INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

1st Quarter 2004 | The IMPROVE Newsletter | Volume 13 / Number 1

Feature Article: MANE-VUs Rural Aerosol Intensive Network, Page 4

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

- 53 aerosol samplers
- 19 transmissometers
- 43 nephelometers
- 14 film or digital camera systems
- 43 Web camera systems
- 3 interpretive displays

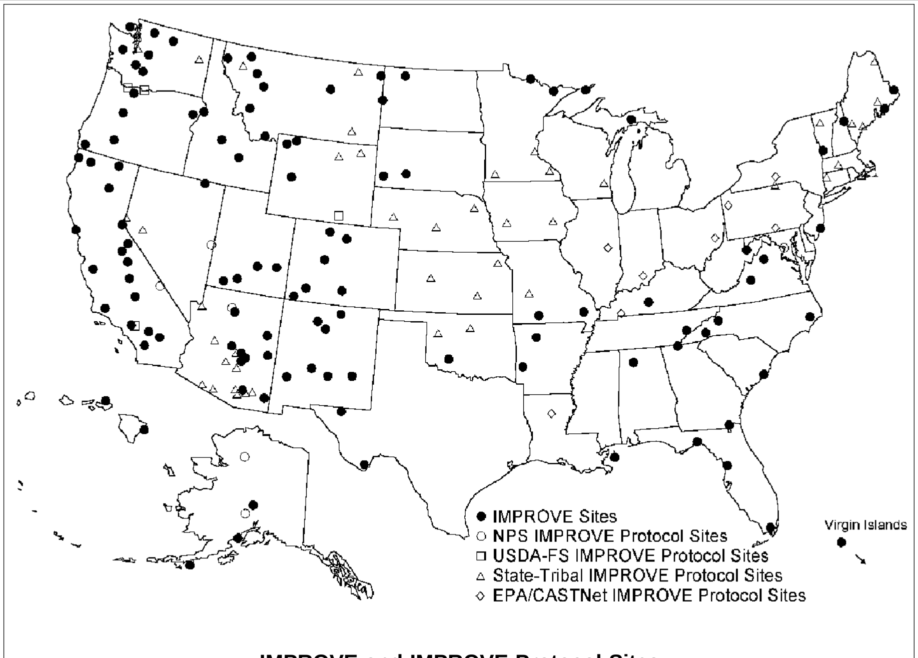
IMPROVE Program participants are listed on page 8. Federal land managers, states, tribes, and other agencies operate supporting instrumentation at monitoring sites as presented in the map below. Preliminary data collection statistics for the 1st Quarter 2004 (January, February, and March) are:

- Aerosol (channel A only) 96% collection
- Aerosol (all modules) 95% completeness
- Optical (transmissometer) 93% collection
- Optical (nephelometer) 97% collection
- Scene (photographic) 73% collection

Instrumentation added to the networks this quarter includes a nephelometer at Cape Romain National Wildlife Refuge, SC, by the VISTAS group in January, and a nephelometer at Cohutta Wilderness, GA, by the USDA-Forest Service in February. A Web camera system was also installed at Point Reyes National Seashore, CA, in January.

Instrumentation that ended operation this quarter includes an aerosol sampler at Brooklyn Lakes, WY (ended December 2003), a nephelometer at Quaker City, OH (ended January 2004), and a camera system at San Juan Islands, WA, (ended February 2004).

A collocated IMPROVE aerosol sampler was installed at the Phoenix supersite in March. This sampler was installed for quality assurance purposes and is not considered a network instrument. It is the first collocated instrument at an IMPROVE site in an urban area.



IMPROVE and IMPROVE Protocol Sites
1st Quarter 2004

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 August 2003. Transmissometer data are available through December 2002 and nephelometer data are available through December 2003. Photographic slide spectrums are also available on the IMPROVE Web site, under *Data*.

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

Special studies

Nitrates are focus of aerosol ion study

A series of special study field campaigns is ongoing at several IMPROVE monitoring locations to examine aerosol ion composition and related sampling issues. The studies, conducted by scientists in Colorado State University's Atmospheric Science Department, with assistance from the IMPROVE monitoring team at UC-Davis, are looking at the size distributions of aerosol ions, the chemical forms of aerosol nitrate, sampling issues related to accurate measurement of aerosol ion species (especially nitrate and ammonium), and temporal variability in $PM_{2.5}$ aerosol ion concentrations.

