INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

4th Quarter 2010 | The IMPROVE Newsletter | Volume 19 / Number 4

Monitoring update

Feature Article: UC-Davis reveals new cassette design for aerosol sampler, 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 155 Class I federally protected areas. Instrumentation that operates according to IMPROVE protocols in support of the program includes:

- 58 aerosol samplers
- 20 nephelometers
- 2 transmissometers
- 70 Webcamera systems
- 5 interpretive displays

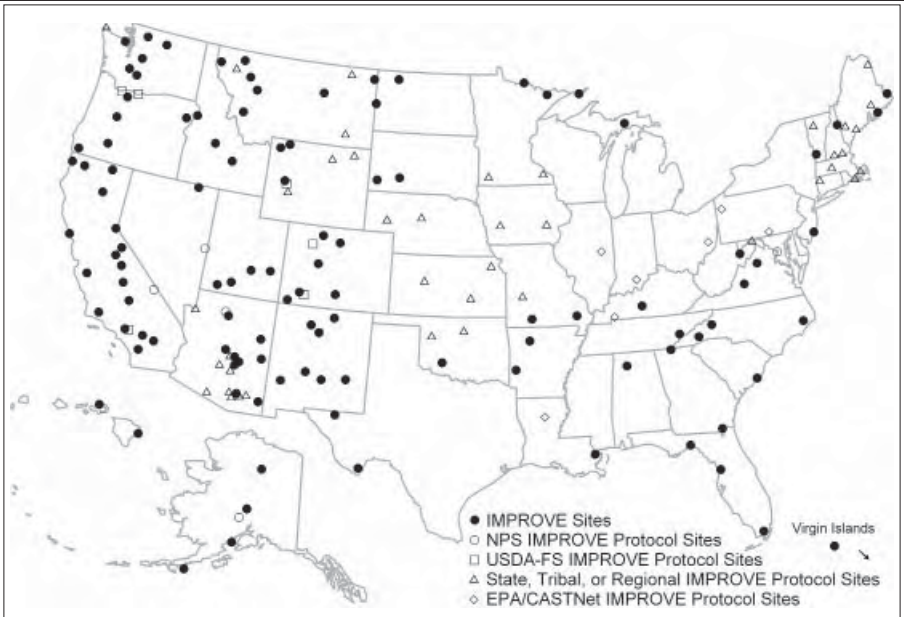
IMPROVE Program participants are listed on page 8. Federal land management agencies, states, tribes, regional air partnerships, and other agencies operate supporting instrumentation at monitoring sites as presented in the map below. Preliminary data collection statistics for the 4th Quarter 2010 (October, November, and December) are:

- Aerosol (channel A only) 95% collection
- Aerosol (all modules) 94% completeness
- Optical (nephelometer) 97% collection
- Optical (transmissometer) 80% collection

The state of New Hampshire joined the IMPROVE Protocol network in November, when aerosol monitoring began at Londonderry (LOND1) in the southeast portion of the state. Also in November, the state of Wyoming added nephelometer monitoring to its existing South Pass station.

Data availability status

Data and photographic spectrums are available on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Data/data.htm* and on the VIEWS Web site at *http://vista.cira.colostate.edu/views*. Aerosol data are available through December 2009. Nephelometer and transmissometer data are available through September 2010 and December 2010, respectively. Webcamera real-time images and data are available on agency-supported Web sites:



IMPROVE and IMPROVE Protocol Sites
4th Quarter 2010

- National Park Service *http://www.nature.nps.gov/air/WebCams/index.htm*
- US Forest Service *http://www.fsvisimages.com*
- CAMNET (Northeast Camera Network) *http://www.hazecam.net*
- Midwest Haze Camera Network *http://www.mwhazecam.net*
- Wyoming Visibility Network *http://www.wyvisnet.com*
- Phoenix Visibility Network *http://www.phoenixvis.net*

The EPA AIRNow Web site *http://airnow.gov* includes many of these as well as additional visibility-related Webcameras. Click on "View Other Visibility Webcams."

