2004 Calendar

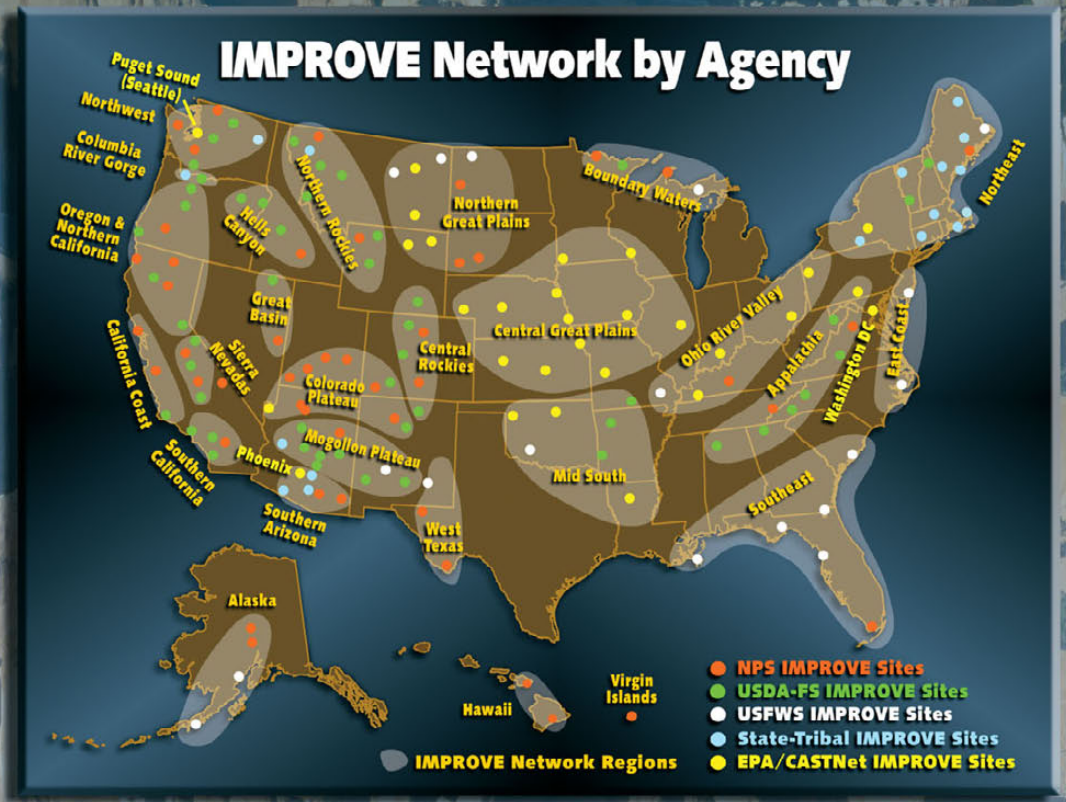
IMPROVE

Interagency Monitoring of Protected Visual Environments

THE IMPROVE PROGRAM

BRYCE CANYON NATIONAL PARK

The Interagency Monitoring of Protected Visual Environments (IMPROVE) Program is a cooperative air quality monitoring effort between federal land managers; regional, state and tribal air agencies; and the Environmental Protection Agency. The IMPROVE monitoring program was established in 1985 to aid in the implementation of the 1977 Clean Air Act goal of preventing future and remedying existing visibility impairment in 156 Class I areas (National Parks, Wilderness Areas, and Wildlife Refuges). The network began operating in 1988 and currently consists of 163 monitoring sites. These data are critical for the implementation of our national goal to reduce regional haze in Class I areas by establishing the current visibility conditions, tracking the progress toward attaining the goal, and identifying the chemical species and emission sources responsible for existing visibility impairment.



Bryce Canyon National Park in southern Utah is named for one of a series of horseshoe-shaped amphitheaters carved from the eastern edge of the Paunsaugunt Plateau. The colorful Claron limestones, sandstones, and mudstones have been shaped by erosion into thousands of pinnacles, spires, and mazes, collectively called "hoodoos". Ponderosa pines, high elevation meadows, and fir-spruce forests border the rim of the plateau, while panoramic views of three states spread beyond the park's boundaries. Surrounded by deserts, these highlands get much more rain than the lowlands below and stay cooler during hot summers.

One year after Congress enacted the 1977 amendments to the Clean Air Act, teleradiometer and aerosol monitoring began at Bryce Canyon National Park, one of six parks within the so-called "Golden Circle" of national parks in the Four Corners region of the Southwest. This region is one of the most intensely monitored in the network and boasts some of the nation's best air quality. The park identifies three magnificent views, or "integral vistas", deserving the most stringent visibility protection. An integral vista is a scenic view which extends beyond Class I boundaries, which view is deemed critical to the enjoyment of the area. Vistas from Bryce, Paria, and Yovimpa Point[s] have been identified as integral to visitor enjoyment, and the National Park Service seeks to protect these views from intrusions such as smoke plumes, strip mines, or other encroachments. Studies at the park have consistently identified clear air and unobstructed views among visitors' top priorities.

IMPROVE data show that annual average visibility at Bryce Canyon is about 95 miles but on the 10% cleanest days visibility approaches natural levels of 140 miles. Preliminary trend analyses show there may be some degradation or worsening of visibility conditions on the haziest days at the park. Layered hazes and plumes from a nearby power plant create visibility impairment that can frequently be seen from some Bryce Canyon viewpoints especially during the winter when air masses are stable. Bryce Canyon's monitoring efforts are part of a collaborative effort by tribal governments, state governments, various federal agencies, and private industry to better understand and manage regional haze, identify visibility impacted areas, and identify sources of haze on the Colorado Plateau and across the western states. Additionally Bryce Canyon has successfully cooperated with private entities to mitigate proposed coal strip mining in the nearby Alton coal fields.

Bryce Canyon National Park

January

"Tug on anything at all and you'll find it connected to everything else in the universe."

John Muir, founder of the Sierra Club

Steve Mazur has been the air quality specialist at Bryce Canyon National Park since 2000. His official duties, however, lead him to wear many different hats. Under supervisor Clyde Stonaker, Steve is a National Park Service Ranger in the Protection Division. Collateral duties include law Enforcement, Search & Rescue, Emergency Medical Services, Health & Fitness, and Backcountry Patrol Operations.

Steve has been the IMPROVE site operator and administrator for almost three years. Additionally he collects ozone data, wet and dry acid deposition data for the National Acid Deposition Program (NADP), and participates in USDA snow surveys.

Air sampling sites are located at 8000 and 9000 feet and winter access is often difficult, requiring skiing or snowshoing to service these sites. An avid fitness enthusiast, Steve spends free time back country hiking, skiing, cycling, weight training, flying, running, fishing, and doing road trips. A favorite food is "ranger's delight" and we can only guess at that recipe!

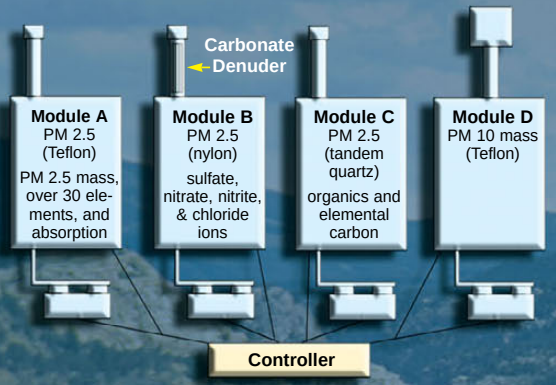
Plume blight on Navajo Mountain as captured by the scene camera.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Dec 2003 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 Feb 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29			**UC-Davis**: *Sampler:* General Lab (530) 752-1123 **ARS**: *Optical:* Carter Blandford or Karen Rosener *Photography:* Karen Fischer (970) 484-7941	**1** *1 Julian day* National Environmental Policy Act, 1969 New Year's Day IMPROVE particle sampling day	**2** *2*	**3** *3*
4 *4* IMPROVE particle sampling day	**5** *5*	**6** *6* Change IMPROVE particle cartridges.	**7** *7* IMPROVE particle sampling day	**8** *8*	**9** *9*	**10** *10* IMPROVE particle sampling day
11 *11*	**12** *12*	**13** *13* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	**14** *14*	**15** *15*	**16** *16* IMPROVE particle sampling day	**17** *17*
18 *18*	**19** *19* Martin Luther King, Jr. IMPROVE particle sampling day	**20** *20* Change IMPROVE particle cartridges.	**21** *21*	**22** *22* IMPROVE particle sampling day	**23** *23*	**24** *24*
25 *25* IMPROVE particle sampling day	**26** *26*	**27** *27* Change IMPROVE particle cartridges.	**28** *28* IMPROVE particle sampling day	**29** *29*	**30** *30*	**31** *31* IMPROVE particle sampling day

"Operator Involvement-- The Key to Network Success"

IMPROVE AEROSOL SAMPLING

NORTH ABSAROKA WILDERNESS AREA



The version II aerosol sampler was introduced into the IMPROVE network in 1999. It employs a new microprocessor controller and implements an upgraded filter cassette design. IMPROVE aerosol data are used for assessing the contribution of various sources to haze. In addition, these data are the basis for tracking progress related to the regional haze regulations.

IMPORTANT: VALID MEASUREMENTS

A visibility impairment value is calculated for each sample day. To get a valid measurement, all four modules must collect valid samples. The Regional Haze Regulation uses the average visibility values for the clean days and the worst days. The worst days are defined as those with the upper 20% of impairment values for the year, and the clean days as the lower 20%. The goal is to reduce the impairment of the worst days and to maintain or reduce it on the clean days. For your site's data to be considered under the Regional Haze Regulations, criteria have been set to determine the minimum number of daily samples needed to have a valid year. Because concentrations of the groups vary seasonally, there are both annual and seasonal criteria. The criteria are:

- 75% of the possible samples for the calendar year must be complete.
- 50% of the possible samples for each calendar quarter must be complete.
- No more than 10 consecutive sampling periods may be missing.

The "blue box" has three dates listed on it. These are the dates (all Tuesdays) on which the filters must be installed.

Each blue box contains:
- 1 flash memory card
- 3 labeled Ziplock® bags
- 1 bag/week labeled with install date and 4 color-coded cartridges, one for each module.

Four cartridges:
Red for Module A
Yellow for Module B
Green for Module C
Blue for Module D

The IMPROVE network operates on the one-day-in-three protocol. Sample change is always on Tuesday. (Arrangement of ambient filters varies each week; pattern repeats every third week.)

For two of the three weeks, the sampler will not be operating on the sample-changing day the operator records final readings, replaces old cartridges, and records the initial readings. There will be initial or final readings for the filter in position 3 on two of the three weeks. The log sheet and display indicate when values for position 3 are recorded.

Every 3rd week, the sampler will be operating when the operator arrives. When sample change is initiated the controller will:

- Suspend sampling.
- Read flow rates on all filters and record information.
- Transfer the cassette in position 3 from the old cartridge to the new one. (New cartridges have no cassette in position 3. The position 3 cassette has a black O-ring attaching it -- the only one that can be removed without a special tool.)
- Transfer the cassette and install a new cartridge. After the initial readings are taken, the sampler will resume collection on the filters in position 3.

The field blanks in position 4 are transparent to the operator and sampler controller. Flow rate measurements are not taken for these.

If for any reason you or your backup cannot make a change on a particular Tuesday or the "blue box" is late, or for any problem or question, immediately call UCD's General Lab at (530) 752-1123. Discussing a problem first will avoid confusion, and a proper diagnosis is more likely to be made. NO problem is too small; it could be a sign of bigger problems, such as unusual readings.

The North Absaroka ("Ab sor ka") Wilderness Area lies in the Shoshone National Forest which encompasses the area from the Montana state line south to Lander, Wyoming, and includes portions of the Absaroka, Wind River, and Beartooth Ranges. Yellowstone National Park borders the area to the west. The Shoshone National Forest was set aside in 1891 as part of the Yellowstone Timberland Reserve, making it the first national forest in the United States. The terrain is varied, ranging from sagebrush flats to rugged mountains many of which are snow-clad most of the year.

The North Absaroka IMPROVE aerosol sampler is located on Dead Indian Hill - so named for an Indian killed in battle as local lore tells it. In spite of its name, the 8,000 foot elevation site provides a beautiful 360 degree view of the Greater Yellowstone Ecosystem, home to an abundance of wildlife, including the grizzly bear and wolf. The site was chosen for its proximity to the North Absaroka and Washakie Wilderness Areas, both in Wyoming. Particulate monitoring began here in January 2000, and though access by vehicle is only about two miles, winter drifts can make the last half mile feel considerably longer. Nine months of the year there is snow on the ground and the area receives "some sort of snowfall every month of the year," says operator Janice Stratman.

