INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

2nd Quarter 2011 | The IMPROVE Newsletter | Volume 20 / Number 2

Monitoring update

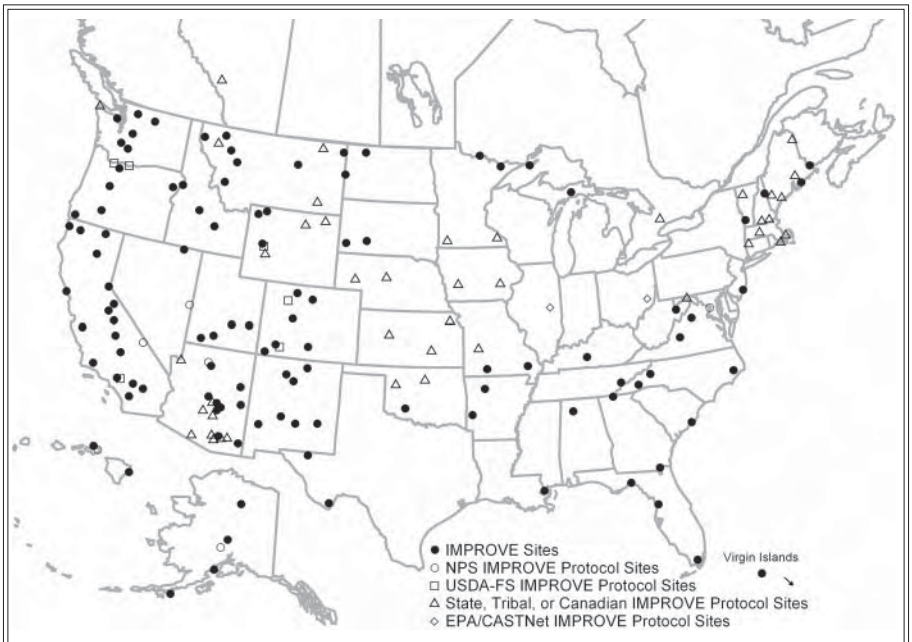
Feature Article: Optec develops LPV-4 LED transmissometer, Page 4

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:

- 55 aerosol samplers
- 20 nephelometers
- 2 transmissometers
- 77 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 2011 (April, May, June) are:



IMPROVE and IMPROVE Protocol Sites
2nd Quarter 2011

- Aerosol (channel A only) 93% collection
- Aerosol (all modules) 93% completeness
- Optical (nephelometer) 97% collection
- Optical (transmissometer) 94% collection

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 April 2010. Nephelometer and transmissometer data are available through March 2011 and December 2010, respectively. Webcamera real-time images and data are available on agency-supported Web sites:

- 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 "Visibility Cameras."

Monitoring update continued on page 3....

Visibility news

IMPROVE auditor certification and recertification training coming this fall

A one-day training and certification course will be conducted on Tuesday, October 25, for Federal Land Manager staff who have an opportunity to audit IMPROVE sites. Those interested will need to notify training staff in advance if they will be attending for certification or attending as an observer for general information purposes. The agenda will be:

9:00 - 11:30am
Operating principles of the IMPROVE sampler and the critical factors that influence the ability to accurately and precisely measure ambient concentrations. The objective is to understand why the audit is constructed in its current fashion.

- Why the control of flow rate is important and, therefore, how the constants for setting the flow are critical.
- The significance of the data card.
- The reasons behind the siting criteria and the site evaluation, influence of trees, haul roads, traffic, lawns that must be mowed, etc.
- Why the handling procedure during recovery and replacement of the filter packages is critical.
- The importance of proper planning and scheduling of audits and the implications of poor communication with UC-Davis.

1:00 - 3:30pm (first rotation session)
Training will be divided into two groups. Group A will visit the site to run through the actual audit procedure. Group B will take an open book exam, followed by a review and discussion.

3:30 - 6:00pm (second rotation session)
Group B will visit the site and run the audit procedure while Group A will return to the classroom for the exam and review.

Those interested in this training and certification course should e-mail their intent to attend to *ricks.solomon@epa.gov* and cc: *crumpler.dennis@epa.gov.*

For more information contact Dennis Crumpler at U.S. EPA. Telephone: 919/541-0871. E-mail: crumpler.dennis@epa.gov.