***Monitoring update** continued on page 7....*

Visibility news

Still time to order your 25th anniversary IMPROVE apparel

Many site operators took advantage of last fall's offer to receive a complimentary t-shirt or ballcap commemorating the program's 25th anniversary. The IMPROVE Steering Committee is proud of its commitment to the program, which helped improve our nation's air quality to the higher standards that we hold ourselves to today. At the core of the program are hundreds of primary, backup, and seasonal operators, who visit the monitoring sites every Tuesday to change the aerosol sampler filters, no matter how severe the weather, how difficult the terrain, or how far they must travel. Several operators' personal trials and tribulations in maintaining their monitoring sites and instrumentation are told in the IMPROVE Newsletter *operators of distinction* feature and the annual calendar pages featuring monitoring sites and their staff.

Because several operators received their vouchers for a complimentary t-shirt or ballcap in late December and even into early January, any operator who has not yet taken advantage of the offer can still do so. The second and final order for the IMPROVE apparel will be placed in early March.

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

Five protocol sites see final filter changes

Five IMPROVE Protocol aerosol sites ceased sampling effective January 1, 2011, because funding for their operation is no longer available. The closed sites are Arendtsville, PA; Cadiz, KY; Livonia, IN; M.K. Goddard, PA; and Sikes, LA. All of these sites began operation in 2001 and all were associated with EPA's CASTNET network. Funding for these sites had been provided by EPA. All samplers will undergo a final flowrate calibration before the equipment is removed in early 2011.

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

2011 IMPROVE calendars are available but going fast

The 2011 IMPROVE calendars have been distributed, and a few extras are still available upon request. We know these calendars are important to site operators, as they serve as a visual reminder when filters need to be changed, when sampling days occur, and when other special sampling events are scheduled. We are committed to improving the production schedule of the calendar so a more timely distribution can be made in the future, as our goal is to have the calendars in the hands of our operators well before each new year begins. This production schedule relies in large part on the people who contribute articles, photographs, and other information to the calendar.

Month-to-month, these calendars provide a wealth of information to readers, with informational topics related to the program, special studies, instrument operation, and topics to aid site operators. Our readers' favorite feature, however, may be the monthly insights that describe specific monitoring sites, their resources, and their operators.

Because of the great amount of content in the calendar, production (layout, design, printing, shipping) takes several months to complete. We ask everyone who is selected as a contributor to submit your article information and graphics during the early months of the year so we can prepare, print, and distribute your 2012 calendar well before the new year sampling schedule begins. And if you are an operator who has not yet been featured, why don't you volunteer for it? We would love to learn about your area, where you live and where you work, and why your monitoring site is special. All we need to get started is a few facts and a few photos, and then next year we'll all be able to read about the interesting places and its people as we flip our calendar pages.

To request a 2011 calendar or to contribute an idea for the 2012 calendar, contact Jeff Lemke at CIRA. Telephone: 970/491-2209. E-mail: lemke@cira.colostate.edu.

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

PUBLISHED BY:

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The IMPROVE Newsletter is published four times a year (February, May, August, and November) under National Park Service Contract C2350064025. To submit an article, to receive the IMPROVE Newsletter, or for address corrections, contact:

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IMPROVE Newsletters are also available on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Publications/news_letters.htm.*

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Aspects of the job

Air Resource Specialists, Inc. supports the IMPROVE Program with optical and scene monitoring networks and visibility science research

Visibility and its science came to the forefront in the late 1970s with perception studies followed by the first forms of visibility monitoring instrumentation – camera systems that monitored and documented an important scenic vista. Air Resource Specialists, Inc. (ARS) supported early visibility efforts using hundreds of automatic film camera systems. At about the same time, the first optical instrument came on the market – the teleradiometer – and ARS operated and managed both automatic and manual teleradiometer networks for federal land managers.

