INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

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Feature Article: Recent findings concerning ammonium and nitrate, 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:

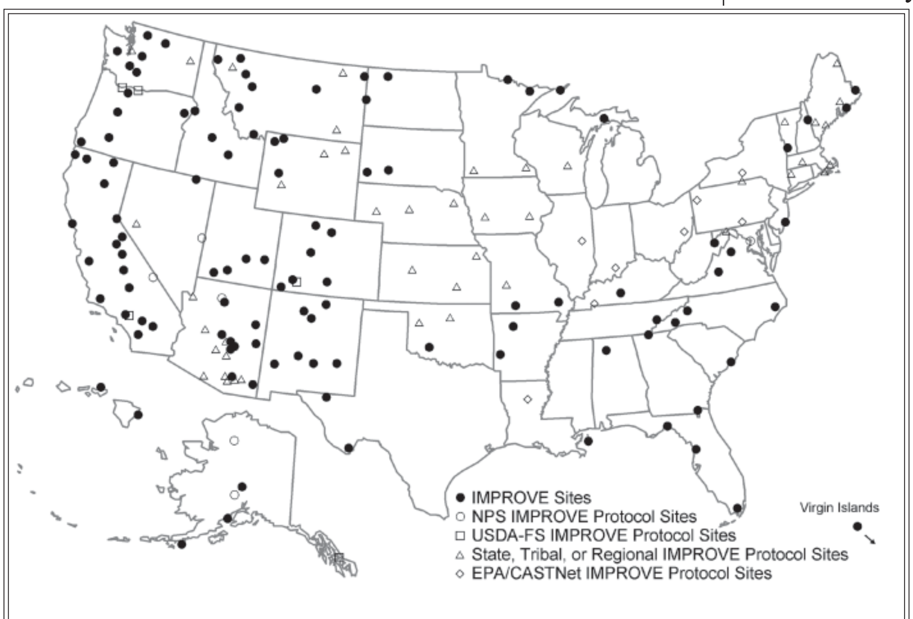
- 67 aerosol samplers
- 15 transmissometers
- 44 nephelometers
- 11 film or digital camera systems
- 51 Web camera systems
- 3 interpretive displays

IMPROVE Program participants are listed on page 8. Federal land managers, 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 2005 (January, February, and March) are:

- Aerosol (channel A only) — 95% collection
- Aerosol (all modules) — 94% completeness
- Optical (transmissometer) — 92% collection
- Optical (nephelometer) — 94% collection
- Scene (photographic) (does not include Web cameras) — 62% collection

Due to budgeting concerns, the USDA-Forest Service ended nephelometer data collection at Great Gulf Wilderness, New Hampshire, on April 1, 2005. The instrument will be left in place for awhile until other interested parties decide if they can fund the site. The instrument has operated during the summer months since 1995 and year-round since 2001. Budgeting also threatens continuance of the transmissometers at Bridger Wilderness, Wyoming, and San Gorgonio Wilderness, California, both installed in 1998. The USDA-FS is looking for funding partners for these operations. If funding partners cannot be found, monitoring at both locations may cease at the end of the fiscal year.

The state of Wyoming is sponsoring a nephelometer and Web camera in Boulder, WY. The nephelometer, run according to IMPROVE Protocol, became operational in January.



IMPROVE and IMPROVE Protocol Sites 1st Quarter 2005

Data availability status

Data are available on the IMPROVE Web site, at *http://vista.cira.colostate.edu/improve/Data/data.htm.* IMPROVE and other haze related data are also available on the VIEWS Web site, at *http://vista.cira.colostate.edu/views*. Aerosol data are available through May 2004. Transmissometer and nephelometer data are available through December 2003 and December 2004 respectively. Photographic slide spectrums are also available on the IMPROVE Web site, under *Data*. Real-time Web camera displays are available on a variety of agency-supported Web sites.