Five field campaigns have been completed to date, each lasting approximately one month:

- Bondville (February 2003)
- San Gorgonio (April and July 2003)
- Grand Canyon (May 2003)
- Brigantine (November 2003)
- An additional campaign is planned for July/August 2004 in Great Smoky Mountains National Park.

Measurements during the campaigns include:

- 24-hour denuder/filter-pack measurements to look at $PM_{2.5}$ ion composition, aerosol sampling artifacts, and key trace gas (NH_3, HNO_3) concentrations,
- 48-hour Micro Orifice Uniform Deposit Impactor (MOUDI) measurements to examine ion size distributions from approximately 0.1 - 10 µm, and
- A Particle Into Liquid Sampler (PILS) coupled to two ion chromatographs to look at $PM_{2.5}$ aerosol ion concentrations with a time resolution of 15 minutes.

Ions being measured by all three techniques include Na^+, K^+, NH_4^+, Mg^{2+}, Ca^{2+}, Cl^-, NO_3^-, and SO_4^{2-}.

Preliminary results from the studies indicate that large concentration variations are present within 24-hour periods at all of the studied locations. Aerosols at Bondville, for example, were observed to rapidly change between sulfate-dominated and nitrate-dominated forms and vice versa. Large diurnal swings in aerosol concentrations at San Gorgonio occur nearly every day in conjunction with daily upslope-downslope wind patterns. The form of nitrate present at different IMPROVE sites was also found to vary, with ammonium nitrate (NH_4NO_3) dominating at some sites (e.g., Bondville in winter) and coarse mode sodium or calcium nitrate dominating at other locations (e.g., during the Grand Canyon study). The importance of coarse mode nitrate observed in these campaigns is consistent with other recent observations in summertime special studies at Big Bend and Yosemite National Parks. Potential artifacts associated with ion sampling and extraction from nylon filters are also being studied. One clear initial result is that while nylon filters are efficient at retaining nitric acid that volatilizes from collected NH_4NO_3 particles, a significant fraction of ammonium collected as NH_4NO_3 on these filters is lost over the course of a 24-hour sample.

For more information contact Jeff Collett at Colorado State University. Telephone: 970/491-8697. Fax: 970-491-8449. E-mail: collett@lamar.colostate.edu.

Nephelometer comparison study

A 6-month nephelometer comparison study began in April, using eight instruments from three manufacturers. Air Resource Specialists, Inc. staff and researchers from the Cooperative Institute for Research in the Atmosphere and Colorado State University are cooperatively performing the study in Fort Collins, Colorado.

Nephelometers in the study include:

- 1 Optec NGN-2 ambient nephelometer
- 2 Modified, size-cut Optec NGN-2 nephelometers
- 1 Optec NGN-3 size-cut nephelometer
- 2 Ecotech M9003 integrating nephelometers
- 2 Radiance Research M903 nephelometers

Meteorological parameters are also used. Heating of the sample air can occur in nephelometers. This heating can modify the ambient aerosols, particularly at high relative humidities. The Radiance Research and Optec instruments use flash-style and halogen lamps, respectively, as light sources, which can contribute to sample chamber heating. The more recently developed Ecotech nephelometers use cooler light emitting diodes (LEDs) as the light source instead of standard lamps.

All instruments except the ambient NGN-2 are equipped with $PM_{2.5}$ inlets. Temperature is measured in the inlet and in the exhaust near the measurement chamber to monitor temperature changes to the sample air. Of particular interest is each instrument's response to various relative humidity conditions. The results of this study will include comparisons of measured optical parameters with emphasis on performance, uncertainties, and limitations of each monitoring technique.

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.

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

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 2004 are:

