2007 Calendar

IMPROVE

Interagency Monitoring of Protected Visual Environments

Colorado State University

CIRA

IMPROVE

Interagency Monitoring of Protected Visual Environments

The IMPROVE Program

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 175 monitoring sites. The data collected 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.

The program monitors visibility with IMPROVE aerosol samplers. The four-module samplers measure fine particle mass, sulfur, soil elements, nitrate, carbon, chloride, and coarse mass. Other instrumentation used in support of the program include optical and scene monitoring instrumentation. Optical instrumentation includes transmissometers that measure total atmospheric extinction and nephelometers that measure the scattering component of extinction. Scene monitoring uses camera systems that document the visual appearance of a scene.

IMPROVE Data Uses

Federal land managers (FLMs), states, tribes, and other monitoring entities share IMPROVE monitoring information. A centrally located, national visibility database archive is coordinated by the 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 the need for future air quality-related policy 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 $PM_{2.5}$ and PM_{10} 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.

Chassahowitzka National Wildlife Refuge, Florida

Al Peterson relates that, "Being in a semi-tropical climate, there are few challenges in operating the IMPROVE site at Chassahowitzka NWR. Because the heat in the IMPROVE shed can become almost unbearable in the late morning and afternoon, I like to arrive early while it's still relatively cool. Heavy rains can also be a problem because the area where the shed is located is prone to flooding. Although the shed itself has never flooded, I sometimes have to slosh through ankle-deep water to get to it." Despite occasional difficulties, he says, "What I like is the satisfaction I get from being part of a program that is concerned with the quality of the air we all breathe. If what I do can somehow improve air quality, my efforts are for a good cause."

Peterson reports that visibility is almost always good in the area, with the exception of impairment from early morning fog that is common during the winter months. He adds, "There is a nuclear power plant and two or three coal-fired power plants located about 20 miles north of the IMPROVE site. Soot from the coal-fired plants is almost always found in rain water at the site."

Chassahowitzka NWR is also a rainwater collection site for the National Atmospheric Deposition Program. In addition to measuring visibility, Peterson operates the National Trends Network and Mercury Deposition Network sites at the refuge and maintains a complete weather station, the data collected being used by the staff biologist for various studies.

Al is a retired quality control manager for a small electronics company. He moved to Florida seven years ago and became a volunteer for the U.S. Fish and Wildlife Service because he had plenty of spare time and a life-long interest in wildlife and conservation. He feels that the part of Florida known as the Nature Coast, with its many preserves and parks, was a natural fit. In his spare time he likes to hike, kayak, and hone his skills in photography and meteorology. One day a week he volunteers at the Crystal River NWR office greeting visitors and doing general office work. He also volunteers at the Homosassa Springs Wildlife State Park once a week.

January

"When a man throws an empty cigarette package from an automobile, he is liable to a fine of $50. When a man throws a billboard across a view, he is richly rewarded."

- Pat Brown, quoted in David Ogilvy, *Ogilvy on Advertising*, 1985

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** *1 Julian day* National Environmental Policy Act, 1969 New Year's Day	**2** *2* Change IMPROVE particle cartridges.	**3** *3* IMPROVE particle sampling day	**4** *4*	**5** *5*	**6** *6* IMPROVE particle sampling day
7 *7*	**8** *8*	**9** *9* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	**10** *10*	**11** *11*	**12** *12* IMPROVE particle sampling day	**13** *13*
14 *14*	**15** *15* Martin Luther King, Jr. IMPROVE particle sampling day	**16** *16* Change IMPROVE particle cartridges.	**17** *17*	**18** *18* IMPROVE particle sampling day	**19** *19*	**20** *20*
21 *21* IMPROVE particle sampling day	**22** *22*	**23** *23* Change IMPROVE particle cartridges.	**24** *24* IMPROVE particle sampling day	**25** *25*	**26** *26*	**27** *27* IMPROVE particle sampling day
28 *28*	**29** *29*	**30** *30* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	**31** *31*			

Dec 2006

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Feb 2007

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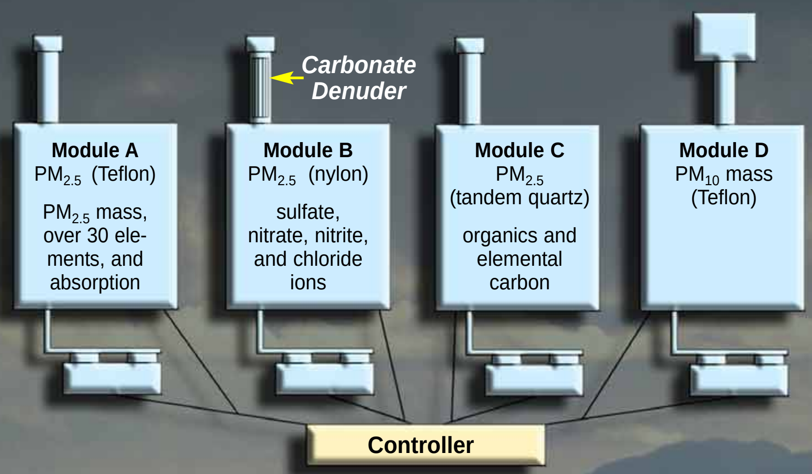
The Aerosol Sampler

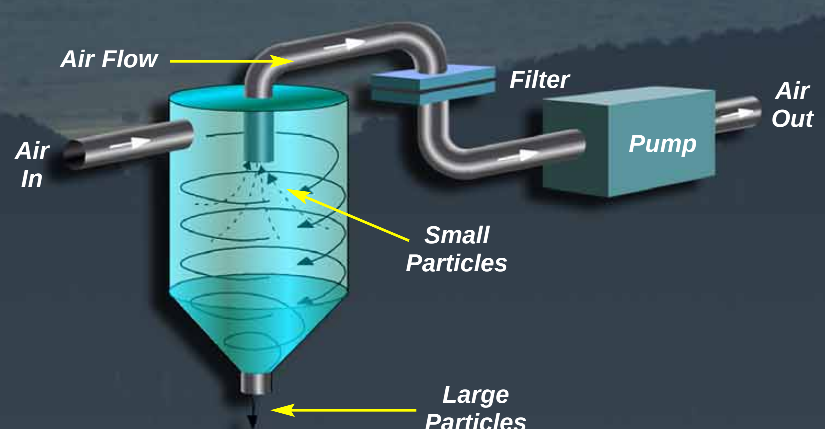
IMPROVE
Interagency Monitoring of Protected Visual Environments

Aerosol Monitoring



The standard IMPROVE particulate sampler has four sampling modules. Modules A, B, and C collect fine particles (2.5 microns and smaller {$PM_{2.5}$}), while module D collects larger particles (10 microns and smaller {PM_{10}}). Fine particles have the greatest impact on visibility, can adversely affect human health, and are often the result of human activities. The coarse mass (particles larger than 2.5 microns) is primarily composed of soil and carbonaceous material and is often of natural origins. 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.

The IMPROVE fine particle modules employ a cyclone at the air inlet which spins the air within a chamber. Fine particles are lifted into the air stream where they are siphoned off and collected on a filter substrate for later analysis. The large particles impact on the sides of the chamber and fall into a collection cup at the bottom.



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 regulations use the average visibility values for the clearest days and the worst days. The worst days are defined as those with the upper 20% of impairment values for the year, and the clearest days as the lowest 20%. The goal is to reduce the impairment of the worst days and to maintain or reduce it on the clear 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. There are both annual and seasonal criteria. The criteria are

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

Filter analysis provides concentrations and composition of atmospheric particles. Common fine particles include sulfates, nitrates, organic material, elemental carbon (soot), and soil. An indication of source contribution to visibility impairment can be obtained from the analysis of trace elements.

vanadium/nickel ⇨ petroleum-based facilities, autos
arsenic ⇨ copper smelters
selenium ⇨ power plants
crustal elements ⇨ soil dust (local, Saharan, Asian)
potassium (nonsoil) ⇨ forest fires

Sample Protocol

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 are initial or final readings for the filter in position 3 for two of the three weeks. The log sheet and display indicate when values for position 3 are recorded.

Every 3rd week, the sampler is operated 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 resumes collection on the filters in position 3.

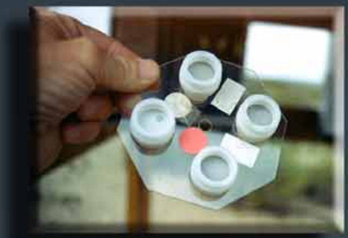
The field blanks in position 4 are transparent to the operator and sampler controller. Flow rate measurements are not taken for these.

If for any reason a backup person cannot make a change on a particular Tuesday or the "blue box" is late, or for any problem or question, the operator calls 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 "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 Ziploc® bags
1 bag/week labeled with install date and 4 color-coded cartridges, one for each module

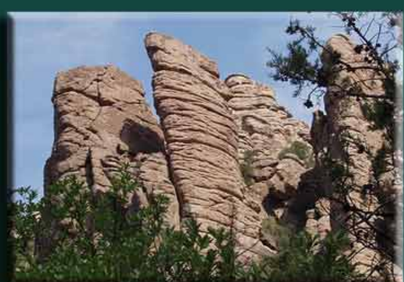
Module A filter pack



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

Chiricahua National Monument, Arizona

Carrie Dennett is the IMPROVE operator at Chiricahua Natl. Monument in south-eastern Arizona. Visibility is usually excellent in this area. The cracks and crevices of Cochise Stronghold, 60 miles away, are often visible. This viewshed -- the wonderland of rocks -- is what visitors come to see. On clear days visibility averages 150 miles, while on the haziest days, visibility averages only 65 miles. Trend data indicates that visibility in Chiricahua is improving on the clearest days and degrading on the haziest days.



There are some concerns on the horizon. The monument's proximity to Mexico makes it a prime candidate for monitoring the effect of Mexico's pollution on air quality in the United States. One of the most important mining and metallurgical centers in the Sonoran region of Mexico is located in Canaea, 25 miles south of the Arizona border. Power plants, smelters, and other sources in Pima, Pinal, and Cochise counties in Arizona, and in Hidalgo County in New Mexico, all contribute pollutants to the monument. There is also concern about U.S. plans to build an additional incinerator and power plants within a 50-mile radius of the monument, including the construction of a coal-burning power plant in Bowie, AZ, 25 miles to the north.

Dennett says that the main challenge in operating the site is maintaining continuity in staffing. "With the constantly shrinking budget, it's hard to hire a permanent employee these days." The air quality data is used for interpretive displays to educate visitors about the importance of air quality.

In other research, wildlife studies are being conducted to look at bat populations, Mexican spotted owls, the connectivity of carnivore populations between sky islands, and a new study to determine the effects of fire on the spotted owl's prey base (small mammals).

A scenic vista looking east-southeast toward Hatchett Peak, center, 60 miles distant.

February

"Your grandchildren will likely find it incredible - or even sinful - that you burned up a gallon of gasoline to fetch a pack of cigarettes!"

\- Dr. Paul MacCready, Jr.

Jan 2007

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Mar 2007

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

UC, Davis: <u>Sampler:</u>
General Lab
(530) 752-1123

ARS: <u>Optical:</u>
Carter Blandford or
Karen Rosener
<u>Photography:</u>
Karen Fischer
(970) 484-7941

"Operator Involvement -- The Key to Network Success"

IMPROVE Filters

Interagency Monitoring of Protected Visual Environments

Filters cycle through several processes before they reach the monitoring site and after they return to the University of California, Davis.