IMPROVE data show the current annual average visibility at Absaroka is about 100 miles, compared to estimated natural visibility of 140 miles. On the clearest days visibility can be 126 miles, occurring most often during the winter months. Visibility drops to about 58 miles on the haziest days during late summer and early fall. The particles responsible for visibility reduction in this area are made up of biogenic carbon, which comes primarily from forest fires. The second largest contributor to visibility reduction is sulfates which come primarily from fossil fuel combustion.

Fire at Pass Creek

North Absaroka Wilderness Area

February

"Plans to protect air and water, wilderness and wildlife, are in fact plans to protect man."

Stuart Udall

Site Operators **Ed** and **Janice Stratman** began monitoring here on contract with the Forest Service about 4 years ago. "We do everything from cutting firewood to balancing budgets, from snow removal to cooking and cleaning cabins for the guests," say the Stratmans. While the nearest post office for receiving and sending filter substrates is 30 miles away in Cody and the nearest neighbor is 12 miles distant, these and other inconveniences are taken in stride. Indeed, the rewards of raising their seven children in this pristine landscape have been well worth the effort. Ed teaches math part-time at a nearby college (50 miles away) and is a member of the local volunteer fire department.

Winds blew the shelter on its side before the crew arrived to install the aerosol sampler.

With a little muscle and ingenuity, the shelter was made ready.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 *32 Julian day*	2 *33* Groundhog Day	3 *34* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	4 *35*	5 *36*	6 *37* IMPROVE particle sampling day	7 *38*
8 *39*	9 *40* IMPROVE particle sampling day	10 *41* Change IMPROVE particle cartridges.	11 *42*	12 *43* Lincoln's Birthday IMPROVE particle sampling day	13 *44*	14 *45* Valentine's Day
15 *46* IMPROVE particle sampling day	16 *47* President's Day	17 *48* Change IMPROVE particle cartridges.	18 *49* IMPROVE particle sampling day	19 *50*	20 *51*	21 *52* IMPROVE particle sampling day
22 *53* Washington's Birthday	23 *54*	24 *55* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	25 *56*	26 *57* Grand Canyon National Park established, 1919	27 *58* IMPROVE particle sampling day	28 *59*
29 *60*						

Jan 2004

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Mar 2004

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

UC-Davis: *Sampler:*
General Lab
(530) 752-1123

ARS: *Optical:*
Carter Blandford or
Karen Rosener
Photography:
Karen Fischer
(970) 484-7941

"Operator Involvement-- The Key to Network Success"

TROUBLESHOOTING THE FILTER CHANGE

GATES of the MOUNTAINS WILDERNESS AREA

The first step in correctly diagnosing and solving any problem is to call UCD's General Lab at (530) 752-1123. No problem is too small, and a correct diagnosis is more likely to be made.

Has a filter or cartridge been dropped?

The cartridges are well protected and unless the operator is physically forcing air through the media there should be no immediate problem. Pay careful attention to any fluctuation in the normal readings on that particular set of filters. As with any significant event, note it on the logsheet and detail what occurred. Notify UCD about any questions or concerns.

What if the filter gets wet?

Although this can significantly affect the sample, UCD may or may not be able to send a replacement. Call the lab so that UCD can deal with it properly and note it on the logsheet.

Missed changing filters on the regular Tuesday?

Immediately call UCD to get instructions before proceeding with the sample change. Experienced operators should still call UCD to advise of any deviation in the sample changing schedule.

*** If there are remaining sampling days in the week:** Remove the exposed filters as would normally be done, and put in the clean filters that were to have been installed on the last change day. Make a note on the logsheet.

*** If the week is completely missed:**
Remove the exposed filters as would normally be done but do not put in the filters for the missed change day. Keep these in the shipping box and send them back to UCD when both weeks in that box have passed. Install the appropriate filters for the current week. Make a note on the logsheet of the filters that were not installed.

Trouble with the "red button"-controlled motors:

Sometimes when the weather turns cold, the electric motor that raises and lowers the solenoids works very slowly. If this occurs, or if the red-buttons fail to work for any reason, follow these steps:

Modules A-C:
The motor is located in the top right area.

1. Disengage motor by gently pushing down on the top of the motor.

2. "Lockout" the motor by rotating it toward the solenoids.

3. Raise and lower the solenoids by turning the handwheel at the top of the module.

Module D:
The motor is located in the bottom left area.

1. Disengage motor by gently pushing up on the bottom of the motor.

2. "Lockout" the motor by rotating it toward the solenoids.

3. Raise and lower the solenoids by turning the handwheel at the bottom of the module.

For questions or problems with:
Filter boxes, flashcards, and sample changes: contact Sujan Bhattarai, Joan Hancock, Jose Avena, Jose Mojica, or Steven Ixquiac at (530) 752-1123.

Controllers, equipment malfunctions, sampler maintenance, and flow adjustments: contact Jose Mojica at (530) 752-9044 [cell: (530) 867-4391], or Steven Ixquiac at (530) 752-4108 [cell: (530) 304-1468].

Sampler audits: Steven Ixquiac (see above).

In July 1805 members of the Lewis and Clark expedition entered the Rocky Mountains by foot and boat on the Missouri River. Passing through an extremely narrow gorge between towering limestone cliffs, the mountains appeared to open up like a giant gate. Meriwether Lewis wrote, "I shall call this place Gates of the Mountains," a name still used today. The 28,562-acre wilderness area in Montana was established as part of the original Wilderness Act in 1964 and is administered as a unit of the Helena National Forest. Marked by steep canyons, craggy peaks, and open meadows the area is one of the smallest and least visited wilderness areas in the US. Big-game species found in the area include bear, elk, moose, big horn sheep, mule and whitetail deer, and Rocky Mountain goats. Walking the trails, one can see a variety of songbirds, hawks, eagles, and owls.

Hogback Mountain is home to the Gates of the Mountains IMPROVE facility, co-located with the fire lookout tower on top of the mountain at an elevation of 7800'. Located 25 miles north-northeast of Helena, Montana, the site is just 3 air miles south of the wilderness area and monitors the same influences that affect air quality in the wilderness. Monitoring began in July 2000 and a remote digital camera was added in the spring of 2001 to document views of the major mountain ranges to the west. Current visibility averages about 127 miles, although visibility varies from 180 miles on the clearest days to 78 miles on the haziest days. On average days, sulfates and organic compounds account for the largest fraction of visibility degradation at 37% and 30%, respectively. At times emissions from sources as far away as the Pacific coast and Canada are transported here.

Total stationary sources of emissions in Montana have been reduced significantly over the last 15 years. The Anaconda smelter, which emitted over 300,000 tons of sulfur dioxide (SO_2) per year, shut down in 1980, reducing the statewide emissions of sulfur dioxide by 80%. Most of the Montana point sources are downwind or at considerable distance from national forest wilderness areas, however the East Helena lead smelter is a large source with the potential to impact the Gates of the Mountains wilderness. The most notable form of observed air pollution in the Montana Region 1 wilderness areas is smoke from wildland fires and agricultural burning in Montana and Idaho.

In addition to monitoring visibility, the USDA Forest Service has plans to survey lichens in three more Northern Region wilderness areas, including the Gates of the Mountains. Lichens are bio-indicators of air quality since many species are sensitive to air pollution.

Gates of the Mountains Wilderness Area

March

"To be whole. To be complete. Wildness reminds us what it means to be human, what we are connected to rather than what we are separate from."

Congreesional testimony of nature writer Terry Tampest Williams, 1995

Managing the Hogback site is a real challenge shared by three fully trained operators, **Larry Cole**, **Dave Madden**, and **Keith Leatherman**. Summer lightning keeps everyone running with an average of three hits to the shelter each summer season. The resulting hardware problems can often take some time to resolve. During the winter months the problem of maintaining the monitoring site shifts to access. Snow depths often require the use of snowmobiles to get to the site. Trips can be 16 to 20 miles depending on how close you can get the 4x4 truck! Several other district employees help out in the winter when two people and two snowmobiles are required for each trip to meet safety requirements.

Meanwhile, back at the district, Cole's principle duties are in the real estate program, Madden's are in recreation, and Leatherman's are in silviculture, the science, art and practice of caring for forests with respect to human objectives. Cole and his wife (who also works for the Forest Service) have a 10-year old daughter. He enjoys woodworking, hiking, and family vacations. Madden and his wife have a 16-year old daughter. He's run his own composting business in the past, and enjoys hunting, fishing, and thinking outside the box. Leatherman is an accomplished photographer, and enjoys traveling and the music of Zoe Wood.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
UC-Davis: *Sampler*: General Lab (530) 752-1123 **ARS**: *Optical*: Carter Blandford or Karen Rosener *Photography*: Karen Fischer (970) 484-7941	**1** *61 Julian day* Yellowstone Natl. Park established, 1872 IMPROVE particle sampling day	**2** *62* Change IMPROVE particle cartridges.	**3** *63*	**4** *64* IMPROVE particle sampling day	**5** *65*	**6** *66*
7 *67* IMPROVE particle sampling day	**8** *68*	**9** *69* Change IMPROVE particle cartridges.	**10** *70* IMPROVE particle sampling day	**11** *71*	**12** *72*	**13** *73* IMPROVE particle sampling day
14 *74*	**15** *75*	**16** *76* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	**17** *77* St. Patrick's Day	**18** *78*	**19** *79* IMPROVE particle sampling day	**20** *80* Spring Begins
21 *81*	**22** *82* IMPROVE particle sampling day	**23** *83* Change IMPROVE particle cartridges.	**24** *84*	**25** *85* IMPROVE particle sampling day	**26** *86*	**27** *87*
28 *88* IMPROVE particle sampling day	**29** *89*	**30** *90* Change IMPROVE particle cartridges.	**31** *91* IMPROVE particle sampling day			

Feb 2004

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29						

Apr 2004

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

"Operator Involvement-- The Key to Network Success"

OPERATOR SUPPORT: Air Resource Specialists

TUXEDNI WILDERNESS AREA

Air Resource Specialists, Inc. (ARS), supports visibility-monitoring networks for federal land management agencies, state agencies, municipalities, Indian nations, and private industry. ARS currently supports over 75 visibility monitoring sites nationwide and has been the prime contractor to the IMPROVE program, and National Park Service and Forest Service Visibility Monitoring and Data Analysis Programs.

From site installation to takedown, operator support is always available, and it comes in many different forms including on-site training, operator's manuals, shipment of parts and supplies, and telephone support. On-site training is provided to operators at time of instrument installation, annual site servicing, and instrument auditing. During these times, the field specialist explains all facets of site and instrument maintenance and operation. Emergency site visits by a field technician are rare, but they are performed when necessary.

Operator's manuals containing standard operating procedures and technical instructions are provided with each instrument. These documents pertain to instrument operation, troubleshooting, replacing, shipping, and more. Updates are provided when necessary.

More often than emergency site visits, replacement parts are shipped to sites, with instructions for operators on how to replace them. The parts are shipped with return FedEx airbills so operators can conveniently ship the malfunctioning components back to ARS. For those situations where component replacement is too complex, ARS will instruct the operator to ship the entire instrument to ARS for repair. Frequently needed monitoring supplies such as filters, fuses, and optical lamps are shipped so an on-site stock is maintained.

A main component of operator support for the network is technical telephone support. After collecting daily data, data analysts make on average, six or more calls per day to monitoring sites. The analysts also receive calls from operators who note problems while performing a site visit. Most calls last only a few minutes, but sometimes a call lasting 30 minutes or more may be needed before a problem is resolved, depending upon the problem and the experience of the operator.

ARS strongly encourages operators to call if there are any questions about parts, supplies, or instrument operations. It may be wise to call for instructions and troubleshooting advice before attempting to solve any problems.

Carter Blandford, senior data analyst, performs data collection, validation, and provides operator support for transmissometers and nephelometers.

Karen Rosener, data analyst, performs data collection, validation, and provides operator support for transmissometers and nephelometers.

Jared Merk, data analyst, performs data collection, validation, and provides operator support for transmissometers.

Karen Fischer, photographic specialist, performs image collection and system troubleshooting, and provides operator support for photographic systems.

Marty Mills, electronics technician, performs laboratory servicing of transmissometers and nephelometers, and troubleshooting of power-related instrument problems.

