had been operational since 1987. A 35mm film camera was also removed from Pinacate Reserve, Mexico, sponsored by the National Park Service. The camera monitored visibility for four years.



IMPROVE and IMPROVE Protocol Sites
4th Quarter 2004

Data availability status

Data are available on the IMPROVE Web site, at *http://vista.cira.colostate.edu/improve/Data/data.htm*. IMPROVE and other haze related data are also available on the VIEWS Web site, at *http://vista.cira.colostate.edu/views*. Aerosol data are available through February 2004. Transmissometer data are available through December 2003 and nephelometer data are available through September 2004. Photographic slide spectrums are also available on the IMPROVE Web site, under *Data*. Real-time Web camera displays are available on a variety of agency-supported Web sites.

***Monitoring update** continued on page 6....*

Visibility news

IMPROVE committee meeting scheduled

The IMPROVE Steering Committee annual meeting is scheduled for July 26-27 in Acadia National Park, Maine. Further information regarding accommodations, the meeting agenda, and other information will be prepared and distributed as the meeting dates near.

The two-day meeting will also include a tour of the monitoring site, which has a comprehensive list of instrumentation including an IMPROVE aerosol sampler, a nephelometer, a Web camera, and air quality monitoring instrumentation operated by other agencies, including meteorology, ozone, and deposition.

Although not a public meeting, it is open to interested parties. Accommodations are limited, so if you are planning on attending, please contact David Maxwell so arrangements can be made.

Acadia's McFarland Hill monitoring site includes a variety of instrumentation. The park has monitored its air quality since 1979.

For more information contact David Maxwell at the National Park Service Air Resources Division. Telephone: 303/969-2810. Fax: 303/969-2822. E-mail: david_maxwell@nps.gov.

WRAP sponsors visibility data workshop

The Western Regional Air Partnership's Ambient Monitoring and Reporting Forum is hosting a workshop in June. Its purpose is to review findings and recommendations from the Natural Haze Levels Sensitivity project being managed by WRAP on behalf of the regional planning organizations, as well as to review any modifications to the IMPROVE light extinction equation as recommended by the Steering Committe.

The workshop is scheduled for June 9-10, 2005, in Denver, CO. It is open to federal land managers and state, tribal, industry, and environmental participants from across the U.S.

For more information contact Marc Pitchford, E-mail: marcp@noaa.gov or Tom Moore, E-mail: mooret@cira.colostate.edu.

IMPROVE calendars available

The 2005 IMPROVE calendar has been distributed to all monitoring site operators and others associated with the program. This 12-month, wall-sized calendar was created by the Cooperative Institute for Research in the Atmosphere (CIRA), and features site operators and monitoring-related topics such as troubleshooting filter changes, operator support contacts, and cooperative monitoring programs.

We would like to thank all of you who have contributed articles and photographs for publication. The calendars and the information presented in them have become popular since their creation in 2003. Additional calendars are available upon request.

Work on the 2006 calendar has already begun, and suggestions for articles are welcome. We need volunteers to provide photographs, short biographies, and site information for areas to be highlighted next year. This is a great chance to give well-deserved recognition to the hardworking operators that keep the monitoring effort afloat!

For additional calendars, or to submit information for next year's calendar, contact Julie Winchester or Jeff Lemke at the Cooperative Institute for Research in the Atmosphere (CIRA), Foothills Campus, Colorado State University, Fort Collins,CO 80523-1375. E-mail: winchester@cira.colostate.edu or lemke@cira.colostate.edu.

AWMA haze proceedings available

Proceedings from the Air & Waste Management Association's visibility specialty conference held last October in Asheville, NC can now be ordered online. *Regional and Global Perspectives on Haze: Causes, Consequences and Controversies* proceedings are available on CD-ROM. More than 70 presentations are included, addressing emission sources, atmospheric conditions, and aerosol characteristics associated with large-scale haze events; innovative monitoring, assessment, and modeling methods applied to haze; and air quality management implications.

To order a CD-ROM of the proceedings, visit http://www.awma.org/onlinelibrary/.

