

Monitoring update

Network operation status

The IMPROVE (Interagency Monitoring of Protected Visual Environments) 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:

- 58 aerosol samplers
- 5 transmissometers
- 37 nephelometers
- 8 digital or film camera systems
- 55 Web camera 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 2006 (October, November, and December) are:

<ul style="list-style-type: none"> ➤ Aerosol (channel A only) 94% collection ➤ Aerosol (all modules) 92% completeness ➤ Optical (transmissometer) 94% collection ➤ Optical (nephelometer) 93% collection ➤ Scene (photographic) 99% collection (does not include Webcameras)

Several transmissometers ended long-term monitoring this quarter due to funding decisions: Badlands NP, SD; Bandelier NM, NM; Canyonlands NP, UT; Glacier NP, MT; Great Basin NP, NV; Guadalupe Mountains NP, TX; Rocky Mountain National Park, CO; and Yosemite NP, CA.

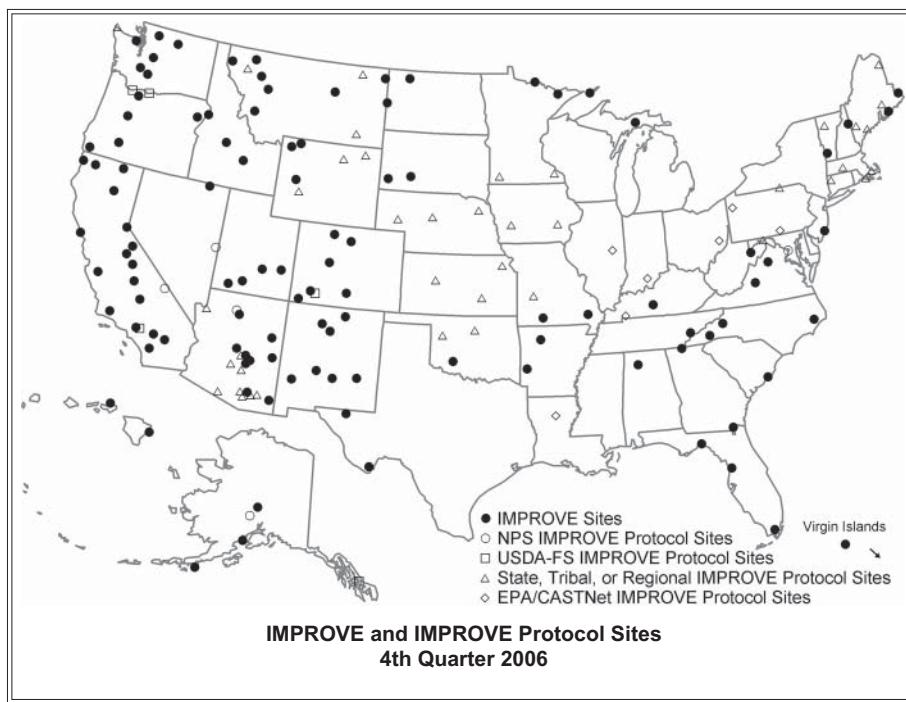
In December, the USDA-Forest Service ended nephelometer monitoring at Dolly Sods Wilderness, WV, where the instrument had operated between 1993 and 1997, and again between 2003 and 2006. Bridger Wilderness, WY, joined their Webcamera network in October. Views from this and all other USDA-Forest Service Webcams may be seen at <http://www.fsvisimages.com>.

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 October 2005. Transmissometer and nephelometer data are available through December 2005 and September 2006 respectively.

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



Monitoring update continued on page 3....

Visibility news

IMPROVE sampler program revised

Enhancements are being made to the computer program that controls the IMPROVE sampler and records operational data such as flowrates and temperatures. These enhancements will reduce the occurrence of spurious or lost data and will streamline the programming code so that future revisions can be made smoothly.