Located at the mouth of Tuxedni Bay off the Cook Inlet in southwestern Alaska, the Tuxedni Wilderness was established in 1970. Its 6000 acres include two islands, Chisik and Duck. Most of the wilderness lies on Chisik Island; tiny, six-acre Duck Island is a rocky dot with almost no vegetation. Chisik slopes upward out of Cook Inlet from sandy beaches on the southern end to 400-foot cliffs on the northern end. From the higher elevations of tundra the volcanoes of Mounts Redoubt and Iliamna are often visible. In 1980 the wilderness became a subunit of the Gulf of Alaska Unit of the Alaska Maritime National Wildlife Refuge administered by the US Fish and Wildlife Service as a refuge for seabirds, bald eagles, and peregrine falcons.

The search for an IMPROVE monitoring location began in 1999, and finding an ideal location proved problematic. The first challenge was finding a remote site accessible year around with continuous power. This was complicated by the fact that in most of remote Alaska residents get their power from diesel generators and heat with wood-burning stoves, emissions from which could contaminate filter samples. Solar power options were limited by the scant six hours of daylight in December through January. Finally the owner of a small inholding on the west side of Cook Inlet near Lake Clark National Park, 8 miles south of the Tuxedni Wilderness, agreed to help. James Isaak is one of very few year-round residents of Silver Salmon Lakes and also operates the only wind-powered generating system on the west side of the Cook Inlet. A diesel generator is used only for back up. James was interested and enthusiastic from the beginning and the site became operational in the fall of 2001.

The Tuxedni Wilderness is remote and only accessible by small boats and airplanes as weather permits. There are no large emission sources in the area which is populated by small urban centers with a limited industrial base. Air quality at Tuxedni is excellent. Average visibility is about 120 miles, while on the 20% clearest days you can see 182 miles, and on the 20% haziest days visibility is still 95 miles. That is clearer than most places in the continental US. Stormy weather, low clouds, and fog are more likely to cause low visibility here. The Tuxedni monitoring site was chosen to be representative of regional haze issues that may affect southwestern Alaska.

View of the Alaska Homestead Lodge

IMPROVE monitor at Silver Salmon Lakes

Wind generator

Tuxedni Wilderness Area

April

"Treat the earth well. It was not given to you by your parents.
It was loaned to you by your children."
Kenyan proverb

James Isaak was born and raised in Alaska, often spending time at Silver Salmon Lakes with the original homesteader, Joe Munger. In 1996 James bought the property and went to work renovating the old homestead to create the remote and beautiful Alaska Homestead Lodge (www.alaskawildlife.com). James married his wife Shelia, a native of southern California with a background in sales and business, enticing her to make a big change in climate and scenery to become his partner in life and new business. Today the Isaaks love sharing their life and lodge with visitors, taking every opportunity to spoil them with all the comforts of home and meals of fresh salmon and halibut, produce from the garden, and pies of fresh picked berries. Life is a step back into yesteryear when times were a little simpler. Visitors enjoy fishing, digging for clams, or watching bears roam the tidal flats.

The Isaaks have made a priority of collecting air quality data for IMPROVE and they do an exceptional job of keeping the site running in the face of unpredictable challenges. James, an accomplished pilot and proud owner of a J3 Piper Cub, makes regular trips 60 miles across Cook Inlet to Soldotna, the only way to exchange used filter packs and pick up parts and equipment to keep the site running. Sometimes the weather prevents him from flying immediately back, but it's all in a days work!

Bear dog Murray distracts bears that get too close to visitors.

The US Fish & Wildlife Service offers a special thanks to James and Shelia Isaak for all the hard work that has made this site possible.

Mar 2004

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

May 2004

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 *92 Julian day*	2 *93*	3 *94* IMPROVE particle sampling day
4 *95* Daylight Saving Time Begins	5 *96*	6 *97* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	7 *98*	8 *99*	9 *100* IMPROVE particle sampling day	10 *101*
11 *102* Easter	12 *103* IMPROVE particle sampling day	13 *104* Change IMPROVE particle cartridges.	14 *105*	15 *106* IMPROVE particle sampling day	16 *107*	17 *108*
18 *109* IMPROVE particle sampling day	19 *110*	20 *111* Change IMPROVE particle cartridges.	21 *112* IMPROVE particle sampling day	22 *113* Earth Day	23 *114*	24 *115* IMPROVE particle sampling day
25 *116*	26 *117*	27 *118* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	28 *119*	29 *120*	30 *121* Arbor Day IMPROVE particle sampling day	**UC-Davis**: *Sampler:* General Lab (530) 752-1123 **ARS**: *Optical:* Carter Blandford or Karen Rosener *Photography:* Karen Fischer (970) 484-7941

"Operator Involvement-- The Key to Network Success"

OPERATOR SUPPORT: UC-DAVIS

The University of California at Davis (UCD) supports the particulate measurements for the IMPROVE program. The network of samplers provides aerosol data for the federal, Indian, state, and local agencies. UCD supports over 180 monitoring sites nationwide, including processing over 6,000 filters each month. Handling large volumes of filters and associated data requires carefully designed operating procedures that minimize errors between site operators and UCD. As with any well-crafted plan, things can go wrong and that is where UCD's operator support staff steps in to help.

If the site operator has any problems, questions, or requests about the IMPROVE particulate sampler, they can call UCD's knowledgeable staff. The laboratory staff fields the initial phone calls. Common dilemmas range from missed sample changes to sampler malfunctions. Usually most problems are resolved on the initial phone call. On occasions where the problem is mechanical or electrical in nature, the operator is referred to the skilled technical staff. Sampler malfunctions are diagnosed and solutions are provided. Suggested solutions can range from a restart of the sampler, sending replacement parts, or scheduling special site visits from our technicians.

In addition to working on site problems, the technical staff schedules yearly visits for general maintenance on the samplers. Prior to the visits, the technical staff looks up the historical performance of the sampler and contacts the site operator for any problems. Once the staff arrives at the site, they conduct a flow audit, sampler repairs and cleanings. While at the site, the technical staff are also available to conduct training sessions on the sampler if so desired by the operator or operators.

To aid the laboratory and technical staff, the data/analytical staff can add further insight into the performance of the samplers. They provide information such as flow rate, mass concentration, and module inter-comparisons to detect any potential malfunctions of the samplers. The laboratory and technical staff references this information to diagnosis the sampler.

No problem is too big or small for the operator support staff at UCD. The support staff can be contacted by phone or e-mail. E-mail to UCD field operations should only be used if phone contact cannot be made. E-mail addresses are in the format of *Lastname@Crocker.UCDavis.edu*.

Sujan Bhattarai
Operator Support
Laboratory Support

Sara Djoundourian
Operator Support
Analytical and Data Support

Pat Feeney
Analytical and Data Support

Joan Hancock
Operator Support
Senior Laboratory Support

Steve Ixquiac
Operator Support
Technical and Field Support

Karen Lum
Operator Support
Electronics Technician

Brian Perley
Analytical and Data Support

not pictured:
Jose Mojica
Operator Support
Technical and Field Support

GREAT SMOKY MOUNTAINS NATIONAL PARK

Straddling the border between North Carolina and Tennessee, Great Smoky Mountains National Park is one of the largest protected areas in the eastern United States. It is also one of the most visited, attracting over 9 million visitors each year. The park is designated an International Biosphere Reserve and a World Heritage site, a fact that points to its importance to the planet.

Air quality research and monitoring has shown that air pollution is impairing visibility, damaging plants, acidifying high elevation streams, and degrading soils. Over the last 60 years average visibility has decreased 40% in winter and 80% in summer months. Increasingly, visitors no longer see distant mountain ridges because of a uniform, whitish haze that blankets the view. This haze should not be confused with the natural mist-like clouds, which gave the Great Smoky Mountains its name. Annual average visibility today is 25 miles, compared to natural conditions of 113 miles. Often visibility is reduced to less than 1 mile. Most of the pollution comes from outside the park. The burning of fossil fuels - coal, oil, and gas - creates most of the problem. Sulfate particles account for 83% of summer haze at the park. Coal-fired power plants are the primary source of sulfur dioxide, which converts to sulfate particles. Airborne pollutants travel into the park from as far away as Ohio and Louisiana. The height and physical structure of the mountains, combined with predominate weather patterns, tend to trap and concentrate pollutants in the park.

In addition to impaired visibility, high levels of ground level ozone pollution threaten people's health and vegetation. Airborne sulfur and nitrogen fall to the ground as acid precipitation that is 10 times more acidic than natural. Certain high elevation soils are receiving so much nitrogen that they are suffering from advanced stages of nitrogen saturation. This condition limits the availability of forest nutrients, especially calcium, to plants and causes the release of toxic aluminum that can harm vegetation and stream life. Clouds with the acidity of vinegar bathe high elevation forests during much of the growing season, and some streams are too acidic to support healthy fish populations. The park has one of the most comprehensive air quality monitoring programs in the National Park Service and has been active in the IMPROVE monitoring program since 1988.

Great Smoky Mountains National Park

May

"To see a world in a grain of sand, and a heaven in a wild flower;
Hold infinity in the palm of your hand, and eternity in an hour."
William Blake

Since 1986, **Jim Renfro** has focused on air quality at Great Smoky Mountains National Park. He now oversees air quality research and monitoring operations, including coordinating the operation of a variety of monitoring networks and instruments dispersed throughout the park. Nearly 10 million measurements are collected each year at the park's eight permanent air quality stations. Jim earned bachelors and master's degrees in Forestry from Southern Illinois University. His background has prepared him well for the research efforts he dives into with enthusiasm. In addition to ambient air quality monitoring, Jim is active in numerous special studies on acid deposition, mercury, visibility, fine particles, trace gases, meteorology, emissions, atmospheric modeling, and ozone effects. He represents the park throughout the Southeast on air quality policy-related matters and remains active in the roles of public education and outreach to inform the public about air quality issues important to the region. Increasing public awareness and understanding of pollution problems and reaching out to all stakeholders has been successful at the park by building strong partnerships at the local, state, and national levels and by continuing to maintain and develop the strong science base needed to deal effectively with air pollution issues.

The park's gas and electric hybrid car.

In November 2002, Jim received the prestigious Stephen T. Mather award from the National Parks Conservation Association for "Outstanding Work in the Field of Air Quality". When work is done, Jim enjoys spending time with his wife, Jeanne and three children Jake, 10, Jaynie, 6, and Joey, 3. Jim's efforts and dedication to the field are widely recognized and appreciated by the National Park Service Air Program and IMPROVE.

Jim at the Look Rock monitoring station.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		Apr 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30	Jun 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30			1 122 Julian day
2 123	3 124 IMPROVE particle sampling day	4 125 Change IMPROVE particle cartridges.	5 126	6 127 IMPROVE particle sampling day	7 128	8 129
9 130 Mother's Day IMPROVE particle sampling day	10 131	11 132 Change IMPROVE particle cartridges.	12 133 IMPROVE particle sampling day	13 134	14 135	15 136 Armed Forces Day IMPROVE particle sampling day
16 137	17 138	18 139 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	19 140	20 141	21 142 IMPROVE particle sampling day	22 143
23 144	24 145 IMPROVE particle sampling day	25 146 Change IMPROVE particle cartridges.	26 147	27 148 IMPROVE particle sampling day	28 149	29 150
30 151 IMPROVE particle sampling day	31 152 Memorial Day (Observed)					

UC-Davis: *Sampler:*
General Lab
(530) 752-1123

ARS: *Optical:*
Carter Blandford or
Karen Rosener
Photography:
Karen Fischer
(970) 484-7941

"Operator Involvement-- The Key to Network Success"

THE BRAVO STUDY

BIG BEND NATIONAL PARK

The Big Bend National Park has a diverse landscape made up of the Chihuahuan desert in which the Rio Grande has cut deep canyons, and the Chisos Mountains which towers over the desert. The scenic beauty of this park is often spoiled by haze, which obscures the many vistas. Big Bend is one of the few parks in which haze has been increasing since the late 1980's.

Dagger Mtn on a clear day. Days as clear as this occur less than 1% of the time.

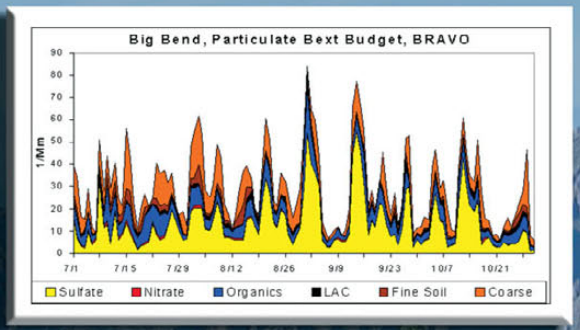
Dagger Mtn. on a hazy day. Days as hazy or hazier than this occur about 20% of the time.

