INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

Summer 2000 | The IMPROVE Newsletter | Volume 9 / Number 3

Monitoring update

Network operation status

The IMPROVE network operated 99 aerosol samplers, 17 transmissometers, 8 nephelometers, and 5 camera systems during the Summer 2000 monitoring season (June, July, and August 2000).

Preliminary data collection statistics for the Summer 2000 season are:

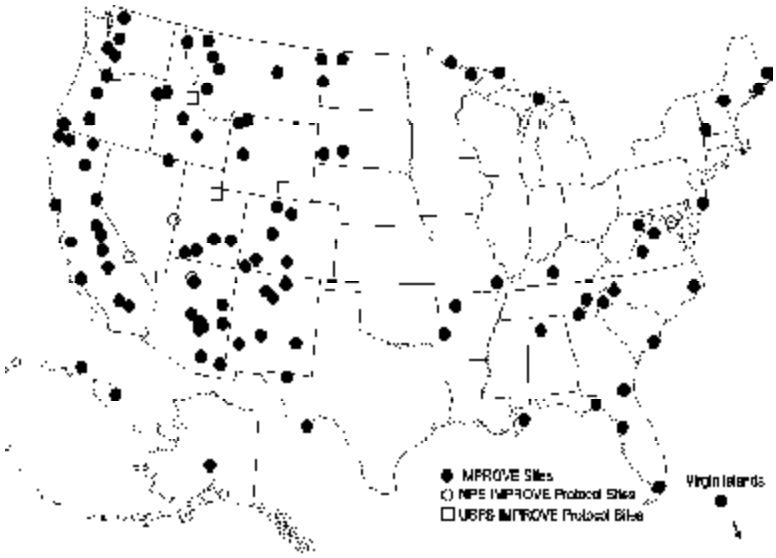
- Aerosol 88% collection
- Optical (transmissometer) 93% collection
- Optical (nephelometer) 95% collection
- Scene (photographic) 83% collection

The following monitoring sites received the new, Version II IMPROVE aerosol sampler during Summer 2000:

Breton NWR
Brooklyn Lakes
Cabinet Mountains W
Caney Creek W
Columbia River Gorge NSA
Craters of the Moon NM
Gates of the Mountains W
Hells Canyon W
Indian Gardens
Lassen Volcanic NP
Pinnacles NM
Redwood NP
St. Marks NWR
Salmon NP
San Gorgonio W
San Pedro Parks W
Sula NF
Swanquarter NWR
Trinity
Washington D.C.
Wheeler Peak W

As of August 31, 2000, the following IMPROVE and IMPROVE Protocol aerosol sites have yet to receive a Version II sampler:

Agua Tibia W
Haleakala NP
Hawaii Volcanoes NP
Hercules-Glades W
Hoover W
Olympic NP
Pasayten W
Saguaro NP
San Gabriel W
Sawtooth W
Simeonof NWR
Trapper Creek
Tuxedni NWR
White Mountain W
Wichita Mountains NWR



IMPROVE and IMPROVE Protocol Sites Summer 2000

Data availability status

Aerosol data for all measurements including carbon are available through November 1999 on the UC-Davis FTP site, at http://improve.cnl.ucdavis.edu. Seasonal summaries beginning with 1998 are also available on the site.

Transmissometer data are available through May 1999 on the Cooperative Institute for Research in the Atmosphere (CIRA) FTP site, at ftp://alta_vista.cira.colostate.edu. Nephelometer processing algorithms are currently being reevaluated. Once the algorithms are finalized, all historical nephelometer data will be reprocessed. A comprehensive site-by-site analysis of the changes and their effects will be prepared and distributed with the revised data.

Photographic slides are archived but are not routinely analyzed or reported. Complete photographic archives and slide spectrums are available from Air Resource Specialists, Inc.

IMPROVE data are available to interested parties for use in presentations, management plans, and other projects. All data are validated using IMPROVE protocols, which are documented in standard operating procedures. Standard operating procedures are available for site selection; instrument installation, operation, and servicing; and data collection, reduction, validation, reporting, and archiving.

Visibility news

"Introduction to Visibility" now online

"Introduction to Visibility," a 68-page booklet explaining the basic concepts of visibility, is now available on the Internet. Topics contained in the booklet include measuring visibility, particle concentrations and visibility trends, identifying sources contributing to visibility impairment, and more. It is available at: http://www.aqd.nps.gov/ard/vis/vishp.html.

