INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

1st Quarter 2008 | The IMPROVE Newsletter | Volume 17 / Number 1

Monitoring update

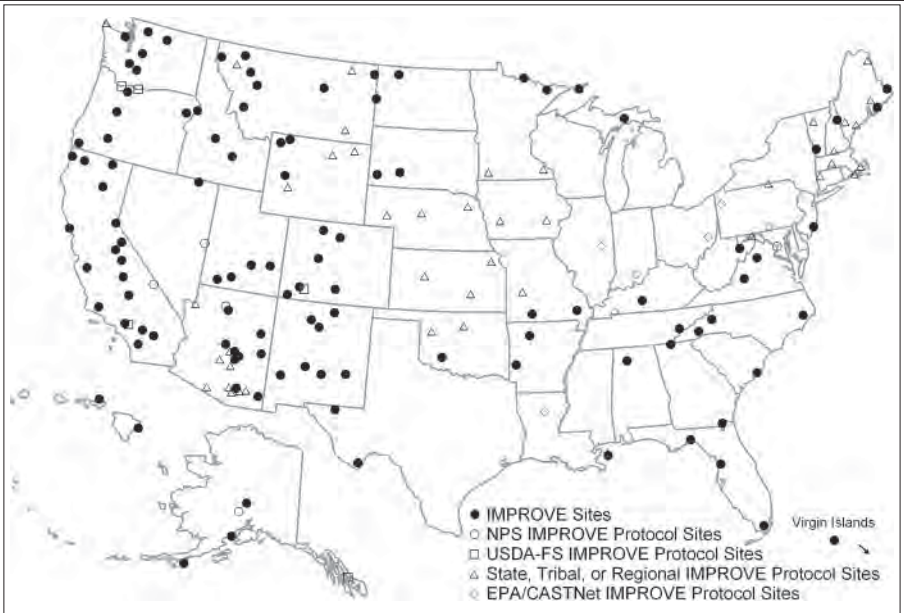
Feature Article: IMPROVE - New technologies and new rules, Page 4

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
- 34 nephelometers
- 4 transmissometers
- 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 1st Quarter 2008 (January, February, and March) are:



IMPROVE and IMPROVE Protocol Sites
1st Quarter 2008

- Aerosol (channel A only) 94% collection
- Aerosol (all modules) 92% completeness
- Optical (nephelometer) 96% collection
- Optical (transmissometer) 94% collection
- Scene (photographic) 93% collection
  (does not include Webcameras)

The Breton Island, LA, aerosol site sponsored by the U.S. Fish and Wildlife Service resumed operations in late January, following a lengthy suspension due to Hurricane Katrina. Its new site designation is BRIS1.

Two NGN-2a nephelometers were installed in the IMPROVE optical network this quarter. Great Basin National Park, NV, and Rocky Mountain National Park, CO, both received nephelometer systems in January 2008.

The CAMNET-sponsored Brigantine Wilderness, NJ, dual digital camera system became operational in March. CAMNET's Hartford, CT; Mohawk Mountain, CT; and Presque Isle, ME, camera systems were all discontinued in February. The Cucamonga Wilderness camera site sponsored by the USDA-Forest Service upgraded from a Remote Digital Camera System, which collects and stores images on a thumb drive, to a Webcamera system in March/April.

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*.

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

Visibility news

Canada expresses interest in national visibility program

In 1999, the U.S. Environmental Protection Agency promulgated the Regional Haze Rule to address visibility impairment caused by many sources over wide geographic areas. Under the rule, states are required to set goals for improving visibility in federal Class I areas, and develop plans that contain enforceable measures and strategies for reducing visibility-impairing pollution.

Canada is now looking at U.S. methods to form its own haze rules. Through a collaborative effort of air management agencies in British Columbia, a visibility coordinating committee has been formed to solicit input on the importance of visibility to various sectors and to review visibility management options. They then will move forward in developing a draft management approach.

