INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

2nd Quarter 2008 | The IMPROVE Newsletter | Volume 17 / Number 2

Monitoring update

Feature Article:
IMPROVE - The beat goes on, 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. Additional instrumentation that operates according to IMPROVE protocols in support of the program includes:

- 59 aerosol samplers
- 34 nephelometers
- 4 transmissometers
- 4 digital camera systems
- 58 Webcamera systems
- 5 interpretive displays

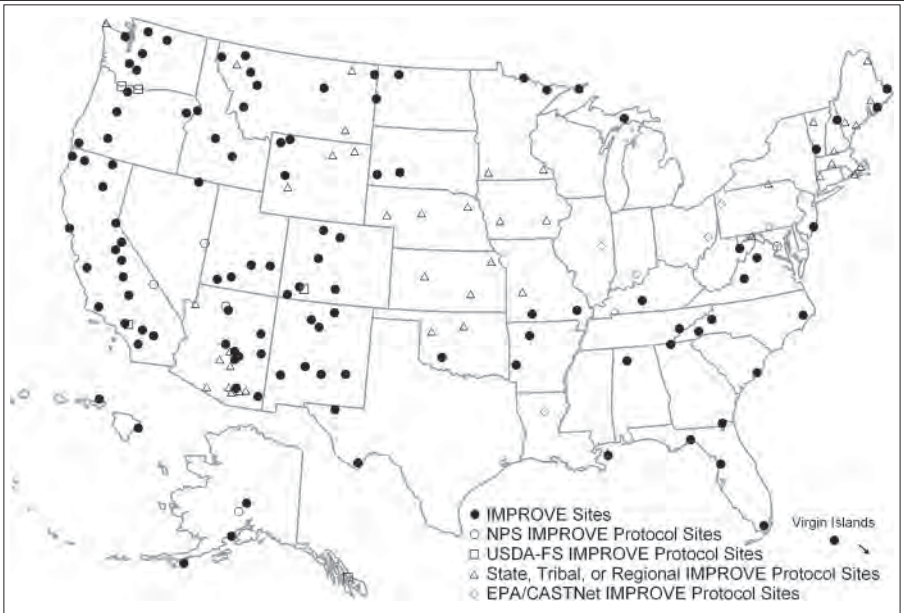
IMPROVE Program participants are listed on page 8. Federal land management agencies, states, tribes, regional air partnerships, and other agencies operate supporting instrumentation at monitoring sites as presented in the map below. Preliminary data collection statistics for the 2nd Quarter 2008 (April, May, and June) are:

- Aerosol (channel A only) 95% collection
- Aerosol (all modules) 93% completeness
- Optical (nephelometer) 97% collection
- Optical (transmissometer) 97% collection
- Scene (photographic) 99% collection
  (does not include Webcameras)

The CAMNET Web site now has a link "More Hazecams" that enables access to other, non-sponsored air quality Web sites with digital cameras. These other hazecams include state of Connecticut-sponsored cameras at Hartford and Mohawk Mountain; the Micmac Tribe's camera at Presque Isle, ME; and a system for Berks County, PA.

Data availability status

Data 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 2006. Nephelometer and transmissometer data are available through March 2008 and December 2007 respectively.



IMPROVE and IMPROVE Protocol Sites
2nd Quarter 2008

Photographic slide spectrums are available on the IMPROVE Web site, under *Data*. Real-time Webcamera displays are available on agency-supported Web sites:

- National Park Service
  http://www.nature.nps.gov/air/WebCams/index.htm
- USDA-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, AZ, Visibility Network
  http://www.phoenixvis.net

Monitoring update *continued on page 3....*

Visibility news

Peplau takes on steering committee representative job for Arizona

Michael Sundblom, the IMPROVE Steering Committee representative for the state of Arizona, left his position with the state last fall to work at the county level and closer to home. The representative's position has now been filled by Steven Peplau.

Stev has held government positions in air quality for 35 years. For 25 years he worked for the Connecticut Department of Environmental Protection, and left as the Director of Engineering and Enforcement. During that time he helped to develop and implement New Source Review programs, enforcement and compliance assistance programs, air toxic programs, and civil penalty and continuous emission monitoring programs. He worked with the EPA and several national workgroups that developed the policies now used in the Title V program for Compliance Assurance Monitoring, Periodic Monitoring, and several key definitions.