Hardcopies are also available from the National Park Service. Telephone: 970/491-8292. Fax: 970/491-8598. E-mail: Klier@cira.colostate.edu

Calculating aerosol data completeness

IMPROVE aerosol data is the basis for calculating the visibility index used to track haze level trends under the regional haze rule. The index calculation involves summing the individual contributions to light extinction from each of five major fine particle species (sulfate, soil, organic carbon, elemental carbon, and nitrate) and from coarse mass. The index represents the average haziness (in deciviews) for the days with the highest 20% of aerosol calculated light extinction and for the days with the lowest 20% of aerosol calculated light extinction. The EPA is working on a guidance document that will provide the approach for making these calculations, while the IMPROVE Steering Committee is investigating the issue of data completeness in regard to the use of its aerosol data for the regional haze rule.

Aerosol data collection statistics, as have been reported in the *IMPROVE Newsletter*, are defined as the total number of successful $PM_{2.5}$ Teflon filter samples divided by the total number of possible sample periods. However, each sample period collects four independent filters (i.e., three fine particle samples and one total sample), which are subjected to several analytical methods, so this approach of reporting data completeness will tend to overestimate the completeness of the data with respect to the data needs of the regional haze index. IMPROVE is considering adopting several other completeness indicators to better communicate the completeness of the data.

Two possible completeness indicators that could be used are fraction of scheduled sample days with all major fine particle species and fraction of major sample days with both PM_{10} and $PM_{2.5}$ mass plus five major fine particle species. The three lines in Figure 1 show these two plus the original method. The third line that shows the aerosol recovery rate for all six factors used to calculate light extinction indicate considerably poorer data recovery than the other methods, especially during the earlier years of IMPROVE. Since both PM_{10} and $PM_{2.5}$ mass are needed to determine coarse mass concentration, the difference between the two new completeness indicators is the rate of invalid coarse mass sample periods. Note that the drop in completeness in 1998 was associated with a manufacturing change in the nylon filter material that caused 10% of the nylon filters to clog. The other filters were valid. Almost all cases were at eastern sites with elevated particulate loadings. If the extinction can be reconstructed without nitrate for these samples, the completeness fractions would increase by 10%.

While the goal of IMPROVE is to have as high a data recovery as possible, to support the data needs of the regional haze rule, it is more important than ever to quickly discover problems that result in missing data. There are a number of reasons that data are lost, including power outages, damaged filters, operator errors, flow rate errors, equipment failures, analysis errors, and sampling artifacts. Often these causes of missing data are randomly distributed throughout the network, but sometimes problems are seasonal, regional, or site-specific. The University of California-Davis will be closely tracking these causes of missing data. This will increase the emphasis on identifying and addressing problems as soon as possible.

For more information contact Dr. Robert Eldred at the University of California-Davis. Telephone: 530/752-1124. Fax: 530/752-4107. E-mail: eldred@crocker.ucdavis.edu

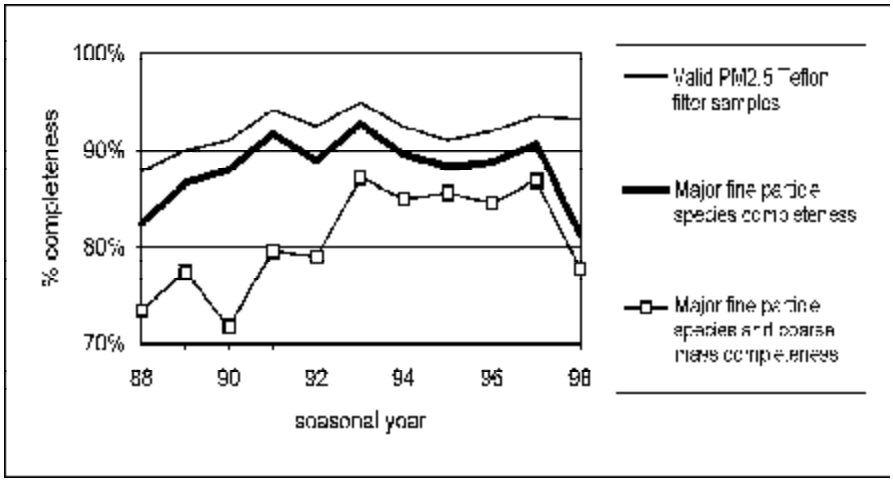


Figure 1. Recovery and completeness of IMPROVE data. The upper line is the recovery rate for $PM_{2.5}$ Teflon samples only, rather than completeness. The second line is the completeness rate for all six fine particle species and the lower line is the completeness rate for all six fine particle species including coarse mass.