On behalf of Environment Canada, Air Resource Specialists, Inc. conducted a survey of key stakeholders in the Regional Haze Rule development process. The survey included participants from the EPA, Regional Planning Organization leadership, U.S. federal land managers, state representatives, key consultants, and industry and environmental stakeholders. Survey questions focused on stakeholders' perceptions of:

- The usefulness and limitations of monitoring, emissions and modeling methodologies, resulting data sets, and tracking metrics.
- Policy considerations and agency roles within the Regional Haze Rule process.
- Expected effectiveness of haze reduction strategies and meeting Regional Haze Rule milestones.

Also investigated was the question of how jurisdictional differences between Canada and the U.S. might affect the development of a similar rule in Canada.

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

IMPROVE sampler controller receives enhanced programming

Air Resource Specialists, Inc. is continuing to work with UC-Davis staff to improve and enhance the IMPROVE aerosol sampler firmware. Initial improvements made last fall addressed reliability and memory card issues. Current enhancements add additional functionality including custom schedules for special studies, controller configuration via the memory card, detailed memory card data and log files, and a cleaner user interface.

This process of improving the controller programming is an ongoing, continuing process to make the sampler more versatile and user-friendly.

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.

Hawai`i Volcanoes National Park evacuates due to sulfur dioxide emissions

High levels of sulfur dioxide SO_2) emitted from two primary volcanic vents caused Hawai`i Volcanoes National Park to close, with evacuation of nearly 2,000 people on April 9, 2008. The park reopened the next morning as winds shifted, moving the gas plume away from populated areas and causing dropping levels of SO_2. High SO_2 levels again caused the park's closure on April 24, 2008.

Recorded SO_2 measurements reached 9.1 parts per million when the evacuation order was given on April 9th. The sulfur fumes emitted from Kilauea Volcano, have been elevated since mid-March, after a gas vent explosion.

The National Park Service performs air quality monitoring in the park, and maintains an SO_2 alert system for park staff and visitors. Sulfate data will be available at a later date from the IMPROVE aerosol samplers at Hawai`i Volcanoes and Haleakala National Parks.

For more information on the recent activity of Kilauea, visit the U.S. Geological Survey - Hawaiian Volcano Observatory at http://volcano.wr.usgs.gov/kilaueastatus.php.

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IMPROVE Newsletters are also available on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Publications/news_letters.htm.*

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Data advisory released

Scientists have posted one data advisory to the IMPROVE Web site this quarter, regarding titanium.

Positive interference in PIXE titanium determinations

- Affects: Module A, Titanium
- Period: Before December 1, 2001

In samples collected before December 1, 2001, the elements Na to Mn were determined by Proton-Induced X-ray Emission (PIXE) on the Crocker Nuclear Laboratory cyclotron. These elements have since been determined by conventional X-Ray Fluorescence (XRF), which has an order-of-magnitude lower detection limit for Ti.

Most titanium in ambient particles is attributed to soil dust, but concentrations determined by PIXE were high and variable relative to other crustal elements. The PIXE readings appear to have included stray contributions from the Ti-containing slide frames in which filters are mounted. The proton beam used for PIXE is less stable than the tube and collimator used for XRF, and the timing of the observed variations suggests a sensitivity to beam tuning.

The cyclotron runs for PIXE analysis were organized by the indicated climatological sample quarters, and these analytical boundaries coincide with the main transitions between periods of generally high or low reported Ti/Fe ratios. Scientists recommend data users estimate Ti from Fe and other crustal elements in pre-December 1, 2001, samples.

Complete discussions of this 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 1 ....*

Operators of distinction

Servicing an IMPROVE monitoring site is usually not too challenging – usually. But David Richie, site operator at the White River National Forest site in Aspen, Colorado, likes a challenge and wouldn't have it any other way.