ARS continues to operate optical and scene monitoring networks in support of the IMPROVE aerosol program. Both optical and scene divisions at ARS are headed by John Molenar, Vice President and Senior Scientist. As a co-founder of ARS, John has over 30 years' experience in visibility and atmospheric physics research and applications projects. He is a nationally recognized expert in visibility monitoring, data analysis, radiation transfer and pollution dispersion modeling, as well as theory and operation principles of instrumentation. He performs special studies for IMPROVE and other visibility programs to support federal legislation. John is currently heading up a research project using a prototype LPV-4 transmissometer, which uses an LED light source.

Mark Tigges manages the technical aspects of day-to-day operations of the optical division, which nowadays includes transmissometer and nephelometer monitoring and research. Transmissometers and nephelometers are the only current instruments that directly measure the atmospheric components of extinction and scattering. He also manages instrumentation comparison studies to advance the science and operation of these instruments.

Supporting the optical networks are Senior Data Analyst Carter Blandford and Data Analyst Karen Rosener. Both have managed optical datasets for several years, overseeing transmissometer and nephelometer data collection, performing data validation and data management, and providing hours of technical operator support and troubleshooting for the instruments, which can be complicated at times. Dave Beichley is the Optical Field Specialist who travels to monitoring sites to install, maintain, and calibrate the instrumentation and support systems. He also has a background of optical and scene data collection and validation. Marty Mills, Electronic Technician, provides in-house troubleshooting, repair, and maintenance of the optical instrumentation and support systems. He breaks down the instrumentation into their smallest components during annual laboratory servicing, to refurbish, clean, or replace. He manages ARS' visibility electronics laboratory and is knowledgeable in the operation and fabrication of a variety of optical instrumentation and data acquisition systems. He is also intricately involved with special research studies centered around instrument improvement and technical advancement.

Aspects of the job continued on page 6....

The optical and scene network staff at ARS provide operational support to agencies that operate IMPROVE Protocol visibility instrumentation. From left to right are: Marty Mills, Dave Beichley, Karen Rosener, Carter Blandford, Mark Tigges, John Molenar, Scott Cismoski, Karen Fischer, Julie Giron, and Gloria Mercer.

Feature article

UC-Davis reveals new cassette design for IMPROVE aerosol sampler (by C. McDade, UC-Davis)

Introduction

A new filter cassette design will be rolled out in the IMPROVE network this spring. In the new design, the metal screen that supports the filter will be detached, unlike the current screens, which are permanently attached to the plastic cassette body. This new design will result in more consistently uniform sample deposits on the filters, thereby improving the reliability of measurements such as the x-ray fluorescence analysis that is used to determine elemental concentrations.

The new cassette design is shown in Figure 1. The metal screen can be removed by the UC-Davis laboratory technicians for cleaning and then re-installed along with a clean filter for the next sampling event. Once the cassette is reassembled with the cassette cap in place, the filter fits snugly against the screen, just as it did with the old design. For comparison, Figure 2 shows the old cassette design, with the screen permanently attached. Because the cassettes are serviced and reassembled in the UC-Davis laboratory, the change to the new cassette screens will be transparent to the site operators. The assembled cartridges that are shipped to the sites in blue boxes will look just the same before and after the change to the new screens.

Motivation for change

The switch to the new design was motivated initially by some changes in the cassette manufacturing process. The IMPROVE network was in need of additional cassettes to replace damaged pieces and to accommodate new sites. Due to some engineering changes in the manufacturer's shop it was no longer possible to manufacture cassettes in precisely the same configuration as the existing cassettes. Attempts were made to produce a modified attached screen cassette that would be comparable to those already in use in the network. However, field tests of attached screen prototypes using the manufacturer's modified approach were unable to demonstrate satisfactory measurement agreement with the existing design.

Reengineering of the cassette design was needed to achieve comparability between the old and new units, so the scientists and engineers at UC-Davis decided to take advantage of the opportunity to develop a superior design. Their literature review found that essentially all samplers used in other aerosol networks employ a detached screen design. Furthermore, initial prototype tests at Davis indicated that a detached screen design would improve sample uniformity. So, the UC-Davis group embarked on a redesign and testing program that led to the final detached screen cassette design that will soon be deployed in the network.