Steve moved to Arizona in 1996 and served as the first Division Manager of Maricopa County's Air Quality Program. For six years he developed and implemented new statutes and regulations for the county program. A majority of his time was spent in developing the program, work plans, budgets, justifications for fee increases, and staff increases.

In 2003, Steve joined the Arizona Department of Environmental Quality (ADEQ) as the Assessment Section Manager and now manages the budget and operations of 65 air monitoring sites operating over 600 pieces of equipment. The section is also responsible for periodic emission inventories; industrial source, Mobile 6, and SIP modeling; GIS map development; prescribed burning program; special studies for air toxics; daily air quality forecasting programs; data management activities; the border monitoring program; and outreach activities.

The IMPROVE Steering Committee welcomes Steve, and looks forward to meeting and working with him.

Mr. Peplau may be contacted at the ADEQ. Telephone: 602/771-2274. Fax: 602/771-2366. E-mail: peplau.steven@azdeq.gov.

IMPROVE meeting scheduled for October

An IMPROVE Steering Committee meeting is scheduled for October 28-29, 2008, at the Okefenokee National Wildlife Refuge in southern Georgia. The U.S. Fish and Wildlife Service is hosting this two-day meeting.

All IMPROVE participants are welcome to attend the meeting, which will include discussions of current network status and operations, current research activities, and other concerns related to the network. Meeting participants will also tour the Okefenokee IMPROVE monitoring site.

A complete meeting agenda and other arrangements are expected to be finalized and distributed to IMPROVE participants in early fall.

For more information contact Marc Pitchford at the National Oceanic and Atmospheric Administration. Telephone: 702/862-5432. Fax: 702/862-5507. E-mail: marc.pitchford@noaa.gov.

Characterizing smoke from California fires

California has been plagued by forest fires during early Summer 2008. Over 1,700 individual fires burned at the height of the activity; most started by lightning from dry thunderstorms during June. Smoke from these fires blanketed much of the state, especially the Central Valley, causing spikes in levels of airborne particulate matter.

Several UC-Davis graduate students associated with IMPROVE have used IMPROVE samplers in Davis to collect samples since late June, encompassing many of these smoke events. Unlike normal IMPROVE samples, which are collected on a strict 24-hour schedule, these fire samples were collected on an 8-hour schedule, thereby providing enhanced time resolution of the smoke's behavior and also avoiding the filter clogging that is typical of samples collected in thick smoke. The results will provide insight into the nature of the smoke, and will increase our understanding of how IMPROVE samplers operate under smoky conditions.

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.

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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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Data advisory released

Scientists have posted one data advisory to the IMPROVE Web site this quarter:

Bias between masked and unmasked elemental measurements

- Affects: Module A, Sulfur
- Period: Evident since 2002

Until recently, masks were used at many sites in the IMPROVE and IMPROVE Protocol networks to reduce the nominal collection area of A-Module filters from 3.53 cm^2 to 2.20 cm^2. Masking improved XRF sensitivities at low concentrations, but caused occasional clogs at high concentrations. As of 2008, all filters have been unmasked.

A relative bias between masked and unmasked elemental measurements can be seen by comparing the sulfur/sulfate ratios measured under both conditions, as sulfate ion concentrations have generally reported about 5% more sulfur than masked sites at a given measured sulfate concentration, and the sulfur reported from masked sites has typically risen by about 5% when they have converted to unmasked operation. It is not known whether these differences reflect under-reporting from masked samples or over-reporting from unmasked samples, or contributions from both.

This advisory includes all sites in the IMPROVE and IMPROVE Protocol networks. It is recommended that data users should consider the masking status of the filters when evaluating small differences in time and space.

Complete discussions of this and all other data advisories can be found on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Data/QA_QC/Advisory.htm.*

For more information or to submit an advisory, contact Bret Schichtel at CIRA. Telephone: 970/491-8581. Fax: 970/491-8598. E-mail: schichtel@cira.colostate.edu.

Monitoring update *continued from page 1 ....*

Operators of distinction

Site operators are a varied bunch -- some are federal employees who service their IMPROVE sites in addition to their already tightly scheduled duties, and some are retired people who want a little part-time work. IMPROVE site operator Tina Thompson at Chiricahua National Monument, AZ, falls into a third category -- she has an interest in her environment and finds time to do more.