The aerosol sampler at WHRI1 is in a former radio dispatch building atop Aspen Mountain at 11,200 feet elevation. The area has seen record breaking snowfall with over 400 inches this winter. "During the ski and summer seasons I can ride the ski gondola up to the monitoring site," says David. "In the off-season I hike or ski – 3,000 vertical feet – for a couple of hours. I enjoy the physical nature of a hike and the aesthetic beauty I see along the way."

The site is sponsored through a partnership between the USDA-Forest Service and the Wilderness Workshop, a conservation advocacy group in the region. "It is a nice, balanced partnership with both parties focusing on the importance of air quality," says David.

David's responsibilities as Wilderness Monitoring Coordinator include passive and continuous ozone monitoring, surface water sampling for pollutants, invasive weed surveys, campsite monitoring and visitor use studies, and implementing wilderness character protocols – employing keywords from the 1964 Wilderness Act: "opportunities for solitude," "natural," "undeveloped," and "untrammeled" to establish resource trends as originally mandated by the Act. Maintaining good air quality is part of the "natural" statutory language.

David studied English at the University of Virginia and became a wilderness ranger in Aspen in 1999, assisting the former air quality IMPROVE operator. His interests include challenging treks outdoors such as backcountry skiing, hiking, and trail riding. "If you pay attention to the horse you experience more – horses sense things better than humans and you can pick up what they are sensing," says David.

David's wife Hilary and two young sons Sam and August, also enjoy the wilderness of Aspen and all that comes with it.

David Richie, Wilderness Monitoring Coordinator at the White River National Forest IMPROVE site in Aspen, Colorado, dug out 8 feet of snow to gain access to the sampler modules this winter.

Monitoring update continued on page 7....

Feature article

IMPROVE: New technologies and new rules

Entering the 21st century without looking back (1998 - 2002)

Introduction

In the last issue of this newsletter, we discussed the administrative development of the program and expansion of the monitoring network from 1993-1997. Now halfway through our historical journey, we see a mature, stable, and confident program. This next period, 1998-2002, brought some exciting innovations and changes. The program was on a full-speed-ahead course with new technologies, new rules, and new members.

New technologies

The period 1998-2002 was an exciting time for program scientists and researchers. Several new types of monitoring instrumentation were developed, including Version II of the IMPROVE aerosol sampler, NGN-3 size-cut nephelometers, and high-resolution digital camera systems.

The version I IMPROVE aerosol sampler, which operated in the network since 1988, was aging. Many of its components were no longer available, and it could not accommodate the new 1-day-in-3 monitoring schedule that IMPROVE was soon to adopt. The new Version II sampler design promoted easier maintenance and servicing, and incorporated a new controller with microprocessor and new filter cassettes. The Version II sampler (Figure 1) was also more than capable of handling several new requirements requested by the EPA. These requests included integrating collected data with the national particulate matter (PM) monitoring program – which required the monitoring schedule to change to a 1-day-in-3 operation starting in 1999, all past and future data were to be provided to the EPA AIRS (now AQS - Air Quality System) database, and a portion of monitoring sites were to include routine, collocated sampling to allow precision and accountability assessments.

Another new type of instrument released in 1999 was the NGN-3 $PM_{2.5}$ size-cut nephelometer, manufactured by Optec, Inc. The NGN-3 is similar to the NGN-2 deployed in the IMPROVE optical network, but was designed for applications where continuous monitoring of $PM_{2.5}$ particle size is required.

Finally, high-resolution digital camera systems were now available and were a high-technology option to film-based cameras for visibility monitoring. The Northeast visibility monitoring camera network (CAMNET), coordinated by NESCAUM, became the first Web site to display collected digital images in near real-time, and provided regional haze awareness to the pubic via the Internet.

Figure 1. The four-module IMPROVE Version II aerosol sampler installed underneath a lean-to type structure at Zion National Park, Utah.