Visibility news continued on page 5...

Feature article

Assortment of interpretive air quality exhibits promote understanding in national parks

Introduction

Reporting the results of research and monitoring programs is an important component of the interpretive programs the National Park Service uses to promote education about air quality and related issues. Collected data and images, relayed to the public in easily understood terms, can help to bring an understanding of air quality-related issues to thousands of people. Interpretive programs may educate park visitors by providing information about:

- The importance of good air quality in the nation's parks
- How air pollution affects park resources such as plant and animal life
- The sources of air pollution and how it is transported from one area to another
- How the National Park Service is protecting the air resource
- Conservation activities in the parks and other areas

Many parks have permanent exhibits designed to inform and educate visitors about air quality issues affecting resources in their areas. An assortment of interpretive air quality exhibits are in use in the national parks, including wayside text exhibits, visitor center kiosks, and Web pages.

Wayside text exhibits

Text exhibits at wayside pullouts are in use at a number of parks. Some of these exhibits include photographic examples of the scenic view at the pullout during good and poor visibility days. These exhibits allow the visitor to compare the visibility they are currently experiencing to the photographs in the exhibit. Figure 1 is a photographic exhibit located at Many Parks Curve in Rocky Mountain National Park, Colorado.

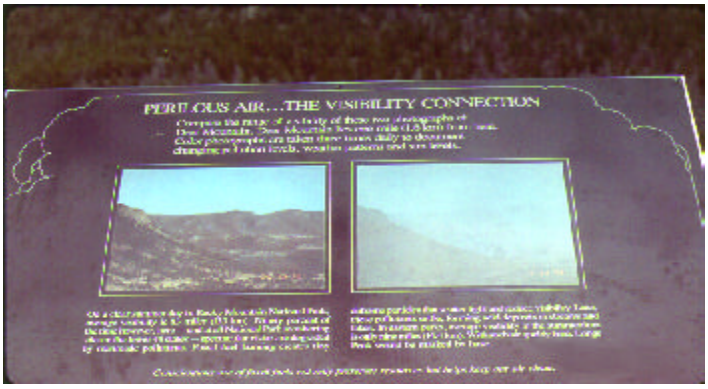


Figure 1. Interpretive air quality exhibit at Rocky Mountain National Park, includes good and poor visibility photographs for comparison.

Close by is another text exhibit that explains a transmissometer monitoring system. Figure 2 shows the exhibit, located on a boardwalk overlooking a scenic view. Underneath the boardwalk a transmissometer transmitter, operated by the IMPROVE Program, collects visibility data. The exhibit explains what a transmissometer is and how it operates, and includes a drawing of the transmissometer components.

Figure 2. Interpretive air quality exhibit at Rocky Mountain National Park, Colorado. The exhibit explains visibility monitoring using a transmissometer system.

A unique text exhibit that provides real-time visibility data is installed in Grand Canyon National Park, near the Yavapai Museum. Hourly transmissometer data collected from the rim of the canyon are radio-linked to the exhibit. A moving scale on the exhibit is automatically updated with these data each hour; the scale allows the visitor to relate the visual range monitored by the transmissometer to observed conditions within the canyon. The park plans to upgrade the real-time display and add a camera in the future. Figure 3 shows visitors viewing the Grand Canyon exhibit.

Figure 3. A wayside air quality exhibit at Grand Canyon National Park, Arizona, combines text with real-time visibility data.

Visitor center kiosks

Attractive kiosk displays in a park's visitor center can attract a large number of people. A kiosk in Big Bend National Park, Texas, displays real-time IMPROVE transmissometer data as a digital readout. The readout changes hourly as new data are collected, and are displayed as visual range values in both English and Spanish. The park also plans to upgrade its exhibit with a Web camera in the future.

Great Smoky Mountains National Park, Tennessee, has a comprehensive visitor center kiosk designed to inform visitors about park air quality. The three-sided kiosk, shown in Figure 4, is located in the Sugarland Visitor Center. The kiosk includes color computer monitors that display real-time visibility, meteorology, and ozone data; informative brochures; and text panels that inform readers about the views they see and the air they breathe at the park.