Pre-Shipping...

1. Clean A and D module filters are pre-weighed on a balance before shipping the blue box. Clean B and C module filters are simply placed in a cassette without being weighed. This process is called uploading.

2. The uploader weighs the A and D filters. Each filter has an ID according to the site it will be sent to and the date that the filter will be used. Each A and D filter's weight is automatically recorded in a database.

3. After the box has been uploaded, the work is double-checked. This is the final process before the box is shipped out.

After Return From the Field...

4. After the log sheets and flashcards are removed from the box, the data in the flash card is read and automatically placed into a database.

5. After the flash card is read into the database, its data is compared to the data written on the log sheets. Any problems a box might have are dealt with at this point.

6. The B and C filters are placed in a petri dish with the corresponding identification sticker.

7. The B and C petri dishes are placed in trays in a particular order generated by the database.

8. After the B and C filters are downloaded, the box moves on to the post-weighing station where the sampled A and D filters are weighed.

9. After post-weighing, the filter is stored in a pre-labeled slide mount for later analysis.

10. After downloading the B and C filters and post-weighing the A and D filters, the box is placed back at the uploading station to start the process again.

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 log sheet 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 log sheet.

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 log sheet.**

* 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 log sheet 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.

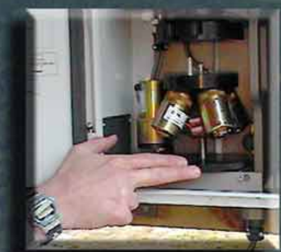
2. "Lockout" the motor by rotating it toward the solenoids.

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 and sample changes: **contact Jose Mojica or Tammy Labelle at (530) 752-1123.**

Flash cards, equipment malfunctions, sampler maintenance, or flow adjustments: **contact Jose Mojica or Ted Scharfen at (530) 752-1123.**

Sampler audits: **Steven Ixquiac (530) 752-4108.**

You may e-mail any of the above using the format lastname@crocker.ucdavis.edu.

Shenandoah National Park, Virginia

Liz Garcia has been the primary air quality station operator at Shenandoah National Park since the fall of 2004. In addition to operating and maintaining the IMPROVE sampler, she collects dry deposition samples for the Clean Air Status and Trends Network (CASTNet), wet deposition samples for both the National Trends Network and the Mercury Deposition Network as part of the National Atmospheric Deposition Program, ozone and SO_2 concentration samples, and fine particle and meteorological data. With her part-time position she is kept busy. Liz says, "One of the biggest challenges is trying to keep all the equipment running the way it is supposed to run. Numerous power outages during the spring, winter, and fall, and the mice, don't help much."

A southwesterly view from Dickey Ridge

Shenandoah National Park lies within the Blue Ridge Mountains, with spectacular views to the east and west from Skyline Drive, which winds for 105 miles along the crest of the mountains, host to 101 miles of the Appalachian Trail. Visibility is an important resource at Shenandoah, and a major concern. Natural visibility is about 90 miles, but current average visibility is only 15-25 miles. Visitors who have frequented the park over the years have commented on the declining views. On the haziest days, 85% of the impairment is caused by sulfates primarily from electric utilities and industrial boilers.

Ozone concentrations are a concern, especially during the hot summer months. Shenandoah's ozone readings frequently exceeded 85 parts per billion (ppb), a level dangerous to people with heart and respiratory problems, but in recent years, readings have only occassionally exceeded 85 ppb. Acid deposition is another concern. Shenandoah has some of the highest measured deposition of both sulfur and nitrogen of all national parks. Sulfur deposition has been high enough to cause the acidification of many streams within the park, with associated harmful impacts on fish, aquatic insects, and other life forms.

On days when she is not working on air quality, Liz is helping out with other natural resource endeavors, such as the Peregrine Falcon Restoration Project and the Hogcamp Branch Stream Restoration Project, and is pulling out invasive exotic plants and mapping rare plant populations. In her spare time she enjoys hiking, backpacking, and canoeing with her husband and their two dogs.

March

"There are no passengers on Spaceship Earth. We are all crew."
- Marshall McLuhan, 1964

Feb 2007

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Apr 2007

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

ARS: *Optical*: Carter Blandford or Karen Rosener

Photography: Karen Fischer (970) 484-7941

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 60 Julian day Yellowstone Natl. Park established, 1872 IMPROVE particle sampling day	2 61	3 62
4 63 IMPROVE particle sampling day	5 64	6 65 Change IMPROVE particle cartridges.	7 66 IMPROVE particle sampling day	8 67	9 68	10 69 IMPROVE particle sampling day
11 70	12 71	13 72 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	14 73	15 74	16 75 IMPROVE particle sampling day	17 76 St. Patrick's Day
18 77	19 78 IMPROVE particle sampling day	20 79 Change IMPROVE particle cartridges.	21 80 Spring begins	22 81 IMPROVE particle sampling day	23 82	24 83
25 84 IMPROVE particle sampling day	26 85	27 86 Change IMPROVE particle cartridges.	28 87 IMPROVE particle sampling day	29 88	30 89	31 90 IMPROVE particle sampling day

IMPROVE
Interagency Monitoring of Protected Visual Environments

Optical and Scene Monitoring Networks

The NPS visibility monitoring program started in 1978 without particulate measurements. Some instruments used in the early network currently operate at some sites according to IMPROVE protocols. Data from the aerosol network, the optical network, and the scene network are compiled to better understand and document visibility events and trends.

The **optical monitoring network** uses transmissometers and nephelometers to measure the ability of the atmosphere to scatter and absorb light. **Transmissometers** measure the extinction properties of the atmosphere. Extinction is a measure of the light scattered and absorbed over a known distance through the atmosphere. Extinction data are useful for relating visibility directly to particle concentrations. Visibility results are calculated and reported as visual range or extinction. There are currently 5 transmissometers operating under IMPROVE guidelines.

Nephelometers measure the amount of light scattered by particles and gases in the atmosphere. Estimates of scattering combined with estimates of the absorption coefficient (from aerosol monitoring filters) can be used to determine total light extinction. Temperature and relative humidity sensors are often installed as part of the standard nephelometer configuration. There are currently 37 nephelometers operating under IMPROVE guidelines.

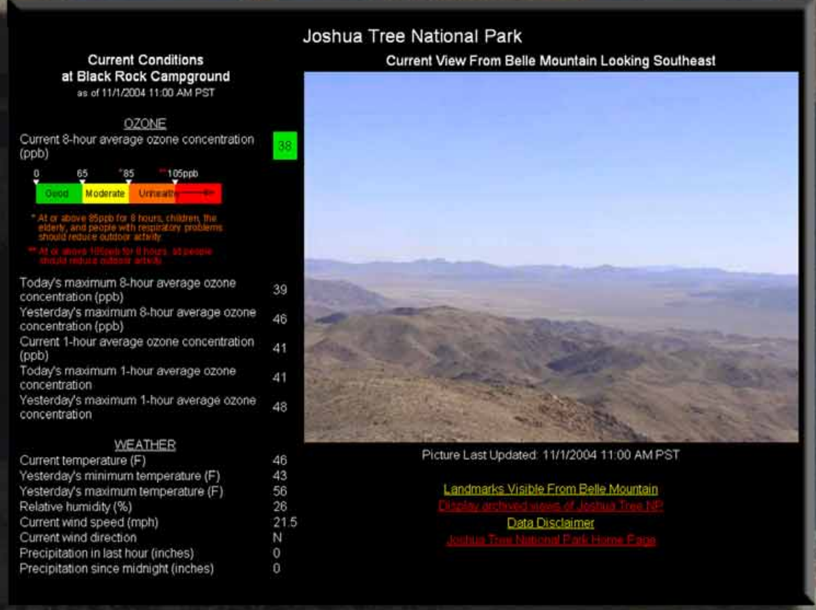
In the **scene monitoring network**, **film and digital camera systems** are used at a number of IMPROVE monitoring sites to document the appearance of a view as sun angle, cloud, vegetative cover, and visibility levels change.

There are currently 8 standard camera systems operating within the IMPROVE network. Images from monitoring sites with over five years of data were selected to capture the range or "spectrum" of visual conditions at each site. Visibility photographs can be viewed at: http://vista.cira.colostate.edu/views/Web/IMPROVE/Data_IMPRPhot.htm. To view USDA Forest Service visibility photographs, go to http://www.fsvisimages.com/all.html.

Film camera

Web camera systems are useful for documenting the occurrence of haze episodes. Live pictures of current visibility, weather conditions, and ozone data are transmitted to the Web. Views are usually updated at 15-minute intervals. There are currently 54 web camera systems operating in conjunction with the IMPROVE monitoring network. Links to the real-time internet cameras in the Class I areas can be found at: http://vista.cira.colostate.edu/views/Web/WebcamsClass1/webcam.htm.

Web camera



Joshua Tree National Park

Current Conditions at Black Rock Campground
as of 11/1/2004 11:00 AM PST

OZONE

Current 8-hour average ozone concentration (ppb)	38

* At or above 85ppb for 8 hours, children, the elderly, and people with respiratory problems should reduce outdoor activity

Today's maximum 8-hour average ozone concentration (ppb)	39
Yesterday's maximum 8-hour average ozone concentration (ppb)	46
Current 1-hour average ozone concentration (ppb)	41
Today's maximum 1-hour average ozone concentration	41
Yesterday's maximum 1-hour average ozone concentration	48

WEATHER

Current temperature (F)	46
Yesterday's minimum temperature (F)	43
Yesterday's maximum temperature (F)	56
Relative humidity (%)	26
Current wind speed (mph)	21.5
Current wind direction	N
Precipitation in last hour (inches)	0
Precipitation since midnight (inches)	0

Current View From Belle Mountain Looking Southeast

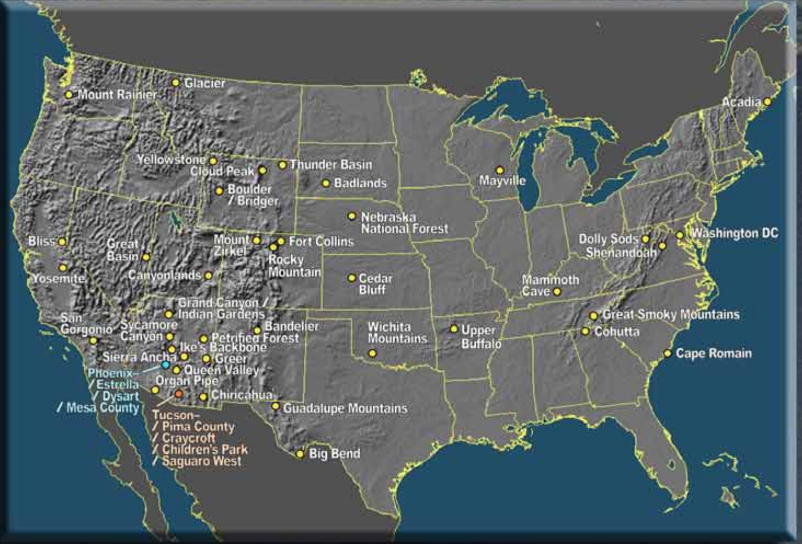
Picture Last Updated: 11/1/2004 11:00 AM PST

Landmarks Visible From Belle Mountain

Data Disclaimer

Joshua Tree NP web cam page

Camera networks across the U.S.