Tina has been the Air Quality Operator at Chiricahua as a contract employee since April 2006. "I've enjoyed learning about the equipment and I like the challenge of keeping everything running in good order," said Tina. The air quality station at Chiricahua has a comprehensive array of monitors. In addition to the IMPROVE sampler, Tina maintains instrumentation for the National Atmospheric Deposition Program, the National Park Service Gaseous Pollutant Monitoring Program, and the Clean Air Status and Trends Network. She devotes about four hours every Tuesday to weekly checks and routine maintenance of the instrumentation, and collecting and changing filters. Tina is also quick to respond to the station during the week if anything goes awry, and is proactive in communicating with all of the networks she supports.

Tina's interest in nature has always been with her. She pursued interests in forestry at Northern Arizona University and agriculture and animal husbandry at Cochise College. Currently, she spends two days each week working at Chiricahua's Visitor Center.

Being a lifelong resident of Arizona, the remainder of Tina's time revolves around her family and working on the family ranch. "Growing up here on the ranch has given me a deep respect and love for the land. I have always been interested in the plants and animals that surround us, and I have turned into a natural history nut that can't pass up a good field identification book," said Tina. She is the fifth generation to live and work on the ranch; her great, great grandfather homesteaded it in 1879. Tina, her husband David, and son Cory still live at the original homestead site.

Her interest in nature is also seen in her gardening, canning vegetables, and photographing southern Arizona. She will take a little time off from all these interests this summer when she celebrates her 20th wedding anniversary.

Air Quality Operator Tina Thompson ensures the IMPROVE sampler runs smoothly by making mid-week checks if necessary.

Monitoring update continued on page 7....

Feature article

IMPROVE: The beat goes on

The sturdy and stable monitoring program is fine-tuned (2003-current)

Introduction

Beginning with an idea in 1985 that transformed into reality in 1988, we have journeyed back 15 years into the IMPROVE Program in the last three feature articles. We have looked at the program's concept and its inception, the site selection process, administrative development, network expansion, innovations, new technologies, and new rules. We now conclude with this fourth and last article, looking at the most recent period, 2003-current.

In 2003, with the established aerosol network in fine shape and the supporting optical and scene networks going strong, program participants now concentrated on tweaking the small things. The program had been in operation for 15 years and was running sturdy and stable. This last look we take brings us instrument and laboratory improvements, supportive additions, and numerous, special research studies.

Instrument and laboratory improvements

Many changes occurred in the program beginning in 2003, which involved instrumentation or laboratory analysis. To enable fine-tuning of aerosol operations, proposed changes needed to be tested first, and that required an enhanced test facility at UC-Davis. The university built a new test site atop its engineering building, located next to Crocker Nuclear Lab (Figure 1), which would now be the focus of numerous tests and the center for routine instrument diagnostics.

Tests of sampling changes, including new cassettes and filter lots, could be performed, as well as special investigations such as studying nylon filter characteristics, and comparing the Version I and Version II samplers. Site operators complained of inlet clogging, so this problem was also studied at the new test site, and resulted in redesigned inlets to deter insects and other clogging factors. The filter cassettes were also redesigned after thorough testing at the new facility.

Figure 1. The new UC-Davis aerosol sampler test site, located atop the engineering building, uses various operational configurations of modules, which are used for numerous tests and comparison studies. A third sampler shelter was added shortly after this photo was taken.

Other instrument changes in the program included the development of a hybrid $PM_{2.5}$ nephelometer that uses an LED light source, and further enhancement of digital camera models capable of taking high-resolution images.

Laboratory improvements were seen and implemented during this period as well. Beginning in 2005, UC-Davis designed and implemented a new X-Ray Fluorescence (XRF) system, which does not require helium, but instead uses a vacuum system for more consistent analysis results. The program also purchased a new mobile laboratory, to allow mobility during the program's special studies. The 20-foot by 8-foot laboratory is mounted on a truck body, and houses a chemistry lab with benchtop space, a deionized water supply, and a glove box for handling samples in a clean environment. It also houses an array of gas, aerosol, and optical instruments. The university also upgraded its filter weighing laboratory by installing a new ventilation system that controlled the laboratory's temperature and humidity.