***Monitoring update** continued on page 6....*

Visibility news

IMPROVE's transitions to a new carbon analyzer

Since the beginning of the IMPROVE network in 1986, all carbon analysis of particle samples have been conducted by the Desert Research Institute (DRI) following the Thermal Optical Reflectance (TOR) method and hardware developed by Dr. James Huntzicker and his students at the Oregon Graduate Institute. The TOR method releases carbon from particles collected on quartz filters by heating them to specific temperatures in a helium atmosphere. The carbon released is then measured and labeled organic carbon. Four organic carbon (OC) subfractions correspond to four temperatures used during the OC phase of analysis. Oxygen is then added to the helium, and the temperature is further incremented, to combust non-volatile carbon corresponding to three additional temperature levels, to obtain three elemental carbon (EC) subfractions. Changes in laser light reflected from the particle deposit during the analysis process are used to adjust biases due to charring of OC that could be mistaken for EC, or oxidation of EC in the helium atmosphere that could be mistaken for OC. Recent experiments show that OC and EC defined by this reflectance are independent of the temperatures used to define the OC and EC subfractions.

In cooperation with Atmoslytics, Inc. (Calabasas, CA), DRI has developed new hardware and software to enhance the IMPROVE TOR and other carbon analysis protocols. More than 35 of these units are now being used in eight countries for OC, EC, carbonate carbon, and thermal fraction analyses. Last year DRI evaluated the older DRI/OGC and newer DRI Model 2001 units to ensure that the new systems provide OC and EC concentrations equivalent to those of the old systems. The DRI report posted on the IMPROVE Web site (*http://vista.cira.colostate.edu/improve/Publications/GrayLit/*) shows that OC and EC are the same for samples with a wide range of concentrations and composition. During their evaluation, DRI developed a novel approach to assess the actual temperatures of the quartz filters during each step of the analysis. This permitted the temperature profiles of the new system to be custom tailored to better simulate the temperatures that the samples experienced in the original analyzers. After due consideration of the information supplied by DRI, the IMPROVE Steering Committee has approved the use of the new carbon analyzer for all samples collected beginning January 1, 2005.

For more information contact Marc Pitchford at EPA/NOAA. Telephone: 702/862-5432. Fax: 702/862-5507. E-mail: marc.pitchford@noaa.gov.

Ambler station proves to be a challenge

The National Park Service (NPS) established an IMPROVE Protocol monitoring site in Ambler, AK, in October 2003. The installation was completed in June 2004, and has proved to be a maintenance challenge. The site sits just outside Kobuk Valley National Park, above the Arctic Circle, near the town of Ambler. It represents the NPS' Western Arctic region, a remote and sparsely populated area in the state.

Obtaining a long-term operator has been a challenge, but the site is fully operational now. Monitoring equipment includes an IMPROVE aerosol sampler, wet/dry deposition sampler, mercury sampler, and meteorological instrumentation operated by various air monitoring programs.

It is commonly assumed that Alaskan air is clean and pristine. Although true, seasonal airflow patterns during the winter and spring have been shown to transport European and Asian pollutants across to Alaska.

At left, the air quality monitoring shelter in Ambler, AK, with IMPROVE aerosol sampler, CASTNet filter-pack tower, and meteorological tower. Wet deposition and mercury deposition samplers are nearby.

The site's proximity to the town of Ambler is shown below.

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.

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)

Networks achieve 94% completeness for 2004

Aerosol completeness statistics for the IMPROVE and IMPROVE Protocol aerosol networks show an impressive 94% for 2004. Data from modules A, B, C, and D must be present for a sample day to be considered complete. After being 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 177 sites in the networks, only 6 failed to meet these criteria. Generally, sites that failed did so because of unique situations, and most involved the 10 consecutive missed sample stipulation. Collection statistics for each site for 2004 are provided in the following listing.