Optical monitoring networks

Canyonlands National Park
Utah

Joe Carlson (center) mans the IMPROVE network samplers at Canyonlands Natl. Park in Utah. He says, "Coming in as a new air quality operator has proven both rewarding and challenging. With each weekly check, you gain experience operating the stations, but you're never quite ready for those surprise problems that pop up. Air quality stations are frequently struck by lightning here. Having specialists at UC, Davis available for assistance is key in solving these problems."

The scenery is crucial for visitor enjoyment. "If visitors cannot see the spectacular landscape Canyonlands has to offer due to haze or smog," he said, "the air is not in the state that it should be. Collecting information about the visibility at Canyonlands helps preserve the amazing vistas of the park and the surrounding areas."

He values the role he plays, saying, "I may be a very small part of the larger picture, but I feel like I am an important part of helping to protect a resource that most visitors do not think about. However, this resource is probably one of the most important we have within the park. The breathtaking panoramic views at Canyonlands are an inseparable part of the park experience that would not be possible without clean air."

Joe has an associate's degree in natural resources conservation, and a bachelor's degree in recreation with a concentration in outdoor recreation management and education. He's been working for the NPS seasonally since 2003, initially in interpretation, and most recently in visitor/resource protection (law enforcement). He enjoys rock climbing, backpacking, mountain biking, most outdoor activities, and the lifestyle of a seasonal park ranger.

Looking toward the Colorado River and Canyonlands Natl. Park, as seen from Dead Horse Point State Park.

April

"There is a sufficiency in the world for man's need but not for man's greed."
- Mohandas K. Gandhi

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 — 91 Julian day — Daylight Savings Time Begins	2 — 92	3 — 93 — IMPROVE particle sampling day — Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	4 — 94	5 — 95	6 — 96 — IMPROVE particle sampling day	7 — 97
8 — 98	9 — 99 — IMPROVE particle sampling day	10 — 100 — Change IMPROVE particle cartridges.	11 — 101	12 — 102 — IMPROVE particle sampling day	13 — 103	14 — 104
15 — 105 — IMPROVE particle sampling day	16 — 106	17 — 107 — Change IMPROVE particle cartridges.	18 — 108 — IMPROVE particle sampling day	19 — 109	20 — 110	21 — 111 — IMPROVE particle sampling day
22 — 112 — Earth Day	23 — 113	24 — 114 — IMPROVE particle sampling day — Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	25 — 115	26 — 116	27 — 117 — IMPROVE particle sampling day	28 — 118
29 — 119	30 — 120 — Arbor Day — IMPROVE particle sampling day					

Mar 2007

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May 2007

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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"

Research Triangle Institute International

RTI International (a trade name of the Research Triangle Institute) is dedicated to conducting research and development that improves the human condition by turning knowledge into practice. With a staff of more than 2,500, RTI offers innovative research and technical solutions to governments and businesses worldwide in the areas of environment, health and pharmaceuticals, education and training, surveys and statistics, democratic governance, economic and social development, advanced technology, and energy. Read more at www.rti.org.

The second largest independent nonprofit research organization in the United States, RTI maintains nine offices in the United States, five international offices, and one international subsidiary, as well as project offices around the world.

The Environmental Chemistry Department's Ion Analysis Laboratory has analyzed filter extracts for the IMPROVE program since 1985. As a nonprofit organization, RTI values the quality of its work above all else. Our concern for quality demands the use of well-qualified staff, state-of-the-art equipment and facilities, and appropriate, approved standard operating procedures (SOPs). RTI's proven management and analytical teams have delivered high-quality air quality monitoring results for over 30 years to governmental and commercial organizations, including the National Park Service (NPS), the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), Ogawa & Co. USA, Inc., Air Sciences, Inc., the Canadian province of British Columbia, and numerous state and local governments. RTI has carefully selected, experienced personnel who enhance the capabilities of the ion analysis team. When we began analyzing filters for the IMPROVE program in 1985, our laboratory had two ion chromatographs and a staff of two chemists. Our laboratories now have ten operating ion chromatographs and a staff of seven chemists, including a former Dionex service representative who uses his experience to maintain the instrumentation and optimize instrument performance.

The Ion Analysis Laboratory is supervised by David Hardison. David's 30 years of experience in analysis of environmental samples by IC gives him the depth of knowledge to keep the program running smoothly and the ability to identify potential results of interest to the users of the data.

Eva Hardison, manager of the Environmental Chemistry Department, has worked on the IMPROVE project since RTI was awarded its first NPS contract in 1985. Eva's extensive background in air monitoring provides insight into the operation of the IMPROVE system and allows valuable connections of analytical data to real world conclusions.

RTI uses carefully written SOPs that are based on 20 years of directly applicable experience with the NPS and that are designed to meet the data quality objectives of the program. The work performed by RTI for the IMPROVE program and the NPS under the current contract can be divided into three technical areas:

1. Nylon filter analysis for anions and/or cations

RTI receives nylon filters in lots of approximately 400 each, every 7 to 10 days (~22,000 filters per year) from the particulate monitoring coordination contractor (PMCC), the University of California at Davis. To minimize loss of volatile material, the filters are stored in a freezer in a locked sample custody room until they are extracted using an established procedure that is appropriate for the analytes requested and that is shown to be quantitatively reproducible and at least 97 percent efficient. Sample extracts are stored in a refrigerator prior to analysis. Within 45 days after sample receipt, each sample extract is analyzed for Cl^-, NO^{2-}, NO^{3-}, and $SO4^{2-}$ using ion chromatography. For optional special studies, the filters are analyzed for NH^{4+}, Na^+, K^+, Ca^{2+}, and Mg^{2+}. These analyses are supported by all appropriate QA/QC procedures. After analysis, the extracts are stored in a locked coldroom at 4°C for possible reanalysis, if requested by the PMCC. Approximately 6 months after the data for a batch of extracts have been reported to the PMCC, RTI destroys the stored extracts for that batch unless advised otherwise by the PMCC.

2. Carbonate-impregnated filter preparation and analysis for sulfur dioxide as sulfate ion

RTI procures quartz filters and chemically coats them as necessary for the collection of sulfur dioxide. The coated filters are shipped to the PMCC in batch sizes requested by the PMCC to allow for timely shipment of filter packs to field personnel. Approximately 1 percent of the filters are retained by RTI for QC purposes. RTI receives a batch of approximately 35 to 40 24-hour filter samples per quarter from the PMCC (~250 samples per year.) The filters are stored in a freezer in a locked sample custody room until they are extracted using a procedure that has been shown to be quantitatively reproducible and at least 97 percent efficient. Sample extracts are stored in a refrigerator prior to analysis. Within 15 days of receipt of the samples, the extracted solutions are analyzed for sulfate ion using ion chromatography. These analyses are supported by QC/QA procedures. After analysis, the sample extracts are stored in solution form at 4°C for possible reanalysis, if requested by the PMCC. After approximately 6 months, RTI is advised by the PMCC as to the final disposition of the samples.

3. Ozone passive sampler preparation and analysis

During the summer ozone season (May through September), RTI purchases coated collection pads from Ogawa & Co., USA, Inc., loads and labels Ogawa passive samplers for collection of ozone, places each sampler in a resealable plastic bag and then into an airtight vial, and ships the samplers in batches to designated field sites on a monthly basis according to a schedule prepared by Dr. John Ray, the NPS Technical Representative for passive ozone analyses. The samplers are deployed on sampling poles under shelters, or rainshields, where they are exposed for a period of one week. At the end of the exposure period, the sampler is returned to its plastic bag and vial, and at the end of the month, all weekly samples are returned to RTI for analysis. A typical summer ozone study involves collection and analysis of ~1,200 samplers.

Sikes, Louisiana

The IMPROVE site in Sikes, Louisiana, is located in Winn Parish in north-central Louisiana, on a remote abandoned farm. Fourteen years ago, Benny Long was contacted by an environmental agency in an effort to find a suitable location for a site in this area. He retired as captain for the Enforcement Division of the Louisiana Department of Wildlife and Fisheries, is very familiar with the rural parts of this parish, and was instrumental in the original set up of the site in 1993. Since then he has been the primary IMPROVE site operator, and his wife, Joe Llaine, is his back-up operator. His chocolate Labrador retriever, Captain, is the official mascot of the Sikes location.

"Weather in this area is always a factor, as well as road conditions," says Benny. "We have more than the normal number of power outages in this rural area. A large portion of this parish is US Forest Service land made up of the Kisatche National Forest. The parish's major industry is timber, with several sawmills, paper mills, and plywood plants nearby. The relative humidity is higher than average due to gulf moisture, and often feels like a tropical rain forest. Winters are relatively mild, and summers are very hot and humid. Spiders, wasps, and other insects often create problems with the equipment on site."

"I am a fan of LSU Tiger football, and enjoy living on Saline Lake in northwest Winn Parish with my family, my dogs, and horses. I have spent my recreational life and work in the outdoors, and enjoy fishing and hunting in my retirement. I have three children and four grandchildren who love the outdoors as much as I do. For this reason, air quality is of utmost importance to me and my family. I have appreciated the opportunity to work with IMPROVE at this location, and hope that this data proves to be beneficial in determining air quality concerns."

May

"The old Lakota was wise. He knew that man's heart away from nature becomes hard; he knew that lack of respect for growing, living things soon led to lack of respect for humans too."

\- Chief Luther Standing Bear

Apr 2007

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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 121 Julian day Change IMPROVE particle cartridges.	2 122	3 123 IMPROVE particle sampling day	4 124	5 125
6 126 IMPROVE particle sampling day	7 127	8 128 Change IMPROVE particle cartridges.	9 129 IMPROVE particle sampling day	10 130	11 131	12 132 IMPROVE particle sampling day
13 133 Mother's Day	14 134	15 135 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	16 136	17 137	18 138 IMPROVE particle sampling day	19 139 Armed Forces Day
20 140	21 141 IMPROVE particle sampling day	22 142 Change IMPROVE particle cartridges.	23 143	24 144 IMPROVE particle sampling day	25 145	26 146
27 147 IMPROVE particle sampling day	28 148 Memorial Day (Observed)	29 149 Change IMPROVE particle cartridges.	30 150 IMPROVE particle sampling day	31 151		

Jun 2007

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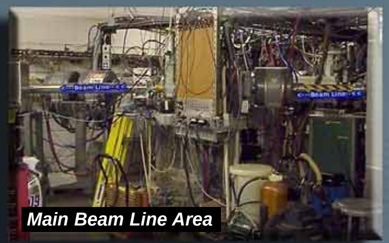
UC DAVIS UNIVERSITY OF CALIFORNIA Crocker Nuclear Lab

The Crocker Nuclear Laboratory (CNL) – http://media.cnl.ucdavis.edu/crocker/website/default.php – is located near the center of the University of California, Davis campus, not far from the state capital in Sacramento. CNL houses a low energy particle accelerator, an isochronous cyclotron that is one of the few of this design remaining in productive operation. The laboratory hosts a diverse group of research programs, nearly all of which are related to applied science programs. The unique capabilities of the 76-inch cyclotron and related facilities at CNL have been utilized by scientists and engineers from private industry, universities, and government agencies.