The programming changes were prompted by the modification of the IMPROVE sampler to create the new URG-3000N sampler, to be used in the Environmental Protection Agency's Speciation Trends Network (STN). The 3000N has several new features such as active flow control, and modification of the program was necessary to accommodate these new features. Air Resource Specialists, Inc. wrote the program for the URG-3000N sampler. These modifications resulted in a more streamlined and less error-prone program, and it was decided to take advantage of these enhancements for IMPROVE networks.

The new program will be installed in each sampler operating in the IMPROVE and IMPROVE Protocol networks during the 2007 annual maintenance visits by the University of California-Davis. The differences will be transparent to field operators, so the day-to-day sampler operation will not change. The positive changes will be reflected in better data recovery and in less effort by UC-Davis in retrieving and restoring compromised data.

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.

Upcoming events

The USDA-Forest Service will host the next IMPROVE Steering Committee meeting, scheduled for September 5-7, 2007, in Durango, Colorado. Further details and a complete agenda will be available as the meeting draws near.

The Air and Waste Management Association (AWMA) Rocky Mountain States Section is hosting a technical conference pertaining to "Air Quality Issues in the Rocky Mountain Region." The conference will be held May 17, 2007, at the Denver West Marriott hotel, in Golden Colorado. The all-day event will feature keynote speakers, a panel discussion, presentations by four state air quality directors and the international AWMA president, and two technical sessions. Conference details and the specific agenda are still being formed. Announcements will be posted when available.

STAPPA/ALAPCO now NACAA

The State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO) has been a well-known name for over 30 years and is a member of the IMPROVE Steering Committee. The association has recently changed its name to the National Association of Clean Air Agencies (NACAA).

The NACAA represents air pollution control agencies in 53 states and territories and over 165 major metropolitan areas across the U.S. The association promotes information exchange and communication among various levels of air pollution control and regulatory agencies.

For more information about NACAA, visit their Web site at <http://www.4cleanair.org>.

Data advisories added to IMPROVE Web site

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

Elemental concentrations above the MDL can go undetected

- Affects: Module A, Aluminum species
- Period: Entire data record

The minimum detectable limits (MDLs) for XRF and PIXE analysis are based on the background spectrum of an element's primary energy peak. Measured aluminum and silicon concentrations correlate strongly, but aluminum is undetected, however, in many samples for which measured silicon indicates aluminum concentrations well above the MDL. Scientists recommend data users estimate undetected aluminum from silicon.

Sulfur interference in XRF determination of silicon

- Affects: Module A, Silicon species
- Period: Starting December 1, 2001

Accurate determination of silicon is difficult when sulfur concentrations greatly exceed silicon concentrations. Reported uncertainties and detection limits for silicon do not adequately account for the interference by sulfur. Scientists recommend that data users distrust reported silicon concentrations when sulfur is much greater than silicon, and disregard reported uncertainties and MDLs.

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.

Speciation Trends carbon sampling update

The Environmental Protection Agency's (EPA's) Speciation Trends Network (STN) and supplemental sites are modifying their carbon sampling methods and changing to a new system to be more comparable with the IMPROVE network's methods (see The IMPROVE Newsletter, 2nd Qtr 2006).

A new carbon sampling instrument, the URG-3000N, has been designed and tested. The sampler is based on the IMPROVE Version II C-module, but includes an active mass flow controller, which will better measure and control the instrument's flow rate and record significantly more information on the removable CompactFlash® memory card.

The EPA has selected the first group of final monitoring locations, and the new sampler is scheduled to be installed at 57 initial locations beginning in March. Over 150 installations are expected before the project is complete. Air Resource Specialists, Inc. (ARS) will perform the initial sampler installations, calibrations, and training. Research Triangle Institute (RTI) will manage the preparation and shipment of the carbon filter media, and analysis will be performed by Desert Research Institute (DRI).

For more information contact Joann Rice at EPA. Telephone: 919/541-3372. E-mail: rice.joann@epamail.epa.gov.

2007 IMPROVE calendars available

Another year of the popular IMPROVE calendars have been produced and delivered, and extra copies are available upon request or online from <http://vista.cira.colostate.edu/improve/Publications/Calendars.htm>.