Site	% Year	% 1stQtr	% 2ndQtr	% 3rdQtr	% 4thQtr	# Mis.
Acadia	95	90	90	100	100	3
Addison Pinnacle	89	97	100	65	97	11
Agua Tibia	88	87	90	84	90	2
Arendtsville	99	97	100	100	100	1
Atlanta	96	n/a	100	94	97	1
Badlands	99	100	100	100	97	1
Baltimore	93	n/a	n/a	85	100	3
Bandelier	98	100	97	94	100	2
Big Bend	96	100	93	100	90	3
Birmingham	95	n/a	100	90	97	3
Bliss	86	55	97	100	93	12
Blue Mounds	96	100	93	94	97	4
Bondville	93	97	100	84	90	3
Bosque del Apache	98	100	97	100	97	1
Boundary Waters	93	84	97	94	100	3
Breton	72	77	43	84	100	17
Bridger	100	100	100	100	100	0
Bridgton	95	100	100	100	80	5
Brigantine	98	100	97	97	97	1
Bryce Canyon	89	81	93	84	97	3
Cabinet Mountains	96	97	100	87	100	4
Cadiz	90	90	100	87	83	5
Caney Creek	100	100	100	100	100	0
Canyonlands	91	68	100	97	100	3
Cape Cod	95	97	93	100	90	3
Cape Romain	95	100	80	100	100	3
Capitol Reef	82	90	83	71	83	5
Casco Bay	99	100	100	100	97	1
Cedar Bluff	99	100	97	100	100	1
Chassahowitzka	80	35	100	94	93	20
Cherokee	98	94	100	100	100	1
Chicago	98	100	93	100	100	2
Chiricahua	96	97	100	94	93	2
Cloud Peak	97	90	100	100	97	2
Cohutta	97	100	100	90	97	1
Columbia Gorge E.	94	94	100	84	100	5
Columbia Gorge W.	91	94	83	87	100	3
Connecticut Hill	95	97	100	84	100	5
Crater Lake	93	94	93	87	100	3
Craters of Moon	91	97	90	77	100	3
Crescent Lake	94	100	90	87	100	4
Death Valley	95	100	100	90	90	3
Denali	97	100	100	94	93	1
Detroit	98	100	100	90	100	2
Dolly Sods	100	100	100	100	100	0
Dome Land	87	97	70	94	87	8
Douglas	94	n/a	100	97	90	2
El Dorado Springs	93	100	100	100	70	3
Ellis	93	97	83	100	93	3
Everglades	98	97	97	97	100	1
Flathead	93	94	97	94	90	3
Fort Peck	86	74	90	81	100	5
Fresno	100	n/a	n/a	100	100	0
Frostburg Reservoir	97	n/a	88	100	100	3
Gates of the Mtns.	94	90	87	100	100	3
Gila	90	81	97	84	100	5
Glacier	96	100	90	97	97	3
Grand Canyon	99	97	100	100	100	1
Great Basin	94	94	97	90	97	3
Great Gulf	98	97	93	100	100	2
Great River Bluffs	93	81	93	100	100	6
Great Sand Dunes	98	100	100	100	90	1
Great Smoky Mtns.	97	100	100	90	97	3
Guadalupe Mtns.	90	87	93	84	97	4
Haleakala	93	87	90	100	97	2
Hawaii Volcanoes	90	94	100	84	83	4
Hells Canyon	99	100	100	97	100	1
Hercules-Glades	100	100	100	100	100	0
Hillside	93	77	100	100	97	3
Hoover	95	100	97	84	100	5
Houston	98	n/a	100	100	93	1
Ike's Backbone	96	97	100	87	100	4
Indian Gardens	73	81	87	65	60	5
Isle Royale	99	97	100	100	100	1
James River	99	97	100	100	100	1
Jarbidge	93	94	97	100	83	5
Joshua Tree	98	97	100	94	100	2
Kaiser	93	100	97	94	83	3
Kalmiopsis	100	100	100	100	100	0
Lake Sugema	94	90	87	100	100	4
Lake Sugema (moved)	75	n/a	n/a	n/a	75	1
Lassen Volcanic	92	87	83	100	97	5
Lava Beds	96	97	93	97	97	2
Linville Gorge	96	100	97	97	90	2
Livonia	97	100	100	97	90	1
Lostwood	96	87	97	100	100	2
Lye Brook	90	100	100	81	80	4
Mammoth Cave	98	100	100	100	90	3
Martha's Vineyard	95	97	90	100	93	1
Meadview	98	100	100	97	97	2
Medicine Lake	97	100	97	90	100	3
Mesa Verde	98	100	100	94	100	1
Mingo	84	84	80	87	83	4
MK Goddard	99	100	100	97	100	1
Mohawk Mountain	98	100	90	100	100	3
Monture	93	97	80	100	97	5
Moosehorn	100	100	100	100	100	0
Mount Baldy	96	97	90	97	100	1
Mount Hood	99	97	100	100	100	1
Mount Rainier	98	100	97	100	97	1
Mount Zirkel	88	94	97	68	93	10
Nebraska	93	87	90	94	100	3
New York	98	n/a	n/a	95	100	1
North Absaroka	93	97	77	100	100	5
North Cascades	92	57	93	90	100	5
Northern Cheyenne	97	100	97	90	100	3
Okefenokee	97	100	100	90	97	2
Old Town	96	100	87	97	100	1
Olympic	94	90	93	94	100	3
Omaha	85	94	77	84	87	7
Organ Pipe	93	97	80	97	100	5
Pasayten	94	94	90	97	97	2
Petrified Forest	80	97	87	61	73	4
Petersburg	95	n/a	100	100	90	3
Phoenix	94	100	83	100	93	5
Phoenix (collocated)	88	100	83	84	97	6
Pinnacles	99	100	100	97	100	1