Design tests

Prototype units of the new detached screen design were prepared and tested extensively at UC-Davis to ensure comparability with the existing attached screen design. UC-Davis has an outdoor IMPROVE sampler test facility where up to 16 sampler modules can be operated concurrently. Tests were run using paired sets of attached and detached screen cassettes, all sampling the ambient Davis air

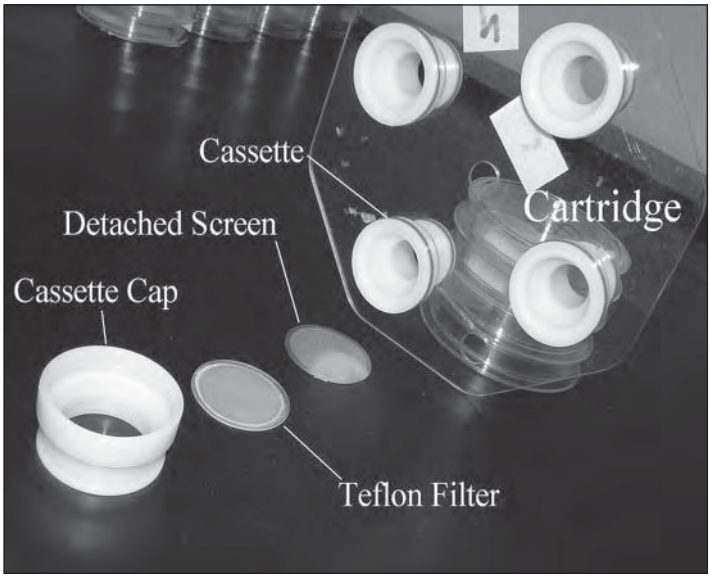


Figure 1. Detached screen cassette.

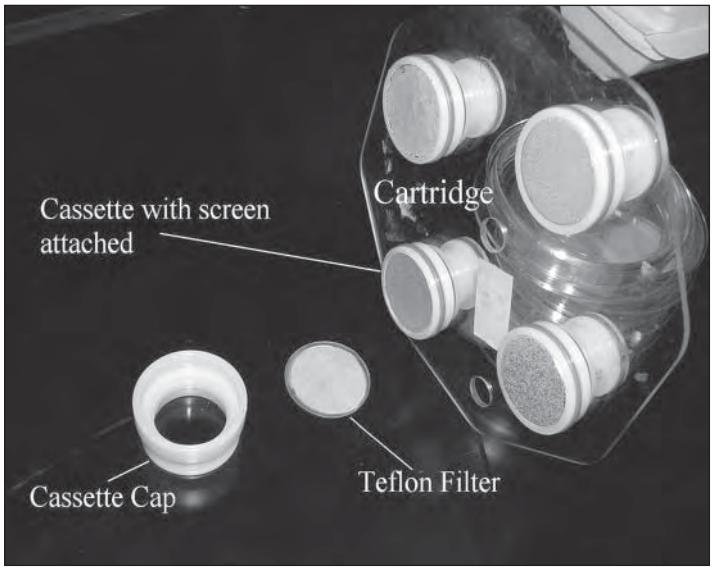


Figure 2. Attached screen cassette.

at the same time. The flow rate through each sampler module was carefully set and calibrated so that flow rate differences among the modules would be insignificant, thereby ensuring that the flow rate-dependent cyclone particle size cutpoint would be the same for each module.

Teflon® filter samples were collected in Davis; then they were weighed and subjected to x-ray fluorescence analysis to determine elemental concentrations and to laser absorption measurements to quantify aerosol light absorption. These tests demonstrated that samples collected using the old attached screen cassettes and the new detached screen cassettes were comparable. The differences observed between the sets were very small and were well within the statistical uncertainty of the routine IMPROVE measurements.

