INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

4th Quarter 2007 | The IMPROVE Newsletter | Volume 16 / Number 4

Monitoring update

Feature Article: IMPROVE Development and expansion, 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:

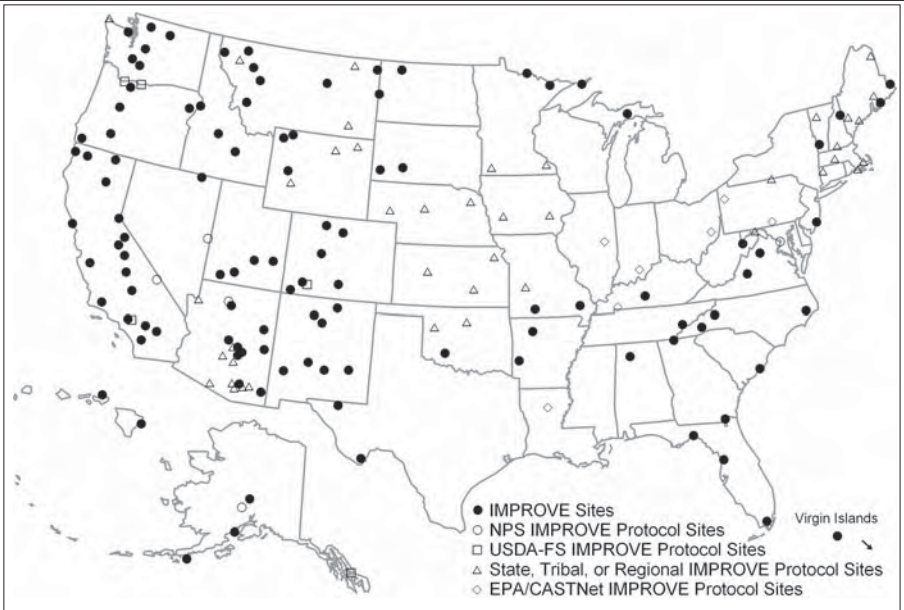
- 59 aerosol samplers
- 4 transmissometers
- 32 nephelometers
- 5 digital camera systems
- 57 Webcamera systems
- 5 interpretive displays

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 2007 (October, November, and December) are:

- Aerosol (channel A only) 95% collection
- Aerosol (all modules) 93% completeness
- Optical (transmissometer) 95% collection
- Optical (nephelometer) 97% collection
- Scene (photographic) (does not include Webcameras) 75% collection

An aerosol sampler was installed in October at Pack Monadnock Summit, NH, an established air quality station operated by the state and University of New Hampshire. A nephelometer was installed at Glacier NP, MT, in November, and at Rocky Mountain NP, CO, in December, and the nephelometers at Chiricahua NM and Petrified Forest NP were transferred from National Park Service responsibility to the state of Arizona.

Both Grand Canyon NP transmissometers ended routine monitoring this quarter; the South Rim instrument was one of the first to be installed in the network, in December 1986, and was removed October 1. The In-Canyon instrument was installed December 1989 and is now only used to support the public visibility display.



IMPROVE and IMPROVE Protocol Sites
4th Quarter 2007

Finally, the last two 35mm film cameras, at Bryce Canyon NP, UT, and Grand Canyon NP, AZ, were discontinued October 1. The cameras have taken three photographs every day since 1984 and 1983 respectively.

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. Transmissometer and nephelometer data are available through December 2006 and September 2007 respectively.

Photographic slide spectrums are available on the IMPROVE Web site, under *Data*.

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Visibility news

USDA-Forest Service representative to IMPROVE changes hands

For those who don't already know, Rich Fisher, the long-time IMPROVE Steering Committee representative for the USDA-Forest Service, retired as of early January 2008. Rich supervised many technical aspects of the Forest Service's air quality program in addition to serving on the IMPROVE committee. The entire IMPROVE community thanks Rich for his years of dedication to the program, congratulates him on his retirement, and wishes him and his family all the best.

Scott Copeland was appointed to be Rich's replacement as of December 20, 2007. "I'm honored to be representing the Forest Service on the steering committee," said Copeland, "it is a great group of people to work with, and a very successful and important program."