With the Internet becoming a new technology for society, the IMPROVE Web site began to be developed by the Cooperative Institute for Research in the Atmosphere (CIRA) in 2000 (Figure 2). Its objective was to provide access to IMPROVE data, data products, and general information about visibility science and regulations.

A final new technology introduced during this period was the coming online of a new XRF (X-Ray Fluorescence) system to analyze the aerosol data. Plans had begun to stop using PIXE (Proton-Induced X-ray Emission) and instead use a new, copper anode XRF system.

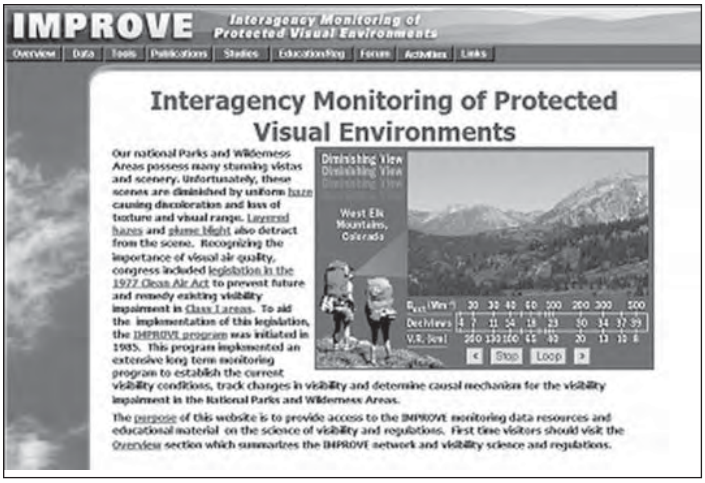

Figure 2. The IMPROVE Web site was developed by CIRA in 2000.

setting up basic organizational structures and technical work plans in anticipation of developing specific plans to reduce regional haze.

In 2001, the EPA announced the availability of two guidance documents, which states and regional planning organizations would use to help them in their efforts. The "Estimating Natural Visibility Conditions" and "Tracking Progress" guidance documents (Figure 4) supported the regional haze program and offered ways to address program requirements. Another important document was the development of a QAPP for aerosol monitoring, which the EPA accepted in 2002. EPA began the requirement of monitoring programs having acceptable QAPPs for all federally funded programs that generated data for use in regulations.

New rules

This 1998-2002 period also saw striking new rules being developed and implemented, which spurred increased expansion of the aerosol network. The Regional Haze Rule, guidance documents, and the program's first Quality Assurance Project Plan (QAPP) were all created in support of the Regional Haze Rule. EPA also called for the creation of regional planning organizations.

On April 22, 1999, the EPA issued final regional haze regulations, which called for states to establish goals for improving visibility in 156 federal Class I areas, and to develop long-term strategies for reducing air pollutant emissions that cause visibility impairment. State and local air quality agencies would implement the regional haze program through the formation of five regional planning organizations (Figure 3). Members of the regional groupings began by