Because multiple samples from each cassette type were acquired during each test, it was also possible to determine the measurement precision within each type. These results indicated that the precision of the mass and elemental measurements using the new detached screen design is typically tighter, a welcome improvement over the existing design.

The improved precision is likely the result of improved sample uniformity. Figures 3 and 4 show typical sample deposit patterns using attached and detached screens, respectively. The deposit on the attached screen filter exhibits non-uniformity around the edge of the filter. This "dead zone" with no deposit is a result of the process used to press the screen into the plastic cassette body, whereby plastic clogs some of the screen holes around the perimeter. The deposit on the detached screen filter exhibits no edge effects, since intact holes extend all the way to the edge of the filter.

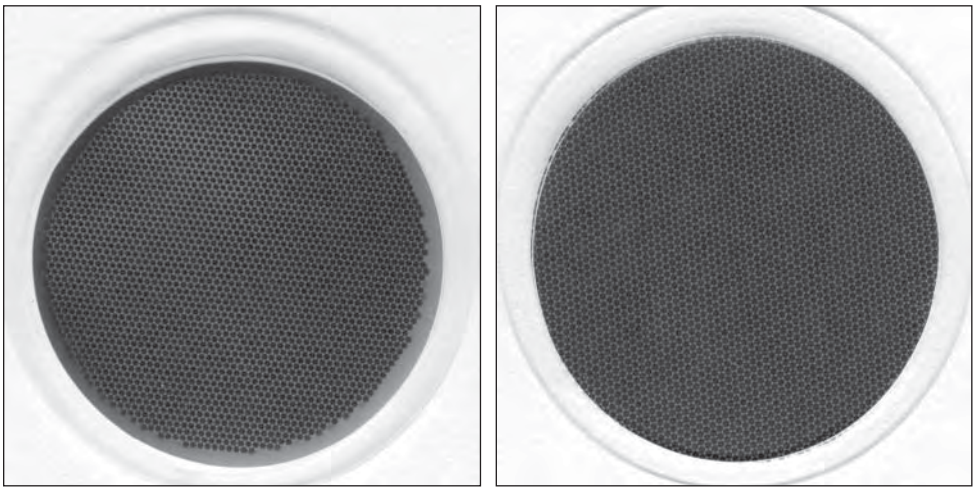
Different screens for different modules

New screens are being purchased for all cassettes, but the existing plastic cassette bodies will be used with the detached screen design. Equipment in the UC-Davis machine shop will be used to punch the attached screen out of each unit and then smooth any rough edges that remain on the plastic body. Once that quick procedure is completed the detached screen will fit precisely into each cassette body. Some new cassette bodies, identical to the existing ones, are also being purchased to increase the inventory of available cassettes.

Only the 25 millimeter cassettes are being converted to the detached screen design. The 37 millimeter B-module cassettes will remain unchanged and will retain the attached screen design. The 37 millimeter nylon filters are extracted in solution which is then used for ion analysis, so the uniformity of the sample deposit does not influence the analysis.

The 25 millimeter cassettes used in the A, C, and D modules will all be converted to the detached screen design in order to achieve consistency throughout the measurement set. However, the benefits of improved sample uniformity are expected only for the A-module Teflon® filter. X-ray fluorescence, laser absorption, and proton beam hydrogen measurements applied to this filter each use an incident beam that covers only the central portion of the filter, so uniformity is crucial in extrapolating the results to the entire filter. The D-module PM_{10} Teflon® filters are weighed only, so sample uniformity does not impact the analysis

The C-module employs a quartz filter, with physical characteristics that differ from Teflon®. Teflon® is a plastic and Teflon® filters are pulled down firmly to the surface of the screen when the vacuum pump is on. Hence, sample material is deposited only in the immediate area of the screen holes, so the characteristics of the screen can influence the sample deposit. The "imprint" of the screen holes can be seen clearly when Teflon® filter deposits are viewed under a microscope. Quartz filters, on the other hand, are made of multiple layers of randomly oriented media and have a porous or fibrous texture that distributes the sample uniformly across the entire filter surface, independent of the geometry of the backing screen.