The increasing haze has concerned the National Park. In 1993, a U.S. and Mexico bi-national work group was created to investigate the potential impact of two large Mexican power plants, Carbón I & II, located near Big Bend. In March of 1996, this work group recommended a comprehensive field study be established to identify the contribution from all major sources and source regions. This lead to the creation of the Big Bend Regional Aerosol and Visibility Observational Study (BRAVO).

The primary objectives of BRAVO were to understand the long-range transboundary transport of haze from regional sources in the U.S. and Mexico and determine their contribution to Big Bend's haze. An additional goal was to determine the chemical, physical & optical properties of Big Bend haze. Air samples were collected throughout Texas with an intensive monitoring site at the K-Bar ranch in Big Bend from July through October 1999. Equipment included instruments to measure particle size distributions, particle growth as a function of relative humidity, dry and ambient particle light scattering, and aerosol composition.

The K-Bar monitoring site from a nearby ridge

There were two distinct periods with different particulate components contributing to Big Bend's haze. In July and August sulfate and dust (fine soil + coarse mass) were the major contributors each accounting for about 30% of the haze. Some of this dust was attributed to transported from Sahara Africa. In September and October sulfate accounted for more than 50% of the particulate light extinction while dust and organics account for about 20%.

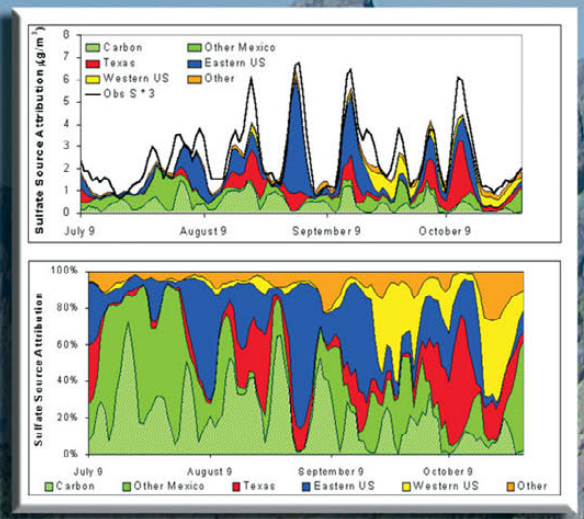


The contribution of major particulate components to haze measured during the BRAVO study.

To address the central question of BRAVO, what sources were responsible for Big Bend haze, a number of source apportionment methods were used. These methods identified the contributions from Mexico, Texas, eastern US and western US as well as from the Carbón I & II power plants, to Big Bend's particulate sulfate concentrations. Sulfates were examined, because they had the largest contribution to Big Bend's haze, they are primarily due to anthropogenic sources, and they are among the best modeled aerosol species. All techniques were extensively evaluated and reconciled with each other.

Final BRAVO estimates are presented in the figures below. On average during the BRAVO period, U.S. sources were responsible for about 55% of Big Bend's particulate sulfate, with eastern U.S., Texas, and western U.S. sources each responsible for about 30%, 17% and 9% respectively. Mexican sources were responsible for about 38% of Big Bend's particulate sulfate with the Carbón I & II power plants contributing about 20%.

Mexico's contributions to Big Bend particulate sulfate during the BRAVO study period were relatively high during times with below average particulate sulfate concentrations. The Texas and eastern US sources tended to contribute to Big Bend during the highest sulfate concentrations. However, Mexico, Texas, and eastern US each had major contributions to Big Bend during peak particulate sulfate episodes. The days with the lowest sulfate concentrations were dominated by contribution from Mexico in July - September. At the end of September and October, the western US was also a major contributor to the low sulfate days.



Smoothed daily estimates of the fraction contributions by source regions to particulate sulfate and the particulate sulfate concentration at Big Bend during the study period.

**The results, findings, and conclusions expressed in this paper are solely those of the authors and are not necessarily endorsed by the management, sponsors, or collaborators of the BRAVO Study.*

Clear and Hazy Days

Big Bend National Park

June

"We should preserve every scrap of biodiversity as pricesless while we learn to use it and come to understand what it means to humanity."

E.O. Wilson, from *The Diversity of Life*

The vast empty desert of Big Bend National Park called to John Forsythe for 15 years before he decided to move there. His life centered in Austin but as often as he could John loaded up the VW van and escaped to the park. In 1988 he landed a full-time position with the park and happily relocated. John's first duty was to survey and map all the springs in the park, walking every inch of its varied terrain. Subsequent duties included helping in law enforcement and on the fire crew, becoming an emergency medical technician, and aiding research efforts on exotic species in the park. In 1991 John moved into air quality full-time as a physical science technician with Resource Management. He says keeping all the monitoring equipment going is sometimes more that a full time job. "The hardest thing is trying to split your time trying to be in two places at once. You might hike 5 miles to fix a transmissometer and need to be back at the K-Bar site for a reading at the same time." Safety precautions are a high priority in the field and John carries a radio and extra water at all times. "You might be only 15 minutes from the road but it can be 110 F and a twisted ankle or a wrong step on one of the park's rattlers can land you in real trouble." After 13 years of looking at air quality John has seen it all, from the very best days when you can pick out individual plants on the Chisos, to the very worst days when you can't even see the nearby ridges.

What really comes across is John's love of the park and working in the outdoors. He has spent over thirty years in this park and he's still counting! John and his wife (a middle-school teacher in the park's school) enjoy backpacking, canoeing, and bicycling. John has bicycled from both California and Houston to Big Bend and he and his wife plan to tour the country on bicycles when they retire. John's dedication to air quality monitoring at Big Bend has paid off, data recovery here is among the best in the network.

Sampler site at K-Bar Ranch, Chisos Mtns. in background.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
UC-Davis: *Sampler*: General Lab (530) 752-1123 **ARS**: *Optical*: Carter Blandford or Karen Rosener *Photography*: Karen Fischer (970) 484-7941		1 *153 Julian day* Change IMPROVE particle cartridges.	2 *154* IMPROVE particle sampling day	3 *155*	4 *156*	5 *157* National Trails Day IMPROVE particle sampling day
6 *158*	7 *159*	8 *160* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	9 *161*	10 *162*	11 *163* IMPROVE particle sampling day	12 *164*
13 *165*	14 *166* Flag Day IMPROVE particle sampling day	15 *167* Change IMPROVE particle cartridges.	16 *168*	17 *169* IMPROVE particle sampling day	18 *170*	19 *171*
20 *172* Father's Day IMPROVE particle sampling day	21 *173* Summer begins	22 *174* Change IMPROVE particle cartridges.	23 *175* IMPROVE particle sampling day	24 *176*	25 *177*	26 *178* IMPROVE particle sampling day
27 *179*	28 *180*	29 *181* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	30 *182*			

May 2004

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

Jul 2004

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

"Operator Involvement-- The Key to Network Success"

YOSEMITE SPECIAL STUDY

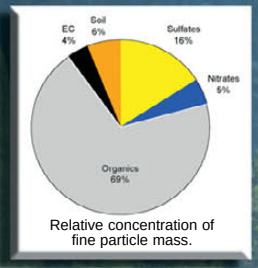
YOSEMITE NATIONAL PARK

During the late summer and fall Yosemite National Park experiences some of the highest organic mass concentrations of any national park in the United States and, on a fractional basis, carbonaceous particles are the single largest contributor to visibility impairment. Over a period of several weeks in late summer and fall of 2002, a special study was conducted to investigate the origins and physical/optical characteristics of this carbon aerosol.

Air samples were collected at Turtleback Dome, located above the western entrance to Yosemite Valley. Equipment deployed included instruments to measure particle size distributions, particle growth as a function of relative humidity, dry and ambient particle light scattering, and aerosol composition.

View looking down at the measurement site on Turtleback Dome.

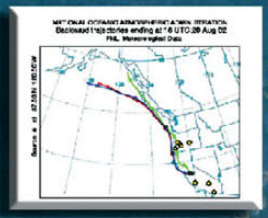
The photographs below were taken from the measurement site on Turtleback Dome looking into Yosemite Valley on days with strongly contrasting visibility. Fine aerosol concentrations and visibility degradation at the site varied strongly over the course of the measurements.



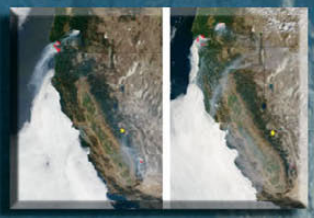
Relative concentration of fine particle mass.

Fine aerosol mass at the site was dominated by organic carbon at 69% with concentrations varying between 2 and 14 µg/m³. The average fine mass concentration was approximately 10 µg/m³. Close tracking of NO_3^- and Na^+ concentrations provides strong evidence of the upwind reaction of nitric acid with sea salt forming coarse particle sodium nitrate rather than fine particle ammonium nitrate.

During the study there were several large forest fires in the western United States. Back trajectories calculated for August 20 suggest an influence from the large fires burning in southwest Oregon during that time.

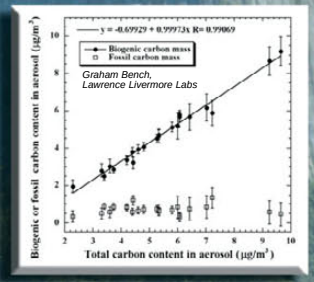


The locations of several large forest fires along with back trajectories are plotted for August 20. Back trajectories were computed for 3 ending heights in the Central Valley upwind of the park (500, 1000, and 2000 m agl).



MODIS satellite photos taken on August 12th and August 16th showing smoke transport. Red symbols denote major fire locations, and the yellow stars show Yosemite.

Carbon isotope measurements were used to determine relative contributions of fossil vs. biogenic carbon sources. Results indicate 73 to 95% of the PM2.5 carbon was of biogenic origin. The following graph depicts variation of biogenic and fossil carbon mass with total PM2.5 carbon. Interestingly, the fossil carbon mass concentration varies little; nearly all variability in total carbon mass coming from biogenic carbon concentration changes.



Graph showing the relationship of biogenic carbon mass and fossil carbon mass to total PM2.5 carbon based on the carbon isotope measurements.

Back trajectory calculations combined with the results from carbon isotope measurements suggest a dominant influence of fire emissions on fine particle carbon.

Yosemite National Park is located in California's Sierra Nevada Mountains 150 miles east of San Francisco and is only a 6-hour drive from Los Angeles. Its polished granite domes and high glacier-sculpted relief offers world-class rock climbing and incomparable views of spectacular mountain-and-valley scenery. Designated a World Heritage Site in 1984, Yosemite was internationally recognized for its unique scenic beauty, outstanding wilderness values, and biological diversity. Each year, up to four million visitors flock to the park for its waterfalls, clear streams, meadows, and forests that include groves of giant sequoias, the world's largest living things.

Air pollutants and air-borne contaminants are currently recognized as one of the most significant threats to park resources. Increasing pollution creates hazy skies obstructing views of El Capitan, Yosemite Falls, Half Dome, and the many other vistas for which the park has become known. Air quality monitoring is extensive in Yosemite. Monitoring locations within the park include Turtleback Dome where ozone, visibility, dry deposition, and meteorology are monitored; Yosemite Valley where PM10, PM2.5 (particulate matter of sizes 2.5 microns or less and 10 microns or less), ozone, NO_x (various nitrous oxides) and meteorology are monitored; and Hodgdon Meadow where wet deposition is monitored. Visibility monitoring began in 1988 and photographic records document views between the years 1982 and 1995. Visibility ranges from about 44 miles on the 20% haziest days to 107-157 miles on the 20% clearest days. Most of the time you can see from 67 to 83 miles. Currently, the park exceeds the state and federal 8-hour standard (unhealthy) for ozone approximately 5 times each summer. Given the increased growth and development in the adjacent San Joaquin Valley, it is suspected that the number of exceedance days will increase. (Ozone produces foliar damage in ponderosa and Jeffrey pines.) Spring snowmelt and late summer rains trigger episodes of acidification which can't be completely neutralized in park lakes and streams. Adjacent to one of the dirtiest air basins in the country, Yosemite lies within the Mountain Counties Air Basin. Regional weather patterns concentrate pollutants from San Francisco and the San Joaquin Valley, transport them hundreds of miles, and deposit them in the park.