FLMs coordinate through MOU to protect AQRVs in oil/gas development areas

The Federal Land Managers (FLMs) of the Department of Agriculture and Department of the Interior, along with the Environmental Protection Agency, signed a Memorandum of Understanding (MOU) in June to follow a clearly defined, efficient approach through the decision-making process regarding oil and gas development on federally managed lands. The approach is designed to comply with National Environmental Policy Act (NEPA) requirements using appropriate environmental analyses, yet maintain adequate protection of air quality and air quality related values (AQRVs) on those lands.

MOU continued on page 6....

Wildfires overrun IMPROVE monitoring sites

It is turning out to be one of the most severe wildfire seasons in history, with numerous wildfires in the Southwest burning due to extreme dry conditions. Two such fires have ripped through the IMPROVE monitoring stations in New Mexico and Arizona this spring and summer.

The Gila Cliff Dwellings National Monument (GICL1), NM, IMPROVE monitoring station was overrun with wildfire in May. Caused by human activity, the Miller Fire spread through the station's terrain and approached the aerosol monitoring shelter; fortunately, Site Operator Gilbert Jimenez acted quickly to protect the sampler. With assistance, Jimenez wrapped the bottom of the aerosol shelter with a fire-protective foil, which resulted in the shelter being spared from flame contact. The sampler shelter and modules were saved; however, electrical power was lost for several days and resulted in three lost samples. The fire consumed nearly 90,000 acres and was contained in mid-June.

Another wildfire in the West broke out in May which burned the entire Chiricahua National Monument in southeastern Arizona. This human-caused fire was one of several in the

Wildfires continued on page 3....

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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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Wildfires continued from page 2....

region that grew rapidly due to extremely dry conditions, and grew to be the fourth largest wildfire in state history with over 222,000 acres burned. The fire caused the evacuation of all the monument's staff and visitors, and was a close call for IMPROVE and other air sampling operations.

On the day Site Operator Tina Thompson performed her weekly air quality station maintenance visit, the Horseshoe 2 Fire had encroached within one mile of the monitoring station. She informed fire crews of the location of the station and its instrumentation, and asked crews to clear away any brush and other fuel materials. Fire personnel not only positioned a crew at the station, but called for slurry drops around the area as well.

The following day, Thompson needed a fire crew to escort her to the station to check its status. Flames came right up to the station, but crews successfully kept the fire at bay. It will be several months before the aerosol filters are analyzed, but some may be unusable to extreme particulate loading. The station's filters preceding this period are also expected to contain higher than normal particulate loading due to several major wildfires in the Southwest during this period.

The Horseshoe 2 Fire at Chiricahua National Monument, AZ (CHIR1) can be seen just yards away from the IMPROVE aerosol sampler. Photograph by IMPROVE Site Operator Tina Thompson.

Visibility news continued on page 6....

Monitoring update

continued from page 1 ....

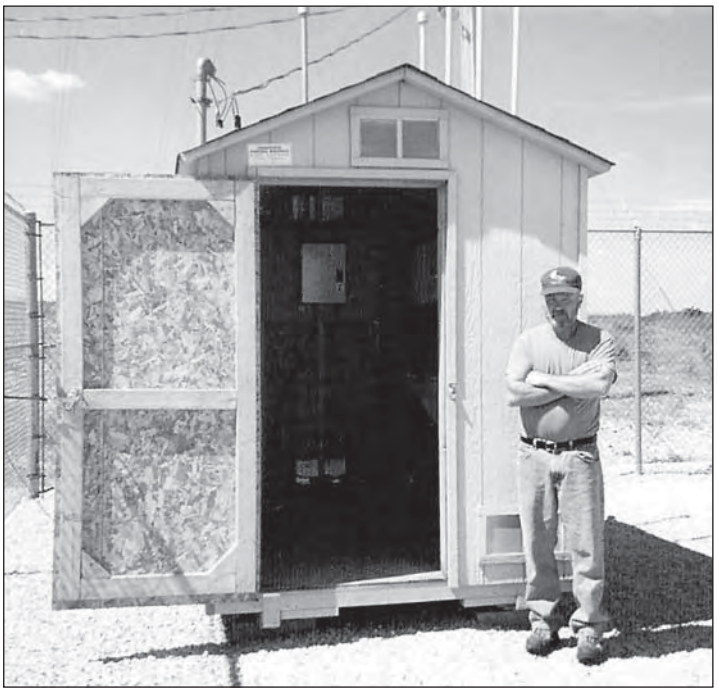
Operators of distinction

Strong family values go a long way in the Wyman family, who are all IMPROVE site operators at the Hercules-Glades Wilderness monitoring site in southern Missouri.