Figures 3 and 4. Attached (left) and detached (right) filters.

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

***Aspects of the job** continued from page 3....*

The scene monitoring division nowadays supports the aerosol network with high resolution digital camera systems. Webcamera systems are commonly used to provide a visual representation and documentation of the atmosphere, or visual scene, which can be easily understood by the general public. Scott Cismoski, Project Engineer, manages the technical aspects of day-to-day operations of the scene division, and specializes in the design and manufacture of digital imaging monitoring instrumentation and development of camera system control software.

Karen Fischer, Digital Photographic Specialist, supports numerous scene monitoring networks. She assembles new camera systems, troubleshoots the systems operating at field locations, provides operational support to over 70 site operators, and maintains and edits Webcamera Web sites on a daily basis. Each morning, her eyes are the first to see if a Web site is experiencing image upload problems.

Rounding out the group and providing a variety of support to both the optical and scene networks is Julie Giron, Technical Assistant, who prepares, assembles, and distributes a variety of monitoring reports, site visit reports, and administrative progress reports to air quality managers that detail various aspects of each section and status of monitoring sites. Gloria Mercer, Contract Support Coordinator and Technical Writer, provides support functions to the entire IMPROVE Program by developing quarterly IMPROVE Newsletters, and coordinating steering committee meetings, calendar distribution, and other administrative assistance for the steering committee.

Several of these ARS staff have supported the IMPROVE aerosol program with optical and scene monitoring for over 20 years, and are well familiar with visibility theory and principles of instrument operation. As most of the sites monitor in rural or remote areas of the country and with a limited power supply, they can develop instrumentation specific to area needs. They support numerous federal, regional, state, and municipal agencies nationwide that operate monitoring programs with IMPROVE Protocols, and participate in special studies to research and advance instrumentation for future needs.

Visibility news *continued from page 2 ....*

IMPROVE trends report to be released this spring

We are excited to announce that the fifth installation of the IMPROVE report will be available in early spring. The report summarizes data from 2005-2008 and provides valuable insights into the behavior of atmospheric aerosols and their impact on haze in the United States. Aerosol mass concentrations and reconstructed aerosol light extinction coefficients (b_{ext}) are presented. In addition, data from the Environmental Protection Agency's Chemical Speciation Network (CSN) are incorporated into the report to highlight the similarities and differences in remote/rural and urban aerosol concentrations and b_{ext}. Data from over 300 sites from the combined networks were included in the analyses and provide unprecedented spatial and seasonal detail of aerosol concentrations and b_{ext} in the United States.

The report is organized as follows. An overview of the IMPROVE network, including descriptions of measurements and any relevant changes to the monitoring network, is provided at the beginning of the report. Included in this overview is a brief history of the CSN Network and comparisons between collocated IMPROVE and CSN sites to determine biases that could impact interpretations of the combined data. Following the overview, spatial and seasonal patterns of speciated aerosol concentrations and b_{ext} are presented for both the IMPROVE and CSN networks. New analyses for this report include estimates of short-term (2000-2008) and long-term (1989-2008) temporal trends for major aerosol species from the IMPROVE network. Trends provide important information as to the behavior of major aerosol species over time, especially in relation to regulatory efforts. In addition, urban excess is explicitly examined through a comparison of IMPROVE and CSN data. The report will also include an in-depth analysis of Regional Haze Rule metrics for the 2005-2009 period, relative to projected glide paths. The report concludes with special studies and analyses conducted since the last report that are relevant to the IMPROVE Program.

The review process will be conducted online. The report will be available for download and public comments will be invited for a period of time, after which the comments will be evaluated and incorporated into the report as appropriate. Look for the report on the IMPROVE Web site in early March (*http://vista.cira.colostate.edu/improve/Publications/improve_reports.htm*).

For more information contact: Dr. Jenny Hand at the Cooperative Institute for Research in the Atmosphere (CIRA). Telephone: 970/491-3699. Fax: 970/491-8598. E-mail: hand@cira.colostate.edu.

