2010 Calendar

IMPROVE

Interagency Monitoring of Protected Visual Environments

CIRA

Colorado State University

IMPROVE Monitoring Update

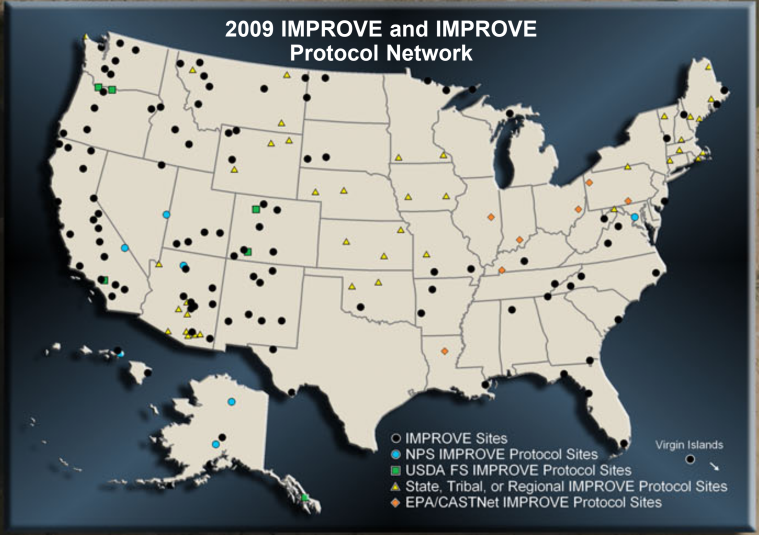
The IMPROVE (Interagency Monitoring of Protected Visual Environments) program consists of 110 aerosol visibility monitoring sites selected to provide regionally representative coverage and data for 155 Class I federally protected areas. Additional instrumentation that operates according to IMPROVE protocols in support of the program includes

- 59 aerosol samplers,
- 34 nephelometers,
- 4 transmissometers,
- 4 digital camera systems,
- 58 webcam systems,
- 5 interpretive displays.

Data and visualization tools can be found on the IMPROVE website at http://vista.cira.colostate.edu/improve/Data/data.htm and on the VIEWS site at http://vista.cira.colostate.edu/views.

Photographic slide spectrums are available on the VIEWS website under Imagery. Real-time webcamera displays are available on the following agency-supported websites:

Visibility Information Exchange Web System:
http://views.cira.colostate.edu/web/
National Park Service:
http://www.nature.nps.gov/air/WebCams/index.cfm
USDA-Forest Service: http://www.fsvisimages.com
CAMNET (Northeast Camera Network): http://www.hazecam.net
Midwest Haze Camera Network: http://www.mwhazecam.net
Wyoming Visibility Network: http://www.wyvisnet.com
Phoenix, Arizona Visibility Network: http://www.phoenixvis.net


2009 IMPROVE and IMPROVE Protocol Network

Network Notes

A new IMPROVE Protocol aerosol monitoring site was established at Gates of the Arctic National Park and Preserve, AK, in October 2008, sponsored by the National Park Service (NPS). The site was established to represent air quality at Gates of the Arctic National Park in north-central Alaska and is located at Bettles, AK, north of the Arctic Circle. Sample collection began in November 2008.

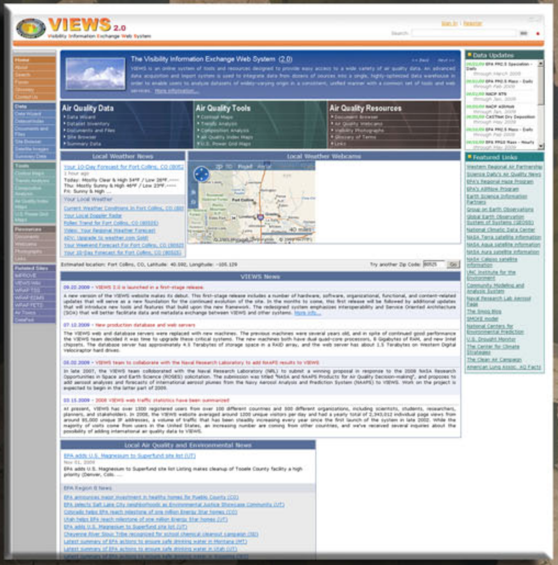
New York State participates in the IMPROVE Protocol aerosol monitoring network by operating an urban site in the South Bronx. The station is one of two National Air Toxics Trends sites in New York State and is used by various state agencies and universities to perform health-related air quality studies.