CNL Research

Research topics include basic nuclear physics, applied solid state physics, radiation effects, and planetary geology and cosmogenics. The aerospace industry has used the CNL facility for simulation of radiation effects produced by solar and cosmic radiation. The Naval Research Laboratory, NASA, JPL, and Lawrence Livermore National Laboratory have used the CNL radiation effects facility to support research in various areas of the space program. While physics remains an important part of the research, in recent years the focus has expanded to include air quality studies, radioisotope production, and the application of pulsed electromagnetic power to food and agriculture. Other research programs include

- Identification of particulate pollutants and the mechanism by which they are transported
- Radiation effects of semiconductors
- Development of alternatives to insecticides, pesticides, and conventional forms of water treatment
- Retinal melanoma treatment facility



Main Beam Line Area

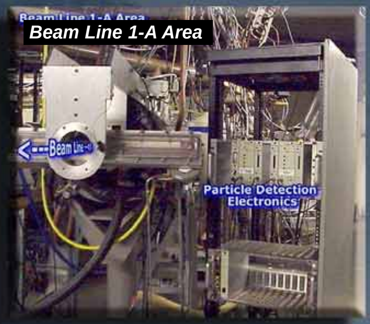
North Cave Experimental Area

Air Quality Research

The Air Quality Research Group is composed of professors, research scientists and associates, and students from the combined disciplines of physics, chemistry, atmospheric science, and ecology. The group is supported by contracts from many sources, the largest being the National Park Service (NPS), the Environmental Protection Agency (EPA), and the U.S. Department of Agriculture (USDA).

● National Park Service Research

National Park Service research is focused on particulate monitoring throughout the United States. Since 1987 the Air Quality Group has been responsible for the particulate analysis for the IMROVE program by providing both collection and elemental analysis of particulate samples gathered in the Class I Areas.



Beam Line 1-A Area

Determination of chemical composition can help distinguish air masses and identify different types of pollutant sources. Techniques to nondestructively analyze air filters are now routinely used at CNL for gravimetric mass, optical absorption, elemental composition by proton-induced x-ray emission (PIXE) and X-ray fluorescence (XRF), and hydrogen by proton elastic scattering analysis (PESA).

Crocker Nuclear Laboratory has participated in a number of special regional studies affiliated with IMPROVE to investigate the possible effects of major emission sources on Class I areas. Several of these studies involved operating networks of more than 30 sites. The regional studies include

- 1990 PREVENT (Pacific Northwest Regional Visibility Experiment using Natural Tracers) summer intensive
- 1992 Project MOHAVE (Measurement of Haze and Visual Effects) winter and summer intensives
- 1999 Big Bend Regional Aerosol and Visibility Observational Study (BRAVO)

Crocker Nuclear Laboratory has also participated in special studies to examine aerosol properties and measurement methods

- 1991 Shenandoah/Penn State study of water content and acidity
- 1991 Meadview study of sulfate artifact
- 1994 Great Smoky Mountains study of eastern aerosols
- 1995 SEAVS (Southeastern Aerosol and Visibility Study)
- 1998 Grand Canyon study of light absorption
- 2002 Yosemite study of ions, organics, and coarse particle properties
- 2003 Smoke composition during controlled burns
- 2004 Great Smoky Mountains ion study
- 2004-2006 carbon-14 measurements at several IMPROVE sites
- 2006 Rocky Mountain National Park aerosol study (ROMANS)

● USDA

Evaluation of dust emission from agricultural practices in the San Joaquin Valley was funded by the U.S. Department of Agriculture to examine particulate matter (less than 10 micrometers in size) generated by agricultural practices in California's San Joaquin Valley. The flux of PM10 emissions from the various stages in the harvesting of almonds, walnuts, figs, wheat, tomatoes, and cotton has been studied and emission rates for clay, silt, and sandy soils determined.

● LIDAR

LIght Detection And Ranging (LIDAR) technology provides an on-site, detailed image of the aerosol relative concentrations within the scanned region. CNL researchers are using LIDAR to understand non-point source PM emissions from agricultural operations in the San Joaquin Valley.

● Remote Sensing

Remote sensing can be the source of accurate and current Geographic Information System (GIS) data layers. Research focuses on the extraction of information from digital spectral image data to provide GIS data layers such as land cover type, urban boundary layers, roads, rivers, and other lines of communication, and vegetation stress.

Pulsed-Laser Applications in Food and Agriculture

The chemistry and agriculture program at the Crocker Nuclear Laboratory is investigating the applications of pulsed ultraviolet light (PUV) and of selected radio frequency bands (RF) to affect the reproduction mechanisms of pathogenic organisms in several media, including fresh fruits & vegetables, processed foods, waste materials, and many other non-food materials such as soils and wood. PUV has been shown to affect microbial flora on the surface of fresh fruits and control pathogenic bacteria and viruses in several transparent or partially transparent liquid fluids such as drinking water, fruit juices, milk, and plasma. In addition, PUV is effective for surface insect & mite disinfestation applications.

Medical Uses of the 76" Cyclotron

One of the newest programs, the Eye Therapy Facility, is the first involvement of the CNL cyclotron in direct machine-to-patient transfer of radiation for medical treatment. One of three in the United States, the Eye Therapy Facility treats patients from as far away as New Zealand for retinal melanoma. In collaboration with physicians and technicians from UC-San Francisco's Ocular Oncology unit, the facility treats nearly 120 patients a year.

Eye Treatment Room

Beam Line #0 Area

Glacier National Park, Montana

Mary Hamisevicz, (right) and Lindy Key are the operators of the IMPROVE site for Glacier National Park. The park, created in 1910, includes over one million acres of habitat and protection for a variety of wildlife and wildflowers, and is a dramatic example of glacially-shaped landforms.

The spectacular vistas that Glacier is famous for make visibility a great concern in this park. Natural causes of visibility impairment include wildfires and wind-blown dust. Primary human causes of impairment come from agricultural, slash, prescribed, and wood stove burning in the area, as well as from local industry and road dust. Regional sources of air pollution include Plum Creek Manufacturing, the Columbia Falls Aluminum Company (located 6 miles south of the park), and oil and gas processing plants located east of the continental divide in Alberta, Canada. Fluoride emissions from the aluminum reduction plant prompted concerns in the late 1960s about fluoride toxicity to vegetation and grazing animals. New smelting processes have been implemented with significant reductions in fluoride emissions, but fluoride in the air and vegetation continues to be monitored. Mary and Lindy are part of that ongoing survey. They hike to remote locations in the park to collect vegetation samples, which are then sent to an independent laboratory for analysis. Mary says, "These hikes are a favorite part of our jobs and have provided us the opportunity to see grizzly bears, moose and calves, badgers fighting, and goshawk attacks."

Lake McDonald

Reggie

Mary, a chemist, joined the air quality staff in 2001. In her spare time, she teaches emergency medical service classes for Flathead County. Her dog, Reggie, frequently accompanies her to work.

Lindy has monitored air quality in the park since 1989. She and husband, Carl Key, of the USGS, have raised two children here. She enjoys quilting, bread baking, hiking, and skiing.

Preston Park

June

"God forbid that India should ever take to industrialism after the manner of the west... keeping the world in chains. If [our nation] took to similar economic exploitation, it would strip the world bare like locusts."

\- Mahatma Gandhi

May 2007

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Jul 2007

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

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

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1 152 Julian day	2 153 IMPROVE particle sampling day
3 154	4 155	5 156 National Trails Day IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	6 157	7 158	8 159 IMPROVE particle sampling day	9 160
10 161	11 162 IMPROVE particle sampling day	12 163 Change IMPROVE particle cartridges.	13 164	14 165 Flag Day IMPROVE particle sampling day	15 166	16 167
17 168 Father's Day IMPROVE particle sampling day	18 169	19 170 Change IMPROVE particle cartridges.	20 171 IMPROVE particle sampling day	21 172 Summer begins	22 173	23 174 IMPROVE particle sampling day
24 175	25 176	26 177 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	27 178	28 179	29 180 IMPROVE particle sampling day	30 181

Air Resource Specialists, Inc.

ARS, Inc.

Since 1983, Air Resource Specialists, Inc. (ARS) has provided visibility monitoring services to the National Park Service. Based in Fort Collins, Colorado, the professional staff of over 50 scientists, field specialists, and support personnel conduct a wide range of consulting services including environmental monitoring; data management, analysis, and research; and modeling and compliance.

Visibility Monitoring - Optical

ARS has nationally recognized expertise in visibility monitoring, maintains visibility monitoring networks, and performs special studies for federal land management agencies, state agencies, municipalities, Indian nations, and private industry.

ARS is the current visibility contractor for the National Park Service and USDA Forest Service optical and scene monitoring networks and has developed a complete set of quality assurance documentation to operate and maintain the instrumentation according to IMPROVE protocols.

The NPS and USDA-FS both operate nephelometer systems and transmissometer systems with collocated meteorological sensors to help interpret the data. ARS designs, installs, operates, and maintains visibility monitoring instrumentation, including nephelometers, transmissometers, and a wide range of other monitoring instrumentation, with special expertise in the implementation of remote monitoring systems. Operator support takes a high priority in monitoring networks to ensure the highest quality data capture possible.

ARS also assists IMPROVE participants with the design, implementation, and coordination of major visibility special studies and field programs, including WHITEX, Denver Brown Cloud, the Southern Utah Intensive, Phoenix/Tucson Urban Haze, PREVENT, MOHAVE, SEAVS, GRAVS, the Dallas/Fort Worth Visibility Study, the Mount Zirkel Reasonable Attribution Study of Visibility Impairment, the Northern Front Range Air Quality Study, ACE-2, BRAVO, and RoMANS.

Visibility Monitoring - Scene

ARS operates scene monitoring networks for the National Park Service and other federal, regional, state, tribal, and municipal land management agencies. Scene monitoring technology (performed with photographic systems) has evolved from film-based camera systems to the high-resolution digital Web-based systems widely used in monitoring programs today.

The National Park Service, USDA-Forest Service, Bureau of Land Management, IMPROVE, and numerous state visibility scene archives are maintained by ARS. The archives consist of over 500,000 visibility photographic slides taken since 1979 at monitoring sites throughout the United States. All slides are catalogued and filed for access to support visibility-related research, presentations, and other applications. Selected slides are compiled, digitized, and maintained on CD.

With the advent of digital cameras, ARS has designed and developed several high resolution digital camera systems for the purpose of visibility monitoring. Most IMPROVE protocol monitoring sites have made the change to these newer systems from film-based systems. ARS's remote digital camera system operates with custom camera control computer software and can operate on AC line power or DC solar power, with images uploaded directly to the Internet or collected on a USB flash drive or flash card.

The NPS, USDA-FS, regional planning organizations, and other agencies display near real-time images and air quality data on their Web sites using high resolution digital camera systems. ARS also hosts many of the Web sites on its servers. The system's software collects an image of the current view, collects associated air quality data from a nearby monitoring station, and transfers both to an Internet site every 15 minutes for public viewing and archive. These Web camera systems are also used for interpretive visibility displays at several national park visitor centers. Visit http://www2.nature.nps.gov/air/WebCams/index.htm or http://www.fsimages.com for Web sites using these digital systems.

Ambient Air Quality and Meteorological Monitoring

ARS maintains and supports criteria pollutant and meteorological monitoring networks nationwide, including government and private networks in urban, rural, and remote areas. The networks include continuous gaseous analyzers, particulate monitors, and meteorology sensors. ARS has also developed and operated solar-powered portable air quality and meteorological systems for remote, low power applications. ARS is the prime contractor for the National Park Service's Gaseous Pollutant Monitoring Program. Data management, analysis, and research environmental monitoring network data are managed at ARS through a centralized data management center.