Yosemite National Park

July

"We shall never achieve harmony with land, any more than we shall achieve absolute justice or liberty for people. In these higher aspirations, the important thing is not to achieve but to strive."

Aldo Leopold

Katy on Mt. Whitney

Katy Warner has a bachelor's degree in Environmental Studies and has lived in Yosemite for over 20 years. Currently the Air Quality Specialist for the park, Katy oversees all air quality monitoring efforts including IMPROVE and visibility monitoring, acid deposition, and ozone monitoring. An avid (some say obsessed) backpacker and hiker, Katy spends most of her free time on the trail. She has hiked the Appalachian Trail, Vermont's Long Trail, the John Muir Trail, and is currently doing sections of the Pacific Crest Trail. Birding, kayaking, cross-country skiing, splitting firewood, and playing and listening to music are also high on her list of favorite activities. "Twenty years in Yosemite and I still love it!" she says.

Kyle in Guatamala

Kyle Kline is an Oregon native who attended Southern Oregon University, focusing on Environmental Studies. Working as a seasonal operator for IMPROVE, Kyle helps maintain and service all the air quality monitoring equipment. He says, "The best thing about being a site operator is the view. You can see Half Dome and El Capitan as you look down the valley from the site. It gets you outside and out of the office!" Kyle spends most of his time outside enjoying rock climbing, mountain biking and hiking.

Transmissometer and aerosol sites on Turtleback Dome.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
UC-Davis: *Sampler*: General Lab (530) 752-1123 **ARS**: *Optical*: Carter Blandford or Karen Rosener *Photography*: Karen Fischer (970) 484-7941	Jun 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 Aug 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31			1 183 Julian day	2 184 IMPROVE particle sampling day	3 185
4 186 Independence Day	5 187 IMPROVE particle sampling day	6 188 Change IMPROVE particle cartridges.	7 189	8 190 IMPROVE particle sampling day	9 191	10 192
11 193 IMPROVE particle sampling day	12 194	13 195 Change IMPROVE particle cartridges.	14 196 IMPROVE particle sampling day	15 197	16 198 National Parks Day	17 199 IMPROVE particle sampling day
18 200	19 201	20 202 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	21 203	22 204	23 205 IMPROVE particle sampling day	24 206
25 207	26 208 IMPROVE particle sampling day	27 209 Change IMPROVE particle cartridges.	28 210	29 211 IMPROVE particle sampling day	30 212	31 213

"Operator Involvement-- The Key to Network Success"

THE REGIONAL HAZE RULE

MOOSEHORN NATIONAL WILDLIFE REFUGE

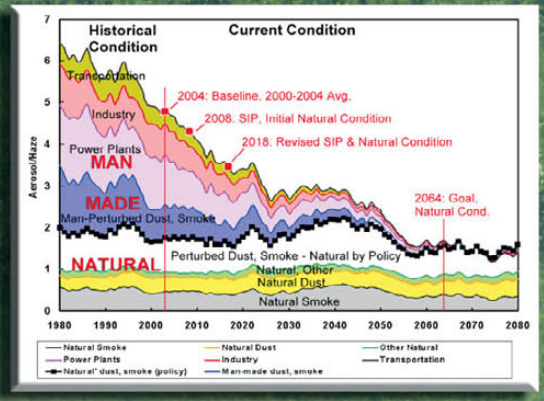
Background

In amendments to the Clean Air Act in 1977, Congress set a national goal for visibility as "the prevention of any future, and the remedying of any existing impairment of visibility in mandatory Class I Federal areas which impairment results from man-made air pollution." The Environmental Protection Agency (EPA) was required to issue regulations to assure "reasonable progress" toward meeting the national goal.

In 1988 the EPA, the states, and the Federal Land Managers (National Park Service, USDA Forest Service, US Fish and Wildlife Service, and Bureau of Land Management) began monitoring fine particle concentrations and visibility in 30 Class I areas across the country under the IMPROVE program. In 1990, Congress amended the Clean Air Act, putting additional emphasis on regional haze issues. In 1997 the EPA proposed regional haze regulations in conjunction with new national ambient air quality standards for fine particulate matter (PM2.5). Final regional haze regulations were promulgated in 1999 under the Regional Haze Rule which set a national goal of reaching natural visibility conditions by 2064 and established a time line for reaching that goal.

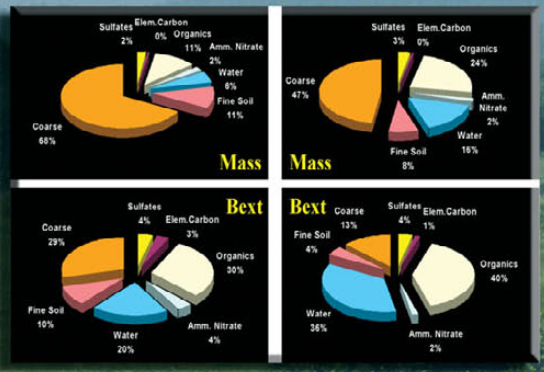
The Rule

The haze rules require states to establish and update Baseline, Natural, and Current visibility conditions where: baseline conditions represent visibility at the time the rules are established, between 2000 and 2004; natural conditions represent visibility in the absence of human-caused impairment; and current conditions represent the most recent multiyear average and reflect progress from the baseline period. (Current conditions are updated for each state implementation plan (SIP) revision.)



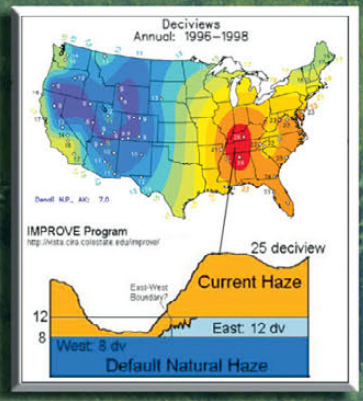
Natural Aerosol Conditions - Default Values

The Regional Haze Rule provides initial default values for the Natural Haze Conditions. The default haze for the west is 8 deciviews, while for the east it is 11 deciviews. This is obtained by estimating the natural concentration of SO_4, EC, OC, NO_3, and fine and coarse soil, and weighing each aerosol component by corresponding extinction efficiences (Trijonis, 1990).



Current Haze Conditions (1996-98)

The current haze level along the West Coast is >15 dv, well over the default 8 dv. Much of the mountainous West is in the 8 - 10 dv range, very near the default natural value. Most of the eastern US (except the upper midwest and New England) is above 20 dv, compared to the 12 dv natural default. Expressed as an extinction coefficient, the current eastern US haze is about 90 Mm^{-1} compared to the default natural value of about 30 Mm^{-1}. Hence, as a very rough initial estimate, the eastern US extinction levels are currently about 3 times the default natural haze stated in the Regional Haze Regulations.

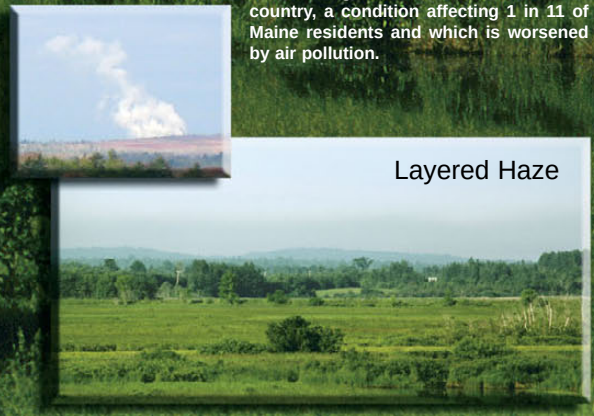


Rudy Husar, CAPITA, Washington University, St. Louis, MO

Moosehorn National Wildlife Refuge is the easternmost refuge in the Atlantic flyway, a migration route that follows the east coast of North America. Located south of Calais, Maine, the 23,000 acre refuge is a nesting ground and stop-over for a variety of migratory birds and habitat for moose, bear, mink, beaver and other species. In 1937 Moosehorn National Wildlife Refuge was purchased with Duck Stamp funds. It is one of the oldest National Wildlife Refuges and a part of the early conservation movement in America.

The refuge received national attention when a pair of bald eagles took over an empty osprey nest in 1991. The pair continues to nest and has produced at least 10 offspring. The bald eagle was placed on the endangered species list in 1978. Declining populations were attributed to DDT, a pesticide causing females to lay eggs too fragile to sit on. The eagle was removed from the endangered list in 1999.

Air quality has been a concern at Moosehorn since 1984. Former refuge manager, Doug Mullen, noticed that emissions from a paper mill 4 miles upwind were impairing visibility at the Refuge. (Approximately 1/3 of the refuge is designated wilderness and granted special air quality protection.) An 8mm time-lapse video camera recorded the plume coming over the wilderness. In 1997, representatives from Georgia-Pacific paper mill cooperated with the Fish and Wildlife Service to reduce emissions. Air quality monitoring at Moosehorn has continued with an IMPROVE aerosol monitor installed in 1994. On average, visibility is about 50 miles with the summer season being the haziest. On clear days visibility can be over 100 miles but is reduced to 28 miles on the haziest days. Regardless of season, most of the problem comes from sulfates, as much as 72 percent. Most of the sulfate haze is the result of coal combustion from power plants both in the region and from the Ohio River Valley. Seventy percent of the pollution in Maine comes from out of state, transported by the jet stream. The Center for Disease Control reports that the state has the highest rate of asthma in the country, a condition affecting 1 in 11 of Maine residents and which is worsened by air pollution.



Moosehorn National Wildlife Refuge

August

"A nation that destroys its soils destroys itself. Forests are the lungs of our land, purifying the air and giving fresh strength to our people."

President Franklin Roosevelt

Maurry Mills began his career with the National Wildlife Refuge System making $1.60 an hour as a student aid in 1971 at the Great Swamp National Wildlife Refuge (NWR). In 1977 Mills transferred to Rachel Carson NWR becoming its first full-time refuge manager. 1985 brought a transfer to the Moosehorn NWR and a shift into wildlife biology. Today as the refuge's biologist he oversees the wildlife inventory and monitoring projects, bird banding, and implementation of the fire, forest, and marsh and water management programs. For 10 years Mills has cared for a permanently injured 21-year-old adult male bald eagle named "Bart". Bart (named for Bartlett Island where he was hatched) is used in programs to teach people about bald eagles and explain why they were once endangered.

Mills has been the operator of the IMPROVE site since its installation in 1994. The site has good road access most of the year, but it can be challenging to get there during the winter and early spring since the road isn't plowed. He remembers getting the snowmobile stuck several times last winter in waist deep snow! Several trips last winter were also during the coldest and windiest days of the year. In spite of the hazards Moosehorn's data recovery is among the highest in the network!

Mills lives in Dennysville, along the Dennys River, with wife Beth and two of his three daughters, Abby and Laura. He enjoys working outdoors and the opportunity of viewing the variety of wildlife. "It gives me the opportunity to work with the area's natural resources and see positive effects of our management actions. I also enjoy working with the volunteers and interns we employ during the field season." Though spare time is a luxury, Mills serves on the boards of the Quoddy Regional Land Trust and the Dennys River Watershed council and makes time for bird watching, fishing, hunting, and gardening.

Sampler site at McConvey Rd. northwest of Baring Unit Headquarters

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 *214 Julian day* IMPROVE particle sampling day	2 *215*	3 *216* Change IMPROVE particle cartridges.	4 *217* IMPROVE particle sampling day	5 *218*	6 *219*	7 *220* IMPROVE particle sampling day
8 *221*	9 *222*	10 *223* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	11 *224*	12 *225*	13 *226* IMPROVE particle sampling day	14 *227*
15 *228*	16 *229* IMPROVE particle sampling day	17 *230* Change IMPROVE particle cartridges.	18 *231*	19 *232* IMPROVE particle sampling day	20 *233*	21 *234*
22 *235* IMPROVE particle sampling day	23 *236*	24 *237* Change IMPROVE particle cartridges.	25 *238* IMPROVE particle sampling day	26 *239*	27 *240*	28 *241* IMPROVE particle sampling day
29 *242*	30 *243*	31 *244* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.				