Aerosol

Addison Pinnacle	Gates of the Mountains	Pasayten
Badlands	Glacier	Phoenix
Bandelier	Great Basin	Pinnacles
Big Bend	Great Gulf	Presque Isle
Bliss	Great Sand Dunes	Proctor Research Center
Blue Mounds	Great Smoky Mountains	Quabbin Reservoir
Bondville	Hawaii Volcanoes	Quaker City
Bosque del Apache	Hells Canyon	Rocky Mountain
Bridger	Hercules-Glades	Saguaro
Bridgton	Hoover	Saguaro West
Brigantine	Isle Royale	Salt Creek
Bryce Canyon	Jarbidge	San Gorgonio
Cabinet Mountains	Kaiser	Seney
Caney Creek	Kalmiopsis	Shenandoah
Cape Cod	Linville Gorge	Sikes
Cape Romain	Livonia	Simeonof
Casco Bay	Lye Brook	Snoqualmie Pass
Cedar Bluff	Mammoth Cave	Starkey
Chassahowitzka	Martha's Vineyard	Sycamore Canyon
Chiricahua	Meadview	Theodore Roosevelt
Cohutta	Medicine Lake	Three Sisters
Connecticut Hill	Mesa Verde	Trapper Creek - Denali
Craters of the Moon	MK Goddard	Upper Buffalo
Crescent Lake	Mohawk Mountain	Washington DC
Death Valley	Moosehorn	Weminuche
Denali	Mount Rainier	White Mountain
Dolly Sods	Mount Zirkel	Wind Cave
El Dorado Springs	Northern Cheyenne	Yosemite
Ellis	Okefenokee	Zion
	Old Town	

Transmissometer

Bandelier	Petrified Forest
Grand Canyon (South Rim)	San Gorgonio
Grand Canyon (In Canyon)	

Nephelometer

Big Bend	Mammoth Cave
Grand Canyon (Hance)	Mount Rainier

Photographic

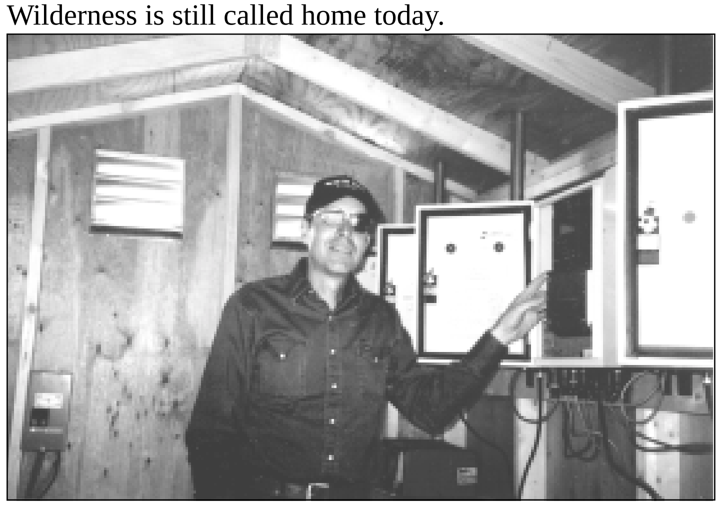
Red Rock Lakes

Operators of distinction

Retirement isn't all that for Bob Palko, site operator at White Mountain Wilderness, New Mexico. After 25 years of teaching school in nearby Ruidoso, Bob retired, but he still keeps busy with various activities and interests, one of which is maintaining an aerosol sampler for the IMPROVE Program. His dedication to the operation of the site is reflected in the amount of data collected. The site collected 93% of all possible data in 2003, with help from back-up operators Coy Stambaugh and Cheryl Palko.

Bob contracts with the USDA-Forest Service to run the aerosol sampler, which is the only air quality piece of equipment at White Mountain. "The site is actually between two wildernesses," said Bob. "It lies between the White Mountain Wilderness and the Capita Mountains Wilderness, in the south-central part of the state." The very remote region does see some tourists, however, who come primarily to ski. Every Tuesday Bob ensures the filter cartridges are changed, and mails the exposed ones back to the laboratory for analysis. "The site is not unusual," said Bob, "it has occasionally received lightning strikes since its installation in January 2002. And for a period of about 10 days or so the power was out due to its being connected to the local village well pump, which was undergoing maintenance."

Since Bob made a career in teaching, this is his first job in the air quality field. In addition to servicing the aerosol sampler, Bob also is a structure protection specialist for the New Mexico Type II Incident Management Team. His skills are called upon during wildland fires; the team also assisted with the Columbia Space Shuttle Recovery mission in early 2003. Bob's other activities and interests are traveling (he has been to Europe several times), hiking, and being a WWII history buff. He and his wife moved to New Mexico in 1973, where they raised two daughters, and the house he built near the White Mountain Wilderness is still called home today.



Bob Palko enjoys being IMPROVE site operator in the White Mountain Wilderness, New Mexico.

Feature article

Aerosol/visibility related rural “transport supersites” in the Northeast U.S. under the MANE-VU program: The Rural Aerosol Intensive Network (RAIN)

(by George Allen, NESCAUM)

Regional haze in the Mid-Atlantic/Northeast Visibility Union (MANE-VU) domain is driven by a combination of transported aerosols from sources within and outside of the 12-state region. Determining the relative contribution of source regions to visibility degradation is a key task under the Regional Haze Rule. A new network of sites is being deployed in Spring 2004 to assess this issue.