The USDA Forest Service acquired operation of an existing aerosol monitoring site at Ripple Creek Pass, CO, in March. The site, in the Flat Tops Wilderness, is equipped with a four-module IMPROVE aerosol sampler and plays a key role in monitoring local impacts from nearby oil and gas developments.

The NPS Air Resources Division in Denver, CO, has established a three-year partnership with Olympus America, Inc., to fund technical support and equipment upgrades for the network. The partnership includes funding to operate the network and upgrade hardware, software, and related supporting communications systems at four sites. Updates to 12 additional sites are planned in the future. Upgrades include replacing existing cameras with Olympus E-420 digital SLR cameras, replacing selected computers, replacing or relocating critical component enclosure parts, replacing existing camera cables where needed, upgrading custom camera software, upgrading selected Internet communications systems, and upgrading FTP server software.

The EPA's Carbon Speciation Network (CSN) began replacing its carbon sampling channel with an IMPROVE-type sampler three years ago. Installation at all 196+ monitoring sites is now nearing completion, and preliminary studies indicate the new CSN carbon sampler and the IMPROVE carbon module track well.

On September 22, 2009, VIEWS 2.0 was launched in a first-stage release. This release includes a number of hardware, software, organizational, functional, and content-related updates that will serve as a new foundation for the continued evolution of the site. In the months to come, this first release will be followed by additional updates that will introduce new tools and features that build upon the new framework. The redesigned system emphasizes interoperability and Service Oriented Architecture (SOA) that will better facilitate data and metadata exchange between VIEWS and other systems. At present, VIEWS has over 1500 registered users from over 100 different countries and 500 different organizations, including scientists, students, researchers, planners, and stakeholders. In 2008, the VIEWS website averaged around 1200 unique visitors per day and had a yearly total of 2,343,012 individual page views from around 85,000 unique IP addresses, a volume of traffic that has been steadily increasing every year since the first launch of the system in late 2002. While the majority of visits come from users in the United States, an increasing number are coming from other countries, and several inquiries have been received about the possibility of adding international air quality data to VIEWS.



Mesa Verde National Park, Colorado

Paul Bohman has been an air quality sampler operator at Mesa Verde Natl. Park for about one year. He writes, "Previously I had worked as a maintenance laborer at this park for almost 10 years. I now collect information from six different monitoring machines. Via the internet and the post office, I transport the information for analysis to laboratories in four states.”

Paul says, "Mesa Verde's air quality is influenced dramatically by up-wind coal-fired power plants and oil and gas field developments." Coal-fired power plants in New Mexico and Arizona are the largest sources of air pollutants, including sulfur dioxide and nitrogen oxides, in Mesa Verde National Park. The air quality information diligently collected every week is used to determine changes in visibility as well as assess increasing ozone levels and rates of nitrogen deposition in the park. A new 1500-megawatt coal-fired power plant is under active development just 46 miles from the park. Seven power plants currently operate within 186 miles of the park and three others are being proposed just beyond that distance. Sound air quality data is the only way for air quality managers to assess potential adverse impacts of further development. "The challenges", Bohman says, "are knowing whom to call when something breaks, and being proactive to prevent data loss."

About his life outside the park, he says, "Thirty-four years ago I worked on a dude ranch and had the brilliant thought that someday I would have my own farm/ranch. In 1996 that thought became a reality." He and his partner Mary operate Confluence Farm in the Mancos Valley, raising several varieties of green, leafy organic vegetables and root crops. He adds, "We have been selling our produce commercially full time for three years. We started a four-person Community Supported Agriculture (CSA) last year and added another seven customers this year. Our CSA program is a 13-week, early fall, farm direct-to-customer sales model. I enjoy the challenges of owning and operating a small vegetable farm which is an eternal work in progress."

Paul's other pursuits are live music venues, bicycle riding, hiking, climbing, camping, and thrift store shopping.