This year's calendar features a view of Trail Ridge Road, the highest continuous roadway in the U.S. (Rocky Mountain National Park, Colorado). The photograph was taken by Jeff Lemke, a member of the CIRA team that produces the calendars. Calendar highlights include the various contractors and laboratories connected with the IMPROVE Program as well as discussions of the aerosol, optical, and scene networks, and other interesting topics. And don't overlook the discussions of selected operators throughout the networks, their work, and their monitoring sites.

Operators find the calendars extremely useful by tracking when sampling days are and when the cartridges should be changed, and using the notes displayed in the daily grid of each month.

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 leinke@cira.colostate.edu.

Monitoring update *continued from page 1*

Operators of distinction

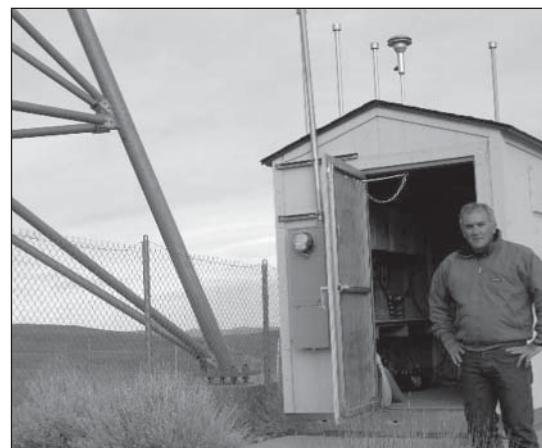
“Servicing the site is calm, pleasant, and enjoyable most of the time,” said Casey Shannon, IMPROVE operator at the Hoover, CA, USDA-Forest Service monitoring site. Casey, a hydrologic technician for the Inyo National Forest, works on projects concerning the protection and enhancement of water and air quality, soil productivity, and watershed improvement and restoration. He also serves as the forest hazmat coordinator, keeping current on federal, state, and local environmental regulations, responding to hazmat spills, and training others in hazmat cleanup.

Casey developed his environmental protection knowledge and skills through 19 years of experience with the University of California White Mountain Research Station and the USDA-Forest Service. He loves the wilderness environment and, as a native Californian, has spent time hiking, mountain climbing, fishing, skiing, and studying wildland hydrology.

Having two people service the Hoover site is a luxury, so Casey usually performs solo visits. Such was the case in December, when Casey found a winter storm brewing. While en route to the monitoring site for a Tuesday visit, Casey noted silt, rocks, and an occasional tree branch swirling in the roadway, as wind gusts rose to an estimated 60-80 mph. “The winds rocked my

vehicle up to the 8,500 foot site. When I arrived, I could see the storm front building on the horizon,” said Casey. He made it to the shelter, changed the filters, and performed routine module maintenance. Wind gusts increased to an estimated 100+ mph by the time servicing was complete. “The shelter rocked and vibrated loudly and nearby 150-foot high microwave towers and attached equipment roared with a deafening sound,” said Casey, “and since the shelter door faces the wind, I was uncertain if I could open it to leave.” But Casey persevered, got the job done, and upon his servicing visit the following week, he found the shelter intact and the weather tranquil. Thank you Casey for your adventure and dedication!

Casey Shannon, IMPROVE site operator at the Hoover, California, monitoring site in the Inyo National Forest. Note the air quality shelter is dwarfed by the adjacent microwave tower.



Monitoring update continued on page 7....

Feature article

Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States: Report IV (by Linsey J. Debelle¹, Gebhart, K.A.², Malm, W.C.², Pitchford M.L.³, Schichtel, B.A.², and White, W.H.⁴)

Overview and summary

Scientists at the Cooperative Institute for Research in the Atmosphere (CIRA) have completed the fourth in a series of periodic reports that describe the data collected by the IMPROVE monitoring network. This article is a short summary of the report, which provides a broad examination of the IMPROVE data as well as results from special field studies and data analyses conducted since the 2000 report (Report III).