Rick Wyman, the primary operator, has maintained the aerosol sampler since its installation in 2001. A former U.S. Forest Service employee, he now works for the Missouri Department of Agriculture assisting the Department of Conservation in trapping gypsy moths and other invasive species. "Gypsy moths are not yet established in Missouri, but they are present," said Rick. "Its populations can devastate a forest, and one of its favorite foods, oak, is prominent in Missouri forests," said Rick.

Rick takes aerosol sample collection very seriously and always strives for a good collection record, which may involve an equipment change or quick troubleshooting of a problem. Rick's wife Leslie, mother Frances, and father Elwood, all serve as backup operators at the monitoring site, and lend Rick a hand when necessary. These efforts enable the Hercules-Glades site to be one of the top data collection sites every quarter.

All of the Wymans are active in conservation, ecological, or preservation activities in their area. Both sides of the family have lived in southern Missouri for five generations, and through their help with protecting the environment, and educating others about its importance, it seems they plan on staying there for generations to come.



IMPROVE site operator Rick Wyman has maintained the Hercules-Glades Wilderness (HEGL1) monitoring site, sponsored by the U.S. Forest Service, since its inception in 2001.

Monitoring update continued on page 7....

Feature article

Optec develops LPV-4 LED transmissometer for optical visibility measurements

(by J.V. Molenar, Air Resource Specialists, Inc.)

Background and early development

A transmissometer directly measures the irradiance of a light source after the light has traveled over a finite atmospheric path. The transmittance of the path is calculated by dividing the measured irradiance at the end of the path with the calibrated initial intensity of the light source. Using Bouger's law, the average extinction (b_{ext}) of the path is calculated from the transmittance and length of the path. It is attributed to the average concentration of all atmospheric gases and ambient aerosols along the path. Transmissometers are the only instrument able to make a completely ambient measurement of b_{ext} without perturbing or selectively sampling atmospheric aerosols or gases.

For this reason, in 1985, the National Park Service (NPS) funded the development of a long-path transmissometer. Jerry Persha of Optec, Inc. constructed the prototype instrument (LPV-0). Initial testing of the transmissometer was done at Optec and Air Resource Specialists, Inc. (ARS) facilities during the fall of 1985. In February 1986, Optec, ARS, and NPS staff conducted the first field test at Grand Canyon National Park (Figure 1) over path lengths up to 15 km.

After analysis of the data, the instrument was upgraded to the LPV-1 and a second round of intensive field trials was completed during the fall of 1986 at Meteor Crater, Arizona. The study compared the LPV-1 transmissometer with other existing optical instrumentation (integrating nephelometers and contrast measurements by teleradiometers of natural and artificial black targets). The transmissometer proved to be an instrument that could accurately measure ambient b_{ext}. This led to its commercialization as the LPV-2 transmissometer, which continues to successfully operate at many sites in the IMPROVE, NPS, U.S. Forest Service, state, urban, and special study visibility networks since 1986.

Operational theory

The LPV transmissometer receiver incorporates sophisticated optics and electronics to collect the modulated light of the transmitter, separate it from background ambient light and amplifier noise, and measure the irradiance. The LPV receiver has proven to be a robust instrument; the basic operation of the system has remained essentially unchanged the past 25 years, with the only upgrades being better and more stable electronic components and software. The transmitter, however, has undergone significant changes.

The LPV-2 transmitter operates using a 15-watt tungsten filament lamp as the light source. The lamp output is increased by a factor of 100 with the use of a Koehler projection system, which collects the light in a solid angle of 11° as seen from the filament, and concentrates it into a 1° cone. The output of the lamp is stabilized by reflecting with a glass slide approximately 8% of the light in an area 0.17° in diameter from the central axis to a silicon photodiode detector. The output of the detector is fed into a feedback circuit that increases the lamp voltage as needed to maintain a constant lamp output. The signal is mechanically chopped

Figure 1. Jerry Persha (Optec, Inc.) at Grand Canyon National Park, testing prototype LPV-0 transmissometer - February 1986.

at 78.125 Hz to provide for a modulated beam which can be detected day or night by the receiver (Figure 2).