Figure 4. The air quality kiosk at Great Smoky Mountains National Park, Tennessee, includes computer monitors displaying real-time visibility, meteorological, and ozone data; informative brochures; and text panels that inform readers about the air resource and its effects on park resources.

The Great Smokies exhibit is linked through the Internet to monitoring equipment located elsewhere in the park. Several computer screens cycle through at 15-minute intervals, and display real-time visibility, ozone, and meteorological conditions. Data and images are collected from a nephelometer; ozone analyzer; ambient temperature, relative humidity, wind speed, wind direction, and precipitation sensors; and a digital camera. This same information is also provided on a Web page. See the *IMPROVE Newsletter*, Volume 7, No. 2 (Spring 1998) for a complete discussion regarding this exhibit.

Web pages

Interpretive exhibits using Web pages is the newest method of providing air quality information to the public. The same information provided in the kiosk at Great Smoky Mountains National Park is also provided on a Web page. Figure 5 shows the Great Smoky Mountains National Park Web page displaying real-time visibility, air quality, and meteorological data. The Web page is updated every 15 minutes and can be viewed on the Internet at: http://www.aqd.nps.gov/ard/parks/grsm/grsmvc.htm.

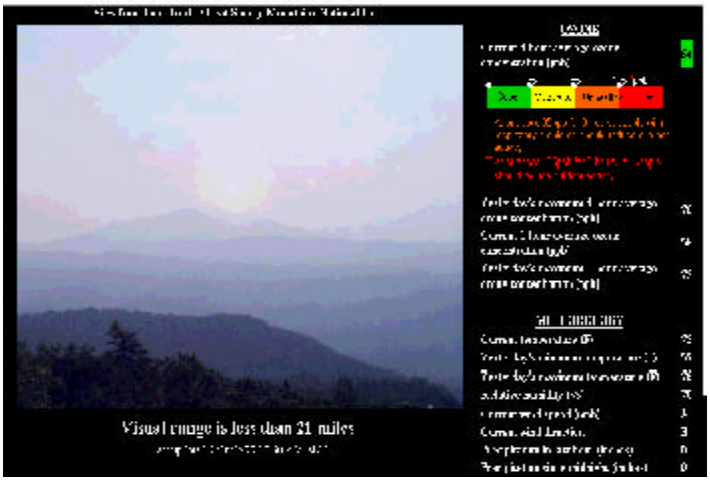


Figure 5. The Great Smoky Mountains National Park, Tennessee, Web page displaying real-time visibility, air quality, and meteorological data.

Acadia National Park, Maine, also has an interpretive air quality Web page, which is part of the Northeast Real-Time Air Pollution Visibility Camera Network (CAMNET), sponsored in part by NESCAUM. The park operates a digital camera system that photographs visibility conditions and puts acquired images, along with other visibility and air quality information on the Internet. Figure 6 shows one of the Web pages that uses the scene photographed at Acadia National Park. The CAMNET Web address is: http://www.hazecam.net.

Future Exhibits

In addition to the exhibit upgrades at Grand Canyon and Big Bend National Parks, three National Park Service locations are planning new exhibits or will upgrade their existing interpretive exhibits with digital camera systems. Acadia National Park, Maine; Mammoth Cave National Park, Kentucky; and Joshua Tree National Monument, California, are proposing interpretive displays that will provide presentations similar to that used at Great Smoky Mountains National Park. The displays will include real-time digital images, a gallery of good to poor visibility images, a description of unhealthy ozone levels and appropriate precautions, and actions the public can take to reduce ozone and visibility impairment. All three exhibits will be completed by Summer 2001.

Shining Rock Wilderness, North Carolina, is also developing a Web exhibit similar to the Great Smoky Mountains Web page.

For more information about developing air quality exhibits, contact Air Resource Specialists, Inc. Telephone: 970/484-7941. Fax: 970/484-3423. E-mail: info@air-resource.com