Networks achieve continued on page 6....

Feature article

Recent findings concerning particulate ammonium and nitrate sampling at IMPROVE sites

(by J. Collett, Jr., S. Kreidenweis, X-Y. Yu, and T. Lee; Dept. of Atmospheric Science, Colorado State University, and W. Malm; National Park Service/CIRA)

Introduction

A series of studies is ongoing at Colorado State University to investigate issues related to sampling of particulate ions, especially nitrate and ammonium, in the IMPROVE network. Researchers have conducted six field experiments to evaluate sampling and analysis protocols in the past two years at several IMPROVE sites, including:

- Bondville, IL
- San Gorgonio Wilderness, CA
- Grand Canyon National Park, AZ
- Brigantine National Wildlife Refuge, NJ
- Great Smoky Mountains National Park, NC/TN

Site locations and study periods were chosen in most cases (Great Smoky Mountains excepted) to examine periods where nitrate was an important particle component. Measurements were made using several URG annular denuder/filter-pack samplers, a MOUDI aerosol cascade impactor, and a Particle-Into-Liquid-Sampler (PILS) for semi-continuous measurements of $PM_{2.5}$ composition. A photograph of a typical site setup is shown as Figure 1.

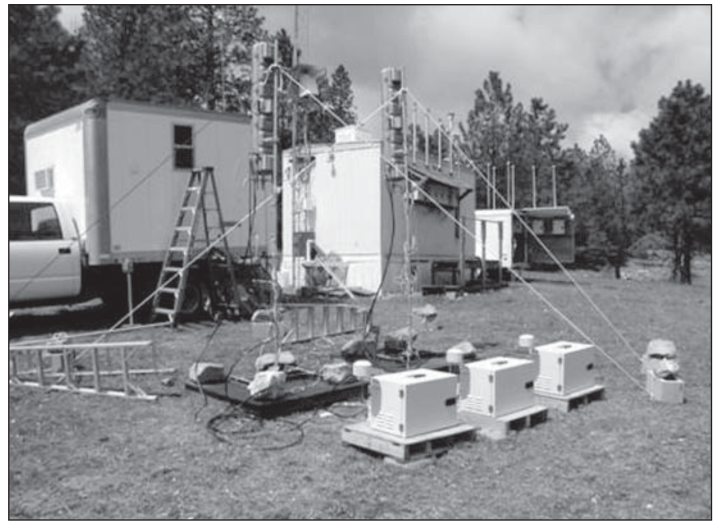


Figure 1. Typical study setup with URG annular denuder/filter-pack samplers in the foreground and a mobile truck lab (containing the MOUDI aerosol impactor and PILS system) in the background. The trailers to the right house several IMPROVE samplers.

Areas of investigation include:

- Losses of particulate nitrate off nylon filters.
- Aqueous extraction efficiency of particulate nitrate collected on nylon filters.
- Loss of particle ammonium off nylon filters.
- The chemical form and size distribution of particulate nitrate.

A brief summary of key findings for these topics is presented here. Conclusions for many of these investigations remain preliminary.