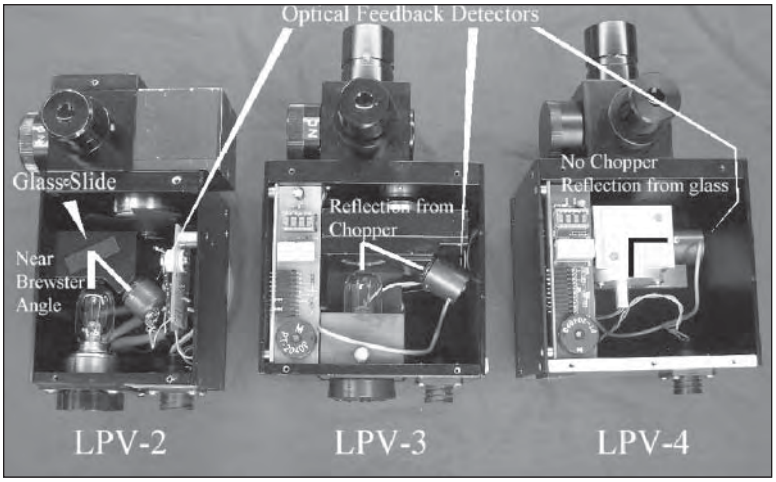


Figure 2. Configuration of LPV-2, LPV-3, and LPV-4 transmitters.

Recent developments and improvements

Early transmissometer data indicated that the output of the transmitter was not being held constant, but was increasing at a rate of about 2% per 500 hours of lamp operation. This was eventually traced to the problem of the light reflected in the transmitter to the optical feedback circuit being polarized because the reflection angle was near the Brewster angle (the angle at which light is completely polarized upon reflection). As the filament in the incandescent lamp aged, the degree of polarization of the light changed. Since the feedback detector was receiving only one plane of polarization, it was increasing the lamp output too much. This was addressed with the introduction of the LPV-3 transmitter, which changed the angle of the feedback optics and removed the glass slide using the back of the chopper as the reflective surface (Figure 2).

These modifications reduced but did not completely eliminate the lamp brightening issue. In addition, operating complications due to the need for multiple lamps with multiple calibration constants and the use of a mechanical chopper to modulate the light source have required additional servicing of the system, increased costs to operate the instrument, and most importantly, require a careful examination and interpretation of extinction data collected by the system.

By 2009, light-emitting diode (LED) light sources had become brighter and less expensive. LED light sources have since successfully replaced the tungsten filament lamps in almost all currently operating Optec Next Generation Nephelometers. Thus, in 2010 Optec and ARS funded the development of the LPV-4 LED transmitter to further address the transmissometer transmitter issues. An LED light source uses less power than the tungsten filament lamp, has a useful life of over 10,000 hours, can be electronically modulated, and is unpolarized. This will reduce power requirements, remove the need to have multiple calibrated lamps for a year of operation, eliminate data loss due to chopper motor failures, and eliminate the lamp brightening issue (Figure 2).

In the fall of 2010 Optec constructed a prototype LPV-4 transmitter which ARS began testing in November 2010 at its Fort Collins, Colorado, testing facility. Figure 3 shows the raw output of the transmitter from November 30, 2010 – April 7, 2011. This is over 3,000 hours of continuous operation without a failure. In addition, transmitter output has shown no apparent increase in brightness on the cleanest days during this period. The transmitter is currently being tested by operating continuously in a laboratory and completing a thorough calibration every 300-500 hours when very clean ambient conditions exist. Results of this test are expected by early 2012.

For more information contact John Molenar at ARS. Telephone: 970/484-7941. Fax: 970/484-3423. E-mail: jmolenar@air-resource.com