Jul 2004

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Sep 2004

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

UC-Davis: *Sampler*:
General Lab
(530) 752-1123

ARS: *Optical*:
Carter Blandford or
Karen Rosener
Photography:
Karen Fischer
(970) 484-7941

"Operator Involvement-- The Key to Network Success"

WESTERN REGIONAL AIR PARTNERSHIP

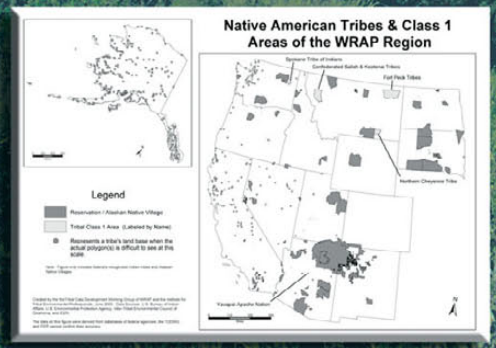
TONTO NATIONAL MONUMENT

The Western Regional Air Partnership, or WRAP (www.wrapair.org) is a collaborative effort of tribal and state governments and various federal agencies to implement the recommendations of the Grand Canyon Visibility Transport Commission (GCVTC), and to develop the technical and policy tools needed by western states and tribes to comply with the U.S. EPA's regional haze regulations. The WRAP is in the process of expanding its scope from 16 Class I areas addressed by the GCVTC, to 116 Class I areas across the WRAP region, representing a broad array of visibility impairment and emission impacts. There are also five tribal Class I areas. The WRAP region includes 75 percent of the nations 156 mandatory federal Class I areas, half the land mass of the continental United States, a very large portion of publicly-owned lands, and numerous tribal jurisdictions (many with large land areas). It also produces a minority of total U.S. emissions, borders both Canada and Mexico, and receives pollution from Asia. Most WRAP members are faced with rapid population growth and other challenges to preventing deterioration of air quality, including regionally-important environmental issues, such as fire and drought.

The WRAP was formed in 1997 as a successor organization to the GCVTC. Since 1997, most of WRAP's focus has been implementing the GCVTC's recommendations (defined in Section 309 of the federal regional haze rule), a major milestone of which is the submission by the end of 2003 of state implementation plans (SIPs) to the US EPA in accordance with Section 309. The completion of Section 309 SIPs (expected for five WRAP region states) represents a significant accomplishment and will benefit all WRAP members in future haze control efforts. Nonetheless, legally, they only address the contribution of emissions from these states to the visibility impairment at 16 Class I areas on the Colorado Plateau. The contribution of these emissions to the other 100+ WRAP region Class I areas, and the contribution of emissions from other WRAP states to more easterly Class I areas remains to be addressed.

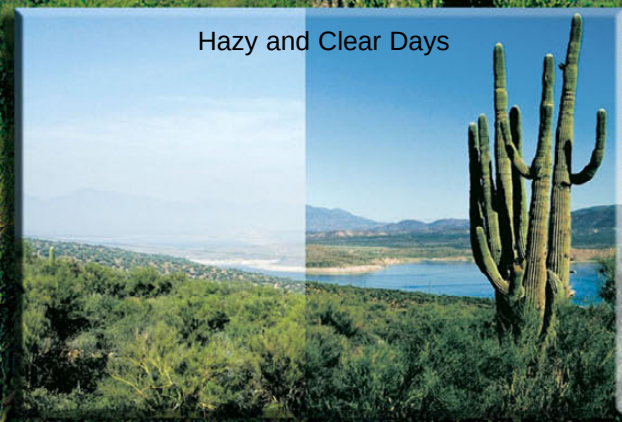
These challenges in meeting the national regional haze planning deadline in the next four years include an apportionment of emission reduction obligations among states and tribes, which also implies a more explicit apportionment of the causes of haze (i.e., source apportionment) than has been required so far. Whereas Section 309 is prescriptive in the types of control strategies that must be implemented, the national regional haze program (Section 308) has a much less specific requirement that BART be implemented and that "reasonable progress" be achieved. Identifying, screening, and ranking such control strategies to achieve reasonable progress will need to be evaluated using the statutory factors of cost, time necessary for compliance, energy and non-air quality impacts, and the remaining useful life of affected sources. The state of Alaska has joined the WRAP, which increases the complexity through the need to develop additional data, associated analytical requirements, and the consideration of more than 200 Alaskan native villages.

The WRAP is administered jointly by the Western Governors Association (WGA) and the National Tribal Environmental Council. WRAP activities are conducted by a network of committees and forums composed of WRAP members and stakeholders who represent a wide range of viewpoints. The WRAP recognizes that residents have the most to gain from improved visibility and that many solutions are best implemented at the local, state, tribal, or regional level with public participation. WRAP uses the WGA-developed environmental management principles known as Enlibra (www.westgov.org/wga/initiatives/enlibra). Use of the Enlibra principles has helped garner support from western governors and other stakeholders as an example of how environmental issues should be addressed in the region.



The Tonto National Monument is located at the northeastern boundary of the Sonoran Desert in central Arizona, 62 miles northeast of Phoenix. Best known for the cliff dwellings of the prehistoric Salado people who farmed the Salt River valley in the Tonto basin for 300 years, it is also the home of the many-armed giant Saguaro cactus. The valley is now covered by Roosevelt Lake, and rugged terrain gives way to canyons and mountains producing spectacular and ever-changing vistas. In sheltered alcoves, high in the cliffs the ancient, empty dwellings look out at scenic panoramic views of mountains, hills, valley, and lake.

Originally overseen by the USDA Forest Service, Tonto National Monument became a unit of the National Park Service in 1933. Today 80,000 people visit the Monument each year with the busiest season from mid-January through late April. Visibility monitoring began at Tonto in 1988 and is sponsored by the USDA Forest Service. An IMPROVE aerosol monitor, transmissometer, and camera system were installed to document the changing levels in air quality. Annual average visibility in this area ranges from 65 to 80 miles. On the 20% clearest days visibility is between 9 and 120 miles, but on 20% haziest days visibility drops to between 47 and 66 miles. On average, sulfates contribute about a third of the measured haze. Wind blown dust from roads and construction activities, especially during the windy spring season, account for another third of the haze. (Although large dust events were attributed to transport from Asia.) Haze at Tonto can also be attributed to organic carbon, usually related to emissions from fire, automobiles, and industrial processes. One period of low visibility attributed primarily to increased levels of organic and elemental carbon occurred in late June to early July of 2000. Visibility dropped to 45 miles during this period, which coincides with the Rodeo-Chediski fires that consumed 450,000 acres in east central Arizona.



Tonto National Monument

September

"Modern society will find no solution to the ecological problem unless it takes a serious look at its lifestyles."
Pope John Paul II

Born in southern Arizona, **Janet Lenon** received a bachelor degree in early childhood education from Northern Arizona University, in Flagstaff. After two years of teaching kindergarten, Janet continued her education completing a masters in anthropology. The doors opened to a new career with the National Park Service in 1988.

Janet has a long history of service with the National Park Service that continues through the present day. Her work has taken her all over the west and southwest including: Glen Canyon and Curecanti National Recreation Areas, Black Canyon of the Gunnison and Teton National Parks, Tumacacori National Historic Park in New Mexico, and of course Tonto National Monument where she has worked for seven years.

Janet's primary duties at Tonto are in fee collection and interpretation, which includes leading hikes and doing school programs. More and more her time is split with resource management duties like making air quality measurements, getting involved with the integrated pest management program, and helping with the rattlesnake research project. Janet has been in charge of IMPROVE sampler operations for four years, a job she welcomes especially during the heat of summer when the only air conditioning is in the shelter! During the fires in 2000, Janet reported "you could see the smoke settling in the Tonto Basin". During periods of road construction, dust can also be a problem due to the site's proximity to a major highway. The National Park Service Air Quality Division and the U.S. Forest Service greatly appreciate Janet's continuing efforts on behalf of the IMPROVE program!

Northeast view of the Tonto aerosol monitor

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Aug 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 Oct 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31			**1** *245 Julian day*	**2** *246*	**3** *247* IMPROVE particle sampling day	**4** *248*
5 *249*	**6** *250* Labor Day IMPROVE particle sampling day	**7** *251* Change IMPROVE particle cartridges.	**8** *252*	**9** *253* IMPROVE particle sampling day	**10** *254*	**11** *255*
12 *256* IMPROVE particle sampling day	**13** *257*	**14** *258* Change IMPROVE particle cartridges.	**15** *259* IMPROVE particle sampling day	**16** *260*	**17** *261*	**18** *262* National Public Lands Day IMPROVE particle sampling day
19 *263*	**20** *264* Pollution Prevention Week	**21** *265* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	**22** *266* Autumn begins	**23** *267*	**24** *268* IMPROVE particle sampling day	**25** *269*
26 *270*	**27** *271* IMPROVE particle sampling day	**28** *272* Change IMPROVE particle cartridges.	**29** *273*	**30** *274* IMPROVE particle sampling day		

UC-Davis: *Sampler:*
General Lab
(530) 752-1123

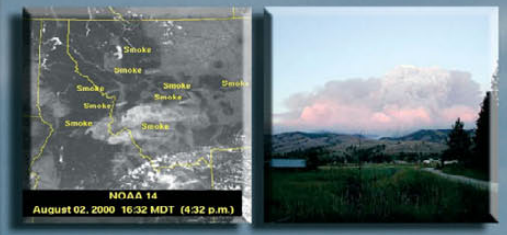
ARS: *Optical:*
Carter Blandford or
Karen Rosener
Photography:
Karen Fischer
(970) 484-7941

"Operator Involvement-- The Key to Network Success"

FIRES AND IMPROVE

EDWIN B. FORSYTHE NATIONAL WILDLIFE REFUGE

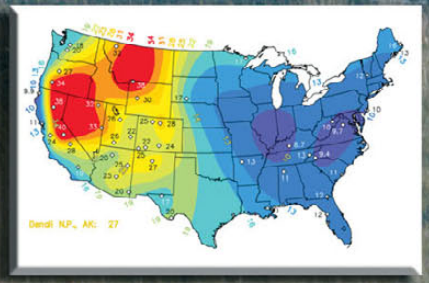
Forest fires degrade visibility, as can be seen from this satellite image of Idaho taken August 2, 2000, and this photo of smoke from the Valley Complex Fire in the Bitterroot National Forest in Montana, one of those shown in the satellite image. Of course, the nature and the mixture of the vegetation covering our national landscape is largely a result of such natural fire activity. It has been estimated that between 40 and 50 million acres of forest burned each year in the contiguous United States through the early 20th century. Drought cycles, El Nino/La Nina cycles, and other climatic features would have greatly affected the year-to-year amounts. However, through the second half of the 20th century, suppression efforts have been responsible for reducing the burned area to approximately 4 million acres/year. The effectiveness of this suppression has cost forests their health, created invasive species problems, and resulted in large, unnatural fuel buildups, especially in the western U.S. where population growth has dramatically expanded the interface between forests and urban areas.



To restore healthy forests and reduce fire hazards to people and their communities, fire is being reintroduced in a managed fashion. Between 1994 and 2000, the Departments of Interior and Agriculture increased their effort to reduce fire risks through prescribed fire and thinning by close to 500 percent. In 1999, the departments treated 2.2 million acres, mostly with prescribed fire. In 2000, the country experienced its largest wildfire year in over 40 years with 8.4 million acres burned, and still over 1 million acres of prescribed fire was accomplished. Clearly, the amount of fire and its resulting smoke that will be experienced over the coming years is increasing. This will certainly affect visibility in the nations parks and wildernesses.

IMPROVE monitoring suggests that organic carbon aerosol, emitted from these forest fires, contributes a significant percentage to visibility extinction in the Western US.

Under the Regional Haze Rule, officials are charged with the responsibility to use IMPROVE data to separate natural fire contributions to haze from other sources of carbonaceous material. Forest and other fires can be either natural or human induced. Emissions from major forest fires are likely classified as natural phenomena, while emissions from prescribed burning to reduce organic fuel accumulation would be classified human induced and subject to policy decisions. Significant scientific problems remain with our ability to quantify and allocate these emissions.



Organic % of aerosol extinction on the 20% haziest days in 2000.

At the Cooperative Institute for Research in the Atmosphere (CIRA), the National Park Service air quality research team is developing methods to uniquely trace smoke from forest fires as a component of the IMPROVE sample. Statistical tools are being used to see if there is a unique chemical component profile to fingerprint smoke. Models of regional air quality are also being applied to sort the fire and smoke contributions to haze.