Loss of nitrate from nylon filters

The retention of $PM_{2.5}$ nitrate by denuded nylon filters was evaluated. Losses of nitrate from the nylon filter were negligible at all locations and seasons studied. Results are presented in Yu et al. (2005).

Aqueous extraction of $PM_{2.5}$ nitrate sampled on nylon filters

The deionized water extraction of $PM_{2.5}$ nitrate sampled on nylon filters was examined. Filters were extracted using deionized water with sonication. A replicate set of filters was extracted with an alkaline carbonate/bicarbonate solution and sonication. Differences between the two extraction methods were negligible, suggesting that deionized water extraction with sonication efficiently removes collected $PM_{2.5}$ nitrate. This observation holds even for periods where significant ammonium nitrate volatilization (and recollection of volatilized nitric acid on the nylon filter medium) was known to occur. Results are presented in Yu et al. (2005).

Loss of ammonium off nylon filters

Significant losses of $PM_{2.5}$ ammonium off denuded nylon filters were observed at all study locations. Table 1 provides an overview of the observed loss by site/study period. The degree of ammonium loss varies from site to site. For example, the average ammonium loss was:

9.7% in Bondville in winter

24% in San Gorgonio in April

28% in San Gorgonio in July

18% in Grand Canyon

24% in Brigantine

18% in Great Smoky Mountains

In many cases, the losses can be explained by volatilization of collected ammonium nitrate. At Great Smoky Mountains, however, there is insufficient $PM_{2.5}$ nitrate to explain the amount of ammonium lost. Significant loss of ammonium from acidic, ammoniated sulfate salts (e.g., ammonium bisulfate) present at Great Smoky Mountains is unlikely. It is possible that ammonium loss from organic ammonium salts is responsible for some of the volatilized ammonia measured at this site.

Table 1. Ammonium loss from denuded nylon filters in six field experiments.

Site	% of $PM_{2.5}$ NH_4^+ lost			
	max	min	avg	std
Bondville FEB 03	18	0.7	9.7	5
San Gorgonio APR 03	45	8.6	24	9
Grand Canyon MAY 03	65	5.2	18	14
Brigantine NOV 03	52	5.8	24	14
San Gorgonio JUL 04	48	16	28	9
Great Smoky Mountains JUL-AUG 04	35	10	18	6

The chemical form and size distribution of particulate nitrate

IMPROVE and other networks generally assume that $PM_{2.5}$ nitrate is present in the form of ammonium nitrate. Measurements of aerosol ion composition and ion size distributions, however, reveal that this is often a poor assumption. A significant portion of $PM_{2.5}$ nitrate measured at many of the study sites (Grand Canyon, Brigantine, Great Smoky Mountains, and San Gorgonio (summer)) actually appears to be comprised of the lower tail of a coarse mode of nitrate formed by reaction of nitric acid (or its precursors) with sea salt and/or soil dust. Figure 2 depicts the average particle ion size distributions measured during the Grand Canyon study, illustrating the clear separation of sulfate and nitrate species into fine vs. coarse particle modes. A similar phenomenon has been observed in previous studies at Yosemite and Big Bend National Parks in California and Texas, respectively. Ammonium nitrate was the dominant nitrate form at Bondville in winter and San Gorgonio in spring.

Conclusions

Particle nitrate collection and measurement by the IMPROVE approach appears to provide a good measure of $PM_{2.5}$ nitrate, aside from any possible bias due to nitric acid removal efficiency changes associated with denuder aging. Separate tests are underway to examine this issue. Accurate measurement of $PM_{2.5}$ ammonium would greatly aid our understanding of aerosol composition and issues of particle hygroscopicity and aerosol mass and composition sensitivity to changes in precursor emissions. Sampling of ammonium on a denuded nylon filter yields significant negative biases, however, due to volatilization of collected ammonium. Surprisingly, these losses do not appear to be restricted only to locations where ammonium nitrate is a dominant aerosol component. Addition of an upstream denuder to remove gaseous ammonia and a backup acidic filter (or denuder) to capture ammonium volatilized from collected particles could be considered to account for this bias.