The carbon analysis laboratory at Desert Research Institute (DRI) upgraded its methods and protocols in 2005. Its old carbon analyzers were wearing out, and researchers had begun comprehensively studying a new carbon analyzer and its operations. Analysts anticipated a changeover in instruments as soon as acceptable comparison results were obtained. Along with the use of the new carbon analyzer (DRI Model 2001) were new protocols (IMPROVE_A protocols), developed to mimic the temperature cycle used in the older system. Acceptance of transferring all future carbon analysis to the new analyzer and protocols was not made until all researchers and IMPROVE Steering Committee members were satisfied with the new standards.

Supportive additions

During the last few years, numerous and varied additions came to the IMPROVE program that supplement and support operations. Several of the more notable examples of these additions are described below.

A nephelometer elevator system was announced as being available in 2005. This device would alleviate a site operator from having to climb a 14-foot tower or raise a ladder to service the instrument (Figure 2). Some operators are prohibited by park safety policies from doing any climbing.

Figure 2. Field Specialist Dave Beichley demonstrates the nephelometer elevator system. The instrument is lowered to ground-level via a manual hand crank for servicing. The unit is then cranked back to the top of the tower for operational monitoring.

Beginning in 2003, the quality assurance (QA) portion of the IMPROVE Program was further refined and helped to maintain IMPROVE's highly accredited reputation for excellence. The QA program included several facets. On the instrument side, collocated aerosol samplers were installed at several sites throughout the network to help assess measurement uncertainties. These collocated modules will operate indefinitely, and their data will be included in a new, improved database. The database was redesigned to allow more versatility and to include these collocated data, data checks, and flags to assess data integrity. A QA coordinator at UC-Davis began a review of the database contents and operational and analytical procedures.

Another aspect of comprehensive QA efforts was the reemergence of the site auditing program. EPA staff developed an auditor training program and site auditing schedules began to take the shape defined in the program's Quality Assurance Project Plan.

Also at this time, data were presented online to thousands of users via the new Visibility Information Exchange Web System (VIEWS). The new Web site complements the IMPROVE Web site, and is a depository for data which are accessible to anyone logging on.

Most significantly during this period was the introduction of a new, improved algorithm for determining reconstructed extinction. After much analysis, the new algorithm was formally accepted by the steering committee in December 2005, and has been adopted by every state for state implementation plan (SIP) development per the Regional Haze Rule.

On the scene monitoring side, WinHaze visual air quality modeling software was developed in the 1990s (Figure 3). This software enables users to visually see the difference in various scenes, using specific, modeled visual parameters. This lead to the development of techniques to calibrate digital cameras in 2005, to derive visibility metrics directly from images; a process similar to that used in slide scanning analysis using film cameras during the 1980s. Digital cameras have now replaced all film-based cameras in the networks, and many sites use high-resolution digital images to support public Web pages.

Many more administrative, support efforts were made to supplement the program in recent years. Steering committee meetings were attended on a more scheduled basis, and began to be rotated from place to place; the meetings are now held in locations where IMPROVE monitoring exists, in various parts of the country. A site visit tour, hosted by the sponsoring agency and site operator, is always well attended as part of the meetings. Site operators are also recognized for their efforts through the creation of IMPROVE calendars beginning in 2003 (Figure 4). Short articles tell about site operators lives, locations, and work. Feature operator articles also continue to be published in the quarterly IMPROVE Newsletter.

Even with these supportive additions to the program, not all was optimistic. While program participants busied themselves with scientific advancements in aerosol monitoring, and while refinements to the program were occurring, the EPA let it be known that a possible funding cut may be seen in the future. The IMPROVE Steering Committee used the advance notice to conduct an assessment and develop a network reduction plan in 2006. The plan assessed program priorities and effectiveness, and the adequacy of the network for meeting the monitoring requirements of the Regional Haze Rule. To date, the EPA funds have not yet been reduced.

***The beat goes on** continued on page 6....*

The beat goes on continued from page 5....