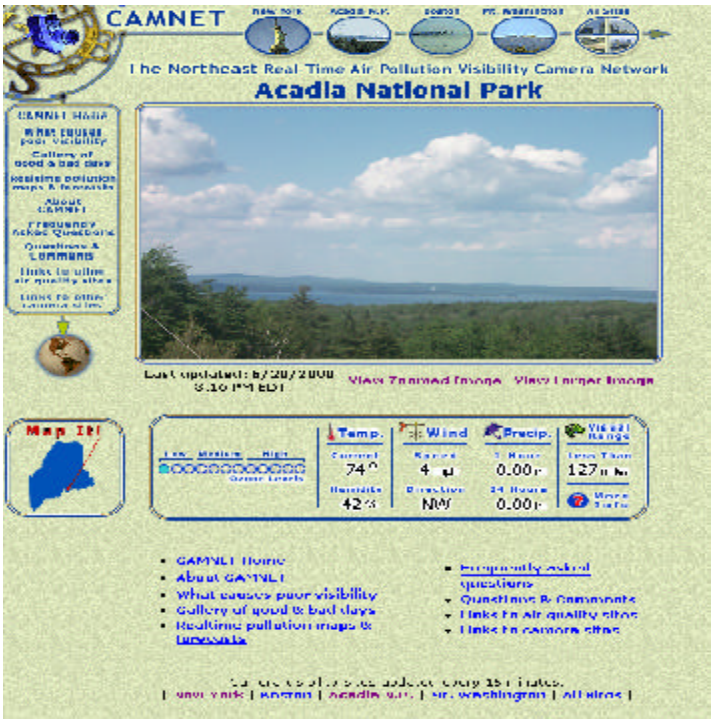


Figure 6. A Web page from the Northeast Air Pollution Visibility Camera Network, displaying the scene and real-time visibility and meteorological data at Acadia National Park, Maine.

Visibility news

continued from page 2 ....

Transmissometer data files undergo change

All transmissometer data files are in the process of being modified, to allow scientists and researchers easier analysis of the data. Three changes will make additional information readily available in the final validated data files:

- The instrument serial number will be added to the data files.
- The lamp numbers used during monitoring will be added to the data files to track lamp changes.
- The 4-character site abbreviation code will change to a 4-character alpha and 1-character numeric code. This change will make the transmissometer site abbreviation codes consistent with aerosol site abbreviation codes. The 17 IMPROVE-operated transmissometer locations with their old and new abbreviation codes are:

Badlands NP	BADL	BADL1
Bandelier NM	BAND	BAND1
Big Bend NP (Lone Mountain)	BIBE	BIBE1
Big Bend NP (Grapevine Hills)	BIGH	BIBE2
Bridger W	BRID	BRID1
Canyonlands NP	CANY	CANY1
Chiricahua NM	CHIR	CHIR2
Glacier NP	GLAC	GLAC1
Great Basin NP	GRBA	GRBA1
Grand Canyon NP (South Rim)	GRCA	GRCA1
Grand Canyon NP (In-Canyon)	GRCW	GRCW1
Guadalupe Mountains NP	GUMO	GUMO1
Petrified Forest NP	PEFO	PEFO2
Rocky Mountain NP	ROMO	ROMO2
San Gorgonio W	SAGO	SAGO1
Shenandoah NP	SHEN	SHEN2
Yosemite NP	YOSE	YOSE2

Completion of the data file changes is expected to be finished by the end of 2000. Data will be made available on CD-ROM to all those who currently possess a CD-ROM of the data. The files will also be replaced on CIRA's FTP site.

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

Agencies join visibility monitoring effort to expand the IMPROVE Protocol network

IMPROVE aerosol monitoring is expected to be performed at 145 locations throughout the United States. The IMPROVE Program will operate 110 IMPROVE sites in or near Class I visibility areas. The remaining sites, referred to as "Protocol" sites, will be operated by IMPROVE contractors using the same equipment and protocols for committee agencies, states, or tribes.

Figure 1 shows a map of IMPROVE Protocol sites that are expected to begin monitoring using IMPROVE aerosol protocols, and the agency supporting the monitoring. While IMPROVE sites are the direct responsibility of the IMPROVE Steering Committee, IMPROVE Protocol sites are operated for a Federal Land Manager, a state, or other government entity.

IMPROVE Protocol sites are generally located in non-urban areas and operate all four filter modules (A, B, C, and D). Monitoring procedures follow standard, approved IMPROVE Program methods for data collection, analysis, and reporting. A discussion of IMPROVE's operating protocol for all types of monitoring can be found in the *IMPROVE Newsletter*, Volume 9, Number 1 (Winter 2000).

