INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

4th Quarter 2005 | The IMPROVE Newsletter | Volume 14 / Number 4

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Monitoring update

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 156 Class I federally protected areas. Additional instrumentation that operates according to IMPROVE protocols in support of the program includes:

- 58 aerosol samplers
- 14 transmissometers
- 42 nephelometers
- 8 digital or film camera systems
- 55 Web camera systems
- 3 interpretive displays

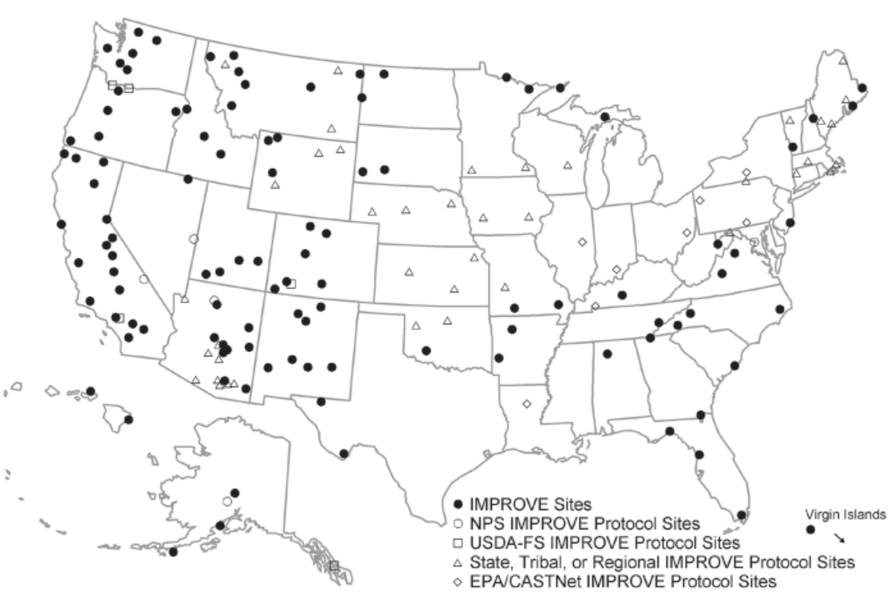
IMPROVE Program participants are listed on page 8. Federal land management agencies, states, tribes, regional air partnerships, and other agencies operate supporting instrumentation at monitoring sites as presented in the map below. Preliminary data collection statistics for the 4th Quarter 2005 (October, November, and December) are:

- Aerosol (channel A only) — 96% collection
- Aerosol (all modules) — 94% completeness
- Optical (transmissometer) — 95% collection
- Optical (nephelometer) — 95% collection
- Scene (photographic) (does not include Web cameras) — 84% collection

The U.S. Fish and Wildlife Service discontinued the remote digital camera systems at Wichita Mountains, KS, and Bosque del Apache, NM. The cameras collected high-resolution images of the areas for three years; both were discontinued in October 2005.

The USDA-Forest Service began operating two new high-resolution Webcam systems this quarter. These systems were installed in Boundary Waters Canoe Area Wilderness, MN (December 2005), and Upper Buffalo Wilderness, AR (November 2005).

The transmissometer system at Big Bend National Park, TX, was discontinued by the National Park Service in October. It has operated since January 2000.



IMPROVE and IMPROVE Protocol Sites
4th Quarter 2005

Data availability status

Data are available on the IMPROVE Web site, at *http://vista.cira.colostate.edu/improve/Data/data.htm*. IMPROVE and other haze-related data are also available on the VIEWS Web site, at *http://vista.cira.colostate.edu/views*.

Aerosol data are available through December 2004. Transmissometer and nephelometer data are available through December 2004 and September 2005 respectively. Photographic slide spectrums are also available on the IMPROVE Web site, under *Data*. Real-time Web camera displays are available on a variety of agency-supported Web sites.