The Rural Aerosol Intensive Network (RAIN) is coordinated by the Northeast States for Coordinated Air Use Management (NESCAUM), but is a cooperative effort of MANE-VU member state air agencies. RAIN covers the region from western Maryland (near large sulfur sources in the Ohio River Valley), through northwest Connecticut (a “swing” site expected to have impact from a wide range of source locations and types), to Acadia National Park on the Maine coast — the proverbial “end of the tailpipe” transport receptor site. The initial network consists of these three rural, moderate elevation (700 to 2,500 feet) sites, in a southwest to northeast line (see Figure 1), all with detailed particulate matter and visibility-related measurements. The network design includes highly time-resolved (1-2 hour) aerosol mass, composition, and optical property measurements to provide enhanced insight into regional aerosol generation and source characterization, factors that drive short-term visibility, and aerosol model performance and evaluation.

Highly time-resolved aerosol data are at the core of this network, since they can provide dramatic insight into source influence and atmospheric and chemical processes (much of this information is lost when sampling on a daily time scale). An example of this is the hourly relationship between sulfate (SO_4) and sulfur dioxide (SO_2) at the summit of Mt. Washington, NH, (6,300 ft.) during a major regional haze event in August 2002 (see Figure 2). The left axis shows SO_4 and SO_2 in molar units for direct comparison, and the right axis shows them in more commonly used units. The bottom plot is the percent sulfur (S) converted from SO_2 to SO_4. The onset of the event mid-day UTC (7AM local time) on August 11th shows both SO_4 and SO_2 rising rapidly over a few hours and then dropping somewhat. The percent S converted shows a relatively smooth rise during this same period, a much less dynamic signal. Over the four core days of the event, August 12th through August 15th, the percent converted gradually rises from about 25% to 75%, which implies a more aged air mass later in the event.

Many other useful temporal aspects of these data are in this example that would be inaccessible from 24-hour duration samples. From a “sub-daily” short-term visibility perspective, factors such as the rapid changes in sulfate shown here combined with strong diurnal cycles in relative humidity can result in very large deviations across a day from average visual range. RAIN will provide both direct hourly measurement of visual range and most of the factors that drive it in the eastern U.S., which will provide opportunities to improve our understanding of the overall process.

Figure 1. RAIN network in the Northeast U.S. Three monitoring locations are shown on a SW to NE line, in western Maryland, northwest Connecticut, and Acadia National Park, Maine.

Recent advances in measurement technologies have made it practical to deploy continuous methods for measuring real-time sulfate and elemental/organic aerosol carbon, that are both relatively straightforward to run and provide high quality data. The Sunset Laboratory field carbon analyzer and the new Thermo

Environmental sulfate analyzer (based on a method developed at Harvard) will be used at the RAIN sites; this will be the first use of these new methods in routine ongoing state-run networks. (The Mt. Washington 2002 hourly sulfate data are from an early version of the Harvard/Thermo analyzer). These methods, combined with other more routine measurements such as IMPROVE aerosol, Optec NGN-2 (wet) nephelometers, continuous $PM_{2.5}$, trace SO_2, ozone, meteorology, and automated digital visibility cameras (CAMNET), make up the RAIN core monitoring lineup. The RAIN network design is an example of supplemental measurements at IMPROVE sites which help fill in the detailed temporal details of the physical, optical, and chemical features of regional haze. This network might also serve as a template for the new rural “Type 2” Ncore Environmental Protection Agency monitoring network design. Some of the RAIN sites will have additional related measurements, including “true” trace carbon monoxide, reactive oxidized nitrogen containing compounds (NO_y), dry scattering (Optec NGN-3a nephelometer), and other measurements.

As part of the “Technology Transfer” process of new measurement methods from research-oriented sites to routine state/local agency deployment, one of the early tasks of RAIN will be to evaluate and optimize the carbon and sulfate aerosol method’s operational parameters. One example of this optimization process is the wide range of choices on how the Sunset Laboratory carbon analyzer could be run. Numerous operational issues and options were identified prior to the start of the RAIN program. These include the magnitude of organic carbon (OC) blanks (which could be a substantial amount relative to rural OC aerosol levels even with the OC sample stream denuder), and the option of a 2-hour cycle for “OC1-2-3-4” thermal fractions, which might be useful for OC source-type characterization especially on a time-resolved basis (and also gives a substantial reduction in the OC blank value). Yet to be determined is how the Sunset carbon analyzer (a thermal/optical transmission (TOT) method) might be run to give a more IMPROVE-like elemental carbon (EC)/OC thermal/optical reflectance (TOR) measurement. We are working closely with Sunset Labs on these and other issues related to this method.