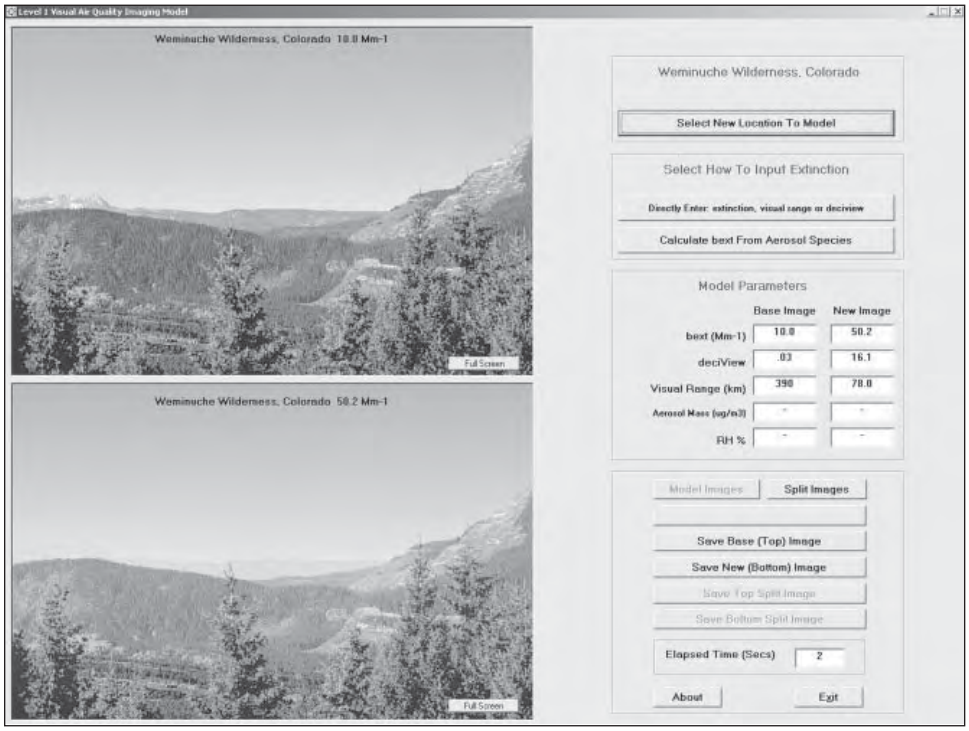

Figure 3. The WinHaze Level 1 air quality modeler allows the user to enter specific visibility metric values, and see the results using pre-selected images. Here a view from Durango, CO (Weminuche Wilderness) showing the San Juan Basin, is modeled. The top photograph shows a pristine day (390 km visual range). The bottom photograph was modeled using a parameter input of 78 km visual range (16.1 deciviews or 50.2 Mm-^{1}).

Special studies

Numerous special research studies were performed during the last five years to advance the knowledge of scientists. Some of these studies are:

- IMPROVE Coarse Mass Speciation Study - This study was performed at nine IMPROVE sites beginning in March 2003. At least one year of monitoring would be performed at each site to determine the composition of coarse particles at these remote locations.

- Ion Studies - An ion/nitrate study was performed at Bondville, IL; San Gorgonio, CA; Grand Canyon, AZ; and Brigantine, NJ, at various times in 2003 to determine the characteristics of ionic aerosol present at these locations. Instrumentation included a Particle Into Liquid Sampler (PILS), a Micro Orifice Uniform Deposit Impactor (MOUDI), and a URG $PM_{2.5}$ cyclone/annular denuder/filter pack sampler that operated for one month at each site.

- Biogenic smoke study - Biomass smoke began to be studied in 2003 at the USDA-FS Fire Science Laboratory in Missoula, MT. The study focused on quantifying smoke parameters such as optical and chemical properties.

- Great Smoky Mountains Ammonia Study - The study was performed in July and August 2004 in a humid, acidic, summer environment, to determine how accurately ammonium can be quantified on a nylon filter, and to assess the effects of any contamination during sample handling.

- ROMANS - The Rocky Mountain Atmospheric Nitrogen and Sulfur Study, performed in 2006, measured visibility reduction and ecosystem effects, and assessed the sources of nitrogen and sulfur contributions across the Colorado Front Range and statewide.

Conclusion

Now that we've looked back on the IMPROVE Program and its history, we can see its development into a full-fledged, federally sponsored program to protect the air quality in our nation's most precious and most protected areas. Generating high quality data to characterize and track changes in air quality in these protected areas is the mission IMPROVE will strive for in the future as well. The future and its evolving needs, regulations, technologies, and scientific advancements will guide us how to proceed.