The Edwin B. Forsythe National Wildlife Refuge (NWR) is located 10 miles north of Atlantic City, New Jersey. Originally two distinct refuges, the Brigantine and Barnegat were combined in 1984 under the Edwin B. Forsythe name honoring the late New Jersey conservationist congressman. This southern New Jersey coastal habitat is actively protected and managed for migratory birds. Nearly 90 percent of the refuge is tidal salt meadow and marsh interspersed with shallow coves and bays. and the remainder is woodlands. More than 6000 acres of the refuge is designated wilderness including two of the few remaining undeveloped barrier beaches. These pristine sites provide critical nesting habitat for threatened piping plovers, black skimmers, least terns, peregrine falcons, and ospreys. Each spring and fall thousands of water birds stop to feed and rest during their long migrations. The refuge is located in one of the Atlantic Flyway's most active flight paths, making it an important link in the network of refuges administered by the US Fish and Wildlife Service. In 2002 the refuge was the recipient of the New Jersey Governor's Eco-Tourism Award.

IMPROVE monitoring began at the refuge in 1991 with both aerosol and nephelometer measurements being recorded. With over 10 years of data some visibility trends have emerged. Annual average visibility today is about 25 miles. On the 20% clearest days, visibility averages between 38 and 47 miles, while on the 20% haziest days visibility drops to between 12 and 14 miles. On average, 81% of the haze can be attributed to sulfates. On clear days sulfates account for about a third of the problem, with influences from wood smoke, sea salt, oil combustion, and soil making up the balance. Between 1992 and 1999 there was a 25 percent decline in the fine particles (PM2.5) that cause haze. It is likely that the reduction of sulfur dioxide emissions under the Acid Rain Control Program affected this trend; no significant reduction in particles has been noted since 1999. Summer tends to be the haziest, coinciding with a seasonal peak in sulfates. Emissions from coal-fired power plants concentrated in the Ohio River Valley are a primary contributor to the sulfate haze, but oil sources located in the New York City area, carbon sources in the Washington DC - Baltimore area, wood smoke from summer forest fires in the southeast, winter residential wood burning, and sea salt from the Atlantic Ocean all affect visibility.

Edwin B. Forsythe National Wildlife Refuge

October

"Leave it as it is. The ages have been at work on it and man can only mar it."
President Theodore Rooseelt

Though retired, **Doug Kellner** starts his day at 6:00 a.m. as a volunteer at the Edwin B. Forsythe National Wildlife Refuge. A third-year volunteer, logging 8-hour days and over 4000 hours to date, Kellner says he likes the challenge of field work, especially fixing things that break. He takes care of both the IMPROVE and the National Atmospheric Deposition Program (NADP) sites, including training new operators. With little time to spare he dons yet another hat as manager of the wood duck program, tracking species' productivity and monitoring water quality in the wetlands in an effort to preserve habitat for migrating water fowl.

Kellner definitely has a history of fixing things. After a stint in the Air Force, he was employed as a radio and radar technician for Eastern and United Airlines, and worked on flight inspection and navigational equipment for the Federal Aviation Administration (FAA). Recalling his thirty years as a field engineer for IBM working in the data processing environment, takes him back to a time when computers had tubes, filled whole rooms, and programs were punched on cards.

Neither retirement nor a battle with melanoma seems to slow Kellner down. He and his wife have gotten pretty good at country line dancing and love to travel. They just returned from a Caribbean Cruise. "I'm not here for the money or rewards," says Kellner, "I'm here because I enjoy it! I worked 30 years in a small room with no windows, now I'm living my dream." Later he confides another dream, "to work with the manatees in Florida before I hang up my hat!"

Sampler site at NWR headquarters near Oceanville

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Sep 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30			Nov 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30		**1** *275 Julian day*	**2** *276*
3 *277* IMPROVE particle sampling day	**4** *278*	**5** *279* Change IMPROVE particle cartridges.	**6** *280* IMPROVE particle sampling day	**7** *281*	**8** *282*	**9** *283* IMPROVE particle sampling day
10 *284*	**11** *285* Columbus Day (Observed)	**12** *286* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	**13** *287*	**14** *288*	**15** *289* IMPROVE particle sampling day	**16** *290*
17 *291*	**18** *292* IMPROVE particle sampling day	**19** *293* Change IMPROVE particle cartridges.	**20** *294*	**21** *295* IMPROVE particle sampling day	**22** *296*	**23** *297*
24 *298* IMPROVE particle sampling day	**25** *299*	**26** *300* Change IMPROVE particle cartridges.	**27** *301* IMPROVE particle sampling day	**28** *302*	**29** *303*	**30** *304* IMPROVE particle sampling day
31 *305* Daylight Saving Time Ends Halloween						

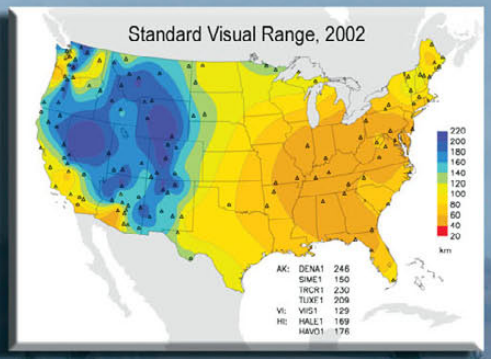
UC-Davis: *Sampler*:
General Lab
(530) 752-1123

ARS: *Optical*:
Carter Blandford or
Karen Rosener
Photography:
Karen Fischer
(970) 484-7941

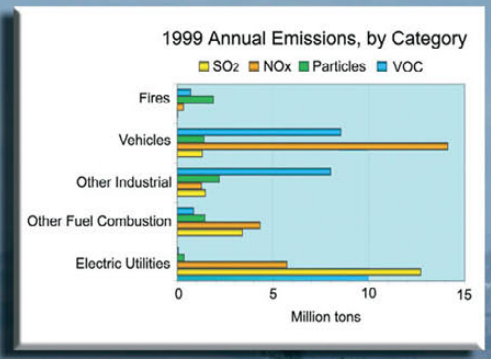
"Operator Involvement-- The Key to Network Success"

AIR POLLUTANT SPATIAL TRENDS

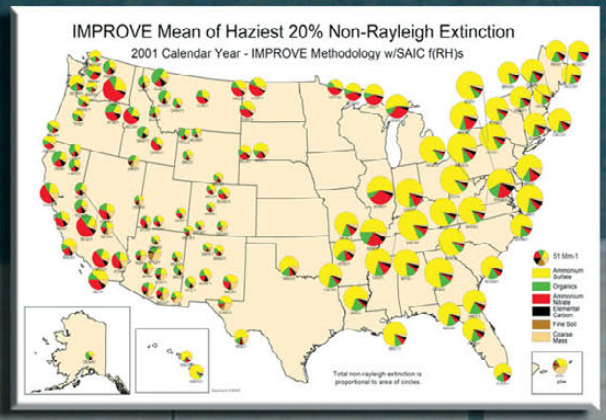
STARKEY EXPERIMENTAL FOREST



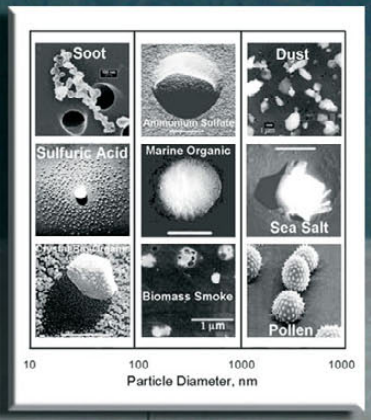
Visibility conditions throughout the United States reported as standard visual range in kilometers. Annual visibility in the Eastern U.S. averages between 15 and 35 miles. Annual visibility in the Western U.S. averages between 35 and 90 miles.



Annual emissions of air pollutants from different major source categories for 1999, in millions of tons. Particle emissions include fine and coarse particles.



This map represents the contributions of six major pollutants on the 20% haziest days. Note that extinction is significantly higher in the east, largely due to higher sulfate concentrations, while higher nitrate concentrations contribute to haze in southern California and Washington's Columbia River Gorge.



Comparative sizes of airborne particles. Image prepared by Rudy Husar, Center for Air Pollution Impact and Trend Analysis, Washington University, St. Louis, MO.

The Starkey Experimental Forest lies within the Wallowa-Whitman National Forest in the heart of the Blue Mountains, 30 miles southeast of La Grande, Oregon. The Starkey Experimental Forest includes 25,000 acres set aside in the 1940s as a center for a variety of wildlife studies. The Starkey Project is a joint wildlife research project conducted by the Oregon Department of Fish and Wildlife and the USDA Forest Service. Twenty seven miles of eight-foot-high fence surround the largest research enclosure ever built to study wildlife. The study area contains habitats typical of those in the intermountain west, and is divided into a large main study area, an intensive timber management area, and a winter feeding and handling area. One research effort, the Breeding Bull Efficiency study, looked at various known-aged bulls and cows to monitor the breeding success of different age classes. Vegetation studies assessed the feed competition between elk, deer, and cattle and the behavioral responses of each species to the other; as well as their responses to traffic patterns and frequency of vehicles on forest roads. An April, 2002 study is assessing the degree to which popular recreational activities (hiking, mountain biking, all terrain vehicles, and horse-riding) disturb elk and deer populations.

A unique automated radio telemetry system that utilizes LORAN-C signals locates deer, elk, and cattle within the forest, generating an animal location every 15 seconds with an accuracy to within 50 meters. One hundred eighty animals are outiffted with radio collars and will be tracked for ten years. The system allows observations of animals in a natural, free-ranging environment and generates 100 times the data of conventional tracking systems at a cost of less than $1 per location.

The Starkey Experimental Forest was chosen as an IMPROVE monitoring site by virtue of its proximity to the Strawberry Mountain Wilderness to the southwest and the Eagle Cap Wilderness to the east. The USDA Forest Service installed an IMPROVE aerosol monitor in March, 2000 to characterize air pollutants that might affect nearby wilderness areas and to assess current air quality conditions. In addition to visibility and aerosol monitoring, weekly measurements for the National Atmospheric Deposition Program are recorded. Visibility at Starkey averages 90 miles. On the cleanest 10% of days visibility is 140 miles or greater, while on the haziest 10% of days, visibility is 35 miles or less. The major air quality concern is from smoke. Local sources include controlled burns on the forest, agricultural field burning, and winter residential wood burning. In general, the area is very rural. Nearby La Grande has a population of 12,500, the town of Pendleton with 17,000 lies 45 minutes west, and Baker City to the southeast has a population under 10,000. The sulfate contribution to haze can be as much as 36 percent and indicates a regional transport of secondary sulfur from industrial sources in western Washington.

Starkey Experimental Forest

November

"The idea of wilderness needs no defense, it only needs defenders."
Edward Abbey

Cheryl Borum and her husband Dale live on a small ranch 10 miles north of La Grande, Oregon. They raise cattle, mules, and honey bees and enjoy day rides and extended pack trips into the wilderness. Two Labradors and an Australian cattle dog help out at the ranch while various cats keep an eye on things from the porch. With a B.S. in animal sciences from Oregon State University, Borum is uniquely suited for this life! She also serves on the board of the local animal shelter where she volunteers much of her free time.

Post college training in computers and geo-satellite positioning systems (GPS) led Borum to her current position as an information technology specialist in the Forestry and Range Sciences Lab out of the USDA Forest Service Pacific Northwest Research Station. Though primarily responsible for the operation and maintenance of the telemetry system, she still makes time to don an air quality hat, taking care of the IMPROVE and NADP monitoring systems. The USDA Forest Service greatly appreciates her efforts and dedication to the IMPROVE monitoring program!

Aerosol monitor on Campbell Flats

Elk Feeding Grounds

Winter Sunrise

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
UC-Davis: *Sampler*: General Lab (530) 752-1123 **ARS**: *Optical*: Carter Blandford or Karen Rosener *Photography*: Karen Fischer (970) 484-7941	1 *306 Julian day*	2 *307* Election Day IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	3 *308*	4 *309*	5 *310* IMPROVE particle sampling day	6 *311*
7 *312*	8 *313* IMPROVE particle sampling day	9 *314* Change IMPROVE particle cartridges.	10 *315*	11 *316* Veterans Day IMPROVE particle sampling day	12 *317*	13 *318*
14 *319* IMPROVE particle sampling day	15 *320* America Recycles Day	16 *321* National Park Service established, 1916 Change IMPROVE particle cartridges.	17 *322* IMPROVE particle sampling day	18 *323*	19 *324*	20 *325* IMPROVE particle sampling day
21 *326*	22 *327*	23 *328* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	24 *329*	25 *330* Thanksgiving	26 *331* IMPROVE particle sampling day	27 *332*
28 *333*	29 *334* IMPROVE particle sampling day	30 *335* Change IMPROVE particle cartridges.				