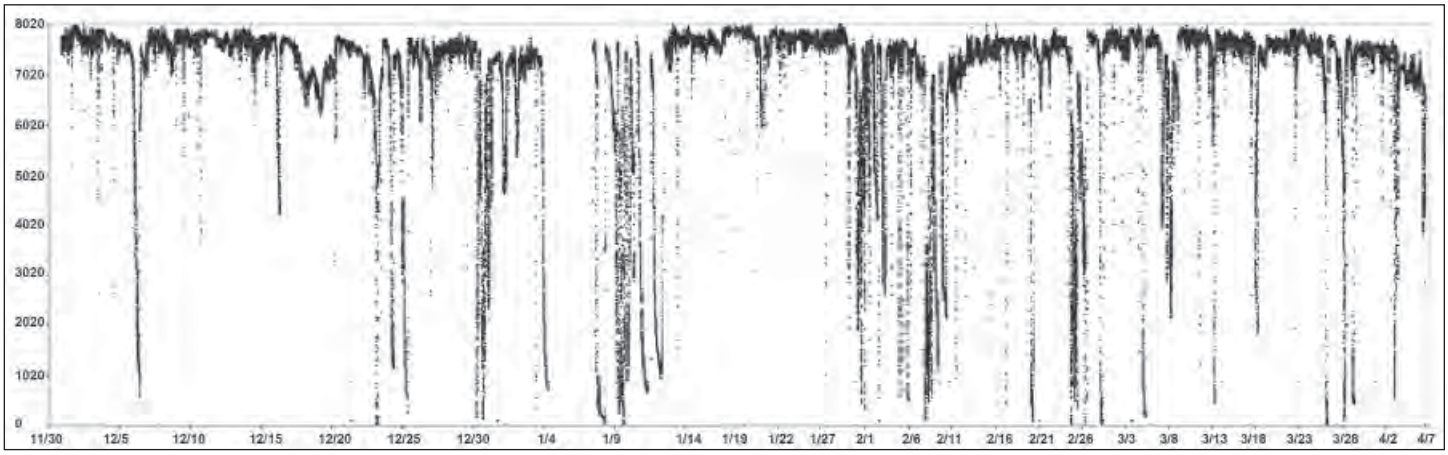


Figure 3. Timeline of raw output from LPV-4 LED transmitter 11/30/2010 - 4/7/2011 (3000+ hours of continuous operation). Large drops in raw counts are due to weather conditions (rain, fog, snow), or moisture/dust on windows.

Visibility news continued from page 3 ....

Arizona visibility monitoring network captures Phoenix dust storm

The evening following our Independence Day celebrations created a stir among Phoenix area residents as a massive dust cloud spread over the city. Video clips of the storm soon made their way to the Internet, and although dust storms are not uncommon in the Southwest, this one made headlines.

The Arizona Department of Environmental Quality (ADEQ) sponsors and operates an urban visibility monitoring network, which includes five Webcameras, one transmissometer, and three nephelometer systems. While the dust particles were too large in this dust episode to be accurately read by the nephelometers, the transmissometer and all five camera systems provided some near-real time documentation of the total magnitude of the event. A time-lapse video of the event as captured by each of the camera systems is available on the ADEQ Web site at *http://www.phoenixvis.net/duststorm.html*.

In addition to the documentation of the event by the Phoenix urban visibility monitoring network, several other monitoring networks picked up on the large dust storm. ADEQ, Maricopa County, and Pinal County State and Local Air Monitoring Station (SLAMS) monitors all measured elevated particulate concentrations from the storm. A continuous PM_{10} monitor at the JLG Phoenix Supersite operated by ADEQ produced an astonishing 6348.6 $\mu g/m^3$ one-hour average. With the dust storm occurring on a scheduled 1-in-3 sampling day, the IMPROVE monitors throughout the state, including an urban IMPROVE monitor in Phoenix, may provide additional information regarding the magnitude and spatial extent of the storm.

For more information contact Bernard Lum at ADEQ. Telephone: 602/771-2364. Fax: 602/771-2299. E-mail: lum.bernard@azdeq.gov.

ADEQ Webcamera looking at South Mountain captured this image of the dust storm on July 5, 2011 at 8:05pm.

Haze reduction agreement awaits federal judge's approval

An agreement filed in the U.S. District Court in Colorado in June requires the U.S. Environmental Protection Agency (EPA) to approve regional haze plans in Colorado, Montana, North Dakota, and Wyoming, calling for coal-fired power plants in those states to reduce their emissions. A federal judge in Colorado is expected to issue final approval of the agreement. The pollution reductions were mandated under the Clean Air Act, but as of yet have not been realized. This recent agreement, among EPA and environmental organizations, intends to prompt realization of these reductions by requiring at least 18 older coal-fired plants in those states to reduce their emissions or end operations.

EPA officials and environmental organizations are also developing a broader agreement that would set deadlines for haze pollution plans in 36 more states, which would affect another 300 older coal-fired plants that were exempted from other air pollution initiates because they were thought to be nearing the end of their operational lifetimes.