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

Visibility news

Tower elevator available for nephelometer systems

Routine Optec NGN-2 nephelometer servicing requires an operator to climb a 14-foot tower or step ladder to inspect the instrument, change lamps, replace the clean air filter, and perform other routine instrument maintenance. Some operators may not feel comfortable climbing towers or ladders, while others may be prohibited by their safety officers.

A tower elevator system is now an available option for nephelometer systems, which allows an operator to perform servicing tasks without having to climb the tower. A hand-crank winch and pulley system is used to lower the nephelometer on a captive rail system, to a working height of about 4 1/2-feet above ground level, and to raise the instrument back to its operational position at the top of the tower. Raising and lowering the 40-pound instrument is easily done by one person. Locking pins and a safety latch keep the unit from accidentally falling.

The elevator system can be mounted to the existing tower and includes a 4-foot hand crank and weather enclosure for the winch components at ground level. The system costs approximately $2,000 and can be available for installation within 90 days of order.

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

The nephelometer tower elevator is operated by hand cranking a winch and pulley system. The operator lowers the nephelometer to a safe servicing height, and again raises the instrument to the top of the tower for routine operation.

IMPROVE calendars available

The 2006 IMPROVE calendar was distributed in December, but additional copies are available upon request.

Since 2003, the wall-sized calendars have been distributed to IMPROVE site operators and air quality managers. The calendars highlight the aerosol sampling days, describe components of the IMPROVE Program, and feature several IMPROVE operators and their monitoring stations.

Cooperative Institute for Research in the Atmosphere (CIRA) staff produced the calendar. Suggestions and information for next year's calendar are welcome. Give your local IMPROVE operators the recognition they deserve, and submit photographs, short biographies, and site information.

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

New newsletter format available

The IMPROVE Newsletter is now available in electronic format (.PDF) via e-mail distribution. If you wish future newsletters to be delivered to you via e-mail, please send your request to IMPROVEnews@air-resource.com. Otherwise, you will continue to receive the newsletter via U.S. Mail.

The newsletter will also continue to be available on the IMPROVE Web site, at *http://vista.cira.colostate.edu/improve/Publications/*.

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.

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 committee approves new algorithm for estimating light extinction

In December 2005, the IMPROVE Steering Committee approved the use of a new algorithm to estimate light extinction from IMPROVE aerosol speciation data. The 2nd Quarter 2005 IMPROVE Newsletter presented a feature article discussing preliminary work regarding changing the algorithm. The recommendations were further refined and the final, approved algorithm is presented as the feature article in this newsletter issue (see page 4).

Scientists will begin generating aerosol extinction values using the new algorithm this winter, which will be available for dissemination on the IMPROVE and VIEWS Web sites. Documentation will also be available that explains the calculations. Data values using the old algorithm will also continue to be available. EPA and IMPROVE scientists will begin to calculate default natural levels using the new algorithm for Regional Haze Rule requirements.

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.

Mark Scruggs retires from NPS ARD

Dr. Mark Scruggs retired on January 3, 2006, after 25 years with the National Park Service Air Resources Division (NPS ARD). For the past several years, Mark was the Assistant Division Chief for Program Operations. He joined the NPS ARD in 1981 as an air quality modeler for the Permit Review Branch and was later in charge of the NPS ARD's Research and Monitoring Branch.

During his long tenure with the NPS ARD, Mark played a major role in expanding the national visibility monitoring network (IMPROVE), and in several intensive field studies that increased understanding of the sources of visibility impairment at parks such as Grand Canyon (Projects WHITEX and MOHAVE) and Big Bend (BRAVO).

Mark's expertise was also recognized by others -- he chaired the Research Forum of the Western Regional Air Partnership and served as an expert witness for the Department of Justice in litigation against major power plants. Prior to joining the NPS, Mark worked for the Environmental Protection Agency and a private consulting firm. His historical perspective, technical expertise, and calm disposition will be sorely missed.