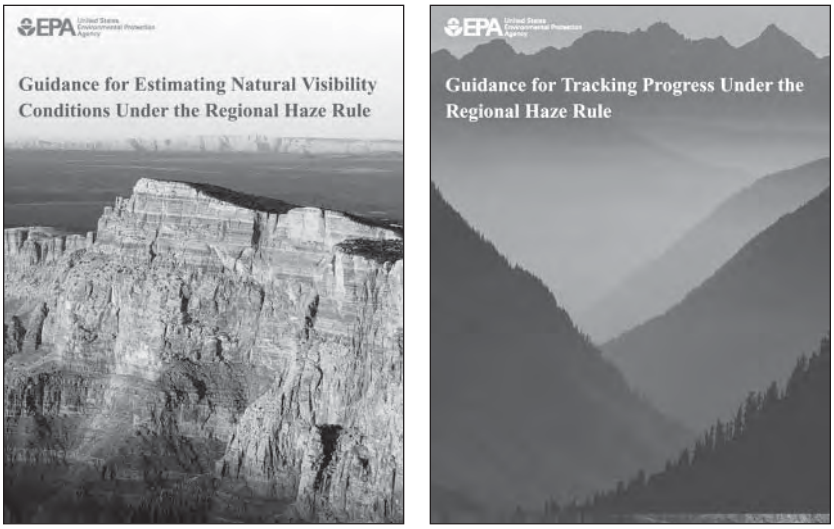

Figure 4. EPA's guidance documents: Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule, and Guidance for Tracking Progress Under the Regional Haze Rule, were developed to aid states in working towards the Rule's goals.

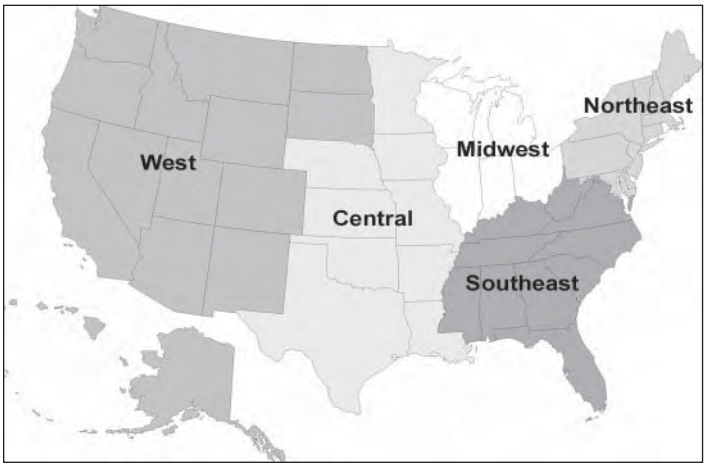

Figure 3. EPA formed five state divisions which would develop into regional planning organizations, and would form working relationships toward the goal of improving visibility and regional haze.

Also beginning in 2001, the IMPROVE program redefined its three-month reporting periods. Historically, visibility data were reported according to meteorological seasons (winter, spring, summer, and fall) where winter was comprised of December, January, and February. From this point on, data were reported according to calendar quarters (1st, 2nd, 3rd, and 4th) where 1st Quarter was comprised of January, February, and March. This change allowed IMPROVE data to be more conveniently compared to other air quality data and standards which traditionally have been based on calendar quarters. The change was also made to aid states in using IMPROVE data to develop their state implementation plans, as directed by the Regional Haze Rule.

New technologies and new rules continued on page 6....

New technologies and new rules continued from page 5....

New members

MARAMA, the Mid-Atlantic Regional Air Management Association, was welcomed to the steering committee in 1999, to help guide the IMPROVE program from a regional perspective. Also that same year, the committee approved a new category of steering committee membership, Associate Membership, to foster additional IMPROVE-comparable monitoring that will aid in understanding of Class I area visibility, without upsetting the balance of organizational interests obtained by the steering committee participants. The state of Arizona became the first Associate Member.

Because of the addition of new steering committee members and development of regional planning organizations, the aerosol network expanded again, to include locations whose data would help define the strategies needed for the new Regional Haze Rule (Figure 5).

Special studies

Two major special studies were performed by IMPROVE scientists and researchers during this period:

- Big Bend Regional Aerosol and Visibility Observational Study (BRAVO) - was designed to investigate the causes of haze at Big Bend National Park, Texas. The network operated from July to October, 1999, measuring fine aerosol mass and its constituents, atmospheric optical properties, gaseous air pollutants, and meteorology.
- Yosemite Aerosol Characterization Study (YACS) - was an intensive field measurement campaign conducted by a number of U.S. research groups from July 15 to September 4, 2002, at Yosemite National Park, California.

Next time

In the next issue of this newsletter, the fourth and final installment of this series, we will look at the period 2003 to the present. This period sees an expanding independent quality assurance program that includes the introduction of the VIEWS Web site, the introduction of a new algorithm for estimating light extinction, and network assessment in anticipation of the first possible large-scale network reduction since the beginning of the program.