Oct 2004

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

Dec 2004

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

"Operator Involvement-- The Key to Network Success"

IMPROVE DATA USES

JAMES RIVER FACE WILDERNESS AREA

Federal Land Managers (FLMs), states, tribes, and other monitoring entities share IMPROVE monitoring information. A centrally located, national visibility database archive is coordinated by EPA for all historical and future visibility monitoring information and data. Protocols are in place to assure that data collected today can be used in future applications and new source review models. Visibility monitoring data are used in each of the following applications:

1. **Visibility Protection Program:** Data are used to identify existing conditions and determine long-term trends. Program data are also used to assess progress toward existing national goals.

2. **Prevention of Significant Deterioration (PSD) Program Requirements:** Visibility data that describe existing conditions can be used as input for New Source Review (NSR) models and to assess a proposed source's potential impact on a particular PSD area.

3. **State Implementation Plans (SIPs), Federal Implementation Plans (FIPs), and Tribal Implementation Plans (TIPs):** Visibility data can be used to quantify existing conditions, support trend analysis, and support impairment designation policies in SIPs, FIPs, and TIPs. Monitoring programs in turn, enable the enforcement of emission limitations and other air quality-related control measures.

4. **Federal Documents (e.g. Regional Assessments, Management Plans, Environmental Impact Statements, etc.):** Visibility data that describe existing conditions are often referenced in federal documents to denote resource conditions prior to land management changes. Data presentations can also be used in political forums to aid in the understanding of existing conditions and need for future air quality-related policies and/or regulations.

5. **Acid Rain Program:** The links between acid rain and visibility degradation, although indirect are quite strong. Of particular importance is the relationship of visibility to the air pollutants associated with acid deposition -- i.e., the relationship of visibility to nitrogen dioxide, nitrate aerosols, and (especially) sulfate aerosols.

6. **Fire Emissions Inventories:** Natural and prescribed fire emissions often impact visibility in Class I and other protected natural areas. With the development of increased fire programs, existing and future visibility data can be used to evaluate the visibility impacts of fire emissions.

7. **Fine Particulate Standards:** Existing visibility-related PM2.5 and PM10 data may be used to supplement Federal Reference Method measurements (e.g. to estimate regional background concentrations) in association with new fine particulate standards.

8. **Other Uses for Non-Class I Area Management:** Visibility data can be used to document the frequency, dynamics, intensity, and causes of urban hazes, establish visual air quality acceptance criteria, and evaluate daily air quality indexes.

The James River Face Wilderness is located near Natural Bridge Station in central Virginia. This is where the James River breaks out of the Shenandoah Valley through a gap in the Blue Ridge Mountains on its eastward journey to the Chesapeake Bay. The wilderness, established in 1975, now contains a total of 8,886 acres and is managed by the USDA Forest Service. To the south, and separated by only a thin strip of dirt, lies the recently designated Thunder Ridge Wilderness. James River Face reaches a high point of 3,073 feet on Highcock Knob near the southern boundary, and a low point of about 650 feet near the river. Vegetation is unusually diverse, especially in the James River Gorge, which is dominated by a typical Appalachian hardwood forest.

Air quality monitoring began near the James River Face Wilderness with the installation of a camera monitoring system in 1987. Camera data provided a valuable first step in characterizing visibility in the southern Appalachians. Upgrading the site to IMPROVE protocol status in 1995 provided information on the types of particles responsible for the haze in the wilderness. In 1998 The Forest Service expanded air quality monitoring to include ozone and wet deposition.

Visibility in the wilderness ranks among the poorest in the eastern U.S., averaging only about 25 miles. On the 10% clearest days, visibility is 45 miles, about half of the natural background visibility. On the 10% haziest days visibility is limited to 13 miles. Camera data from 1987-1993 measured average wintertime visibilities about 4 times greater than summertime values. Ammonium sulfate accounts for 66 percent of the fine particulate matter on average and 72 percent on the haziest days. Historic and current levels of acid deposition, combined with low buffering capacity of the underlying geology, has led to acidification of many headwater streams in the region and the wilderness. Air quality is affected by a huge array of pollution sources located both near and far from the Class I area. The nearest large source of pollution is a pulp mill located three miles from the wilderness. The mill is in the process of installing innovative new technology, a gasification process, to recover chemicals used in the pulping process, resulting in a reduction in fossil fuel usage and lower emissions of criteria and hazardous pollutants.

Hazy and Clear Days

James River Face Wilderness Area

December

"In wilderness I sense the miracle of life."
Charles A. Lindbergh

Kenneth Hickman, better known to us as "Nug", Hickman has been taking care of the James River Face IMPROVE site since 1995. In the early days of visibility monitoring Nug maintained the camera. When James River Face became an IMPROVE protocol site, Nug was the one who renovated an existing cement block building to house the aerosol monitors. Nug is definitely a man of many talents and he has used them all in operating the air station. When the site was again expanded in 1988 another new building was constructed for new equipment. Fortunately, Nug has skills as an electrician and carpenter, in addition to being a biologist, which continue to come in handy. Nug is a native of Buena Vista, VA, and apparently likes it there...because after 15 years with the Forest Service he is still within a stone's throw of his birthplace! Nug is officially a Forestry Technician, but he works primarily as a Biological Technician. He has a BS in Fish and Wildlife Management from North Carolina Wesleyan. When Nug is not in the woods working he spends time with his wife Vickie and two daughters Ruth Virginia, 6, and Mary Katherine, 2, camping and fishing.

Herble Huffman is also a native of Buena Vista, and he hasn't strayed far either. (This really is God's country so why leave!) Herbie has been a Biological Technician for 23 years. He is known far and wide for his sense of humor. (The author can testify to his keen skill at practical jokes...having had my Jeep tied up in pink flagging one afternoon.) Herbie likes to hunt and fish when he is not off fighting fires (his first love after his "gals; wife Mary Lee and 8 year old Morgan"). Herbie has so much energy that he needs a second job to keep him out of trouble! He is a wastewater treatment plant operator for the town of Buena Vista.

Even though Nug and Herbie, well, at least Nug, might be too shy to say it themselves.... they do a fantastic job of keeping the James River Site running without a hitch.

Cindy Hueber, Air Resource Specialist, U.S.D.A. Forest Service

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Nov 2004 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 Jan 2005 S M T W T F S 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31			1 *336 Julian day*	2 *337* IMPROVE particle sampling day	3 *338*	4 *339*
5 *340* IMPROVE particle sampling day	6 *341*	7 *342* Change IMPROVE particle cartridges.	8 *343* IMPROVE particle sampling day	9 *344*	10 *345*	11 *346* IMPROVE particle sampling day
12 *347*	13 *348*	14 *349* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	15 *350*	16 *351*	17 *352* IMPROVE particle sampling day	18 *353*
19 *354*	20 *355* IMPROVE particle sampling day	21 *356* Winter begins Change IMPROVE particle cartridges.	22 *357*	23 *358* IMPROVE particle sampling day	24 *359*	25 *360* Christmas
26 *361* IMPROVE particle sampling day	27 *362*	28 *363* Change IMPROVE particle cartridges.	29 *364* IMPROVE particle sampling day	30 *365*	31 *366* New Year's Eve	**UC-Davis**: *Sampler:* General Lab (530) 752-1123 **ARS**: *Optical:* Carter Blandford or Karen Rosener *Photography:* Karen Fischer (970) 484-7941

"Operator Involvement-- The Key to Network Success"

Sites With >90% Data Completeness in 2002

Site	State	Agency	Completeness
Arendtsville	PA	EPA	100
Ft Peck	MT	Assiniboine & Sioux Tribes	100 *
Grand Canyon	AZ	NPS	100
Isle Royale	MI	NPS	100
Mount Hood	OR	FS	100
Petrified Forest	AZ	NPS	100
Rocky Mountain	CO	NPS	100
Three Sisters	OR	FS	100
Bondville	IL	EPA	99
Cabinet Mountains	MT	FS	99
Chiracahua	AZ	NPS	99
Hercules-Glades	MO	FS	99
MK Goddard	PA	EPA	99
Connecticut Hill	NY	EPA	99
Great Basin	NV	NPS	99
Presque Isle	ME	Micmac Tribe	99
Saguaro	AZ	NPS	99
Simeonof	AK	FWS	99
Starkey	OR	FS	99
Addison Pinnacle	NY	STATE	99
Moosehorn	ME	FWS	99
Seattle	WA	QA	99
Cape Romain	SC	FWS	99
Snoqualamie Pass	WA	FS	99
Wheeler Peak	NM	FS	99
Sac and Fox	KS	Sac & Fox Nations	98 *
Mammoth Cave	KY	NPS	98
Nebraska	NE	FS	98 **
Big Bend	TX	NPS	98
Everglades	FL	NPS	98
North Cascades	WA	NPS	98
Lake Sugema	IA	STATE	98 *
Denali	AK	NPS	98
Mohawk Mountain	CT	STATE	98
Quaker City	OH	EPA	98
Saguaro west	AZ	STATE	98
Hawaii Volcanoes	HI	NPS	98
Quabbin Reservoir	MA	STATE	98
Guadalupe Mountains	TX	NPS	97
Great Gulf	NH	FS	97
Bandelier	NM	NPS	97
Gila	NM	FS	97
Great Smoky Mtns	TN	NPS	97
Lostwood	ND	FWS	97
James River	VA	FS	97
Pinnacles	CA	NPS	97
Bosque del Apache	NM	FWS	97
Columbia Gorge East	WA	FS	97
Wichita Mountain	OK	FWS	97
Trapper Creek-Denali	AK	NPS	97
White Mountain	NM	FS	97
Upper Buffalo	AR	FS	96
Medicine Lake	MT	FWS	96
San Gabriel	CA	FS	96
Voyageurs	MN	NPS	96
Shenandoah	VA	NPS	96
Casco Bay	ME	STATE	96
Lava Beds	CA	NPS	96
Olympic	WA	NPS	96
Washington DC	DC	NPS	96
Seney	MI	FWS	96
Yosemite	CA	NPS	96
Northern Cheyenne	MT	Northern Cheyenne Tribe	96 *
Badlands	SD	NPS	95
Monture	MT	FS	95
Wind Cave	SD	NPS	95
Proctor Research Center	VT	STATE	95
Pasayten	WA	FS	95
Queen Valley (Superstition)	AZ	STATE	95
Cherokee	OK	Cherokee Tribe	95 *
Livonia	IN	EPA	94
Sula	MT	FS	94
Death Valley	CA	NPS	94
Sycamore Canyon	AZ	FS	94
Zion	UT	NPS	94
Kalmiopsis	OR	FS	94
Salt Creek	NM	FWS	94
Okefenokee	GA	FWS	94
Bliss	CA	FS	94
Cadiz	KY	EPA	94
Phoenix	QA	QA	94
Swanquarter	NC	FWS	94
Hoover	CA	FS	93
Mount Baldy	AZ	FS	93
Hells Canyon	OR	FS	93
Mount Rainier	WA	NPS	93
Great Sand Dunes	CO	NPS	93
Craters of the Moon	ID	NPS	93
Joshua Tree	CA	NPS	93
White Pass	WA	FS	93
Flathead	MT	Confederated Salish & Kootenai Tribes of the Flathead Res.	92 *
Cloud Peak	WY	STATE	92 *
Thunder Basin	WY	STATE	92 *
Bridger	WY	FS	92
Crater Lake	OR	NPS	92
Lye Brook	VT	FS	92
Dolly Sods	WV	FS	92
Gates of the Mountains	MT	FS	92
Yellowstone	WY	NPS	91
San Gorgonio	CA	FS	91
Lassen Volcanic	CA	NPS	91
Sawtooth	ID	FS	91
Caney Creek	AR	FS	91
Great River Bluffs	MN	STATE	91 **
Chassahowitzka	FL	FWS	91
Weminuche	CO	FS	90
Columbia Gorge West	WA	STATE	90
Canyonlands	UT	NPS	90
Brigantine	NJ	FWS	90
Ellis	OK	STATE	90 *
North Absaroka	WY	FS	90

LEGEND:

NPS	National Park Service
FS	USDA Forest Service
FWS	US Fish and Wildlife Service
EPA	Environmental Protection Agency
STATE	State Sponsored
QA	Quality Assurance Site
*	Site started in 2nd quarter
**	Site started in 3rd quarter

Three new sites were added in January 2003:
Organ Pipe, AZ, State of Arizona
Martha's Vineyard, MA, Wampanoags Tribe
Zion Canyon, UT, NPS