Figure 4. The IMPROVE calendars have been a popular addition to the program since 2003. They assist operators in filter changes and routine maintenance, provide servicing tips, and include informative articles related to air monitoring programs as well as a monthly IMPROVE site and operator feature.

Monitoring update *continued from page 3 ....*

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 2nd Quarter 2008 are:

Aerosol (Channel A)

Acadia	Guadalupe Mountains	Presque Isle
Addison Pinnacle	Hells Canyon	Proctor Research Ctr
Agua Tibia	Ike's Backbone	Puget Sound
Arendtsville	Isle Royale	Redwood
Bandelier	Joshua Tree	Rocky Mountain
Big Bend	Lake Sugema	Sac and Fox
Birmingham	Linville Gorge	Salt Creek
Bondville	Livonia	San Gabriel
Bridgton	Makah	San Gorgonio
Cabinet Mountains	Mammoth Cave	San Rafael
Casco Bay	Martha's Vineyard	Seney
Chiricahua	Medicine Lake	Shining Rock
Columbia Gorge East	Mesa Verde	Snoqualmie Pass
Columbia Gorge West	MK Goddard	Starkey
Crescent Lake	Mohawk Mountain	Sycamore Canyon
Death Valley	Monture	Tallgrass
Denali	Moosehorn	Theodore Roosevelt
Douglas	Mount Baldy	Three Sisters
Egbert	Mount Hood	Tonto
El Dorado Springs	Mount Zirkel	Trapper Creek-Denali
Ellis	New York	Tuxedni
Fort Peck	North Cascades	Upper Buffalo
Grand Canyon	Northern Cheyenne	Viking Lake
Great Gulf	Organ Pipe	Washington DC
Great River Bluffs	Pack Monadnock	Wichita Mountain
Great Smoky Mtns.	Petrified Forest	Yosemite

Nephelometer

Acadia	Greer	Sierra Ancha
Great Smoky Mtns.	Ike's Backbone	Queen Valley
Hance	Phoenix	

Transmissometer

Cloud Peak

Photographic

Gates of the Mountain
Monture
Shamrock

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)

Sites that achieved at least 95% data collection for 2nd Quarter 2008 are:

Aerosol (Channel A)

Badlands	Indian Gardens	Saguaro West
Cadiz	James River	Shenandoah
Cedar Bluff	Jarbidge	Sikes
Flathead	Kaiser	St. Marks
Fresno	Kalmiopsis	Virgin Islands
Frostburg Reservoir	Lassen Volcanic	Wheeler Peak
Gila	Meadview	White Pass
Great Basin	Okefenokee	White River
Haleakala Crater	Penobscot	Yellowstone
Hawaii Volcanoes	Quaker City	Zion Canyon

Nephelometer

Big Bend	Great Basin	Rocky Mountain
Chiricahua	Indian Gardens	Sycamore Canyon
Cloud Peak	Mammoth Cave	Thunder Basin
Craycroft	Mount Rainier	Tucson
Dysart	National Capital	Tucson Mountain
Estrella	Organ Pipe	Vehicle Emissions
Glacier	Petrified Forest	

Transmissometer

Bridger
San Gorgonio

Photographic

Agua Tibia

Sites that achieved at least 90% data collection for 2nd Quarter 2008 are:

Aerosol (Channel A)

Blue Mounds	Great Sand Dunes	San Pedro Parks
Bridger	Hercules-Glades	Sawtooth
Brigantine	Hoover	Sequoia
Bryce Canyon	Lava Beds	Simeonof
Caney Creek	Mingo	Sula
Canyonlands	Mount Rainier	Swanquarter
Cape Romain	Nebraska	Thunder Basin
Capitol Reef	Olympic	Trinity
Chassahowitzka	Pinnacles	UL Bend
Cherokee	Point Reyes	Voyageurs
Craters of the Moon	Quabbin Reservoir	Weminuche
Dolly Sods	Queen Valley	White Mountain
Everglades	Saguaro	

Nephelometer

Cape Romain	Mount Zirkel	Shenandoah

Transmissometer

Thunder Basin

Photographic

-- none --

IMPROVE

The IMPROVE Newsletter

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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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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:

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