Acknowledgments

The authors are grateful for the assistance provided by Chuck McDade and the rest of the UC-Davis IMPROVE team in study planning and execution. Thanks, too, to the site operators at each IMPROVE site for their assistance in the study.

References

Yu, X-Y., Lee, T., Ayres, B., Kreidenweis, S.M., Malm, W., and Collett, J.L., Jr. (2005) Particulate nitrate measurement using nylon filters. *J. Air Waste Manage. Assoc.*, in press.

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

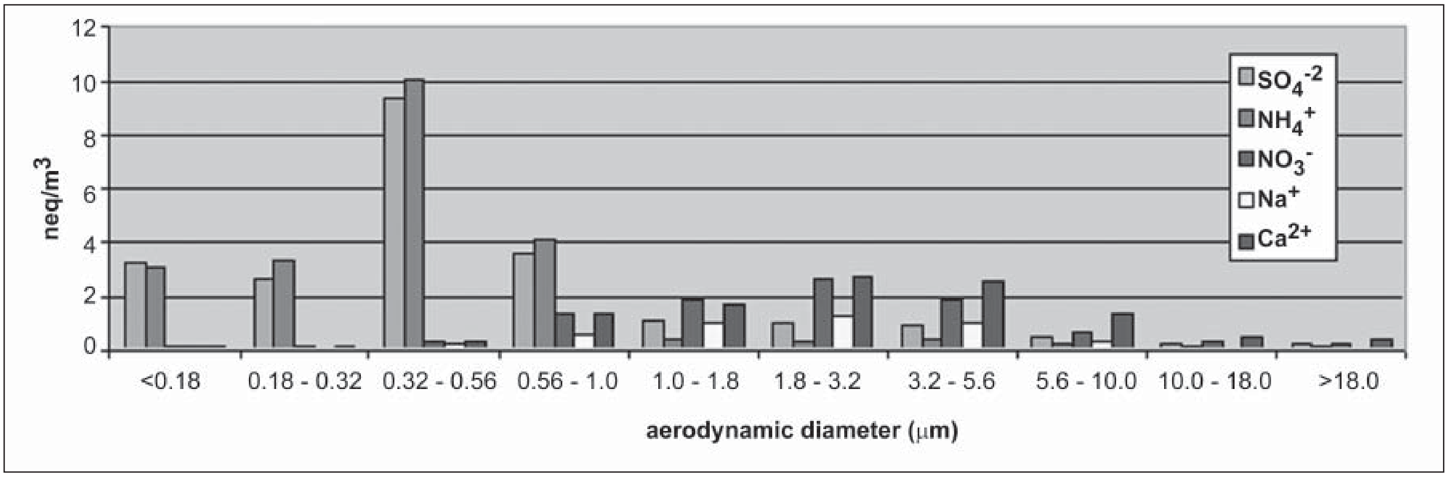


Figure 2. Average concentrations (nanoequivalents/m³) of aerosol ions vs. aerodynamic particle size measured using a MOUDI impactor during the Grand Canyon study.