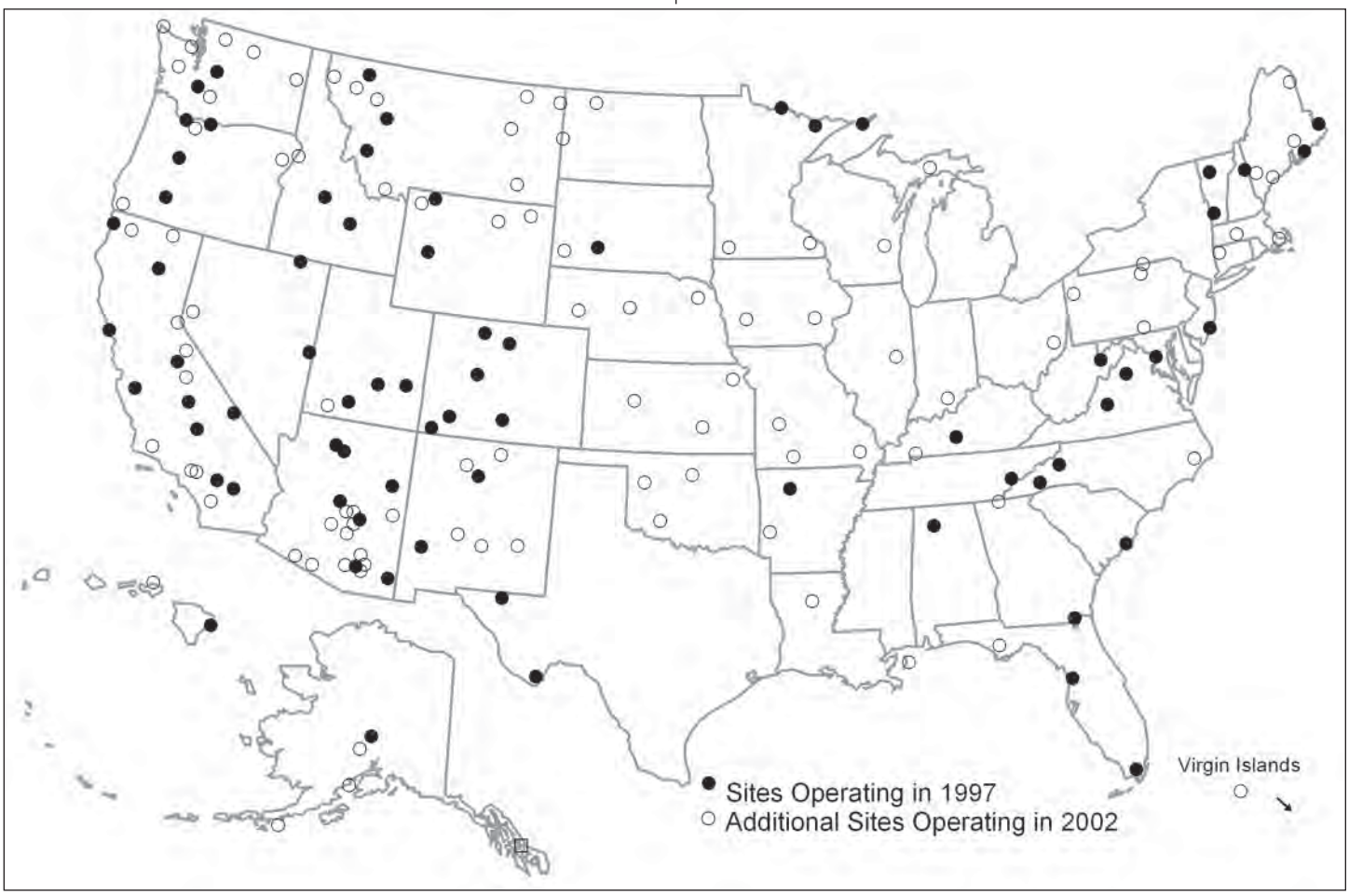

Figure 5. IMPROVE aerosol monitoring network in 1997 and in 2002. Note the growth in the mid-section of the nation, largely due to the development of regional planning organizations.