January

“Don't blow it - good planets are hard to find.”
- quoted in Time Magazine

Dec 2009

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Feb 2010

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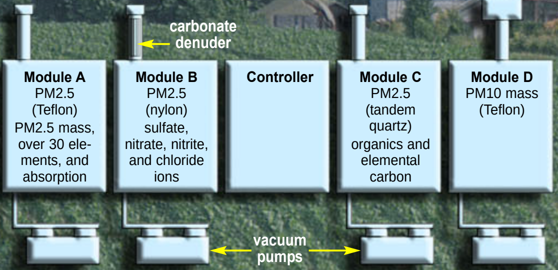
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
◆ Check temperature at setup to assure it is within 10° C of outdoor temperature.				◆ Call UC Davis at 530-752-1123 to figure out how holidays affect sample change schedules.	1 1 Julian day National Environmental Policy Act, 1969 New Year's Day	2 2 IMPROVE particle sampling day
3 3	4 4	5 5 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	6 6	7 7	8 8 IMPROVE particle sampling day	9 9
10 10	11 11 IMPROVE particle sampling day	12 12 Change IMPROVE particle cartridges.	13 13	14 14 IMPROVE particle sampling day	15 15	16 16
17 17 IMPROVE particle sampling day	18 18 Martin Luther King, Jr. Day	19 19 Change IMPROVE particle cartridges.	20 20 IMPROVE particle sampling day	21 21	22 22	23 23 IMPROVE particle sampling day
24 24	25 25	26 26 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	27 27	28 28	29 29 IMPROVE particle sampling day	30 30
31 31					**UC Davis**: *Sampler*: General Lab (530) 752-1123	**ARS**: *Optical*: Carter Blandford or Karen Rosener *Photography*: Karen Fischer (970) 484-7941

The IMPROVE Aerosol Sampler

The IMPROVE sampler is designed to obtain a complete signature of the composition of the airborne particles affecting visibility. PM2.5 (fine) particles are collected on Teflon, nylon, and quartz filters and PM10 particles on a Teflon filter. Each filter is in a separate module. The PM10 module is on the right with the larger inlet head. The inlets are normally 24 inches apart. The controller module is the center box with no inlet.

Aerosol monitoring sites are carefully chosen to be representative of the regional air mass. The site criteria fall into three categories: (1) the site must represent nearby Class I areas; (2) the site should be regionally representative, avoiding local pollution sources or areas with unusual meteorology; and (3) the site must avoid nearby obstacles that could affect sample collection.

IMPROVE Samplers in Detail



carbonate denuder

Module A
PM2.5
(Teflon)
PM2.5 mass, over 30 elements, and absorption

Module B
PM2.5
(nylon)
sulfate, nitrate, nitrite, and chloride ions

Controller

Module C
PM2.5
(tandem quartz)
organics and elemental carbon

Module D
PM10 mass
(Teflon)

vacuum pumps

The IMPROVE aerosol sampler consists of

- a controller module that contains a microprocessor to start and stop sample collection and record the flow rates for each module continuously,
- three PM2.5 modules (A, B, C),
- one PM10 module (D), and
- four vacuum pumps to provide air flow through the filters.

IMPROVE samples are intended to be collected under conditions as close to ambient temperature as possible. Samplers can be mounted in ambient temperature shelters, outdoors on a rack, or on the side of an existing structure. At sites that experience severe weather, it may be preferable to mount the samplers within a shelter to minimize exposure to the equipment and to protect the operator from severe wind and cold during the weekly sample changes. Shelters should be well-ventilated but not heated or air conditioned. Shelters should be able to support heavy snow loads, and sites with deep snow pack may need to be installed on a platform. Extended inlets may be required to keep the inlets at least 1 meter above the typical winter snow pack. The inlets should be at least 24 inches from any other equipment located at the site.

Samplers are typically mounted in one of three configurations:

ambient temperature shelter (not heated or cooled)

outside mounting on the side of an existing shelter or building

outside mounting on a rack built expressly for the IMPROVE samplers

Major Components of Fine Mass Extracted from IMPROVE Sampler Data

Ammonium sulfate: Sulfate is generally the major component of the fine mass throughout the United States, accounting for 20-40% of the mass in the West, and 45-60% in the East. (It is less than organics at most sites in the northwest and less than nitrates at San Gorgonio.) Sulfur primarily enters the atmosphere as SO_2 gas. The SO_2 converts in the atmosphere to sulfuric acid, which reacts with ammonia gas to form ammonium sulfate. There are periods at some sites when there is too much sulfuric acid to be neutralized by ammonia; some of it may remain as sulfuric acid. The rate of transformation and the size of the resulting particle depends on the relative humidity. This has a significant impact on visibility, because in high humidity the sulfate particles are larger and scatter light much more efficiently relative to the mass of sulfur. The scattering per unit mass of sulfur is greater at high humidity than at low humidity. This growth can occur anytime during the lifetime of the particle. If the relative humidity later decreases, the particle will shrink, but not immediately. Therefore the particle size and scattering efficiency depend on the relative humidity of the past as well as the present. The scattering efficiency for a small sulfate particle is less than that for a large one, but still significant. Because sulfate is such an efficient scatterer of light, its contribution to the extinction budget is even larger than its contribution to the mass budget.