Copeland started working with the IMPROVE Program in 1987 on a field study in the Grand Canyon, which was, in part, a shake-down for the early IMPROVE sampler. He worked in the Air Quality Group laboratory at the University of California-Davis for seven years analyzing filters, building samplers, completing his master's degree, and doing lots of field work. In 1994 he joined the Cooperative Institute for Research in the Atmosphere (CIRA) at Colorado State University as the visibility data analyst for the USDA-Forest Service. In the beginning, he literally worked in Rich Fisher's Forest Service office. Copeland then moved into the CIRA building, then moved again into the Washakie Ranger Station in Lander, Wyoming, where he works today and lives nearby.

"I have big shoes to fill," said Copeland, "as Rich has been a respected member of the committee serving in his position since the committee's inception. I'm looking forward to working with the other committee members, IMPROVE partners, and contractors as we slide down the 'glide slope' towards a clearer future."

You may contact Scott Copeland at the USDA-Forest Service in Lander, WY. Telephone: 307/332-9737. Fax: 307/332-0264. E-mail: copeland@CIRA.colostate.edu.

North Absaroka site rebuilt after storm

The NOAB1 IMPROVE site is situated at 8144 feet above sea level on a wind-swept ridgeline about 20 miles northwest of Cody, Wyoming. The sampler is situated to represent the North Absaroka Wilderness, its namesake, and the Washakie and Teton Wildernesses to its south.

Wyoming is known for its strong and persistent winds. November 12, 2007, was a particularly windy day at NOAB1. An adjacent meteorological station recorded winds of 127 mph, which corresponds to the upper end of a "Category 3" hurricane. Two of the "dead men" which anchored the shed pulled out of the ground and a third anchor failed when the cable pulled out of the cable clamps. The shed rolled about 50 yards away and broke apart, damaging the sampler and causing the loss of two month's worth of data. Technicians from UC-Davis and the USDA-Forest Service were able to build a new shelter and install the repaired sampler by January 4, 2008, thus preserving the data integrity for the 2008 sample year.

IMPROVE samplers have been destroyed by fires, hurricanes, and tornadoes in the past, and no doubt more will be destroyed in the future. There are two cautionary notes for site operators to consider after this event.

First, from a preventative perspective, always keep an eye out for damage to the building, tower, shed, stand, or whatever houses the sampler. This includes signs of decay in structural members, loose mooring cables, or any broken or damaged mounting equipment. In this case, the building probably could not have withstood the winds, but maybe another site can be spared in the future. Contact UC-Davis for advice about repair or replacement of IMPROVE sampler structures.

Second, keep in mind that a damaged structure is potentially very dangerous. IMPROVE samplers run on 110-volt line power, possibly creating an electrocution hazard. Please exercise caution around damaged equipment.

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.*

The North Absaroka IMPROVE shelter was demolished by 127 mph winds in November, as documented by its site operators Ed and Janice Stratman (top photo). The sampler modules can be seen lying in the debris in the lower-right portion of the photograph. The sampler was operational in its new shelter by early January (bottom photo).

2008 IMPROVE calendars available

The 2008 calendars have been delivered and extras are still available. This year's calendar again explains sampler operation and provides operator troubleshooting procedures. In addition, this year we include explanations of UC-Davis' annual site maintenance, data quality assessment, measuring temperature and humidity, and a few special studies.

The calendar features 12 operators from around the networks, their sites, their work, and their special interests. These popular calendars display sampling days and cartridge changes due on the daily grid. Helpful hints have been added this year, informing operators to check for any seasonal problems which may occur.

To request a calendar, contact Jeff Lemke at CIRA. Telephone: 970/491-2209. E-mail: lemke@cira.colostate.edu.

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

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

Operators of distinction

The Omaha, NE, IMPROVE Protocol monitoring site is operated by the Omaha Tribe Environmental Protection Department. Thomas Parker, director and technician of the air program, has been the IMPROVE operator since shortly after the sampler's installation in 2003. In addition to changing module filters, he ensures the immediate monitoring area is also maintained such as trimming the weeds and replacing missing shingles on the shelter that have blown off in windstorms. Thomas is also responsible for a wide range of other projects associated with the Tribe's air program, including developing emission inventories, enforcing the program's regulations, and handling various environmental complaints that citizens direct to the air program office.