For more information about IMPROVE Protocol aerosol monitoring, contact Bob Eldred at the University of California-Davis. Telephone: 530/752-1124. Fax: 530/752-4107. E-mail: eldred@crocker.ucdavis.edu

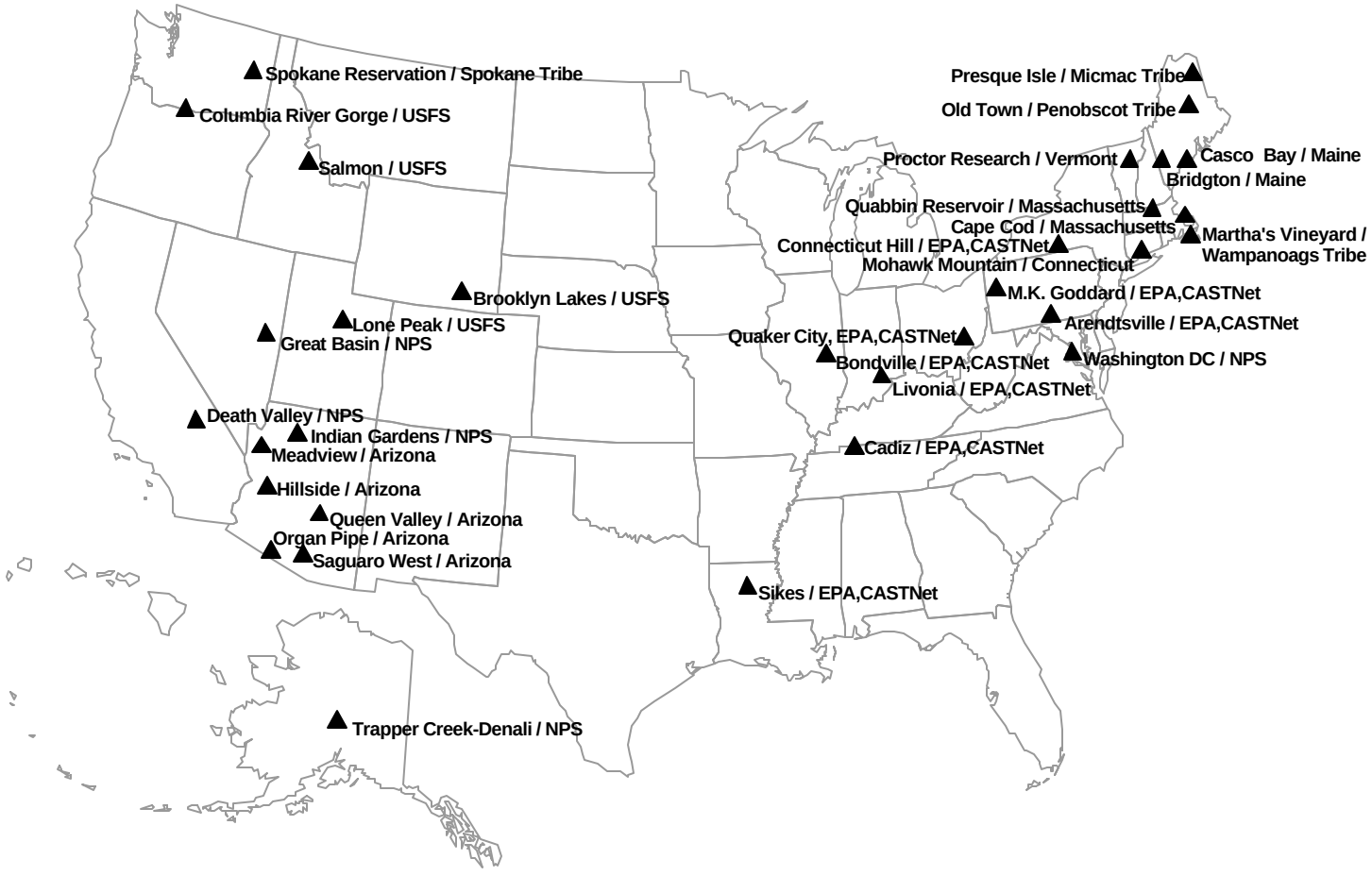


Figure 1. Anticipated IMPROVE Protocol aerosol monitoring sites and sponsoring agencies. The agencies have expressed interest to monitor air quality with an IMPROVE modular aerosol sampler.