The IMPROVE data analysis includes examination of the spatial and seasonal aerosol concentrations and composition for 159 monitoring sites that collected data during the period 2000 through 2004, and long-term trends for 38-49 sites (depending upon the parameter examined) using data from 1988 through 2004. The report also includes analysis of data from 84 sites in the EPA's Speciated Trends Network (STN), which is primarily an urban/suburban network. Incorporation of data from these STN sites extends the spatial and seasonal aerosol patterns from surrounding remote areas into urban areas, providing insights into pollution contributed by regional and local sources.

Spatial trends in aerosol concentration and extinction

Spatial trends for fine particulates and extinction (b_{ext}) were examined using 2000-2004 data from the integrated IMPROVE and STN data set. The worst visibility was found in the eastern U.S. and in southern California, while the best visibility was found in Alaska and in the nonurban West, which has visibility impairment of less than 10 deciviews (dv) (see Figure 1). West of the Sierra Nevadas and including southern California, the dv values are greater than 14, with a maximum value of 18.9 dv at Sequoia National Park, CA. The northwest U.S. and the entire eastern half of the U.S. have visibility impairment in excess of 14 dv, and the regions east of the Mississippi and south of the Great Lakes have impairment in excess of 20 dv. The highest annual dv was about 24, occurring in the general region of the Ohio River and Tennessee Valleys.

Aerosol concentrations were found to mimic the difference between eastern and western light extinction, but on a smaller scale. Findings for specific aerosol species are discussed below.