U.S. EPA regulatory actions are posted on http:/www.epa.gov/visibility/actions.html.

MOU continued from page 2....

Through the coordinated effort, FLMs will be able to make decisions that will not cause nor contribute to National Ambient Air Quality Standard (NAAQS) exceedances, nor adversely impact AQRVs in Class I or sensitive Class II areas. The collaborative approach is designed to increase efficiency and reduce decision-making time.

Specific FLMs involved in the process include the Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service, and U.S. Forest Service, all of whom have a role in issuing environmental analyses associated with development decisions. More information about the MOU is available on the National Park Serivce Web site at *http://www.nature.nps.gov/air/hot/index.cfm*.

For more information contact John Bunyak at the National Park Service. Telephone: 303/969-2818. Fax: 303/969-2822. E-mail: john_bunyak@nps.gov.

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 2011 are:

Aerosol (Channel A) - 41% of all sites

Acadia	Grand Canyon	Petrified Forest
Badlands	Great River Bluffs	Presque Isle
Big Bend	Great Sand Dunes	Proctor Research Ctr.
Bondville	Haleakala	Puget Sound
Boulder Lake	Hawaii Volcanoes	Quabbin Reservoir
Boundary Waters	Hercules-Glades	Quaker City
Breton	Ike's Backbone	Rocky Mountain
Bridgton	Indian Gardens	Sac and Fox
Brigantine	Isle Royale	San Gorgonio
Bryce Canyon	James River	Seney
Cabinet Mountains	Kaiser	Sequoia
Caney Creek	Lake Sugema	Shamrock Mines
Canyonlands	Lava Beds	Shenandoah
Cape Romain	Londonderry	Snoqualmie Pass
Capitol Reef	Mammoth Cave	Sycamore Canyon
Cedar Bluff	Martha's Vineyard	Three Sisters
Columbia Gorge West	Mesa Verde	Tonto
Crater Lake	Mingo	Trapper Creek-Denali
Crescent Lake	Mohawk Mountain	Tuxedni
Denali	Monture	UL Bend
Douglas	Mount Hood	Virgin Islands
Egbert	North Cascades	Weminuche
Ellis	Okefenokee	White River
Everglades	Olympic	Wind Cave
Flathead	Organ Pipe	Wrightwood
Glacier	Pack Monadnock	

Nephelometer - 36% of all sites

Dysart	Indian Gardens	Rocky Mountain
Estrella	Mammoth Cave	Vehicle Emissions
Glacier		

Transmissometer - 50% of all sites

San Gorgonio

Sites that achieved at least 95% data collection for 2nd Quarter 2011 are:

Aerosol (Channel A) - 11% of all sites

Agua Tibia	Frostburg Reservoir	Medicine Lake
Bosque del Apache	Great Smoky Mtns.	Mount Rainier
Casco Bay	Guadalupe Mtns.	San Pedro Parks
Columbia Gorge East	Haleakala Crater	Swanquarter
Craters of the Moon	Lassen Volcanic	Theodore Roosevelt
Dolly Sods	Makah	Trinity

Nephelometer - 42% of all sites

Acadia	Hance	Shenandoah
Big Bend	Mount Rainier	South Pass
Great Smoky Mtns.	National Capital	

Transmissometer - 0% of all sites

-- none --

Sites that achieved at least 90% data collection for 2nd Quarter 2011 are:

Aerosol (Channel A) - 24% of all sites

Bandelier	Jarbidge	Salt Creek
Birmingham	Kalmiopsis	St. Marks
Bliss	Linville Gorge	Starkey
Bridger	Lye Brook	Sula
Cape Cod	Meadview	Tallgrass
Chassahowitzka	Moosehorn	Thunder Basin
Death Valley	Nebraska	Upper Buffalo
El Dorado Springs	North Absaroka	Viking Lake
Fresno	Northern Cheyenne	Wheeler Peak
Gates of the Arctic	Penobscot	White Mountain
Great Basin	Pinnacles	White Pass
Great Gulf	Redwood	Wichita Mountain
Hells Canyon	Saguaro	Yellowstone
Hoover		

Nephelometer - 21% of all sites

Cape Romain	Great Basin	Thunder Basin
Cloud Peak		

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

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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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* 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