A longer term goal of RAIN is to enhance the network with other measurements and sites in future years. A National Weather Service Automated Surface Observing System (ASOS) visibility sensor at a RAIN site would allow the large network of existing ASOS data to be “tethered” to visibility measurements we understand well. Strong aerosol acidity, nitric acid, and ammonia are measurements that would be desirable on either an integrated or real-time basis. There are no continuous nitrate measurements in RAIN at this time, since available methods are not yet sufficiently robust, and nitrate is not (yet) a major factor at these sites. Measurements similar to those in RAIN done to the west and south of the MANE-VU domain (Ohio and Virginia for example) would greatly enhance our understanding of the impact of the large sulfur source region in and around the Ohio River Valley on regional visibility. We expect to make data from RAIN available in real-time to Web data resources like VIEWS, FASTNET, and AIRNow.

RAIN would not be possible without the ongoing support of the participating state air agencies in MD, CT, and ME, as well as the National Park Service and MANE-VU.

For more information contact George Allen at NESCAUM. Telephone: 617/367-8540 x235. Fax: 617/742-9162. E-mail: Gallen@nescaum.org.

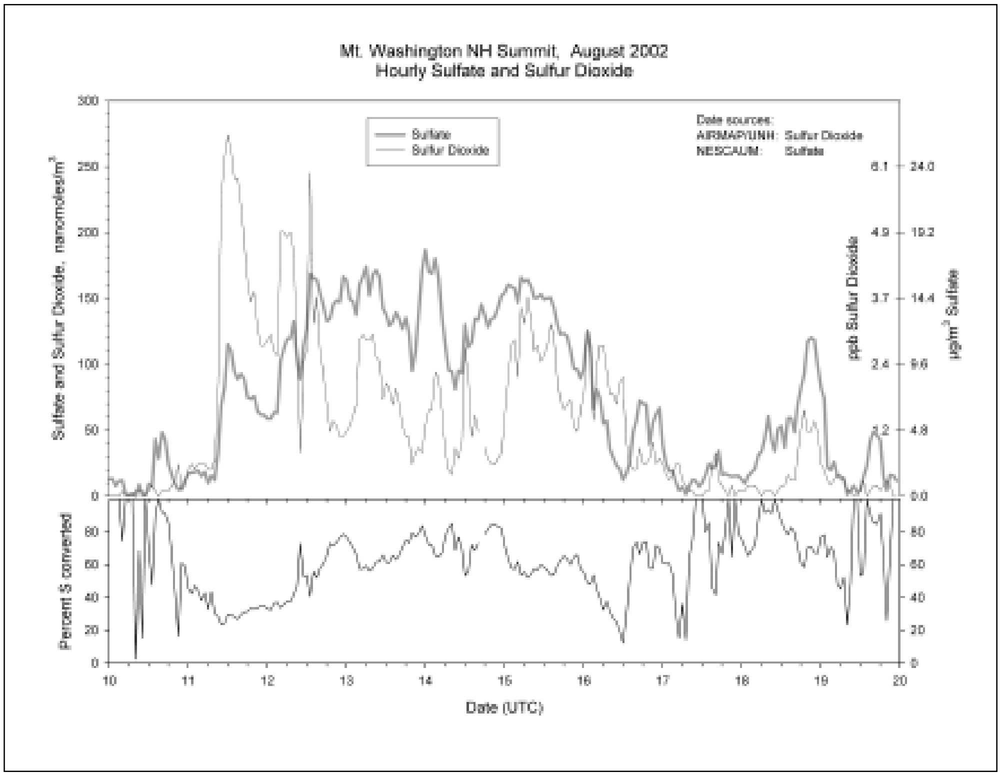


Figure 2. Hourly relationship between sulfur dioxide and sulfate at Mt. Washington, NH, in August 2002.

The bottom portion indicates the percent sulfur converted from sulfur dioxide to sulfate during the same time periods.