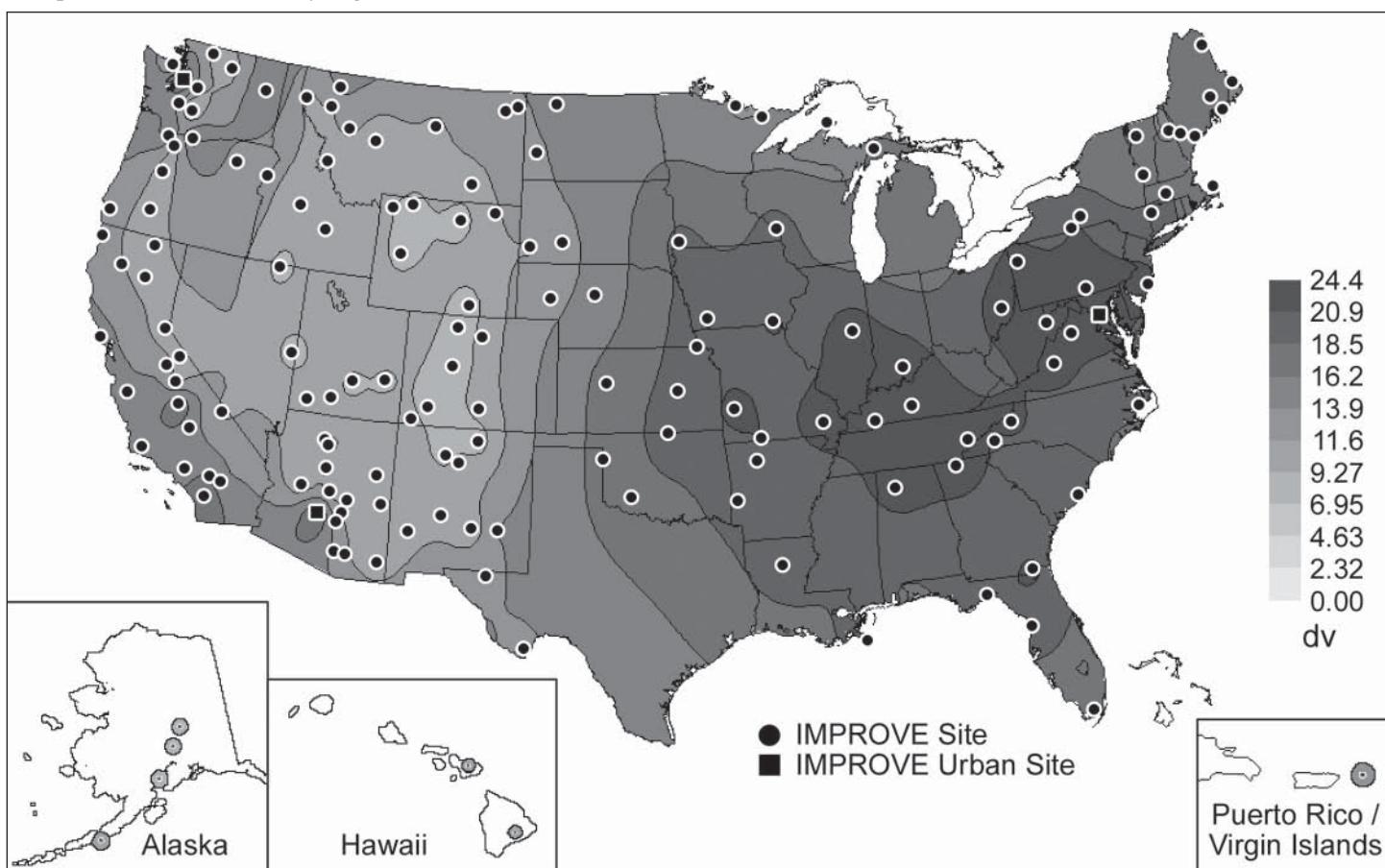


Figure 1. Five-year average (2000-2004) deciview (DV) using only IMPROVE data. Deciview is related to the logarithm of the sum of the particulate b_{ext} and Rayleigh scattering.

Ammonium sulfate

Ammonium sulfate is among the most important contributors to b_{ext} . In the eastern U.S., sulfate accounted for 45%-60% of the reconstructed fine mass and 50%-75% of the particulate b_{ext} in rural locations. The contribution was smaller in the western U.S., varying from 15%-40% of the reconstructed fine mass and particulate b_{ext} . The highest ammonium sulfate concentrations were found in the Ohio River Valley, where there are significant SO_2 emissions, and the Appalachian Mountains. The urban and neighboring rural sites had similar concentrations.

Organic mass by carbon

The highest rural organic mass by carbon (OMC) concentrations and OMC b_{ext} occurred in the Northwest, in the mountains of California, and in the Southeast, while the lowest values were found through the interior West. In the Northwest the OMC accounted for more than 50% of the reconstructed fine mass and particulate b_{ext} . Urban sites had higher concentrations and light scattering than neighboring rural sites. This was most pronounced in the West and Southeast where the urban OMC concentrations were at more than a factor of two higher.

Light-absorbing carbon

Rural light-absorbing carbon (LAC) concentrations were low, representing less than 8% of the reconstructed fine mass at all locations and typically less than 10% of the particulate b_{ext} . Similar to the OMC, the urban LAC concentrations were higher than neighboring rural sites.

Ammonium nitrate

Rural and urban ammonium nitrate concentrations and nitrate b_{ext} were high in California, the central Great Plains, and the Great Lakes region, where both NO_x and ammonia emissions are high. The highest rural nitrate b_{ext} occurred in the Midwest (20-27 Mm^{-3}). In past IMPROVE reports, the IMPROVE network did not contain any Midwest monitoring sites, and the Midwest nitrate "bulge" was missing from these analyses. All urban sites had higher ammonium nitrate concentrations compared to neighboring rural sites.

Fine Soil

Fine soil is the only fine aerosol parameter to show peak values in the arid Southwest, where in rural areas it contributes to 20%-45% of the reconstructed fine mass and up to 10% of the particulate b_{ext} .

Coarse mass

The highest coarse mass concentrations occurred in the agriculturally intensive Midwest and Southwest. Coastal sites also had high coarse mass concentrations. The highest coarse mass contribution to b_{ext} occurred in the Southwest where it contributed to 20% or more of the particulate b_{ext} .

Spatial variability of monthly patterns in fine aerosol species concentrations and extinction coefficients

Spatial variability of aerosol concentrations in the U.S. has been grouped into three regions: the East, Southwest, and Northwest. For these discussions, refer to Figure 2.