The center includes all of the hardware, software, databases, communications, facilities, and support systems to collect, validate, analyze, and report data. Advances in air quality and visibility sciences are performed at ARS by theoretical development, testing, and application of measurement and analysis procedures, including transmissometry and nephelometry, ambient air and meteorological monitoring systems, radiative transfer modeling, scientifically valid computer image simulations of visibility impairment, and extinction budget and cause-effect analyses.

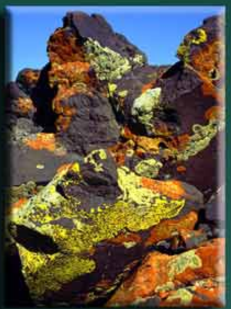
Modeling and Compliance

ARS develops and implements visibility and air quality-related computer modeling techniques, and developed the NPS-sponsored WinHaze program used extensively to generate image simulations of visibility degradation. Visibility modeling has been applied to support congressional hearings, special studies, and a broad range of regulatory, research, and experimental applications. Technical and regulatory air quality modeling and permitting, and compliance support is also provided to industrial, commercial, and governmental clients.

For more information log onto ARS' Web site at http://www.air-resource.com, or call them at 970/484-7941.

Petrified Forest National Park, Arizona

Pat Thompson (on the right) is the physical scientist in charge of the air quality program at Petrified Forest National Park in northeastern Arizona. In addition to air quality responsibilities, Pat is responsible for a wide range of other natural and cultural resources. Currently she is working on the park's Wilderness Management Plan.



She reports, "Our site is probably the only one in the system that is on a remnant of the famous Route 66. The site overlooks the beautiful Painted Desert in Petrified Forest Natl. Park. It is close to park headquarters and access is seldom a problem. We do have a challenge with power to the site, usually in the summer. Frequent thunderstorms will cut power to the northern end of the park and can result in problems. The electric company is working on upgrading our lines, and hopefully, next summer it will be less of a problem."

The responsibility for air quality work in the park is shared by three members of the Resource Management Division, which allows them to cover the site and complete their many other obligations. The team consists of a paleontologist, museum curator, and physical scientist.

When not helping to preserve and protect park resources, Pat likes to take long walks with her cocker spaniel Molly.

Bill Parker (top photo, left) is the paleontologist at Petrified Forest, however, his duties often include management of other resources including air quality, biology, and archaeology. When not exploring the badlands looking for Triassic animals, he enjoys spending time with his wife and teaching their two-year old twin son and daughter about the rest of the world. The Parkers live in Holbrook, Arizona.

Scott Williams (top photo, center) is the park's museum curator. He also performs other jobs in air quality, exhibits fabrication, and produces photographic and digital images of the park for interpretive and educational use. When Scott is not working, he and his wife Heather spend time with their seven-month-old son Weston.

July

"The struggle to save the global environment is in one way much more difficult than the struggle to vanquish Hitler, for this time the war is with ourselves. We are the enemy, just as we have only ourselves as allies."

- Al Gore

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1 *182 Julian day*	2 *183* IMPROVE particle sampling day	3 *184* Change IMPROVE particle cartridges.	4 *185* Independence Day	5 *186* IMPROVE particle sampling day	6 *187*	7 *188*
8 *189* IMPROVE particle sampling day	9 *190*	10 *191* Change IMPROVE particle cartridges.	11 *192* IMPROVE particle sampling day	12 *193*	13 *194*	14 *195* IMPROVE particle sampling day
15 *196*	16 *197* National Parks Day	17 *198* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	18 *199*	19 *200*	20 *201* IMPROVE particle sampling day	21 *202*
22 *203*	23 *204* IMPROVE particle sampling day	24 *205* Change IMPROVE particle cartridges.	25 *206*	26 *207* IMPROVE particle sampling day	27 *208*	28 *209*
29 *210* IMPROVE particle sampling day	30 *211*	31 *212* Change IMPROVE particle cartridges.				

Jun 2007

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Aug 2007

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26	27	28	29	30	31	

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General Lab
(530) 752-1123

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

Desert Research Institute

Environmental science and a unique entrepreneurial culture are hallmarks of the Desert Research Institute (www.dri.edu), a statewide division of the Nevada System of Higher Education. From its primary locations in Reno and Las Vegas, the work of DRI scientists and technicians reaches throughout the world with a focus on environmental change and advancing environmental technologies.

DRI: Northern Nevada Science Center, Reno, NV

DRI: Southern Nevada Science Center, Las Vegas, NV

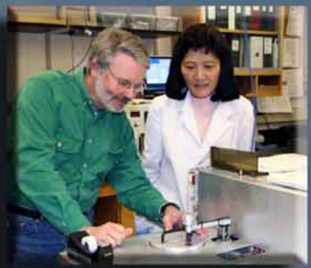
The research organization is divided into three divisions:

- Division of Atmospheric Sciences (DAS)
  http://www.das.dri.edu/
  DAS conducts research into the natural atmosphere and local and regional studies of air quality in the United States and the world. DAS specializes in the development of instruments and techniques for ground-based, aircraft, and satellite observational programs. Inorganic and organic chemistry laboratories provide trace analysis of atmospheric pollutants, supporting assessment of human impacts on air quality.
- Division of Earth and Ecosystem Sciences (DEES)
  http://www.dees.dri.edu/
  DEES research is focused on studying the causes, mechanisms, and history of landscape change over time. Ongoing research includes biogeochemical cycling and responses of plants and animals to changes in climate and anthropogenic factors and on life in extreme environments.
- Division of Hydrologic Sciences (DHS)
  http://www.dhs.dri.edu/
  DHS research is focused on understanding hydrologic systems and encouraging more effective and efficient management of water resources, including the study of how natural and human factors influence the availability and quality of water resources.

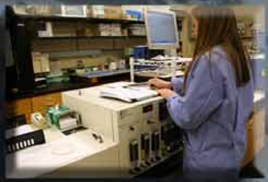
Division of Atmospheric Sciences' Projects of Interest

The Environmental Analysis Facility (EAF)

The EAF was started in 1985 by senior scientist Dr. Judith Chow. This state-of-the-art inorganic chemistry laboratory is fully equipped to quantify atmospheric contaminants, especially at very low concentrations. The facility has capabilities for routine and special air sample analyses, with emphasis on characterizing types of air pollutants and identifying emission sources. The EAF provides tools to identify, control, and reduce atmospheric contaminants. Especially prominent among the studies have been the State of Nevada Air Pollution Study, two Denver Brown Cloud studies, the Mexico City Particulate Study, the Big Bend Aerosol Study, and Chow's ongoing particle measurements in the California Regional $PM_{10}/PM_{2.5}$ Air Quality Study and the Southern Nevada Air Quality Study.



Dr. John Watson and Dr. Judith Chow in the EAF Laboratory.



A technician runs analysis in the EAF carbon lab.

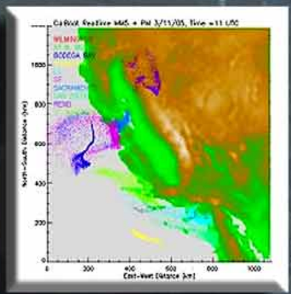
The EAF laboratory supports the IMPROVE cooperative air quality program by developing and applying thermal optical reflectance methods to measure the amount of organic and elemental carbon in the atmosphere. Sampling corresponds to aerosol chemistry measurements that have been taken in urban areas as part of the EPA's $PM_{2.5}$ Speciation Trends Network (STN). New IMPROVE objectives are twofold: to evaluate contributions from regional background and transport to excessive $PM_{2.5}$ concentrations into urban areas, and to establish a baseline (for 2000 through 2004) and monitor changes in contributions to regional haze through 2065.

XRF laboratory analysis

DRI has conducted more than 170,000 IMPROVE carbon analyses following the IMPROVE protocol. Eight carbon fractions are quantified, and remaining filter samples are archived in a sealed container under refrigeration. Carbon fractions from different environments or under specific source impacts (e.g., forest fires, dust storms) can be evaluated in the future.

Evaluation of Regional Scale Receptor Models

The Atmospheric and Dispersion Modeling Laboratory focuses on atmospheric, dispersion, and air quality processes over complex terrain. Advanced methods of air pollution sampling and chemical analysis incorporate meteorology and other factors into developing mathematical models identifying airborne pollutants that contribute to total pollutant load. This research will aid states and regional planning organizations in efforts to meet progress goals and achieve compliance under the U.S. EPA's Regional Haze Rule.



Advanced Computing in Environmental Sciences ACES VisLab

The VisLab is a state-of-the-art scientific visualization laboratory bringing advances in grid computing and scientific visualization to environmental research in the state. The VisLab is both a working laboratory and an excellent demonstration environment, and is a foundation for fully immersive virtual reality visualization.

ACES lab.

High Elevation Atmospheric Research

This mountain-top research facility is one of several locations worldwide. From high alpine environments, scientists conduct studies of the free troposphere, with a focus on aerosol particle and gas scavenging, cloud and precipitation chemistry, aerosol/cloud interaction studies, and designing new cloud physics instrumentation.

Storm Peak Laboratory Steamboat Springs, CO

Desert Research Institute's Global Outreach

DRI scientists have joined colleagues from around the world to study the nature and sources of health-threatening global airborne particles. Air quality "fingerprinting" and modeling techniques have been employed to address worldwide concerns about how air pollution from major metropolitan areas affects the planet's atmosphere and climate. Research efforts are underway to assess the impact of various sources on ambient pollutant levels and to develop control strategies to reduce health impacts in Mexico City, Mexico; Cairo, Egypt; and Addis Ababa, Ethiopia.

Dr. John Watson checks the control mechanism on an air sampler in Mexico City. The mail boxes serve as protective housings for the air pumps.

In Xian, China, research into the effects of air pollutants on Chinese antiquities is an ongoing effort by a team of DRI and Chinese scientists. One thousand terra-cotta figures have been unearthed, and authorities are concerned by their deteriorating condition. Monitoring equipment installed at the museum will help scientists understand if pollutants are part of the problem.

Above: terra-cotta figures and monitoring equipment.

Left: partially excavated soldier

North Cascades National Park, Washington

Michael Larrabee has been operating the Ross Dam IMPROVE site in North Cascades National Park in northern Washington since 2001. The site is scenically located overlooking Ross Reservoir. The park complex was established in 1968 and encompasses 684,000 acres, which includes North Cascades National Park and the Ross Lake / Lake Chelan National Recreation Area. Ninety-three percent of the park complex is managed as the Stephen Mather Wilderness, in honor of the first director of the National Park Service.

Average visibility in North Cascades NP is about 110 miles. The haziest days generally occur during June, July, and August. The park lies fewer than 90 miles from the fast-growing Seattle, WA, and Vancouver, British Columbia metropolitan areas. Farms, industrial operations, cars, and other pollutant sources contribute to high levels of ozone in the Frasier River Valley of British Columbia. The ozone-laden air is transported south, down the tributary valleys of the Frasier River, and into the park. In addition, the park lies in the path of prevailing southwesterly winds blowing across several urban-industrial areas of the Puget Sound lowlands. The park's glacial valleys have steep sides that restrict airflow. When winds are too weak to carry pollution over the mountains, they transport it down the valleys. Another significant source of pollutants is from forest fires ignited on the dry eastern side of the Cascades.