Monitoring Site Assistance:

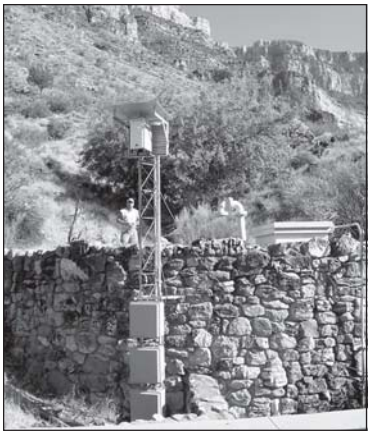
Aerosol sites: contact University of California-Davis
telephone: 530/752-7119 (Pacific time)

Optical/Scene sites: contact Air Resource Specialists, Inc.
telephone: 970/484-7941 (Mountain time)

Indian Gardens nephelometer supplements in-canyon monitoring

After months of planning, the Indian Gardens IMPROVE monitoring site in Grand Canyon National Park, Arizona, received a nephelometer in June. The nephelometer is the result of a cooperative agreement between the National Park Service and the Arizona Department of Environmental Quality.

The system differs slightly from the common IMPROVE nephelometer configuration because it has an automatic span calibration system, identical to sites operating in the Arizona network. Most IMPROVE nephelometer systems use a manual span calibration system, which requires the site operator to perform the span calibrations, while the automatic system performs the procedures without an operator on site.



The nephelometer at Indian Gardens in Grand Canyon National Park, Arizona, is configured with an automatic span calibration system.

The photograph at left shows the nephelometer with a solar radiation and precipitation shield at the top of the tower.

The enclosures at the base of the tower contain (top to bottom) the control box with datalogger, the span gas system, and the SUVA calibration gas tank.

An IMPROVE aerosol sampler has also operated at Indian Gardens since 1989. Indian Gardens is located mid-canyon. The Hance station, located at the rim of the canyon, includes an IMPROVE aerosol sampler, a nephelometer, and a transmissometer. A second transmissometer (receiver component) is located at the rim, while its transmitter component is located at Phantom Ranch, at the floor of the canyon. This instrument monitors the in-canyon air mass from rim-to-floor. Readings from this instrument are displayed on a visibility exhibit at the Yavapai Museum and with the digital image on the National Park Service Web site. The Indian Gardens nephelometer collects data that can be compared to both in-canyon aerosol and transmissometer data.

Visibility has shown to differ greatly from the top of the canyon to the bottom. Generally, air at the top is cleaner than the dirtier air that can settle at the bottom of the canyon. Two concerns for park officials are: 1) when smoke from forest fires on the rim sink down into the canyon at night, and 2) when pollutants are trapped in the canyon during inversions (especially in the winter) from sources in the area (fires, power plants, and others).

For more information contact Carl Bowman at Grand Canyon National Park. Telephone: 928/638-7817. Fax: 928/638-7755. E-mail: carl_bowman@nps.gov.

February conference on particulate matter supersites program and related studies

The American Association for Aerosol Research held a specialty conference February 7-11, 2005, in Atlanta, GA. The international conference drew air quality managers and scientists interested in understanding atmospheric particulate matter accumulation in urban and rural environments. Following is a sampling of papers presented at the conference:

- Seasonal Patterns in Aerosol Composition at Look Rock: Implications for Haze Control (Roger L. Tanner et al.)
- Comparison of Continuous and Filter-Based Measurements of Speciated $PM_{2.5}$ in the Southeastern US (Patricia Brewer et al.)
- Estimates of Secondary Organic Aerosol from the Southeastern Aerosol Research and Characterization Study (SEARCH) (Rick D. Saylor et al.)
- The Importance of Coarse Mode Aerosol Nitrate at Several IMPROVE Monitoring Sites (Taehyoung Lee et al.)
- A Hybrid Receptor Model Integrating Air Quality Data and Eulerian Modeling Results to Apportion Big Bend Texas' Sulfate to United States and Mexican Source Regions (Bret Schichtel et al.)
- Carbon-14 Analysis of $PM_{2.5}$ Aerosols at 5 IMPROVE Sites (Graham Bench et al.)
- Source Identification for Fine Aerosols in the Mammoth Cave National Park (Weixiang Zhao et al.)
- Seasonal Correlations between of NIOSH and IMPROVE Carbon Measurements (Min-Suk Bae et al.)
- Optical Light Scattering Versus Chemical Scattering and $PM_{2.5}$ Concentrations at Urban and Rural Locations in the Southeast (Ivar Tombach et al.)
- Nitrate Concentrations Retained by the $PM_{2.5}$ Federal Reference Method in the Eastern US (Neil Frank)
- New Possibilities for Aerosol Measurements and Source Apportionment (John Watson)
- Using In-Network Precision Data as a Basis for Cross-Network Comparisons (Warren H. White et al.)
- Comparison of Aerosol Data from the STN and IMPROVE Networks (Charles E. McDade et al.)
- IMPROVE XRF Analysis of STN Filters Used in STN's Round Robin EPA Acceptance Tests (Charles E. McDade et al.)

For more information contact the American Association for Aerosol Research. Telephone: 856/439-9080. Fax: 856/439-0525. Web site: http://www.aaar.org.

Visibility news *continued on page 6....*

Feature article

Collocated precision sampling in the IMPROVE Program

(by C. McDade, University of California-Davis)

Beginning in the spring of 2003, collocated aerosol samplers were installed at several sites in the IMPROVE network to help assess measurement uncertainties. Each collocated sampler is identical to the existing sampler and is operated according to the same protocols. Ideally, the two samplers would produce the same concentration value. The differences that are actually observed provide insight into the precision of aerosol measurements.

Collocated measurements are a common feature of most air monitoring networks. The data that they provide represent a generally accepted standard for assessing a measurement's repeatability, in terms of a statistic called precision. Collocated measurements promise to be a valuable addition to the IMPROVE aerosol network.

Each site with redundant measurements is equipped with a single collocated module. This single-module approach was chosen over replicating the entire sampler (four modules plus a controller) for three principal reasons. First, a controller box (which contains the timer electronics) can control up to five modules, so a fifth module can be added without requiring a second controller. Next, most sites have space for an additional module, whereas adding an entire sampler would require a new stand. Finally, using single modules has allowed collocated sampling at a larger number of sites, to better assess differences due to individual site operators or to local atmospheric phenomena.

UC-Davis now operates 6 collocated modules of each type throughout the IMPROVE aerosol network, for a total of 24 modules. They were installed as part of the routine annual site visits as extra modules became available, with the 1st module installed in April 2003 and the 24th installed in November 2004. The sites were selected to represent the various regions of the country, and individual sites were chosen based on the availability of power and space. The locations of the collocated modules are:

Module A ($PM_{2.5,}$ Teflon Filter)

- Mesa Verde National Park, CO
- Proctor Maple Research Facility, VT
- Olympic National Park, WA
- St. Marks National Wildlife Refuge, FL
- Sac and Fox Tribe, KS
- Trapper Creek (Denali National Park), AK

Module B ($PM_{2.5,}$ Nylon Filter)

- Big Bend National Park, TX
- Blue Mounds State Park, MN
- Frostburg Reservoir, MD
- Gates of the Mountains Wilderness, MT
- Lassen Volcanic National Park, CA
- Mammoth Cave National Park, KY

Module C ($PM_{2.5,}$ Quartz Filter)

- Everglades National Park, FL
- Hercules-Glades Wilderness, MO
- Hoover Wilderness, CA
- Medicine Lake National Wildlife Refuge, MT
- Saguaro National Park (Western Section), AZ
- Seney National Wildlife Refuge, MI

Module D ($PM_{10,}$ Teflon Filter)

- Houston, TX (Speciation Trends Network urban site)
- Jarbidge Wilderness, NV
- Joshua Tree National Park, CA
- Quabbin Reservoir, MA
- Swanquarter National Wildlife Refuge, NC
- Wind Cave National Park, SD

Sites may change in the future as local conditions change or as technical issues suggest that collocated sampling at a particular site may prove to be more useful. Collocated sampling is now considered a permanent fixture of the IMPROVE network.