East

In the rural eastern U.S., b_{ext} peaks during the summer months, driven by ammonium sulfate light scattering. The exception is in the central Great Plains and Boundary Waters (Minnesota) regions where summer and winter peaks are found. The winter peaks are due to increased ammonium nitrate scattering when ammonium sulfate concentrations are low.

At urban sites, b_{ext} has a summer and a winter peak in most regions; the summer peak is due to increased light scattering by ammonium sulfate and organics, while the winter peak is due to increased ammonium nitrate light scattering. Fine soil, coarse mass, and light absorption are small contributors to b_{ext} during all months in this region.

Southwest

In the rural southwestern U.S., b_{ext} generally peaks in spring and summer, when light scattering by ammonium sulfate, organics, and soil concentrations are highest. Ammonium nitrate is a small contributor to b_{ext} , except in California where the highest ammonium nitrate light scattering occurs in the colder months.

In the Southwest's urban areas, b_{ext} generally peaks in the colder months, caused by increased light scattering by ammonium nitrate as well as organics. Summer peaks also occurred in Denver, Colorado, and in western Nevada, due to organics. Los Angeles is unique in that b_{ext} peaks during the summer months due to increased light scattering by ammonium sulfate.

Northwest

In the rural northwestern U.S., the seasonality of b_{ext} is varied. In Alaska, the northern Rockies, and the northern California/Oregon regions, pronounced summer peaks occur that are due primarily to increased light scattering from organics (compared to winter months). The Northwest also has a summer peak in b_{ext} due to similar increased light scattering from organics and ammonium sulfate.

The Northwest's urban regions see b_{ext} peaks in the colder months. Similar to the East and Southwest, the cold month peaks were partially due to increased light scattering by ammonium nitrate, as well as increased light scattering by organics at a number of the urban regions. The Northwest's urban ammonium sulfate light scattering is unique in that it does not peak in the summer months, and in Boise, Idaho, and Missoula, Montana, ammonium sulfate light scattering actually peaks in the cold months.

IMPROVE Report continued on page 6....

IMPROVE Report continued from page 5....