In addition to the IMPROVE site, Mike and backup operators Jeannie Wenger and Steve Dorsch maintain an NADP/CastNet/ozone meteorology site, a nephelometer site, a visibility webcam, a climate reference network site, and a NOAA co-op rain gauge. Mike is also involved with research to identify and quantify airborne contaminants captured in seasonal snowpacks, assess the effects of deposition chemistry on aquatic systems, quantify cloudwater contributions to wet deposition, monitor glacier mass balance, and create surface landform maps.

August

"The control man has secured over nature has far outrun his control over himself."
- Ernest Jones, The Life and Work of Sigmund Freud, 1953

Jul 2007

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Sep 2007

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

Cooperative Institute for Research in the Atmosphere

CIRA

Colorado State University

Knowledge to Go Places

The Cooperative Institute for Research in the Atmosphere (CIRA) – http://www.cira.colostate.edu – is a research institute of Colorado State University, Fort Collins, CO. The institute provides a center for cooperation in atmospheric sciences with emphasis on multidisciplinary research programs that go beyond meteorological disciplines to utilize cutting-edge advances in engineering and computer science, facilitating the transition of research results into practical applications in weather and climate.

CIRA and the National Oceanic and Atmospheric Administration (NOAA)

CIRA and NOAA entered into a relationship in 1980 to bring resources together to provide a means to improve the effectiveness of weather and climate research through close collaboration between institutions; to provide a mechanism for cooperation in specific research programs by scientists from Colorado, the nation, and other countries; and to provide a center to train researchers in atmospheric sciences with experience working with multi-faceted research programs. Current research themes include

- Local and mesoscale area weather forecasting and evaluation
- Global and regional climate studies
- Cloud physics
- Applications of satellite observations
- Air quality and visibility
- Societal/economic impacts
- Numerical modeling
- Education, training, and outreach

National Park Service Air Quality/Visibility Research

Visibility in the Elk Mountain Wilderness decreases as haze or deciview values increase.

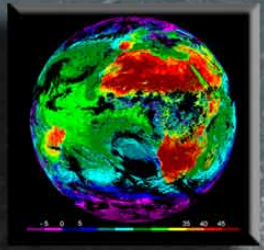
Since the early 1980s, CIRA has supported a visibility research program funded by the National Park Service Air Resources Division. Through the years, the group has conducted research that has helped in formulating and implementing the Clean Air Act and Regional Haze Rule, which mandate protecting air quality and visual resources in national parks and wilderness areas. NPS/CIRA researchers have been instrumental in advancing the science and developing methodologies to study haze. Research focuses on

- Assessing the visual impact of particulates on scenic vistas and regional haze and continuing a three-year field study to monitor and model the complex roles that nitrogen-based atmospheric compounds play in impacting visibility and other air-quality-related values at Rocky Mountain National Park and the Front Range of Colorado
- Using image display techniques to visually interpret and quantify changes in scene appearance
- Detailing chemical composition, mixing, scattering, and absorption properties of aerosols
- Developing simulation and statistical models to understand the response of air quality parameters to air quality regulations and changing population demographics and to examine trends
- Developing state-of-the-art measuring techniques
- Developing source apportionment techniques. New research will focus on tools to determine wildfire impacts on visibility and to define "natural" levels for smoke.
- Designing and implementing web-based analysis and technical support tools. Web systems implemented by the group are receiving increasing attention and becoming a standard for providing technical air quality information.

Trends in haze index (deciview) on haziest days, 1995-2004. Because the haze index is a measure of visibility impairment, with lower deciview levels corresponding to better visibility, a trend toward decreasing deciview means a trend toward improving air quality. Similarly, the up arrows correspond to trends toward higher values of deciview and worsening air quality.

DoD Center for Geosciences/Atmospheric Research

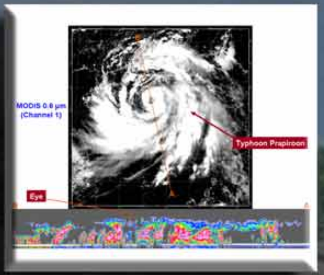
A cooperative agreement with the Army Research Laboratory funds Department of Defense relevant research with a focus on technology transition and interactions with DoD service centers. Research themes include hydrometeorology, cloud icing and aerosols effects, environmental modeling and assimilation, urban and boundary layer environment, and remote sensing of battlespace parameters.



Images such as this map of global skin temperatures are important in predicting the clutter an IR-guided weapon will see in the background when searching for or locking onto a target.

CloudSat Data Processing Center

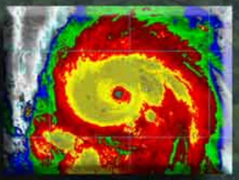
CloudSat is a satellite mission designed to measure the vertical structure of clouds from space. Images of cloud structures created at CIRA will contribute to a better understanding of clouds and climate. Data products delivered to the scientific community include cloud mask, cloud liquid water, and cloud ice analylsis. CloudSat became operational on June 2, 2006.



On August 2, 2006, CloudSat captured a vertical cross section of Typhoon Prapiroon as it approached southern China.

NOAA-NESDIS Regional and Mesoscale Meteorology Branch (RAMMB)

RAMMB conducts research on the use of satellite data to improve analysis, forecasts, and warnings for regional and mesoscale meteorological events, including tropical cyclone and severe thunderstorm genesis, development, intensification, and prediction. RAMMB also is actively involved in satellite training with a focus on GOES imagery and image interpretation.



Hurricane Wilma, 2005

The GLOBE Program

CIRA, in partnership with University Cooperation for Atmospheric Research (UCAR), manages the Global Learning and Observations to Benefit the Environment (GLOBE) web server, real-time data acquisition and visualization, and the central database. The GLOBE program, initiated in 1995, has now expanded to over 13,000 schools in 104 countries. GLOBE student measurements are conducted in the areas of atmosphere, hydrology, soil, and land cover investigations.

CIRA Infrastructure and Satellite Earthstation

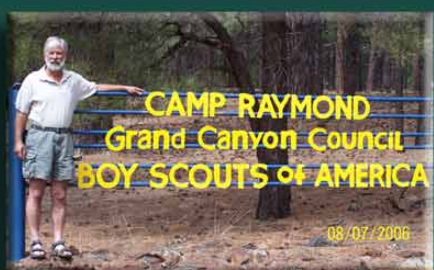
CIRA operates a high-technology infrastructure to support its various research programs, including a satellite earthstation, geophysical data holdings, meteorological models, field equipment, and a fiber-optic computer network with high speed access to real time satellite data. The Geostationary Operational Environmental Satellite (GOES) earthstation has been operational since 1980. Today, collection capability handles three simultaneous GOES transmissions as well as NOAA polar data. CIRA is one of the primary test sites for initial transmissions and sensor verification for new GOES GVAR satellites, successfully collecting the first GOES-8, GOES-9, and GOES-10 images.

NOAA port antenna

Sycamore Canyon Wilderness Area, Arizona

Robert Yaussy operates the air samplers in Sycamore Canyon Wilderness Area in central Arizona. The site was chosen for its good air quality and is used as a bench mark for the rest of the state. Robert operates an IMPROVE site, a nephelometer, and an MDN site.

Robert was born in Los Angeles, California. After military service he remodeled homes and became a firefighter. Since 1990 he has been working as a ranger for the Grand Canyon Council Boy Scouts and lives at Camp Raymond, a Boy Scout camp 25 miles west of Flagstaff, Arizona, and immediately east of the Sycamore Canyon Wilderness.



Mr. Yaussy loves his work and likes the fact that he gets to live on the property. He maintains camp property and buildings; takes people on nature hikes in the area; gives classes on edible plants, survival, history of the area, bird identification, and ballroom dancing; and is a shotgun and rifle instructor. He enjoys where he is and what he does, and sums it up with the words, "Life is good."

Sycamore Canyon is a deep branched canyon system comprising the Sycamore Creek drainage. Terrain near the monitoring site is forested, rolling land, while the canyon depths are steep and populated with shrubs and cacti. Average visibility is about 86 miles, but from November through February there are days when you can see 132 miles. However, on hazy days during the summer, visibility drops to 53 miles. Local sources of pollutants are primarily wildland fire emissions and road dust. Dust emissions may be of major significance if there is increased traffic on the unpaved roads near the Camp Navajo military reservation. Major sources of sulfur in the region include the Navajo (110 miles north) and Mojave (140 miles west) coal-fired generating stations. When conditions are right, emissions from the Four Corners and San Juan power plants in northwestern New Mexico and urban emissions from the Phoenix metro area may also cause significant impact.

September

"Take nothing but pictures. Leave nothing but footprints. Kill nothing but time."
- Motto of the Baltimore Grotto, a caving society

Aug 2007

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Oct 2007

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Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1 244 Julian day
2 245	3 246 Labor Day IMPROVE particle sampling day	4 247 Change IMPROVE particle cartridges.	5 248	6 249 IMPROVE particle sampling day	7 250	8 251
9 252 IMPROVE particle sampling day	10 253	11 254 Change IMPROVE particle cartridges.	12 255 IMPROVE particle sampling day	13 256	14 257	15 258 IMPROVE particle sampling day
16 259	17 260	18 261 National Public Lands Day IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new.	19 262	20 263 Pollution Prevention Week	21 264 IMPROVE particle sampling day	22 265
23 266 Autumn begins	24 267 IMPROVE particle sampling day	25 268 Change IMPROVE particle cartridges.	26 269	27 270 IMPROVE particle sampling day	28 271	29 272
30 273 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

Air Resource Specialists, Inc.

University of California, Davis

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 50 visibility monitoring sites nationwide and has been the prime contractor for the National Park Service and USDA 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 the 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 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 can last as long as 30 minutes or more 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 and validation, and provides operator support for transmissometers and nephelometers.

Cblandford@air-resource.com

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

KRosener@air-resource.com

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

Kfischer@air-resource.com

Marty Mills, electronics technician, services transmissometers and nephelometers, and troubleshoots power-related instrument problems.

Mmills@air-resource.com

The University of California, 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, he/she 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 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 staff are also available to conduct training sessions on the sampler if so desired by the operator(s).

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 intercomparisons 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.

not pictured: Jose Mojica, Operator Support Technical and Field Support

Tamera LaBelle
Lab Technician

Kevin Godding
Lab/Field Technician

Ted Scharfen
Lab/Field Technician

Ciara Remillard
Lab/Field Technician

Steve Ixquiac
Operator Support Technical and Field Support

Pat Feeney
Analytical and Data Support

Brian Perley
Analytical and Data Support

Jarbidge Wilderness Area, Nevada

The IMPROVE site near the Jarbidge Wilderness Area, operated by Jane Smith, is located at the old Mahoney ranger station, which is a short drive up a long driveway from the main Jarbidge Canyon Road, at an elevation of 6,200 feet. Jarbidge has been referred to as "the most remote town of the lower 48 states." It is a 100-mile drive either north or south to do major shopping.

Visibility in this area is among the best in the nation. Jane describes the skies as the bluest and the air as the cleanest there is in the country. During nice weather, Jane delights in taking the time to do the readings. But, she says, "The misery begins when it rains, or in winter when the entry gate is frozen fast in the deep snow. I expect things will be greatly improved shortly because a structure is going to be installed around the equipment, and I will have a roof over my head. Another challenge is getting the replacement pumps and other things delivered to the site intact and then installing them."