Visibility news

WinHaze visual air quality modeler updated

WinHaze version 2.9.6 was released by Air Resource Specialists, Inc. in March. The freeware computer-imaging software program simulates visual air quality differences of various scenes. First created in 1998, the software now contains 134 national park, wilderness, and urban scenes. It allows users to view visual air quality scenarios on their desktop computer as a supplement to air quality monitoring. Users can model scenes using different optical parameters or aerosol species, to simulate effects they have on the scenes. The freeware can be downloaded from the Web by logging onto *http://www.air-resource.com*. Click on What's New for system information and download (the file is 153mb).

WinHaze is also available on CD. Call Air Resource Specialists, Inc. Telephone: 970/484-7941. Fax: 970/484-3423. E-mail: info@air-resource.com.

Operators achieve 93% collection for 2003

Collection statistics for the IMPROVE and IMPROVE Protocol aerosol networks show an impressive 93% data collection for 2003, indicating that site operators operated and maintained their aerosol samplers efficiently. Collected data undergo validation, using specific criteria stipulated by the Regional Haze Rule. For these data to be used to track progress in improving visibility, and be included in preparing state implementation plans, monitoring sites must achieve:

- At least 75% annual completeness
- At least 50% completeness in each calendar quarter
- Have no more than 10 consecutive missed samples

Out of 165 sites in the networks, only 8 failed to meet these criteria. Generally, sites that failed did so because of unique situations, and most involved the 10 consecutive missed sample stipulation. The University of California-Davis, the program's aerosol monitoring contractor, is implementing new procedures that will further assist operators in obtaining the highest possible collected samples. These procedures are:

- Field staff will stress to operators the importance of not missing 10 consecutive samples.
- Field staff will ship replacement equipment by overnight courier (on-site repairs are not attempted), to sites that approach the 10 or more limit.
- Field staff will be sent directly to the site if other remedies have failed (or if the site is approaching the 10 or more limit).

Collection statistics for each site for 2003 are provided in the following listing.

Site	% Year	% 1stQtr	% 2ndQtr	% 3rdQtr	% 4thQtr	# Mis.
Acadia	99	100	97	100	100	1
Addison Pinn.	99	100	100	100	97	1
Agua Tibia	83	87	73	94	77	8
Arendtsville	99	97	100	100	100	1
Badlands	99	100	100	97	100	1
Bandelier	83	87	87	71	90	9
Big Bend	93	83	90	100	100	3
Bliss	82	90	73	77	87	7
Blue Mounds	98	97	93	100	100	2
Bondville	95	100	83	100	97	4
Bosque del Apa.	86	80	90	94	80	3
Boundary Wat.	89	100	90	97	70	5
Breton	88	97	80	100	77	7
Bridger	97	100	100	94	93	2
Bridgton	86	100	73	71	100	8
Brigantine	93	93	93	90	93	2
Brooklyn Lakes	92	90	90	87	100	3
Bryce Canyon	92	100	100	84	83	5
Cabinet Mtns.	98	93	100	100	100	1
Cadiz	96	93	97	100	93	2
Caney Creek	97	100	100	87	100	3
Canyonlands	93	100	83	87	100	5
Cape Cod	80	87	60	77	97	9
Cape Romain	95	100	93	97	90	3
Capitol Reef	81	90	77	58	100	8
Casco Bay	98	100	100	94	97	2
Cedar Bluff	88	100	80	94	80	5
Chassahowitzka	98	100	97	94	100	1
Cherokee	89	93	87	90	87	7
Chicago	100	--	--	--	100	0
Chiricahua	100	100	100	100	100	0
Cloud Peak	93	83	97	90	100	4
Cohutta	83	93	63	81	93	11
Columbia G. E.	99	100	100	100	97	1
Columbia G. W.	92	90	97	90	90	3
Connecticut Hill	98	100	97	97	100	1
Crater Lake	94	100	97	100	80	6
Craters of Moon	85	97	90	81	73	6
Crescent Lake	93	93	100	84	97	3
Death Valley	82	100	40	90	97	14
Denali	98	97	100	97	97	1
Detroit	100	--	--	--	100	0
Dolly Sods	94	97	90	97	93	3
Dome Land	94	100	97	87	93	2
El Dorado Spgs.	99	97	100	100	100	1
Ellis	100	100	100	100	100	0
Everglades	83	90	80	77	87	10
Flathead	97	100	100	90	97	2
Fort Peck	96	93	100	90	100	2
Gates of Mtns.	92	90	87	90	100	4
Gila	86	100	83	81	80	4
Glacier	84	100	93	48	97	15
Grand Canyon	98	100	93	100	97	2

Operators achive 93% continued on page 7....