Monitoring update continued from page 1 ....

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 2010 are:

Aerosol (Channel A) - 53% of all sites

Acadia	Grand Canyon	Quabbin Reservoir
Arendtsville	Great Basin	Rocky Mountain
Badlands	Great River Bluffs	Sac and Fox
Big Bend	Great Sand Dunes	San Gorgonio
Birmingham	Great Smoky Mtns	Sawtooth
Bliss	Guadalupe Mtns	Seney
Bondville	Haleakala	Sequoia
Boulder Lake	Hawaii Volcanoes	Shamrock Mines
Boundary Waters	Hercules-Glades	Shenandoah
Bridger	Hoover	Sikes
Bridgton	Ike's Backbone	Snoqualmie Pass
Cadiz	Isle Royale	Starkey
Caney Creek	James River	Sula
Canyonlands	Joshua Tree	Sycamore Canyon
Cape Cod	Kalmiopsis	Tallgrass
Cape Romain	Lake Sugema	Theodore Roosevelt
Capitol Reef	Linville Gorge	Three Sisters
Casco Bay	Livonia	Thunder Basin
Chassahowitzka	Mammoth Cave	Trapper Creek-Denali
Cherokee	Martha's Vineyard	Trinity
Columbia Gorge East	M.K. Goddard	Tuxedni
Columbia Gorge West	Mohawk Mountain	UL Bend
Crescent Lake	Mount Rainier	Upper Buffalo
Douglas	North Cascades	Viking Lake
Everglades	Northern Cheyenne	Weminuche
Flathead	Okefenokee	White River
Fresno	Pack Monadnock	Wichita Mountain
Frostburg Reservoir	Pasayten	Wind Cave
Gates of the Arctic	Phoenix	Yellowstone
Gila	Presque Isle	

Nephelometer - 20% of all sites

Dysart	Mount Rainier	Thunder Basin
Estrella		

Transmissometer - 0% of all sites

-- none --

Sites that achieved at least 95% data collection for 4th Quarter 2010 are:

Aerosol (Channel A) - 14% of all sites

Blue Mounds	Dolly Sods	Organ Pipe
Bosque del Apache	El Dorado Springs	Proctor Research Cntr
Brigantine	Ellis	Saguaro West
Bryce Canyon	Hells Canyon	San Rafael
Cloud Peak	Indian Gardens	St. Marks
Crater Lake	Lassen Volcanic	Swanquarter
Craters of the Moon	Lava Beds	Virgin Islands
Death Valley	Medicine Lake	

Nephelometer - 60% of all sites

Acadia	Hance	Rocky Mountain
Big Bend	Indian Gardens	Shenandoah
Glacier	Mammoth Cave	Vehicle Emissions
Great Smoky Mtns.	National Capital	

Transmissometer - 50% of all sites

San Gorgonio

Sites that achieved at least 90% data collection for 4th Quarter 2010 are:

Aerosol (Channel A) - 17% of all sites

Bandelier	Mesa Verde	Queen Valley
Cabinet Mountains	Monture	Saguaro
Cedar Bluff	Moosehorn	Salt Creek
Denali	Mount Hood	Sierra Ancha
Egbert	Olympic	Sipsey
Fort Peck	Penobscot	White Pass
Jarbidge	Petrified Forest	Wrightwood
Lostwood	Pinnacles	Yosemite
Lye Brook	Puget Sound	Zion Canyon
Meadview	Quaker City	

Nephelometer - 1% of all sites

Cape Romain	Cloud Peak	Great Basin

Transmissometer - 0% of all sites

-- none --

Monitoring Site Assistance:

Aerosol sites: contact University of California-Davis
telephone: 530/752-1123 (Pacific time)

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

IMPROVE

The IMPROVE Newsletter

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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.

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* Steering Committee Chair

ASSOCIATE MEMBERS
Associate Membership in the IMPROVE Steering Committee is designed to foster additional comparable 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:

STATE OF ARIZONA
Currently vacant