Initial data are available from the collocated modules that were in operation during 2003 and early 2004. Figure 1 shows the results for fine mass ($PM_{2.5}$) from the A Module Teflon filter, and Figure 2 shows the results for $PM_{2.5}$ nitrate from the B Module nylon filter. In both plots, the concentration from the collocated module is shown on the vertical axis and the concentration from the original IMPROVE module is shown on the horizontal axis. The sites included in Figure 1 are Olympic National Park, WA (OLYM); Proctor Maple Research Facility, VT (PMRF); and Sac and Fox Tribe, KS (SAFO). The sites included in Figure 2 are Big Bend

National Park, TX (BIBE); Frostburg Reservoir, MD (FRRE); Gates of the Mountains Wilderness, MT (GAMO); Lassen Volcanic National Park, CA (LAVO); and Mammoth Cave National Park, KY (MACA).

Most of the data points in both of these plots lie along the one-to-one line, indicating good agreement between the two samplers. The few substantial deviations from the one-to-one line occur at very low concentrations, where the relative precision is largest.

Scientists at UC-Davis are analyzing these and other data to gain a first glimpse into the overall measurement precision of the IMPROVE samplers. Over time, these results will be compared to the uncertainties that are reported to the IMPROVE database with each concentration value.

The uncertainties reported to the database are based on uncertainty estimates for each measurement component. For example, estimates of uncertainty due to flow measurement, analytical laboratory measurements, and blank variability, are reported as a combined uncertainty to the database. If the collocated precision measurements approximate the uncertainties reported to the database, then we know that we are accounting for all of the components of uncertainty.

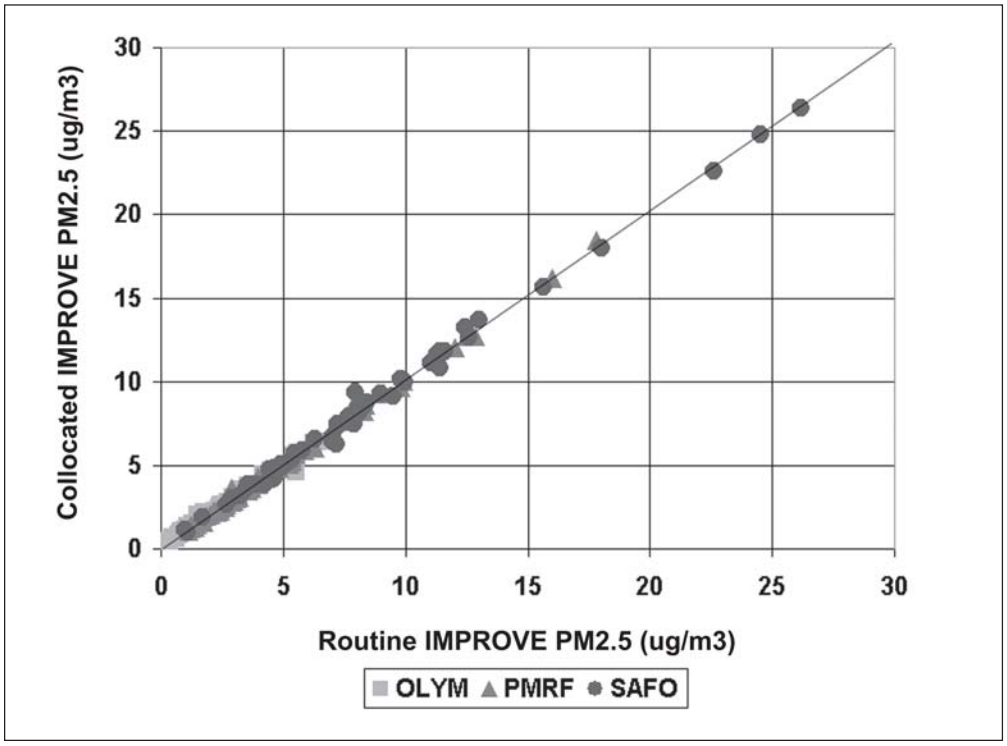


Figure 1. Collocated Fine Mass ($PM_{2.5}$) from A Module Teflon Filters.