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

Operators of distinction

Keeping tabs on reptile and rodent populations is Charles Conner's main responsibility at Organ Pipe Cactus National Monument, in extreme southern Arizona. Maintaining the IMPROVE sampler is another responsibility for the biological technician, as well as operating 11 automated weather stations, performing groundwater measurements at several locations, and a multitude of other duties.

Charles has been the primary operator of the site's aerosol sampler for a year now, and was backup operator when the system was installed in 2003. He has devoted quite some time troubleshooting the aerosol sampler recently. "There have been several equipment failures, but we've worked it out. I've swapped controllers and eliminated problems with the black boxes, and all components are functional now. The only thing remaining is a malfunctioning motor that raises and lowers the filter cartridges. I can get around that, though, by manually lowering and raising the filters until the motor issue is resolved." His dedication to the IMPROVE Program is much appreciated.

IMPROVE site operator Charles Conner maintains the IMPROVE sampler, a nephelometer, and various other air/meteorology instrumentation at Organ Pipe Cactus National Monument, Arizona.

Charles has been at Organ Pipe for 17 years. In addition to his duties there, he also services air monitoring instrumentation in nearby areas for the state of Arizona Department of Environmental Quality, and performs similar environmental monitoring work in Organ Pipe's sister park, the Pinacate Reserve, in Mexico.

Charles has a B.S. degree in mathematics from Caltech, and is fluent in Spanish, which is helpful when living near the U.S.-Mexico border. He keeps his pet rabbit safely away from the reptiles he brings home, and can often be found hiking, playing frisbee, or broadcasting a radio program in nearby Tucson and on a local Indian reservation.

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

Feature article

New IMPROVE algorithm for estimating light extinction approved for use

(by M. Pitchford, National Oceanic and Atmospheric Administration)

Background

The original IMPROVE algorithm for estimating light extinction using IMPROVE particle data was first used in 1993, and has been a useful tool in the understanding of haze by the various particle components in aerosols (sulfate, nitrate, organic compounds, elemental or black carbon, fine soil, and coarse mass). The algorithm performs reasonably well over a broad range of particle light scattering, but tends to underestimate the highest extinction values and overestimate the lowest extinction values. This algorithm for estimating light extinction was adopted by the Environmental Protection Agency as the basis for the regional haze metric used to track progress in reducing haze levels for visibility-protected areas under the 1999 Regional Haze Rule (RHR).

As a result, the IMPROVE algorithm has been scrutinized carefully to assess deficiencies that could bias the implementation of the RHR. In light of the concerns raised by its use in the RHR, the IMPROVE Steering Committee initiated an internal review including recommendations for revisions of the algorithm for estimating light extinction. The review team (composed of scientists from the National Park Service and the Cooperative Institute for Research in the Atmosphere) developed a revised algorithm that reduces biases in light extinction estimates and is as consistent as possible with the current scientific literature. A review of the old algorithm and suggested revisions were presented in The IMPROVE Newsletter, 2nd Quarter 2005.

In July 2005, the status of the algorithm review and revision was presented to the IMPROVE Steering Committee. At that time, a subcommittee was formed to further investigate the proposed algorithm. The subcommittee included scientists who worked on the initial review, as well as scientists who have been critical of the original IMPROVE algorithm. Their work resulted in the final version of the algorithm, which was again presented to the Steering Committee. In December 2005, the IMPROVE Steering Committee voted to adopt this revised algorithm for use by IMPROVE as an alternative to the current approach. This new, approved algorithm and justifications for it are presented in this article.