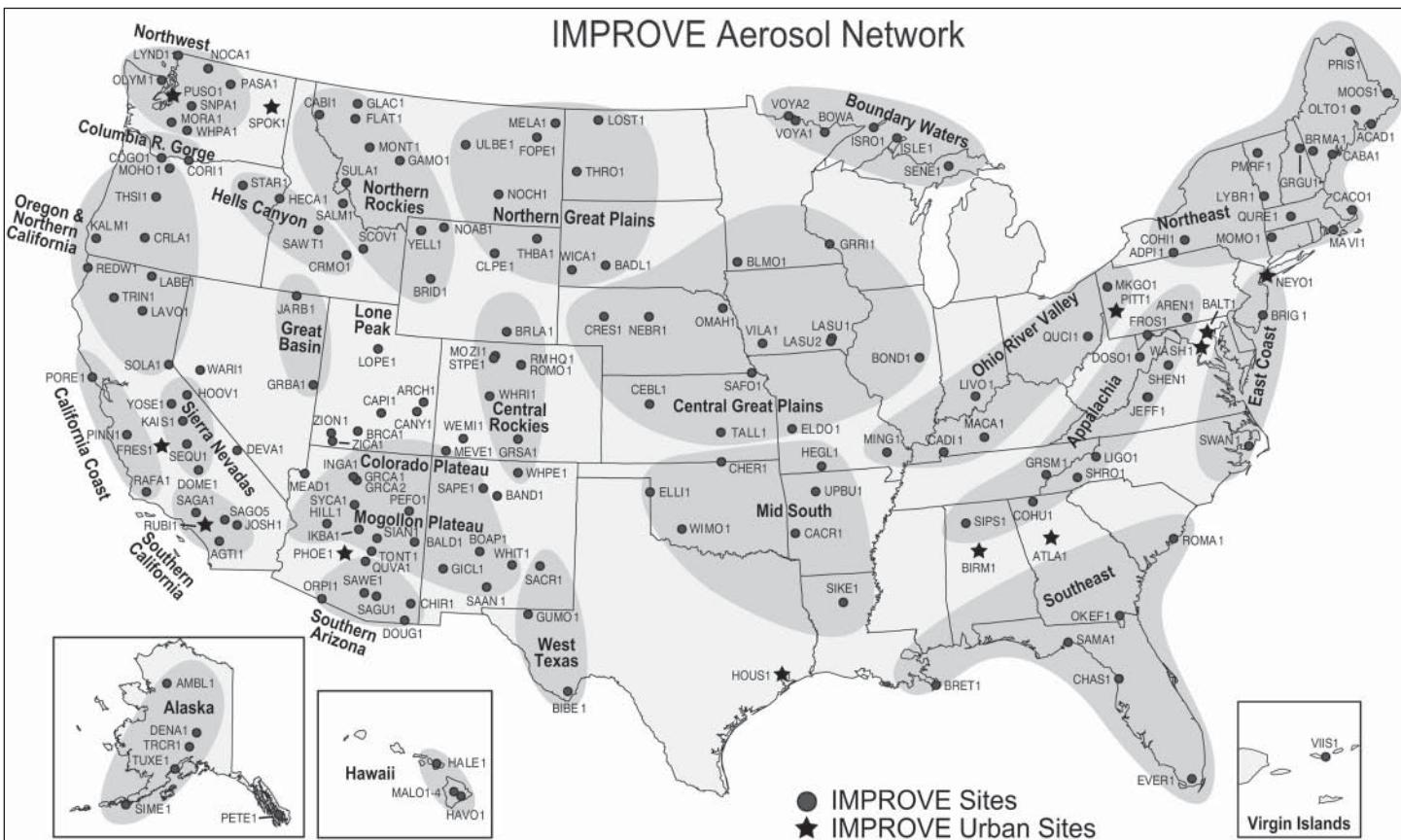


Figure 2. The locations of current and discontinued monitoring sites as of December 2004. The regions used for grouping the sites in some analyses in this report are indicated by shading.

Temporal trends in fine aerosol species concentrations and aerosol extinction

Several studies investigating trends in fine aerosol species concentrations are summarized in the report. Trends in the haze index for the 10-year period 1995-2004, performed by the National Park Service (http://www2.nature.nps.gov/air/Pubs/pdf/gpra/Gpra2005_report_03202006_final.pdf) are discussed here.

Visibility trends in the annual average 20% best and worst days were examined using the Theil regression method for IMPROVE sites with at least 6 complete years out of the 10-year period. Visibility was stable (insignificant trends) or improving at all IMPROVE sites at the 0.05 significance level. Acadia NP, ME; Moosehorn NWR, ME; Lye Brook W, VT; Dolly Sods W, WV; and Shenandoah NP, VA; showed statistically significant improving visibility trends for the clearest days at eastern monitoring sites. Great Smoky Mountains NP, NC/TN; Okefenokee NWR, GA; Mammoth Cave NP, KY; and Washington D.C. also had improving trends on the haziest visibility days. Statistically significant improving trends for the clearest visibility days were observed

at 17 sites in the western U.S. including Alaska. Mount Rainier NP, WA, also showed an improving trend on the haziest visibility days. No sites included in the analysis had a significant worsening trend on either the clearest or haziest visibility days.

Conclusion

The entire IMPROVE report (IV) is available on the IMPROVE Web site at http://vista.cira.colostate.edu/IMPROVE/Publications/IMPROVE_reports.htm. Hard copies will also be available from CIRA.