NPS photographic spectrums now complete

In 1995, the IMPROVE Steering Committee formed a consensus that five years of scene monitoring at a location where visual air quality is not rapidly changing yields a sufficient example of most visual air quality conditions. To secure a representative set of observed air quality conditions for 43 IMPROVE scene monitoring sites, a series of slides was selected for each site from the 35 mm slide visibility archives, digitized, and placed on CD-ROM for permanent archive. All 43 spectrums have been completed, and are:

- Acadia National Park, Maine
- Badlands National Park, South Dakota
- Bandelier National Monument, New Mexico
- Big Bend National Park, Texas

- Boundary Waters Canoe Area, Minnesota
- Bridger Wilderness, Wyoming
- Bryce Canyon National Park, Utah
- Canyonlands National Park, Utah

- Cape Romain National Wildlife Refuge, South Carolina
- Chassahowitzka National Wildlife Refuge, Florida
- Chiricahua National Monument, Arizona
- Crater Lake National Park, Oregon

- Denali National Park, Alaska
- Dolly Sods Wilderness, West Virginia
- Edwin B. Forsythe National Wildlife Refuge, New Jersey
- Everglades National Park, Florida

- Glacier National Park, Montana
- Grand Canyon National Park, Arizona
- Great Basin National Park, Nevada
- Great Sand Dunes National Monument, Colorado

- Great Smoky Mountains National Park, Tennessee
- Guadalupe National Monument, Texas
- Haleakala National Park, Hawaii
- Hawaii Volcanoes National Park, Hawaii

- Jarbidge Wilderness, Nevada/Idaho
- Lassen Volcanic National Park, California
- Lye Brook Wilderness, Vermont
- Mammoth Cave National Park, Kentucky

- Mesa Verde National Park, Colorado
- Mount Rainier National Park, Washington
- Okefenokee National Wildlife Refuge, Georgia
- Petrified Forest National Park, California

- Pinnacles National Monument, California
- Point Reyes National Seashore, California
- Redwood National Park, California
- Rocky Mountain National Park, Colorado
- San Gorgonio Wilderness, California
- Shenandoah National Park, Virginia
- Tonto National Monument, Arizona
- Voyageurs National Park, Minnesota

- Weminuche Wilderness, Colorado
- Yellowstone National Park, Wyoming
- Yosemite National Park, California

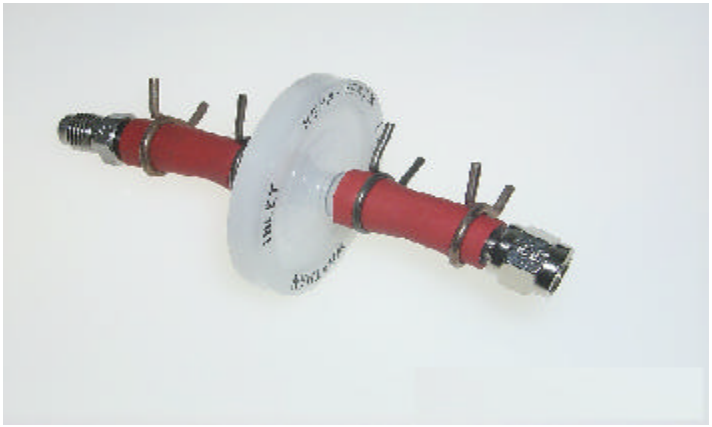
Each CD-ROM contains images that illustrate the range of visual conditions for a site, associated aerosol cumulative frequency summaries, selected episodes, and site specifications. See *IMPROVE Newsletter*, Volume 7, No. 3 (Summer 1998) for a discussion on the creation and specific contents of slide spectrums.

For more information contact Dee Morse at the National Park Service. Telephone: 303/969-2817. Fax: 303/969-2822. E-mail: dee_morse@nps.gov

Relative humidity influence in nephelometer calibrations results in new filter assembly

Tests conducted during Spring/Summer 2000 indicated that upscale calibrations of NGN-2 nephelometers using SUVA 134a were at times abnormally high when the relative humidity was high. Further testing revealed that placing a glass fiber filter in-line between the pressure regulator and flowmeter of the calibration system remedied the problem. Repeated tests verified that with the filter assembly installed, upscale calibrations during periods of high humidity were, in all cases, normal and consistent with calibrations performed at lower relative humidity. Based on these test results, an in-line filter assembly shown below, will be provided for use with all NGN-2 SUVA 134a manual span gas calibration systems.

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



In-line filter assembly for use with calibrating Optec NGN-2 nephelometer systems.

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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 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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IMPROVE Newsletters are also available on the National Park Service Web site at: http://www.aqd.nps.gov/ard/impr/index.htm

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