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 1st Quarter 2008 are:

Aerosol (Channel A)

Addison Pinnacle	Frostburg Reservoir	Okefenokee
Bandelier	Gila	Organ Pipe
Bliss	Glacier	Pasayten
Bondville	Great Basin	Penobscot
Bridger	Great River Bluffs	Petrified Forest
Bridgton	Great Sand Dunes	Pinnacles
Brigantine	Great Smoky Mountains	Point Reyes
Cape Romain	Haleakala Crater	Presque Isle
Capitol Reef	Ike's Backbone	Proctor Research Ctr
Cedar Bluff	Indian Gardens	Puget Sound
Chassahowitzka	Isle Royale	Quaker City
Cherokee	James River	Queen Valley
Cloud Peak	Jarbidge	Seney
Columbia Gorge East	Joshua Tree	Shenandoah
Columbia Gorge West	Livonia	Sikes
Craters of the Moon	Mammoth Cave	Starkey
Crescent Lake	Meadview	Theodore Roosevelt
Death Valley	Medicine Lake	Three Sisters
Denali	MK Goddard	Tonto
Dolly Sods	Mohawk Mountain	Trapper Creek-Denali
Egbert	Moosehorn	Tuxedni
El Dorado Springs	Mount Rainier	Viking Lake
Fort Peck	New York	Yosemite
Fresno	Northern Cheyenne	Zion Canyon

Nephelometer

Big Bend	Greer	Petrified Forest
Estrella	Ike's Backbone	Sierra Ancha
Great Basin		

Transmissometer

Cloud Peak

Photographic

Cucamonga
Gates of the Mountain

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 1st Quarter 2008 are:

Aerosol (Channel A)

Acadia	Linville Gorge	San Gorgonio
Bosque del Apache	Lostwood	Sipsey
Boundary Waters	Makah	St. Marks
Bryce Canyon	Mount Baldy	Sula
Caney Creek	Mount Hood	Sycamore Canyon
Cape Cod	Pasayten	Tallgrass
Hells Canyon	Redwood	Washington DC
Kalmiopsis	Rocky Mountain	White Mountain
Lake Sugema	Sac and Fox	White River
Lava Beds	Salt Creek	Wichita Mountain

Nephelometer

Acadia	Great Smoky Mtns.	Phoenix
Children's Park	Hance	Queen Valley
Chiricahua	Indian Gardens	Rocky Mountain
Craycroft	Mount Rainier	Sycamore Canyon
Cloud Peak	Mount Zirkel	Tucson
Dysart	National Capital	Tucson Mountain
Glacier	Organ Pipe	

Transmissometer

San Gorgonio
Thunder Basin

Photographic

Monture

Sites that achieved at least 90% data collection for 1st Quarter 2008 are:

Aerosol (Channel A)

Agua Tibia	Flathead	San Gabriel
Badlands	Gates of the Mountains	San Rafael
Big Bend	Grand Canyon	Sawtooth
Birmingham	Haleakala	Shamrock Mines
Cabinet Mountains	Martha's Vineyard	Simeonof
Cadiz	Mesa Verde	Snoqualmie Pass
Canyonlands	Mount Zirkel	UL Bend
Casco Bay	Nebraska	Upper Buffalo
Chiricahua	North Absaroka	Weminuche
Douglas	Phoenix	Wheeler Peak
Ellis	Quabbin Reservoir	White Pass
Everglades		

Nephelometer

Mammoth Cave	Thunder Basin	Vehicle Emissions
Shenandoah		

Transmissometer

-- none --

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.

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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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