Overview of revised algorithm

The new algorithm splits ammonium sulfate, ammonium nitrate, and organic carbon compound concentrations into two fractions: small and large. The algorithm for estimating the light extinction from particle components in aerosols is:

$$
\begin{aligned}
b_{ext} \approx\ & 2.2 \times f_s(RH) \times [\text{small sulfate}] + 4.8 \times f_L(RH) \times [\text{large sulfate}] \\
& + 2.4 \times f_s(RH) \times [\text{small nitrate}] + 5.1 \times f_L(RH) \times [\text{large nitrate}] \\
& + 2.8 \times [\text{small organic mass}] + 6.1 \times [\text{large organic mass}] \\
& + 10 \times [\textit{elemental carbon}] \\
& + 1 \times [\textit{fine soil}] \\
& + 1.7 \times f_{ss}(RH) \times [\text{sea salt}] \\
& + 0.6 \times [\textit{coarse mass}] \\
& + \text{Rayleigh scattering (site-specific)} \\
& + 0.33 \times [NO_2\ (\text{ppb})]
\end{aligned}
$$

Though not explicitly shown, the organic mass concentration used is 1.8 times the organic carbon mass concentration, (changed from 1.4 times carbon mass the original algorithm uses). New terms have also been added for sea salt and for absorption by NO_2. The apportionment of the total concentration of sulfate compounds into the concentrations of small and large size fractions is accomplished using the following equations:

$$[\textit{large sulfate}] = \frac{[\text{total sulfate}]}{20\ \mu g/m^3} \times [\text{total sulfate}], \text{ for } [\text{total sulfate}] < 20\ \mu g/m^3$$

$$[\textit{large sulfate}] = [\textit{total sulfate}], \textit{ for } [\textit{total sulfate}] \geq 20\ \mu g/m^3$$

$$[\textit{small sulfate}] = [\textit{total sulfate}] - [\textit{large sulfate}]$$

The same equations are used to apportion total nitrate and total organic mass into small and large size fractions.

Sea salt is calculated as 1.8 x [*chloride*], or 1.8 x [*chlorine*] if the chloride measurement is below detection limits, missing, or invalid. The new algorithm contains three distinct water growth terms, designated f_S, f_L, and f_{SS} for the small and large sulfate and nitrate fractions, and for sea salt, respectively.

Technical justification for revisions

The new IMPROVE algorithm for estimating light extinction from particle speciation data contains five major revisions from the original algorithm:

1) A sea salt term has been added. Sea salt is a particular concern for coastal locations where the sum of the major components of light extinction and mass have been deficient.

2) The assumed organic mass to organic carbon ratio has been changed from 1.4 to 1.8, to reflect more recent peer-reviewed literature on the subject.

3) The Rayleigh scattering factor has been changed from a network-wide constant to a site-specific value. This factor is based on the elevation and annual average temperature of individual monitoring sites.

4) A split component extinction efficiency model for sulfate, nitrate, and organic carbon components has been developed. The model includes new water growth terms for sulfate and nitrate to better estimate light extinction at the high and low extremes of the range of extinction.

5) An NO_2 light absorption term has been added. This term can only be used at sites with available NO_2 concentration data.

A summary of each of these points is discussed below.

Sea salt term

The old IMPROVE protocol for estimating light extinction does not include light scattering by sea salt aerosols. Recent literature shows that inclusion of elements from sea salt (e.g., Na, Cl) increased the accuracy of mass reconstruction at coastal IMPROVE sites. Contributions of sea salt particles to light extinction at some coastal IMPROVE sites may be significant, especially since light scattering by sea salt particles should be significantly enhanced by hygroscopic growth in humid environments. Further study found that fine sea salt aerosols accounted for 43% of estimated light scattering at the U.S. Virgin Islands IMPROVE site.

To include sea salt in the IMPROVE light extinction equation, it is necessary to: 1) estimate the sea salt mass concentration, 2) specify a dry sea salt scattering efficiency, and 3) specify an f(RH) curve for sea salt representing the enhancement of sea salt scattering by hygroscopic growth as a function of relative humidity (RH).

Organic mass to carbon ratio

A factor of 1.4 is used in the original algorithm to convert organic carbon (OC) to organic mass (OM) to account for unmeasured elements (e.g., O, H, N), in OM. More recent study suggested this factor be increased. While additional experimental work is needed to further explore this issue, it is clear that an OC conversion factor of 1.4 is not applicable for remote U.S. Class I areas. A consensus value of 1.8 was recommended for use in the new algorithm.