Thomas enjoys his work and is pursuing a degree in geology with a focus on environmental studies. His coursework began at the University of Nebraska - Lincoln and he now attends the Little Priest Tribal College. His wife is pursuing a biology degree, and together they have four children, ages 5 years to 15 years. "I've invested a lot of time being a scientist," said Thomas, "the environment affects all mankind and I'd like to see my children follow in my footsteps in helping to protect it. I'd like our environment to be healthy for my grandkids and generations to come."

A variety of interests allow Thomas to experience nature, such as hunting, fishing, and other outdoor activities. He's an avid University of Nebraska Huskers football fan, enjoys playing basketball, and is active in several Tribal community activities including the Native American Church, the Native American Grass Dance, and the Native American Powwow Committee.

Thomas Parker, Director and Technician of the Omaha Tribe Air Program, has maintained the IMPROVE sampler at the Omaha site since 2003.

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

Feature article

IMPROVE: Development and expansion

A look back at the 5th through 10th years of the program, from 1993 - 1997

Introduction

In the last issue of this newsletter, we discussed the early years of the program, from inception in 1988 through 1992. During this initial period, a site selection process to monitor visibility in Class I areas was formed, the roles of the key supporting agencies were defined, and special research studies were instituted.

The next five years, 1993 - 1997, show modest expansion of the program, increased involvement by federal agencies, an increasing push on publicizing the program, and a look at budgetary ups and downs.

After publication of the last newsletter and the first installment of this article series, it came to light that several more monitoring sites were operational during the first five years of the program than were shown in the article's map. The article stated that 30 sites operated during the 1988-1992 period. We've now discovered that 24 additional sites began monitoring during that period. We believe these sites were accepted through undocumented conference calls among the steering committee members and agencies, hence the reasoning behind the decisions are now lost. The 24 additional sites that became operational during the early years in the program are:

Arches NP
Badlands NP
Bandelier NM
Craters of the Moon NM
Everglades NP
Great Basin NP
Great Sand Dunes NM
Guadalupe Mountains NP
Hawaii Volcanoes NP
Isle Royale NP
Joshua Tree NM
Lassen Volcanic NP
Meadview, AZ
National Capital-Central
Petrified Forest NP
Pinnacles NM
Point Reyes NS
Redwood NP
Saguaro NP
Scoville, ID
Sequoia-Kings Canyon NPs
Sycamore Canyon W
Yellowstone NP
Voyageurs NP

Network expansion

The IMPROVE networks began in 1988 with 20 sites in Class I areas. By 1997, the network expanded to 80 monitoring locations throughout the nation (see Figure 1). In addition to an expanding aerosol network, the optical and scene networks expanded as well. In 1991, the program operated 15 transmissometers, 2 nephelometers, and 28 film camera systems. By 1997, these instrumentation numbers increased to 20 transmissometers, 29 nephelometers, and 44 film camera systems.

The steering committee at this time considered how to protect the photographic record that was growing daily from 44 film cameras taking thousands of photographic slides. It was known that film degrades over time and some more permanent means of archiving slide sets was needed. As for reporting the collected aerosol data, the first IMPROVE three-year spatial and temporal trends report was released in 1993, and was generally developed every three years from that point forward.

Agency participation

Steering committee meetings were held only three times during this five-year period, but many more undocumented telephone conference calls were made. Telephone calls rather than face-to-face meetings were less expensive as budget issues were a concern for every agency. In 1993, the National Park Service, USDA-Forest Service, and U.S. Fish and Wildlife Service developed long-term monitoring strategies for air quality monitoring and all three agencies began providing substantial resources to the program. The USDA-FS alone added more than a dozen additional monitoring sites during this period.

Getting the word out

An effort was made during 1993-1997 to inform researchers, policymakers, and interested organizations and persons throughout the nation about IMPROVE and the important data sets the program was compiling. In essence, advertise what IMPROVE was doing and how monitoring data could be used formally by government agencies and lawmakers.

Beginning in 1993, an effort was made to expand the program's research into the visibility science. The deciview metric was developed, and has been used ever since as a measurement unit of visual range. Visibility modeling and image simulation methods also advanced. Image simulations, primarily through WinHaze, allowed scientists to create an image of how a selected view would appear when specified concentrations of visibility-related pollutants were present in the atmosphere. Through intensive field studies and focused research programs, scientists expanded the understanding of visual processes and enhanced analytical methods. These research results, along with the quarterly newsletter, were additional tools that allowed dissipation of news and events of the program.