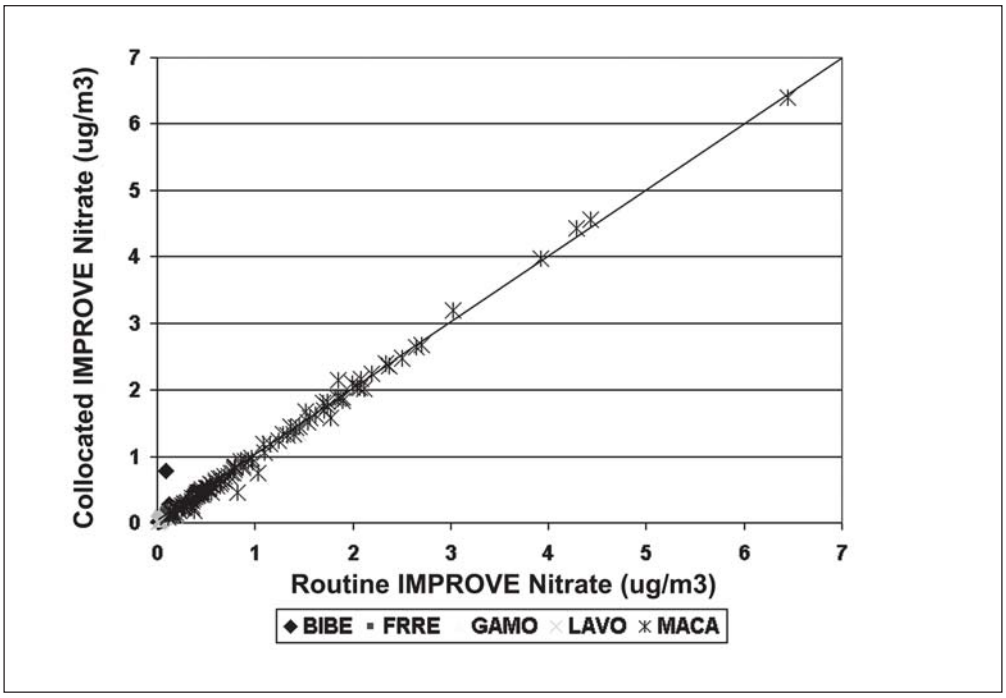


Figure 2. Collocated $PM_{2.5}$ Nitrate from B Module Nylon Filters.

If the collocated precision measurements are greater, however, then we should suspect that there are unaccounted contributors to uncertainty. Further research would be required to identify the missing contributors.

For more information contact Chuck McDade at the University of California-Davis. Telephone: 530/752-7119. Fax: 530/752-4107. E-mail: mcdade@crocker.ucdavis.edu.

Visibility news continued from page 3 ....

WRAP attribution of haze report being reviewed

The objective of the Attribution of Haze (AoH) project is to prepare a policy-level report describing the emission source categories and geographic source regions presently contributing to visibility impairment at each of the over 100 federal and tribal Class I areas in the Western Regional Air Partnership (WRAP) region. Phase I of the project employed two attribution methods:

1) The WRAP Regional Modeling Center at UC-Riverside used the Tagged Species Source Apportionment method to track modeled sulfate and nitrate from source regions to Class I areas.

2) Desert Research Institute used Trajectory Regression Analysis to associated source regions with sulfate mass and extinction measurements at Class I areas.

Regional assessments of fire, carbon, and dust impacts were made as well. Air Resource Specialists, Inc. was contracted to compile these results and prepare the AoH Phase I report. The Phase I report is currently in draft form and out for review. Phase II of the project, expected to begin in mid-2005, will build on the findings and recommendations of Phase I.

For more information visit http://www. wrapair.org/forums/aoh/ars1/index.html, or contact Tom Moore, Telephone: 970/491-8837, E-mail: mooret@cira.colostate.edu, or Joe Adlhoch, Telephone: 970/484-7941, E-mail: jadlhoch@air-resource.com.