Networks achieve *continued from page 3....*

Site	% Year	% 1stQtr	% 2ndQtr	% 3rdQtr	% 4thQtr	# Mis.
Pittsburg	97	n/a	92	100	97	1
Point Reyes	98	97	100	97	97	1
Presque Isle	100	100	100	100	100	0
Proctor Research Ctr.	92	94	73	100	100	8
Quabbin Reservoir	98	100	97	97	100	1
Quaker City	99	100	97	100	100	1
Queen Valley	89	81	90	97	87	5
Redwood	94	94	93	97	93	2
Rocky Mountain	99	97	100	100	100	1
Rubidoux	93	n/a	n/a	n/a	93	1
Sac and Fox	93	97	100	81	97	2
Saguaro	93	87	93	94	100	3
Saguaro West	99	100	97	100	100	1
Salt Creek	96	97	97	94	97	2
San Gabriel	93	84	100	90	100	4
San Gorgonio	95	84	100	100	97	5
San Pedro Parks	84	87	67	97	87	4
San Rafael	92	84	93	97	93	4
Sawtooth	88	94	90	68	100	10
Seattle	96	87	100	100	97	2
Seney	99	100	100	100	97	1
Sequoia	93	84	93	100	97	3
Shamrock Mine	100	n/a	n/a	100	100	0
Shenandoah	91	100	83	94	87	3
Shining Rock	86	77	87	84	97	5
Sierra Ancha	87	97	70	97	83	4
Sikes	92	100	90	84	93	4
Simeonof	93	94	90	90	100	2
Sipsey	85	77	90	90	83	3
Snoqualmie Pass	99	97	100	100	100	1
Spokane	84	94	83	74	83	3
St. Marks	90	81	100	87	93	5
Starkey	100	100	100	100	100	0
Sula	98	97	97	100	97	1
Swanquarter	78	26	100	87	100	20
Sycamore Canyon	99	100	97	100	100	1
Tallgrass	94	94	90	94	100	3
Theodore Roosevelt	93	94	90	100	90	3
Three Sisters	100	100	100	100	100	0
Thunder Basin	89	94	93	77	93	7
Tonto	98	94	100	100	100	1
Trapper Creek	99	100	100	97	100	1
Trinity	97	94	100	94	100	2
Tuxedni	97	97	100	100	90	2
UL Bend	97	94	100	97	97	2
Upper Buffalo	89	87	93	84	93	5
Viking Lake	96	94	97	100	93	2
Virgin Islands	89	77	87	100	90	5
Voyageurs	92	81	97	100	90	3
Walker River	100	100	100	100	100	0
Washington DC	96	97	93	94	100	2
Weminuche	95	90	100	100	90	3
Wheeler Peak	92	94	80	97	97	3
White Mountain	97	100	100	97	90	3
White Pass	93	87	100	87	97	3
White River	98	90	100	100	100	3
Wichita Mountain	95	90	100	97	93	3
Wind Cave	100	100	100	100	100	0
Yellowstone	93	90	100	87	93	3
Yosemite	88	94	90	81	87	4
Zion Canyons	95	100	97	100	83	5

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

Operators of distinction

Few Class I areas exist in the Midwest, so the IMPROVE Program has a small number of monitoring sites in the region. To help fill in the gaps, the Central Regional Air Planning Association (CENRAP) operates an air monitoring station in the Nebraska National Forest, in the central portion of the state. Tim Griffin, operator for the IMPROVE aerosol sampler at the Nebraska National Forest IMPROVE Protocol site, ensures the sampler operates trouble-free and all filters are changed according to schedule. With the assistance of backup operators Forestry Technician Tedd Teahon and District Ranger Patti Barney, the monitoring team obtains collection efficiencies well above the 90% mark.

Tim, a Rangeland Management Specialist for the forest, spends most of his time performing wildlife biological assessments and evaluations, and issuing grazing permits. The weekly trek to the monitoring station takes up a small part of his time. "Visiting the site is an easy 30- to 45-minute drive from the office," said Tim, who began the job of IMPROVE site operator last summer.

He holds a BS degree in wildlife biology and an MS degree in rangeland ecology. "I study both animals and plants," said Tim. "Nebraska National Forest is unique in that it is the largest hand-planted national forest in the nation, maybe in the world. Its 22,000 acres of forest, mostly planted by the Civilian Conservation Corps in the 1930s, consists largely of Ponderosa Pine, Jack Pine, and Eastern Red Cedar."

In his free time, Tim is an avid outdoorsman and hunts, traps, and braids horse tack (reins, saddlebags, and such). He also spends time entertaining his nieces and nephews.

Being on top of servicing the aerosol sampler allowed the Nebraska National Forest operators to achieve 93% collection efficiency for the year 2004. CENRAP is planning to add an Optec NGN-2 nephelometer to the station later this year.

Rangeland Management Specialist and IMPROVE site operator Tim Griffin, delivers a new shipment of filters to the Nebraska National Forest monitoring station for changing.