Operators achieve 93% continued from page 6....

Site	% Year	% 1stQtr	% 2ndQtr	% 3rdQtr	% 4thQtr	# Mis.
Great Basin	85	63	77	100	100	7
Great Gulf	99	100	100	100	97	1
Great Sand Dun.	98	100	90	100	100	3
Great Smokies	96	90	97	97	100	2
Green Riv. Bluffs	93	90	97	84	100	5
Guadalupe Mtns.	72	100	10	77	100	24
Haleakala	94	87	90	100	100	3
Hawaii Volcan.	98	100	100	90	100	3
Hells Canyon	71	87	53	68	77	10
Hercules-Glades	100	100	100	100	100	0
Hillside	99	100	97	100	100	1
Hoover	98	93	100	97	100	1
Ike's Backbone	95	93	100	87	100	3
Indian Gardens	71	100	60	45	80	14
Isle Royale	98	90	100	100	100	1
James River	100	100	100	100	100	0
Jarbidge	90	97	100	97	67	10
Joshua Tree	98	93	100	97	100	2
Kaiser	83	87	77	77	93	6
Kalmiopsis	95	100	100	81	100	3
Lake Sugema	92	97	90	81	100	6
Lassen Volcanic	98	97	97	100	97	1
Lava Beds	98	97	100	100	97	1
Linville Gorge	95	83	100	97	100	2
Livonia	99	100	100	97	100	1
Lostwood	100	100	100	100	100	0
Lye Brook	98	100	100	100	93	1
Mammoth Cave	99	100	97	100	100	1
Martha's Vine.	88	76	90	87	97	5
Meadview	94	100	90	90	100	3
Medicine Lake	92	87	90	94	97	3
Mesa Verde	90	93	70	97	100	4
Mingo	88	70	83	100	100	3
MK Goddard	96	97	87	100	100	2
Mohawk Mtn.	100	100	100	100	100	0
Monture	93	100	80	94	97	5
Moosehorn	99	97	100	100	100	1
Mount Baldy	95	97	90	97	97	3
Mount Hood	99	100	97	100	100	1
Mount Rainier	86	97	90	90	64	9
Mount Zirkel	88	77	87	97	93	7
Nebraska	91	90	97	97	80	6
North Absaroka	88	97	80	97	80	4
North Cascades	91	100	73	97	100	3
N. Cheyenne	91	73	93	97	100	3
Okefenokee	100	100	100	100	100	0
Old Town	97	97	100	100	90	3
Olympic	99	97	100	100	100	1
Omaha	90	--	--	74	100	3
Organ Pipe	97	96	100	94	100	2
Pasayten	97	100	87	100	100	2
Petrified Forest	95	93	97	100	90	3
Phoenix	92	97	80	90	100	5
Pinnacles	98	100	100	94	100	1
Point Reyes	81	57	83	87	97	12
Presque Isle	96	83	100	100	100	3
Proctor Res. Ctr.	99	100	97	100	100	1
Quabbin Resvr.	98	100	100	94	100	1
Quaker City	98	100	93	100	97	2
Queen Valley	99	100	100	100	97	1
Redwood	89	87	83	97	90	5
Rocky Mtn.	97	90	100	97	100	3
Sac and Fox	93	97	100	77	97	4
Saguaro	95	90	90	100	100	3
Saguaro West	99	100	100	100	97	1
Salt Creek	95	93	93	97	97	2
San Gabriel	95	100	100	81	100	3
San Gorgonio	96	97	100	97	90	2
San Pedro Parks	84	70	97	87	83	9
San Rafael	75	83	83	58	77	8
Sawtooth	87	90	90	87	80	5
Seattle	91	90	100	100	73	3
Seney	98	100	90	100	100	3
Sequoia	73	60	73	65	93	10
Shenandoah	89	93	97	84	83	3
Shining Rock	83	73	57	100	100	7
Sierra Ancha	82	63	93	77	93	10
Sikes	99	100	100	97	100	1
Simeonof	90	100	97	65	100	1
Sipsey	90	90	97	97	77	2
Snoqualmie Pass	99	100	100	100	97	1
Spokane	83	80	87	94	73	3
St. Marks	81	67	90	68	100	10
Starkey	100	100	100	100	100	0
Sula	96	100	97	90	97	1
Swanquarter	87	97	90	84	77	10
Sycamore Cnyn.	88	97	83	87	83	3
Tallgrass	98	93	100	100	100	2
T. Roosevelt	85	100	87	71	83	8
Three Sisters	100	100	100	100	100	0
Thunder Basin	85	100	57	90	93	10
Tonto	90	97	87	90	87	4
Trapper Creek	99	97	100	100	100	1
Trinity	93	80	100	97	97	3
Tuxedni	93	90	97	94	90	2
UL Bend	98	100	93	97	100	2
Upper Buffalo	97	100	100	94	93	2
Viking Lake	92	97	90	81	100	6
Virgin Islands	84	100	100	55	83	9
Voyageurs	97	100	93	94	100	2
Walker River	100	--	100	100	100	0
Washington DC	93	90	97	84	100	5
Weminuche	96	90	93	100	100	2
Wheeler Peak	82	83	70	87	87	5
White Mountain	93	100	90	97	83	5
White Pass	98	100	100	97	93	1
White River	100	100	100	100	100	0
Wichita Mtn.	98	100	97	97	100	1
Wind Cave	95	90	93	100	97	3
Yellowstone	88	90	87	87	90	3
Yosemite	93	100	100	84	90	3
Zion	99	97	100	100	100	1