Jane describes her life as a senior as very active. She says, "I work part-time for the U.S. Postal Service. I am an emergency medical technician and the director of the Jarbidge Rescue Emergency Medical Services. I serve as part of the Jarbidge "Pioneer Park" committee and have been kept very busy seeing the project become a reality. I have committed to overseeing the Jarbidge Centennial Committee, and we are working on a plan to host the Jarbidge Centennial in the summer of 2009." In addition, she adds, "About four years ago, the Jarbidge Arts Council was formed, and I have served as a founding board member ever since. For personal enjoyment, I like to read, paint with water colors, hike, and cook. I have been married to Butch for 43 years. We have three grown children and eight grandchildren… and we love living in Jarbidge!"

October

"Give a man a fish, and he can eat for a day. But teach a man how to fish, and he'll be dead of mercury poisoning inside of three years."
- Charles Haas

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	1 274 Julian day	2 275 Change IMPROVE particle cartridges.	3 276 IMPROVE particle sampling day	4 277	5 278	6 279 IMPROVE particle sampling day
7 280	8 281 Columbus Day (Observed)	9 282 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	10 283	11 284	12 285 IMPROVE particle sampling day	13 286
14 287	15 288 IMPROVE particle sampling day	16 289 Change IMPROVE particle cartridges.	17 290	18 291 IMPROVE particle sampling day	19 292	20 293
21 294 IMPROVE particle sampling day	22 295	23 296 Change IMPROVE particle cartridges.	24 297 IMPROVE particle sampling day	25 298	26 299	27 300 IMPROVE particle sampling day
28 301 Daylight Savings Time	29 302	30 303 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	31 304 Halloween			

Sep 2007

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Nov 2007

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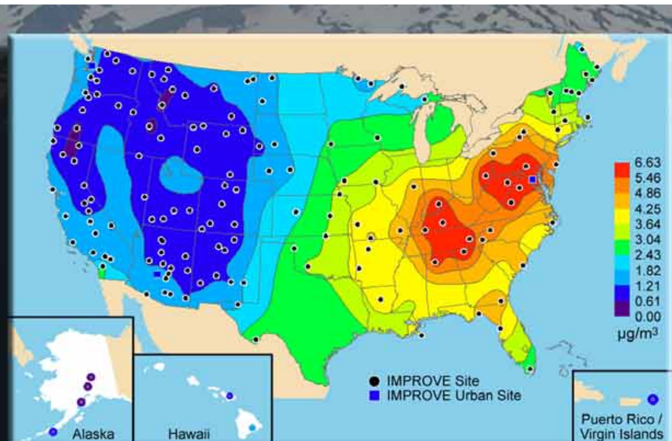
IMPROVE Data Summaries

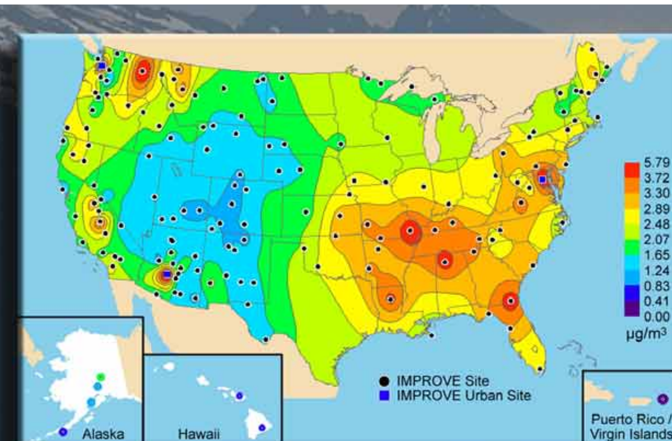
Interagency Monitoring of Protected Visual Environments

Fine particle concentration ($PM_{2.5}$) describes particulate matter that is less than 2.5 µm in diameter -- 1/30th the diameter of a human hair. Fine particles are the major source of visibility-reducing haze in the United States. The chemical composition of particles depends on location, time of year, and weather. The spatial variability of the annual average aerosol ammonium sulfate, ammonium nitrate, and organic carbon concentrations for the period January 2000 to December 2004 are quite distinct. As compared to spatial trends in ammonium sulfate, trends in ammonium nitrate and organic carbon were impacted to a much higher degree by the addition of urban sites.

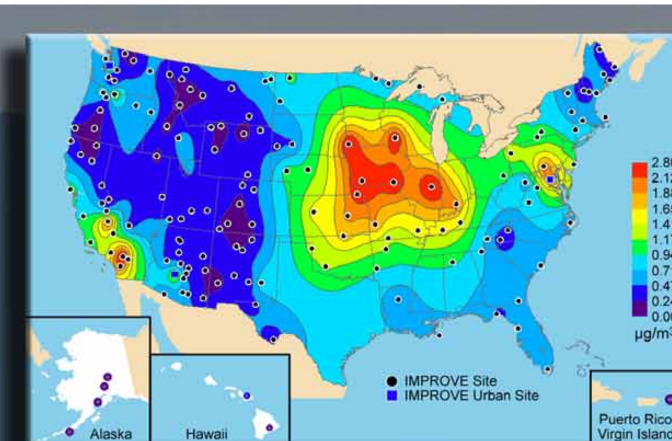
The EPA Speciation Trends Network (STN) monitors speciated fine aerosol mass concentrations in urban and suburban areas. Integrating data from the STN and IMPROVE provides more complete information on the spatial and temporal distributions of $PM_{2.5}$ aerosol mass and its major constituents. The collocation of IMPROVE and STN sites in select urban and rural locations allowed for analysis of the intercomparability between the two monitoring networks; collocated ammonium sulfate, ammonium nitrate, and blank-corrected organic carbon measurements from the two networks were found to be highly correlated. Annual averages for these species were found to have between 10% and 15% uncertainty for cross-network comparisons.



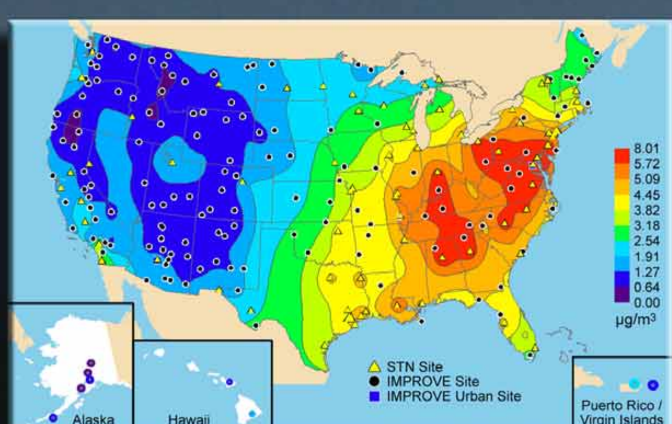
Ammonium sulfate concentrations for the IMPROVE network



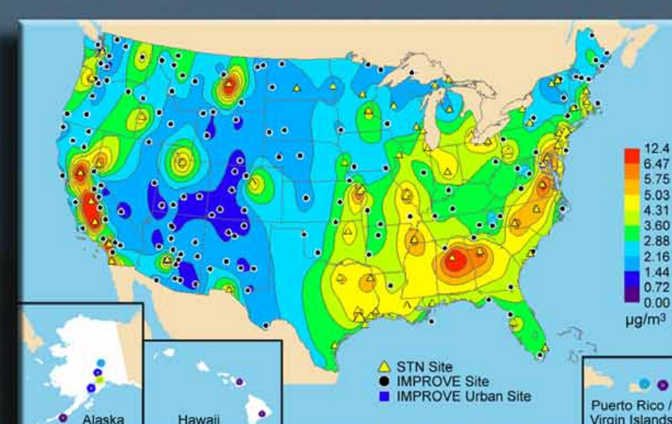
Organic mass concentrations for the IMPROVE network



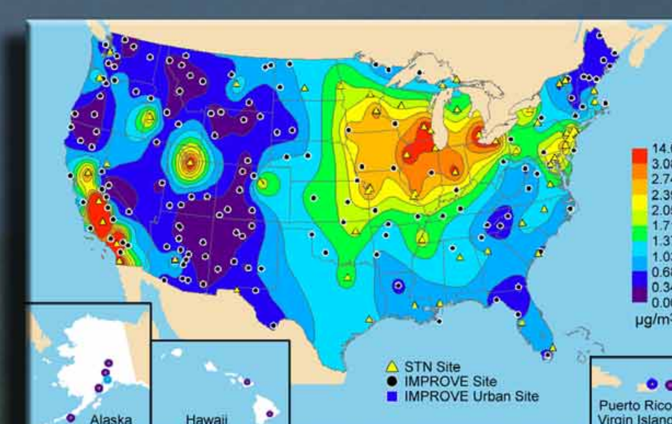
Ammonium nitrate concentrations for the IMPROVE network



Ammonium sulfate concentrations for the IMPROVE and STN networks



Organic mass concentrations for the IMPROVE and STN networks



Ammonium nitrate concentrations for the IMPROVE and STN networks

The highest annual average ammonium sulfate mass concentrations were found in the central eastern United States where there are significant SO_2 emissions. The east-to-west gradient is particularly striking, with concentrations in the central eastern United States a factor of eight higher than the western sites. In general, the east-to-west gradient is so much stronger than the urban-to-rural gradients that the latter are difficult to identify in the isopleth maps. Urban ammonium sulfate concentrations generally did not exceed two times nearby rural concentrations.

Peak rural organic carbon values were found in the Northwest, in the mountains of California, and in the Southeast. A large band through the interior West from the Mexican border into the upper Midwest had low rural concentrations. The addition of the urban STN sites identified additional localized high OMC concentration areas in the interior West, Northeast and Midwest. All of the western states with urban and rural sites available for comparison had urban concentrations at least 2 times higher than nearby rural concentrations. In the East, this was only true in AL, KS, NC, and NH.

Rural and urban ammonium nitrate concentrations were highest in California and in the Midwest, where both nitrogen oxide and ammonia emissions are high. STN sites indicate additional high urban concentration areas in ID, UT, CO, TX, NY, and PA. The western states had urban concentrations at least two times higher than nearby rural concentrations, similar to those of organic carbon. In the East this was only true in NC, OH, TN, MA, NH and VT. The largest absolute differences between urban and rural sites, 2-4 µg/m³, occurred in CO, UT, ID, NY, MI, OH, CA and MN.

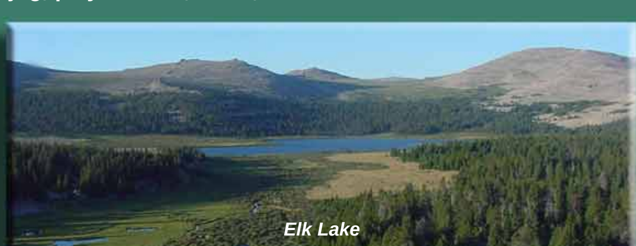
Cloud Peak Wilderness Area, Wyoming

Kris Thiele has been operating the Cloud Peak Wilderness air quality site near Buffalo, in north-central Wyoming, since the summer of 2002. Being the site operator there gives her the opportunity to capitalize on being in the Big Horn Mountains at least once a week. The Cloud Peak Wilderness is located within the Big Horn National Forest, with most of the area being around 9,000 feet in elevation. The wettest months are April, May, and June, and severe lightning storms are common during July, August, and September. Visibility averages between 50 and 70 miles, but clear winter days bring visibilities of 150-170 miles. On extremely hazy days, visibility can drop to between 23 and 35 miles.