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 2005 are:

Aerosol (Channel A)

Arendtsville	Ike's Backbone	San Rafael
Baltimore	James River	Sawtooth
Bandelier	Jarbidge	Seney
Big Bend	Joshua Tree	Sequoia
Birmingham	Kalmiopsis	Shamrock Mine
Blue Mounds	Lassen Volcanic	Shenandoah
Boundary Waters	Lava Beds	Shining Rock
Brigantine	Linville Gorge	Sikes
Cabinet Mountains	Livonia	Simeonof
Caney Creek	Mammoth Cave	Sipsey
Canyonlands	Meadview	St. Marks
Cape Romain	Medicine Lake	Starkey
Chiricahua	Mesa Verde	Sula
Connecticut Hill	MK Goddard	Tallgrass
Crater Lake	Mohawk Mountain	Theodore Roosevelt
Craters of the Moon	Monture	Three Sisters
Crescent Lake	Moosehorn	Tonto
Death Valley	Mount Hood	Trapper Creek-Denali
Denali	Nebraska	Trinity
Detroit	New York	Tuxedni
Dolly Sods	North Cascades	UL Bend
El Dorado Springs	Northern Cheyenne	Upper Buffalo
Fresno	Okefenokee	Viking Lake
Frostburg Reservoir	Organ Pipe	Virgin Islands
Fort Peck	Pasayten	Washington DC
Gila	Petrified Forest	Weminuche
Glacier	Pittsburgh	Wheeler Peak
Great River Bluffs	Presque Isle	Wind Cave
Guadalupe Mountains	Proctor Research Center	Yosemite
Hells Canyon	Saguaro West	Zion Canyons
Hercules-Glades		
Hillside		

Transmissometer

Bridger

Nephelometer

Acadia	Craycroft	Sierra Ancha
Bliss	Grand Canyon (Hance)	Sycamore Canyon
Children's Park	Greer	Thunder Basin
Columbia River (Mt. Zion)	Ike's Backbone	Tucson Central
	National Capital	

Photographic

Red Rock Lakes

Sites that achieved at least 95% data collection for 1st quarter 2005 are:

Aerosol (Channel A)

Acadia	Chicago	Phoenix
Addison Pinnacle	Cloud Peak	Pinnacles
Agua Tibia	Columbia Gorge East	Quabbin Reservoir
Atlanta	Everglades	Rubidoux
Bosque del Apache	Grand Canyon	Sac and Fox
Bridger	Great Basin	Swanquarter
Capitol Reef	Hoover	Sycamore Canyon
Cedar Bluff	Houston	Thunder Basin
Chassahowitzka	Isle Royale	White Mountain
Cherokee	Mount Zirkel	White Pass

Transmissometer

Badlands	Cloud Peak	San Gorgonio
Bandelier	Glacier	Thunder Basin
Canyonlands		

Nephelometer

Big Bend	Great Gulf	Queen Valley
Chiricahua	Mammoth Cave	Seney
Cloud Peak	Mayville	Tucson Mountain
Cohutta	Organ Pipe	Vehicle Emissions
Estrella	Petrified Forest	Wichita Mountains
Grand Canyon (Indian Gardens)	Phoenix	

Photographic

Grand Canyon	Mount Zirkel

Sites that achieved at least 90% data collection for 1st quarter 2005 are:

Aerosol (Channel A)

Badlands	Great Sand Dunes	Saguaro
Bondville	Great Smoky Mountains	Salt Creek
Breton	Lake Sugema	San Gorgonio
Bridgton	Lostwood	Seattle
Bryce Canyon	Lye Brook	Sierra Ancha
Casco Bay	Mingo	Snoqualmie Pass
Cohutta	North Absaroka	Spokane
Douglas	Old Town	Voyageurs
Gates of the Mountains	Point Reyes	White River
Great Gulf	Redwood	Wichita Mountains

Transmissometer

Big Bend	Grand Canyon (South Rim)	Rocky Mountain

Nephelometer

Dolly Sods	Great Smoky Mountains	Mount Zirkel
Dysart		

Photographic

-- none --

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: 910/541-3613
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
P.O. 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: marc.pitchford@noaa.gov
* 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 Parkway
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
Michael Sundblom
Manager, Air Monitoring Unit
ADEQ Air Assessment Section
1110 W. Washington Street
Phoenix, AZ 85007
Telephone: 602/771-2364
Fax: 602/771-4444
E-mail: sundblom.michael@azdeq.gov

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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