Rayleigh scattering factor

Rayleigh scattering refers to the scattering of light from molecules of the air. A constant value of 10 Mm^{-1} is used in the original algorithm, however, Rayleigh scattering depends on the density of the air and thus varies with temperature and pressure. In the new algorithm, site-specific Rayleigh scattering is estimated as a function of temperature and pressure, corresponding to the monitoring site elevation and estimated annual mean temperature, and is rounded to the nearest integer value in units of inverse megameters. Based on the geographic extent of the IMPROVE network, site-specific Rayleigh values will be in the range of 8-12 Mm^{-1}.

Split component extinction efficiency model

The original algorithm employs dry scattering efficiencies of $3m^2/g$ for ammonium sulfate and ammonium nitrate, and $4m^2/g$ for organic matter. More recent studies suggest these values are variable. The new algorithm accounts for the increase of ammonium sulfate/ammonium nitrate and organic matter efficiencies with concentration using a simple mixing model. The concentrations are each comprised of external mixtures of mass (geometric mean diameters/geometric standard deviations) of small (0.2µm/2.2) and large (0.5µm/1.5) particle sizes for ammonium sulfate/ammonium nitrate and organic matter.

In addition, the original algorithm contains separate f(RH) curves to ammonium sulfate and ammonium nitrate scattering based on a hygroscopic growth curve for pure ammonium sulfate. The new algorithm contains f(RH) curves for small- and large-mode ammonium sulfate that are also applied to small- and large-mode ammonium nitrate.

NO_2 light absorption term

The NO_2 absorption efficiency term in the new algorithm is a photopic-weighted absorption efficiency value. It was calculated by dividing the sum of the products of the relative observer photopic response values for viewing an image and the spectral NO_2 absorption efficiency values by the sum of the photopic response values. Most IMPROVE sites are not collocated with NO_2 monitors.

Comparison of old vs. new algorithm

One of the most compelling reasons for developing a new algorithm was to reduce the biases in light scattering estimates at the extremes, when compared to nephelometer measurements which directly measure particle scattering. To assess the performance of the new algorithm, the fractional bias for each sample period was calculated as the difference in estimated aerosol light scattering divided by the measured light scattering using collocated nephelometers. These biases were then averaged into quintiles to indicate the bias in each of those five subsets of data. Analysis shows that the new algorithm has lower fractional bias than the original algorithm, in all but the haziest conditions.

***New algorithm** continued on page 6....*

New algorithm *continued from page 5....*

Scatter plots (Figures 1 and 2) of light scattering estimates from the original and new algorithms vs. nephelometer data for all available data at 21 monitoring sites were used to view the overall performance differences between the two algorithms. These figures show that the bias at the extremes is reduced using the new algorithm compared to the original algorithm (i.e., the points tend to be better centered on the one-to-one line). They also show the somewhat reduced precision of the new algorithm compared to the original (i.e., points are more broadly scattered).

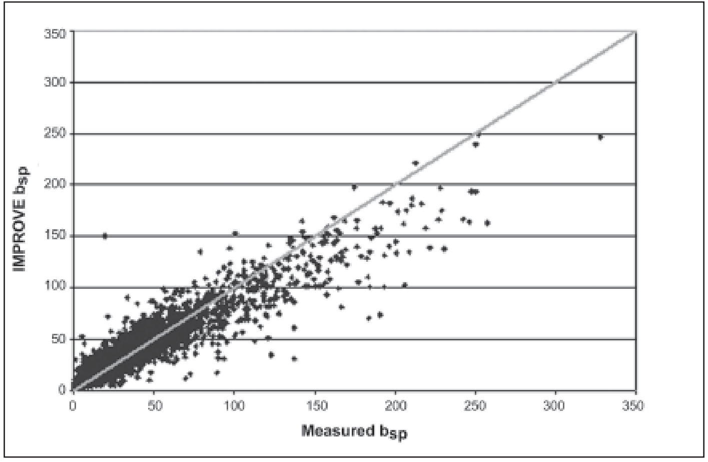


Figure 1. Scatter plot of the original IMPROVE algorithm estimated particle light scattering versus measured particle light scattering.