Big Bend visibility exhibit to be upgraded

The visibility exhibit located in the Panther Junction Visitor's Center in Big Bend National Park, TX, received an upgrade in January. The exhibit utilizes a radio to retrieve and display data from the transmissometer located several miles away. The display provides park visitors with a near real-time measurement of the Big Bend visibility conditions.

For more information contact Scott Cismoski at Air Resource Specialists, Inc. Telephone: 970/484-7941. Fax: 970/484-3423. E-mail: Scismoski@air-resource.com.

Monitoring update continued from page 1 ....

Operators of distinction

Operation of the White River National Forest IMPROVE monitoring site in Colorado is shared by the USFS Aspen Ranger District and the Wilderness Workshop. Through a cooperative agreement, each agency is responsible for site operations half the year. Sloan Shoemaker, executive director of the non-profit Wilderness Workshop, has been upholding their end of the partnership since 1997, servicing the site November through April. USFS personnel operate the site May through October.

"The Wilderness Workshop is a local grassroots, environmental group ensuring the ecological integrity of the wilderness and wildlife habitat in the area," said Sloan. One of its programs, the Wilderness Monitoring partnership with the Aspen Ranger District, monitors air and water quality, invasive weeds, and campsite usage in the nearby Maroon Bells-Snowmass, Collegiate Peaks, Hunter Fryingpan Wilderness areas. See *http://www.wildernessworkshop.org* for more information.

Spring and fall are challenging seasons for site servicing. When the ski gondola is not operating and the road is not plowed, accessing the site involves a 3,000 vertical foot trek to 11,212 feet on skis, snowshoes, ATV, or snowmobile. Fortunately for Sloan, he's a mountain climber and backcountry skier. Despite these challenges, Sloan has a 100% data collection record.

Sloan earned a bachelor's degree in English and nearly completed a master's degree in environmental policy and management. "Long-term baseline air sampling is critically important right now because we anticipate the development of 20,000 gas wells proposed upwind of this site. Maintaining the IMPROVE site is one of the few tools we'll have to ensure protection of our airshed, one of the highest quality airsheds in the lower 48," said Sloan.

In his free time, Sloan likes the outdoors, photography, and spends time with his wife and 15-month old daughter.

Sloan Shoemaker services the IMPROVE sampler every Tuesday, November through April, as part of the partnership between the USFS Aspen Ranger District and the Wilderness Workshop.

Outstanding sites

Data collection begins with those who operate, service, and maintain monitoring instrumentation. IMPROVE managers and contractors thank all site operators for their efforts in caring for IMPROVE and IMPROVE Protocol networks. Sites that achieved 100% data collection for 4th Quarter 2004 are:

Aerosol

Acadia
Arendtsville
Badlands
Baltimore
Bandelier

Birmingham
Bondville
Boundary Waters
Breton
Bridger

Bridgton
Brigantine
Cabinet Mountains
Caney Creek
Canyonlands

Cape Romain
Cedar Bluff
Cherokee
Chicago
Chiricahua

Columbia Gorge East
Columbia Gorge West
Connecticut Hill
Crater Lake
Craters of the Moon