Author's References

- ¹ Cooperative Institute for Research in the Atmosphere (CIRA)
- ² National Park Service (NPS)
- ³ National Oceanic and Atmospheric Administration (NOAA)
- ⁴ University of California - Davis (UCD)

For more information or to request a hardcopy of the report, 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 2006 are:



Aerosol (Channel A)

Acadia	Great Sand Dunes	Rocky Mountain
Addison Pinnacle	Haleakala	Sac and Fox
Arendtsville	Hawaii Volcanoes	Saguaro
Badlands	Hercules-Glades	Saguaro West
Big Bend	Ike's Backbone	Salt Creek
Birmingham	Isle Royale	San Gorgonio
Bliss	James River	Seney
Brider	Jarbidge	Shamrock Mine
Bridgton	Kalmiopsis	Shining Rock
Bryce Canyon	Livonia	Simeonof
Cape Cod	Martha's Vineyard	Sipsey
Casco Bay	Medicine Lake	Starkey
Chassahowitzka	Mingo	Tallgrass
Craters of the Moon	Mohawk Mountain	Three Sisters
Crescent Lake	Monture	Trapper Creek-Denali
Death Valley	Mount Baldy	UL Bend
Dome Land	Mount Zirkel	Upper Buffalo
Douglas	Pasayten	Viking Lake
Ellis	Pinnacles	Voyageurs
Fresno	Presque Isle	Washington DC
Fort Peck	Proctor Research Center	Weminuche
Glacier	Quabbin Reservoir	Wheeler Peak
Grand Canyon	Quaker City	Yellowstone
Great Gulf	Queen Valley	Zion Canyon
Great River Bluffs	Redwood	
<u>Transmissometer</u>		
Cloud Peak	Grand Canyon (In Canyon)	Thunder Basin
<u>Nephelometer</u>		
Cloud Peak		<u>Photographic</u>
Greer		Bryce Canyon
Mammoth Cave		Agua Tibia North
Petrified Forest		Cucamonga
Phoenix		Gates of the Mountains
		Shamrock Mine

Monitoring Site Assistance:

Aerosol sites: contact University of California-Davis
telephone: 530/752-7119 (Pacific time)

Optical/Scene sites: contact Air Resource Specialists, Inc.
telephone: 970/484-7941 (Mountain time)

Sites that achieved at least 95% data collection for 4th Quarter 2006 are:

Aerosol (Channel A)

Baltimore	Great Basin	Penobscot
Bandelier	Guadalupe Mountains	Petrified Forest
Cabinet Mountains	Joshua Tree	San Pedro Parks
Capitol Reef	Mesa Verde	San Rafael
Cedar Bluff	MK Goddard	Sequoia
Cherokee	Moosehorn	Snoqualmie Pass
Chiricahua	Mount Rainier	Sula
Columbia Gorge East	New York	Sycamore Canyon
Denali	North Absaroka	Tuxedni
Dolly Sods	Northern Cheyenne	Virgin Islands
Flat Head	Organ Pipe	Yosemite
Gates of the Mountains		

Transmissometer

Grand Canyon (South Rim)

Nephelometer

Acadia	Estrella	Queen Valley
Children's Park	Grand Canyon (Hance)	Thunder Basin
Chiricahua	Mayville	Tucson Central
Craycroft	Mount Zirkel	Tucson Mountain
Dolly Sods	National Capital	Vehicle Emissions
Dysart	Organ Pipe	Wichita Mountains

Photographic

Sites that achieved at least 90% data collection for 4th Quarter 2006 are:

Aerosol (Channel A)

Agua Tibia	Great Smoky Mountains	Olympic
Blue Mounds	Indian Gardens	Petersburg
Bosque del Apache	Lake Sugema	San Gabriel
Cadiz	Lassen Volcanic	Shenandoah
Canyonlands	Linville Gorge	Sikes
Cape Romain	Lostwood	Swanquarter
Cloud Peak	Lye Brook	Tonto
Columbia Gorge West	Mammoth Cave	Trinity
Crater Lake	Meadview	White Mountain
Egbert	Mount Hood	White River
El Dorado Springs	North Cascades	Wichita Mountain
Everglades	Okefenokee	

Transmissometer

--none--

Nephelometer

Great Smoky Mountains Sycamore Canyon

Photographic

--none--

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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 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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