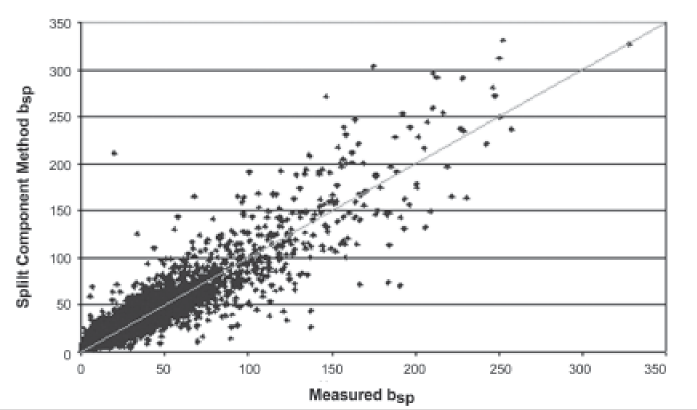


Figure 2. Scatter plot of the new algorithm estimates of light scattering versus measured light scattering.

Directly measured data used in algorithm evaluation

Directly measured light scattering data from collocated Optec NGN-2 nephelometers were key to evaluating the performance of the original IMPROVE algorithm, as well as for development and performance evaluation of several revised algorithms as well as the new, approved algorithm. The 21 nephelometer sites used in the evaluation are:

Acadia National Park, Maine
Big Bend National Park, Texas
Boundary Waters Canoe Area Wilderness, Minnesota
Columbia River Gorge National Scenic Area, Oregon
Dolly Sods Wilderness, West Virginia
Gila Wilderness, New Mexico
Grand Canyon National Park, Arizona
Great Gulf Wilderness, New Hampshire
Great Smoky Mountains National Park, Tennessee/North Carolina
Jarbidge Wilderness, Nevada
Lone Peak Wilderness, Utah
Lye Brook Wilderness, Vermont
Mammoth Cave National Park, Kentucky
Mount Rainier National Park, Washington
Mount Zirkel Wilderness, Colorado
Okefenokee National Wildlife Refuge, Georgia
Shenandoah National Park, Virginia
Shining Rock Wilderness, North Carolina
Snoqualmie Pass, Washington
Three Sisters Wilderness, Oregon
Upper Buffalo Wilderness, Arkansas

In sum, the new algorithm for estimating haze reduces the biases compared to measurements at the high and low extremes, and is most apparent for the hazier eastern sites. The composition of "best and worst days" are very similar by the original and new algorithms. Most of the reduction of bias associated with the new algorithm is attributed to the use of the split component extinction efficiency method for sulfate, nitrate, and organic components, that permitted variable extinction efficiency depending on the component mass concentration. The new algorithm also contains specific changes that reflect a better understanding of the atmosphere as reflected in more recent scientific literature, reflect a more complete accounting for contributors to haze (e.g., sea salt and NO_2 terms), and the use of site-specific Rayleigh scattering terms to reduce elevation-related bias.

Efforts are currently underway to develop monthly average f(RH) terms for all IMPROVE monitoring sites. Once that work is completed, the new algorithm will be added to the suite of data analysis tools on the Visibility Information Exchange Web Site (VIEWS). At this time there has been no formal recommendation from the EPA on use of the new IMPROVE algorithm in tracking visibility progress under the Regional Haze Rule. A more complete discussion and report is available on the IMPROVE Web site at *http://vista.cira.colostate.edu/IMPROVE/Publications/GrayLit/Gray_literature.htm.*

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.