Air Resource Specialists, Inc.
1901 Sharp Point Drive, Suite E
Fort Collins, CO 80525

TO:

First Class Mail

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:

U.S. EPA
Neil Frank
US EPA MD-14
Emissions, Monitoring and Analysis Div.
Research Triangle Park, NC 27711
Telephone: 919/541-5560
Fax: 919/541-3613
E-mail: frank.neil@epamail.epa.gov

USDA-FS
Rich Fisher
Air Program Technical Manager
USDA-Forest Service Air Program
2150A Centre Avenue
Fort Collins, CO 80526
Telephone: 970/295-5981
Fax: 970/295-5988
E-mail: rwfisher@fs.fed.us

STAPPA
Ray Bishop
Dept. of Environmental Quality
Air Quality Division
707 North Robinson
PO Box 1677
Oklahoma City, OK 73101-1677
Telephone: 405/702-4218
Fax: 405/702-4101
E-mail: ray.bishop@deq.state.ok.us

NOAA
Marc Pitchford *
c/o Desert Research Institute
755 E. Flamingo Road
Las Vegas, NV 89119-7363
Telephone: 702/862-5432
Fax: 702/862-5507
E-mail: marcp@snsc.dri.edu
* Steering Committee chair

NPS
William Malm
Colorado State University
CIRA - Foothills Campus
Fort Collins, CO 80523
Telephone: 970/491-8292
Fax: 970/491-8598
E-mail: malm@cira.colostate.edu

FWS
Sandra Silva
Fish and Wildlife Service
P.O. Box 25287
12795 W. Alameda
Denver, CO 80225
Telephone: 303/969-2814
Fax: 303/969-2822
E-mail: sandra_v_silva@fws.gov

WESTAR
Robert Lebens
715 SW Morrison
Suite 503
Portland, OR 97205
Telephone: 503/478-4956
Fax: 503/478-4961
E-mail: blebens@westar.org

BLM
Scott Archer
Sciences Center (RS-140)
P.O. Box 25047
Denver, CO 80225-0047
Telephone: 303/236-6400
Fax: 303/236-3508
E-mail: sarcher@blm.gov

NESCAUM
Rich Poirot
VT Agency of Natural Resources
103 South Main Street
Building 3 South
Waterbury, VT 05676
Telephone: 802/241-3807
Fax: 802/244-5141
E-mail: richpo@dec.anr.state.vt.us

MARAMA
David Krask
Maryland Dept. of the Environment
ARMA/Air Quality Planning and Monitoring
1800 Washington Blvd.
Baltimore, MD 21230-1720
Telephone: 410/537-3756
Fax: 410/537-4243
E-mail: dkrask@mde.state.md.us

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:

STATE OF ARIZONA
Darcy Anderson
Arizona Dept. of Environmental Quality
Air Quality Division
1110 W. Washington Street L120A
Phoenix, AZ 85007
Telephone: 602/771-7665
Fax: 602/771-4444
E-mail: anderson.darcy@ev.state.az.us

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

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

Air Resource Specialists, Inc.
Gloria S. Mercer, Editor
Telephone: 970/484-7941 ext.221
Fax: 970/484-3423
E-mail: info@air-resource.com

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