Budgetary concerns

A major concern during the mid-1990s and a good portion of meeting agendas was fluctuating program funding. Reduced funding resulted in transmissometers being discontinued at four monitoring sites, while NPS scientists argued that more funding was needed for data analysis and development of data presentation products. To address annual changes in available funds, the steering committee developed a site evaluation criteria for use in determining future site decommissioning decisions. They also looked into obtaining federal funds from other sources.

In 1997, the Environmental Protection Agency defined an approach for new Regional Haze Regulations, and the IMPROVE network was inline for a potential leading role in the future policy. In meeting the national visibility goal for Class I areas, the EPA specified that ambient visibility/air quality monitoring would likely be the primary means of tracking progress and the IMPROVE Program could be the model used since it had been successful in producing high quality data of the type needed to track trends and because it had well documented procedures.

The EPA defined the metric to be used in documenting regional haze levels, which is still used today; the approach defined metrics for the clean and hazy days as the average of the deciview values for the 20% cleanest and for the 20% most impaired days, respectively. More monitoring sites would be required for this effort since an assessment would have to be done for each visibility-protected federal Class I area throughout the nation. Because the IMPROVE Program was expected to have a substantial role and voice in the monitoring issues for the regional haze regulations, the program expected an increase in the number of monitoring sites participating in the program.

Special studies

IMPROVE has always had keen interest in special research studies to enhance regular monitoring efforts. Studies that occurred during 1993-1997 included:

***Development and expansion** continued on page 6....*

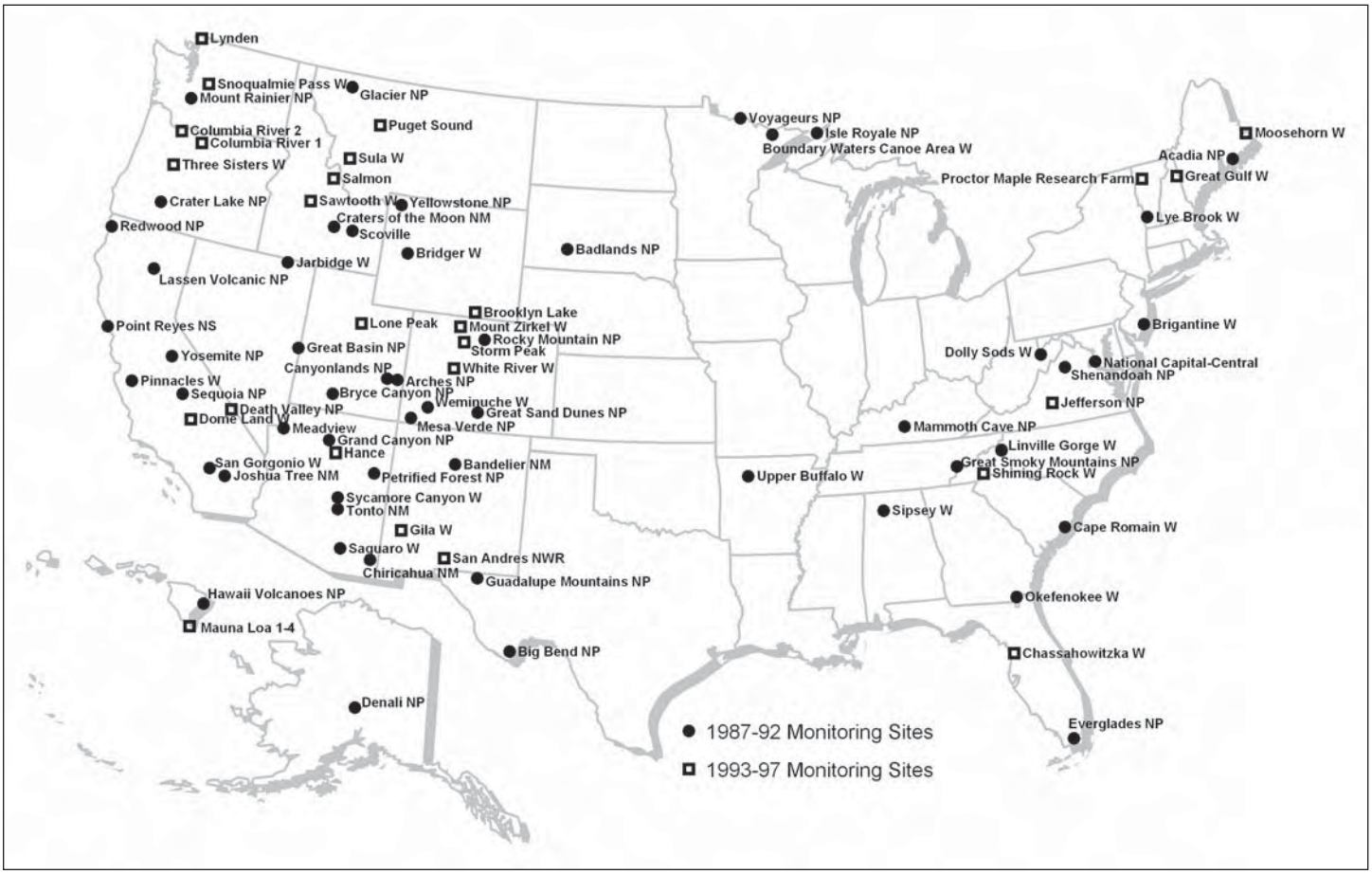

Figure 1. Map of the IMPROVE Program as of 1997. From 1987-1992, 54 sites joined the network. From 1993 to 1997, 26 additional sites joined the network.

Development and expansion *continued from page 5....*

- Southeastern Aerosol and Visibility Study (SEAVS) - measured aerosols under humid Southeastern U.S. conditions to determine the contribution of major aerosol constituents, including water, to the total particle mass and light extinction. Field measurements included particle size, water and optics, aerosol composition, meteorology, and human perception of scenes at the Great Smoky Mountains National Park over a six-week period during Summer 1995.

- Mt. Zirkel Reasonable Attribution Visibility Study - was a one-month winter intensive study completed in early 1995. Aerosol, visibility, and meteorological measurements were collected throughout the Yampa River drainage in northwestern Colorado to determine the extent of visibility impairment and contribution of major sources responsible for the impairment.

- Dallas-Fort Worth Winter Haze Project - was performed in 1994 and 1995 during two winter intensive monitoring periods.

Next time

In the next issue of this newsletter, the third installment of this series will look at the period 1998-2002. This period sees the introduction of the Version II IMPROVE aerosol sampler and digital camera systems, and final acceptance of EPA's Regional Haze Regulations and what that means to the program.

Visibility news *continued from page 3 ....*

Data advisories added to IMPROVE Web site

Three new data advisories have been posted on the IMPROVE Web site this quarter:

Changes in sodium data quality

- Affects: Module A, Sodium
- Period: Starting December 1, 2001

The light elements in samples collected since December 1, 2001, have been determined by X-Ray Fluorescence (XRF). In earlier samples, those elements were determined by Proton-Induced X-ray Emission (PIXE). The XRF analysis is much less sensitive for sodium (the lightest of the elements reported), and sensitivities improve for 2005 and later samples with the conversion of the XRF system to vacuum operation, but are still below those from PIXE. Scientists recommend using the Cl^- ion and non-crustal Sr as alternative markers for sea salt.

Shift in EC/OC split with January 1, 2005, TOR upgrade

- Affects: Module C, Species EC, OC, OC1, OC2, OC3, OC4, OP, EC1, EC2, EC3
- Period: Beginning 2005

After extensive testing, new hardware for IMPROVE_A Thermal Optical Reflectance (TOR) analysis has been used for samples collected on or after January 1, 2005. The improvements provide better control and greater repeatability of the analytical protocol. With the statistical power available from more than two years of data, unforeseen differences can now be identified between the fractionation data from the old and new instruments. The differences are not the same at all sites, but the new data generally identify a higher proportion of total carbon as elemental and a lower proportion as organic. The elemental carbon/organic carbon (EC/OC) distinction is operationally defined, and the differences are not fully understood. Scientists recommend that data users distinguish between 1988-2004 TOR data and later TOR data.

Change in definition of flowrate native flags

- Affects: Module A, B, C, all species
- Period: Beginning January 1, 2005

This is an informational data advisory. During Summer 2006, the IMPROVE cyclone was characterized and it was found that the equations relating cutpoint to flowrate, developed at UC-Davis, are invalid. Therefore, the native validation flags based on flowrate have been revised. The IMPROVE cyclone is based on the AIHL cyclone specifications and the equation for the cyclone has since been changed. The new equation is much less sensitive to flowrate than the equation used in the past.