Crescent Lake
Death Valley
Detroit
Dolly Sods
Everglades

Fort Peck
Fresno
Frostburg Reservoir
Gates of the Mountains
Gila

Grand Canyon
Great Basin
Great Gulf
Great River Bluffs
Hells Canyon

Hercules-Glades
Hoover
Ike's Backbone
Isle Royale
James River

Joshua Tree
Kalmiopsis
Lake Seguma
Livonia
Lostwood

Martha's Vineyard
Medicine Lake
Mesa Verde
MK Goddard
Mohawk Mountain

Moosehorn
Mount Baldy
Mount Hood
Mount Rainier
New York

Nebraska
New York
North Absaroka
North Cascades
Northern Cheyenne

Old Town
Olympic
Organ Pipe
Petersburg
Pinnacles

Pittsburgh
Presque Isle
Proctor Research Center
Puget Sound
Quabbin Reservoir

Quaker City
Queen Valley
Rocky Mountain
Saguaro
Saguaro West

Salt Creek
San Gabriel
Sawtooth
Seney
Sequoia

Shamrock Mine
Sikes
Simeonof
Sipsey
Snoqualmie Pass

Starkey
Swanquarter
Sycamore Canyon
Tallgrass
Tonto

Trapper Creek-Denali
Trinity
UL Bend
Upper Buffalo
Voyageurs

Walker River Paiute
Washington DC
White Mountain
White River
Wind Cave

Transmissometer

Bridger
Petrified Forest

Nephelometer

Children's Park
Grand Canyon (Hance)
Grand Canyon (Indian Gardens)
Greer
Ike's Backbone
Mammoth Cave
Tucson

Photographic

Bryce Canyon
Gates of the Mountains
Grand Canyon
Monture
Mount Zirkel
Wichita Mountains

Sites that achieved at least 95% data collection for 4th quarter 2004 are:

Aerosol

Addison Pinnacle
Atlanta
Bliss

Blue Mounds
Bosque del Apache
Bryce Canyon

Casco Bay
Chassahowitzka
Cloud Peak

Cohutta
Denali

Ellis
Glacier
Great Smoky Mountains

Haleakala
Hillside
Houston

Lassen Volcanic
Lava Beds
Meadview

Monture
Okefenokee

Pasayten
Point Reyes
Rubidoux

Sac and Fox
San Gorgonio
San Pedro Parks

Shining Rock
Sula
Wheeler Peak

White Pass
Wichita Mountains

Transmissometer

Badlands
Bandelier
Canyonlands
Great Basin
San Gorgonio

Nephelometer

Big Bend
Bliss
Chiricahua
Columbia River Gorge (Mt. Zion)
Craycroft
Dysart
Estrella
Great Gulf
Great Smoky Mountains
Mayville
Mount Rainier
Mount Zirkel
National Capital-Central
Petrified Forest
Phoenix
Seney
Shenandoah
Sierra Ancha
Tucson Mountain
Vehicle Emissions
Virgin Islands

Photographic

Aqua Tibia
Bosque del Apache
Red Rock Lakes

Sites that achieved at least 90% data collection for 4th quarter 2004 are:

Aerosol

Agua Tibia
Big Bend
Cape Cod

Douglas
Flathead
Great Sand Dunes

Kaiser
Linville Gorge
Mount Zirkel

Phoenix
Redwood
San Rafael
St. Marks

Theodore Roosevelt
Thunder Basin
Viking Lake

Virgin Islands
Weminuche
Yellowstone

Transmissometer

Grand Canyon (In-Canyon)

Nephelometer

Acadia
Cape Romain
Cohutta
Dolly Sods
Organ Pipe
Sycamore Canyon
Wichita Mountains

Photographic

-- none --

Air Resource Specialists, Inc.
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First Class Mail

IMPROVE STEERING COMMITTEE

IMPROVE Steering Committee members represent their respective agencies and meet periodically to establish and evaluate program goals and actions. IMPROVE-related questions within agencies should be directed to the agency's Steering Committee representative. Steering Committee representatives are:

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Fax: 702/862-5507
E-mail: marc.pitchford@noaa.gov
* Steering Committee chair

ASSOCIATE MEMBERS

Associate Membership in the IMPROVE Steering Committee is designed to foster additional IMPROVE-comparable visibility monitoring that will aid in understanding Class I area visibility, without upsetting the balance of organizational interests obtained by the steering committee participants. Associate Member representatives are:

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Fax: 602/771-4444
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Government organizations interested in becoming Associate Members may contact any Steering Committee member for information.

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The IMPROVE Program was designed in response to the visibility provisions of the Clean Air Act of 1977, which affords visibility protection to 156 federal Class I areas. The program objectives are to provide data needed to: assess the impacts of new emission sources, identify existing human-made visibility impairments, and assess progress toward the national visibility goals as established by Congress.

To submit an article, to receive the IMPROVE Newsletter, or for address corrections, contact:

Air Resource Specialists, Inc.
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Fax: 970/484-3423
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IMPROVE Newsletters are also available on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Publications/* .

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