Ammonium nitrate: Nitrate is generally a minor component of the particulate mass and the extinction budget. At half of the sites, ammonium nitrate is less than 6% of the mass, compared to 32% for ammonium sulfate. The main exceptions are on the West Coast, where the average nitrate concentration can be more than the average sulfate concentration. In the East, it is 15% of ammonium sulfate.

Soil: Most of this component is produced by soil dust. At some sites in the West, soil can be one of the largest components of the mass. Its effect on visibility is less per unit mass than sulfate, because the particles are generally larger than the optimum size. Soil emission is significantly enhanced by disturbances to the soil: off-road and dirt-road vehicular traffic, agricultural activities, and bison stampedes. A smaller source of these elements can come from industrial and mining activities.

Organics: Organic material is the largest component at most sites in the Northwest, and elsewhere, the second largest component. Possible sources are fires (wildfires, controlled burns, slash and field burning, incineration, household heating), industrial emissions, and biogenic emissions.

Elemental carbon or light-absorbing carbon: This component accounts for 5% to 10% of the fine mass, depending on whether LAC (light-absorbing carbon) or B_{abs} (total absorption) is used.

Reconstructed mass: The reconstructed mass generally correlates well with the gravimetric mass, accounting for almost all of the fine mass. About 20% of the unaccounted mass may be nitrate, with the remainder primarily residual water on the particles.

El Dorado Springs, Missouri

El Dorado Springs, Missouri, has a population of 3800 and is located in Cedar County. **Shelly Schieffer** calls it a beautiful place to live, with its farms, lakes, Ozark hills, and an abundance of trees and wildlife, such as deer and turkeys. The area is centered about one to two hours away from the larger populated cities of Springfield, Joplin, and Kansas City. The IMPROVE site is located 13 miles outside of El Dorado Springs.

Ms. Shieffer is certain that with all the chemical plants, industries, hog and turkey farms, and agricultural farming that exists in Missouri, this site provides useful data about air quality. She's glad to know she plays a part in collecting that data, especially since Missouri is among the worst for allergy and asthma sufferers.

Shelly describes herself as a 44-year-old, single mom with four wonderful boys of whom she is extremely proud: Cody, 22; Kyle, 20; Colt, 12; and Jake, who is 10 years old. "I am so lucky they are all well behaved, healthy, smart boys. I have two step-daughters from my ex who have made me a proud grandma (me-mah) already of three granddaughters and one grandson."

She continues, "Life has been interesting to say the least! My first jobs are being mom, sports taxi, and soccer coach, but I've enjoyed working as a certified nurse aide, receptionist, teacher assistant, surgical housekeeper, church secretary, housekeeper for the homebound, and property manager for elderly, handicapped, and disabled tenants. I started working for the Missouri Department of Natural Resources around 10-11 years ago. In the last few years they added the IMPROVE sampler site, and I have enjoyed taking care of both sites together."

Shelly is currently looking for a new job, but has found the love of her life, Dwain Marshall, who is retired from 30 years of bridge construction, is currently a bail bondsman, and has two boys of his own -- Scott, who is 28, and Joey, 13. Dwain helps collect the samples in adverse weather conditions or just because it's dark.

February

"The earth we abuse and the living things we kill will, in the end, take their revenge; for in exploiting their presence we are diminishing our future."

- Marya Mannes, *More in Anger*, 1958

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

◆ Electrical connections (e.g., extension cords) exposed to wet conditions should be GFCI protected.

◆ Watch for frost on the inlets.

Jan 2010

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Mar 2010

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◆ Watch for lightning damage.

◆ Check site conditions (e.g., a tree growing beyond acceptance criteria).

Operator Involvement -- The Key to Network Success

Troubleshooting the Sampler

When a problem is identified with the sampler, first note the issue on the logsheet. The first step in correctly diagnosing and solving any problem is to call the UC Davis sample-handling laboratory at 530-752-1123 (fax: 530-752-4107; e-mail fieldops@crocker.ucdavis.edu). If possible, call from the site to facilitate troubleshooting. No problem is too small, and a correct diagnosis is more likely to be made.