IMPROVE has decided to maintain the existing criteria for the clogged filter (CL), clogging filter (CG), and really high flowrate (RF) native flags, but change the numerical flowrate criterion for the low/high flowrate (LF) flag because the prior criterion was not centered on the correct cutpoint as a result of the shift in the equation. The updated criteria have been applied to data beginning January 2005. The native flags LF and RF translate to a V5 status flag in the IMPROVE VIEWS database, and the native flags CG and CL translate to an M3 status flag.

Complete discussions of these 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 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 4th Quarter 2007 are:

Aerosol (Channel A)

Acadia	Glacier	Petersburg
Arendtsville	Great Gulf	Pinnacles
Badlands	Great River Bluffs	Point Reyes
Bandelier	Great Smoky Mountains	Proctor Research Cntr
Big Bend	Guadalupe Mountains	Quaker City
Birmingham	Hawaii Volcanoes	Rocky Mountain
Bondville	Hercules-Glades	Saguaro
Bridger	Ike's Backbone	Saguaro West
Bridgton	James River	San Gabriel
Brigantine	Jarbidge	San Gorgonio
Bryce Canyon	Mammoth Cave	Shenandoah
Cadiz	Meadview	Shining Rock
Canyonlands	Medicine Lake	Simeonof
Cape Romain	Mesa Verde	Snoqualmie Pass
Capitol Reef	MK Goddard	St. Marks
Casco Bay	Mohawk Mountain	Starkey
Chassahowitzka	Monture	Tallgrass
Chiricahua	Moosehorn	Theodore Roosevelt
Columbia Gorge West	Mount Baldy	Trapper Creek-Denali
Crater Lake	Mount Hood	Tuxedni
Craters of the Moon	Mount Rainier	Upper Buffalo
Crescent Lake	North Cascades	Weminuche
Death Valley	Northern Cheyenne	White Mountain
Denali	Okefenokee	White River
Douglas	Olympic	Wichita Mountain
Fort Peck	Organ Pipe	Zion Canyon
Gila		

Transmissometer	Nephelometer	Photographic
-- none --	Big Bend	Gates of the Mountain
	Craycroft	Monture
	Greer	
	Great Smoky Mountains	
	Hance	
	Ike's Backbone	
	Indian Gardens	
	Sierra Ancha	
	Vehicle Emissions	

Sites that achieved at least 95% data collection for 4th Quarter 2007 are:

Aerosol (Channel A)

Addison Pinnacle	Isle Royale	Quabbin Reservoir
Bliss	Joshua Tree	Redwood
Bosque del Apache	Lake Sugema	San Rafael
Cabinet Mountains	Livonia	Sawtooth
Cedar Bluff	Mingo	Seney
Cherokee	Mount Zirkel	Sipsey
Cloud Peak	Nebraska	Sycamore Canyon
Columbia Gorge East	Pasayten	Three Sisters
Dolly Sods	Penobscot	Viking Lake
Everglades	Presque Isle	Washington DC
Frostburg Reservoir	Puget Sound	Yosemite
Gates of the Mountains		

Transmissometer

Bridger	San Gorgonio	Thunder Basin

Nephelometer

Acadia	Mammoth Cave	Shenandoah
Children's Park	Mount Rainier	Sycamore Canyon
Chiricahua	Organ Pipe	Tucson Central
Dysart	Phoenix	Tucson Mountain
Estrella	Queen Valley	Thunder Basin

Photographic

-- none --

Sites that achieved at least 90% data collection for 4th Quarter 2007 are:

Aerosol (Channel A)

Cape Cod	Hells Canyon	Phoenix
Cohutta	Hoover	Queen Valley
Dome Land	Kalmiopsis	Salt Creek
Egbert	Lassen Volcanic	Sequoia
El Dorado Springs	Lava Beds	Shamrock Mines
Flathead	Lye Brook	Thunder Basin
Grand Canyon	Makah	UL Bend
Great Basin	Martha's Vineyard	Voyageurs
Great Sand Dunes	New York	Wheeler Peak
Haleakala	Omaha	White Pass
Haleakala Crater	Pack Monadnock	Wind Cave

Transmissometer	Nephelometer	Photographic
-- none --	Cloud Peak	Shamrock
	National-Capital	

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)

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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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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