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 2005 are:

Aerosol (Channel A)

Addison Pinnacle	Great Basin	Pinnacles
Badlands	Great Gulf	Proctor Research Center
Baltimore	Great Sand Dunes	Quabbin Reservoir
Bandelier	Guadalupe Mountains	Quaker City
Big Bend	Haleakala	Queen Valley
Bliss	Hawaii Volcanoes	Redwood
Bondville	Hells Canyon	Rocky Mountain
Bosque del Apache	Hoover	Saguaro
Bridger	Ike's Backbone	Saguaro West
Bridgton	Isle Royale	Salt Creek
Brigantine	James River Face	San Gorgonio
Cabinet Mountains	Jarbidge	Seney
Cadiz	Joshua Tree	Shenandoah
Caney Creek	Kalmiopsis	Shining Rock
Cape Romain	Lava Beds	Sikes
Casco Bay	Linville Gorge	Simeonof
Chassahowitzka	Mesa Verde	Sipsey
Cherokee	MK Goddard	Snoqualmie Pass
Cohutta	Mohawk Mountain	Three Sisters
Crescent Lake	Monture	Tonto
Death Valley	Mount Baldy	Trapper Creek-Denali
Denali	Mount Hood	UL Bend
Dolly Sods	Mount Zirkel	Upper Buffalo
Douglas	North Absaroka	Viking Lake
El Dorado	North Cascades	Virgin Islands
Ellis	Okefenokee	Voyageurs
Fort Peck	Olympic	Weminuche
Fresno	Omaha	Wheeler Peak
Gates of the Mountains	Pasayten	White River
Gila	Petersburg	Wichita Mountains
Grand Canyon (Hance)	Phoenix	Zion Canyon

Transmissometer

Badlands	Bridger	Glacier

Nephelometer

Acadia	Grand Canyon (Indian Gardens)	Rocky Mountain
Big Bend		Sycamore Canyon
Organ Pipe	Phoenix	Virgin Islands

Photographic

Cucamonga	Grand Canyon	Shamrock Mines

Sites that achieved at least 95% data collection for 4th quarter 2005 are:

Aerosol (Channel A)

Acadia	Hercules-Glades	Point Reyes
Birmingham	Lake Sugema	Sac and Fox
Chiricahua	Livonia	Sequoia
Crater Lake	Mammoth Cave	St. Marks
Flathead	Martha's Vineyard	Tallgrass
Frostburg Reservoir	Meadview	Theodore Roosevelt
Glacier	Mount Rainier	Washington DC
Great River Bluffs	New York	White Mountain
Great Smoky Mountains	Pinnacles	White Pass
		Yosemite

Transmissometer

Canyonlands	Rocky Mountain	San Gorgonio

Nephelometer

Bliss	Ike's Backbone	Seney
Children's Park	Mammoth Cave	Sierra Ancha
Chiricahua	Mayville	Thunder Basin
Dolly Sods	Mount Zirkel	Tucson Central
Dysart	National Capital	Tucson Mountain
Estrella	Petrified Forest	Vehicle Emissions
Grand Canyon (Hance)	Queen Valley	Wichita Mountains

Photographic

Agua Tibia	Monture

Sites that achieved at least 90% data collection for 4th quarter 2005 are:

Aerosol (Channel A)

Arendtsville	Moosehorn	Shamrock Mine
Blue Mounds	Nebraska	Sierra Ancha
Bryce Canyon	Northern Cheyenne	Starkey
Canyonlands	Petrified Forest	Sula
Cape Cod	Presque Isle	Swanquarter
Cloud Peak	San Gabriel	Sycamore Canyon
Columbia Gorge East	San Pedro Parks	Thunder Basin
Columbia Gorge West	Sawtooth	Wind Cave
Kaiser	Seattle	

Transmissometer

Bandelier	Grand Canyon (South Rim)	Great Basin
Grand Canyon (In Canyon)		Guadalupe Mountains

Nephelometer

Milwaukee	Shenandoah	Upper Buffalo
Nebraska		

Photographic

-- none --

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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. Steering Committee representatives are:

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ASSOCIATE MEMBERS

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

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Government organizations interested in becoming Associate Members may contact any Steering Committee member for information.

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

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

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