From November to June the trail to the site is closed to motorized traffic, so Kris hikes the distance to the site. Quite often, her youngest child, Aaron, age 6, hikes with her and is a faithful member of the "monitoring team." During the summer months, her other two children, Seth, 10, and Nicole, 8, go up with her also and enjoy the mountains and creek nearby. Kris's husband Dan occasionally makes the trip up with them when he is not working at his job as wildlife biologist for Wyoming Game and Fish.

Kris recently took on another challenge. For the past 10 years she has been a stay-at-home mom. An opportunity to teach 6th grade math opened up in the Buffalo school district for the 2006-2007 school year, and with her youngest in kindergarten, Kris has returned to teaching. She would like to incorporate what she has learned as an air quality specialist in her sixth grade math classes.

Besides being with her children and husband, Kris likes to jog, play softball, swim, and hike.


Elk Lake

November

"In an underdeveloped country, don't drink the water; in a developed country, don't breathe the air."
- Changing Times magazine

Oct 2007

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Dec 2007

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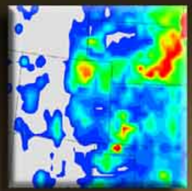
30	31					

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 305 Julian day	2 306 IMPROVE particle sampling day	3 307
4 308	5 309 IMPROVE particle sampling day	6 310 Election Day Change IMPROVE particle cartridges.	7 311	8 312 IMPROVE particle sampling day	9 313	10 314
11 315 Veterans Day IMPROVE particle sampling day	12 316	13 317 Change IMPROVE particle cartridges.	14 318 IMPROVE particle sampling day	15 319 America Recycles Day	16 320 National Park Service established, 1916	17 321 IMPROVE particle sampling day
18 322	19 323	20 324 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	21 325	22 326 Thanksgiving	23 327 IMPROVE particle sampling day	24 328
25 329	26 330 IMPROVE particle sampling day	27 331 Change IMPROVE particle cartridges.	28 332	29 333 IMPROVE particle sampling day	30 334	**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"



RoMANS

Rocky Mountain Atmospheric Nitrogen and Sulfur Study

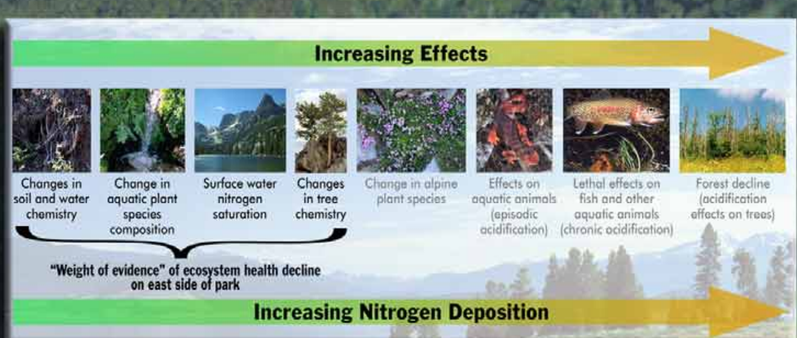
Nitrogen and Sulfur in Rocky Mountain Natl. Park

Rocky Mountain National Park (ROMO) is experiencing a number of deleterious effects due to atmospheric nitrogen and sulfur compounds. These effects include visibility degradation, changes in ecosystem function and surface water chemistry from atmospheric deposition, and human health concerns due to elevated ozone concentrations. The nitrogen compounds include both oxidized and reduced nitrogen. The effects of organic nitrogen compounds are not known at this time. Atmospheric nitrogen deposition in the Rocky Mountain region of Colorado and Wyoming ranges from 1 to 7 kg/ha/yr (approx. 5.5 to 38 lbs./acre/yr) and may be even greater at high elevations over 3500 m (11,500 ft.) in the Front Range. Atmospheric nitrogen deposition generally is greater east than west of the continental divide, except in areas that are directly downwind of large power plants.

Critical Load

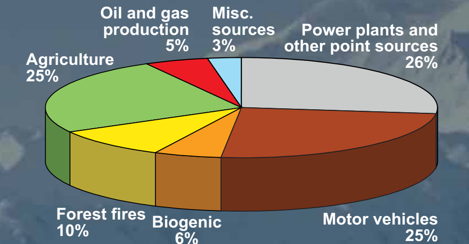
Set atop the continental divide, Rocky Mountain National Park includes the headwaters of the Colorado River, dozens of high mountain peaks, lower-elevation meadows, and evergreen forests. At the highest elevations, wildflowers dot the tundra where bighorn sheep, moose, elk, and marmots exist in delicate balance with their habitat.

The accumulation of nitrogen compounds in Rocky Mountain National Park has crossed a crucial threshold called the "critical load". It means that changes are occurring to park ecosystems and may soon reach a point where the changes are difficult or impossible to reverse. Soils, waters, and aquatic plants are showing evidence of change from wet deposition of nitrogen species in rain and snow, dry particles, and gases. Nitrogen acts like a fertilizer, creating an imbalance in natural ecosystems. It also acts as an acidifying agent in water and soil, leaving these resources vulnerable to acidification effects on fish and forests in the future. The park has set a resource management goal for a critical load of 1.5 kg/ha/yr (8.3 lbs./acre/yr) of wet nitrogen deposition as a level that would be protective of park ecosystems. This is approximately a 50% reduction in wet deposition from current 5-year averages of around 3.1 kg/ha/yr (17 lbs./acre/yr) of wet nitrogen deposition.

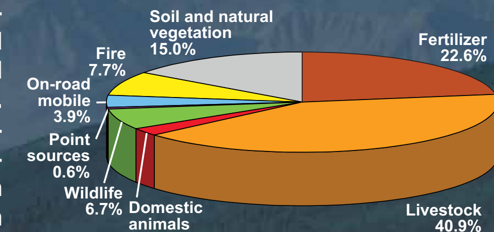


Sources

Nitrogen compounds (e.g., NO_x, ammonia) and sulfur compounds are emitted into the atmosphere from a variety of air pollution sources, including automobiles, power plants, industry, agriculture, and fires. Colorado's Front Range is an area of rapid population growth, escalating urbanization, oil and gas development, and agricultural production. Increases in these activities result in corresponding increases in nitrogen deposition in mountain ecosystems.



Nitrogen Emissions



Ammonia Emissions

The Study

While the effects of nitrogen and sulfur compounds on visibility and the park ecosystem have been documented, less is known about the origin of precursor sulfur and nitrogen species. The RoMANS study is underway to further our understanding of the origins of emissions currently affecting ecosystems and visibility in the Rocky Mountain region of Colorado and to explore how emission controls or reduction strategies can help mitigate pollution effects.

Colorado's temperatures, wind patterns, and storm tracks are heavily influenced by the state's complex topography. Prevailing winds are westerly but with typical easterly upslope / westerly downslope patterns. Air quality in the park is particularly affected when winds blow from the northeast, east, and southeast. Long-range transport has been traced from Mexico, Texas, as well as southern California. The heaviest precipitation occurs from late May through early June and late July through early September. Nighttime inversions, which trap pollutants, are a common occurrence, especially during the winter months.

Measurements

Measurements were made at a core site within Rocky Mountain National Park, at two secondary sites (one located on Gore Pass in the Gore Range, west of Rocky Mountain National Park, and one on the Front Range), and at an array of 27 satellite sites across eastern Colorado and the western slope.

RoMANS Study Objectives

- Identify the overall mix of sulfur and oxidized and reduced nitrogen in the air and precipitation on both the east and west sides of the continental divide.
- Identify the relative contribution to atmospheric oxidized sulfur and oxidized and reduced nitrogen at Rocky Mountain National Park from emissions originating within the state of Colorado vs. outside the state.
- Identify the relative contribution to atmospheric oxidized sulfur and oxidized and reduced nitrogen at Rocky Mountain National Park from emissions originating along the Front Range vs. other regions within the state.
- Identify the relative contribution of various source types within the state of Colorado to nitrogen and sulfur species, including mobile, agricultural, other area sources, and large and small point sources.
- Map spatial and temporal variability of atmospheric deposition within the park and relate observed patterns to likely source types and locations.
- Characterize the meteorological conditions that lead to various atmospheric chemical conditions.

Trapper Creek, Alaska

Joan and Ray Medbery have operated the Trapper Creek IMPROVE station since it was installed in fall 2001. Long-time Alaska residents, the Medberys are officially retired, but they keep busy running a weather station and two stream gauges for the National Weather Service in addition to their IMPROVE site operation duties. Throughout the long, snowy winters on the south side of the Alaska Range, Joan and Ray can always be depended on to strap on their snowshoes, pull out the snow shovel, and keep the site serviced every Tuesday, no matter how deep the snow is or how low the temperature drops.

A few years ago the Medberys were looking for another project to take on, so they decided to build a new house by themselves. It took two years to clear the land and put in the footings, and they spent the past summer building a concrete block foundation by hand. When not busy collecting data and building houses, Joan and Ray like to snowshoe, canoe, and hike along Alaska's rivers and trails. Closer to home, they grow a big garden every year and make wine from some of the fruit they grow.

Mt. McKinley glaciers

The Trapper Creek IMPROVE site is located 23 miles south of Denali National Park and Preserve and was established along with two other sites in 2001 to help characterize air quality patterns influencing Class I areas in Alaska. The long-term aerosol record near Denali NP&P headquarters demonstrates that, while the air is usually exceptionally clean in the interior of Alaska, small amounts of airborne contaminants are measured each year, matching well-documented seasonal patterns of international transport. National air quality regulations can help protect Alaska wild lands from increases in local and regional emissions, but it will take international cooperation to protect Alaska's ecosystems from international pollution, which is likely to grow along with global growth in human population and development.

The summit of Mt. McKinley is the highest point in North America.

December

"Suburbia is where the developer bulldozes out the trees, then names the streets after them."
- Bill Vaughn

Nov 2007

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Jan 2008

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27	28	29	30	31		

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1 *335 Julian day*
2 *336* IMPROVE particle sampling day	**3** *337*	**4** *338* Change IMPROVE particle cartridges.	**5** *339* IMPROVE particle sampling day	**6** *340*	**7** *341*	**8** *342* IMPROVE particle sampling day
9 *343*	**10** *344*	**11** *345* IMPROVE particle sampling day Special IMPROVE particle change. Move cassette #3 from old cartridge to new cartridge.	**12** *346*	**13** *347*	**14** *348* IMPROVE particle sampling day	**15** *349*
16 *350*	**17** *351* IMPROVE particle sampling day	**18** *352* Change IMPROVE particle cartridges.	**19** *353*	**20** *354* IMPROVE particle sampling day	**21** *355*	**22** *356* Winter begins
23 *357* IMPROVE particle sampling day	**24** *358*	**25** *359* Christmas Change IMPROVE particle cartridges.	**26** *360* IMPROVE particle sampling day	**27** *361*	**28** *362*	**29** *363* IMPROVE particle sampling day
30 *364*	**31** *365* New Year's Eve					

UC, Davis: *Sampler*:
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ARS: *Optical*:
Carter Blandford or Karen Rosener
Photography:
Karen Fischer
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Cover photo: A view looking south from Trail Ridge Road, the highest continuous auto road in the U.S., in Rocky Mountain Natl. Park, Colorado. Photographer - Jeff Lemke