Common Sampler Problems

Missed Tuesday sample change:

- If there are remaining sampling days in the week, remove the exposed filters as would normally be done and put in the clean filters that were to have been installed on the last change day. Make a note on the logsheet.
- If the week is completely missed, remove the exposed filters as normal, but do not put in the filters for the missed week (keep the missed samples in the shipping box). Install the cartridges labeled for the current week. On the logsheet for the unused cartridges, note that they were not used and the reason for not using them.

The display is blank:

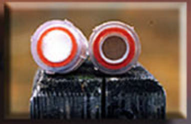
Power may be off.

- Check the main circuit breaker; turn it off and on if you are unsure if it has tripped.
- Check the power strip that the sampler and pumps are plugged into. This may be located inside the pump enclosure. There should be a lighted switch on the power strip. If it is not lit, turn the switch off and then on again.
- Check the power cord for the sampler. This black cord runs from the base of the control module to the power strip. If it is unplugged, reconnect it.
- If you are still not sure if power is on,
    - a. Unplug one of the pumps from its outlet box.
    - b. Disconnect the silver vacuum hose connector from the top of the pump.
    - c. Plug the pump cord directly into the power strip. The pump will start if there is power.
    - d. Reconnect the vacuum hose and plug the pump back into the duplex outlet box.

Sometimes the LCD screen freezes in cold weather. If this is a possibility at the site, remove the keypad by disconnecting the phone jack on the back of it and allow it to warm up.

The elapsed time is zero for one or multiple days:

- Check the following to determine why sampling did not occur on the scheduled day. Describe the problem on the logsheet. If you cannot determine the cause of the problem, call UC Davis at 530-752-1123 as soon as possible.
    - a. Check that the date and time on the controller screen are correct. Adjust if necessary.
    - b. If possible, check whether there was a power outage for the entire day.
    - c. Look at the Module A filter that has an elapsed time of zero. Does the filter look white (like a new filter) or does it look like there is a sample on the filter?


NPS photo, Glacier NP

Pump will not start:

- Check that the pumps are all plugged in (the outlet box that the pump is plugged into may have a switch on it, but this does not control the pump power).
- Test the pump that is not starting by doing the following:
    - a. Unplug one of the pumps from its outlet box.
    - b. Plug the pump cord directly into the power strip (make sure the power strip is receiving power). If the pump starts, the problem is with the outlet box.
    - c. If the pump doesn't start, the problem is with the pump.
    - d. Plug the pump back into the duplex outlet box.
    - e. Call UC Davis and describe the results of the test.
- Extreme cold may prevent pumps from starting. Remove the pump to a warm location (or come back when the weather is warmer) and test. If cold weather is found to be the problem, try one of the following solutions:
    - a. Run pumps continuously by plugging them into switched outlets (power strip or wall outlet).
    - b. Keep pumps warm by placing an automotive electric blanket or other heat source under the pumps.

Pump starts slowly:

Note the slow-starting pump on the logsheet and contact UC Davis. If the weather is extremely cold, see above section "Pump will not start". If the pump is slow to start in normal temperatures, it needs repair. Contact UC Davis and a new pump will be shipped to the site to replace the malfunctioning pump.

The motor drive for the cartridge manifold is not working:

The motor can be disengaged, and the hand wheel can be used to manually raise and lower the cartridge manifold.

PM2.5 Modules A-C:
The motor is located in the top right area.

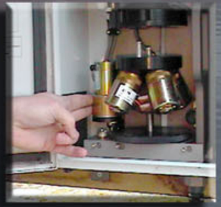

1. Disengage motor by gently pushing down on the top of the motor.


2. "Lock out" the motor by rotating it toward the solenoids.


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

PM10 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. "Lock out" the motor by rotating it toward the solenoids.


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

Bosque del Apache National Wildlife Refuge, New Mexico

Colin Lee and **Bernard Lujan** are the IMPROVE operators at the Bosque del Apache Natl. Wildlife Refuge. Colin writes, "Air quality and visual clarity at our refuge is extremely important. Besides the ecological values that the refuge provides (wetlands, forests, grasslands, and wildlife), we also provide a place for visitors to enjoy spectacular scenery and wildlife. We are a premier destination for birders and nature photographers and are one of the most photographed national wildlife refuges in the country. Fortunately, we have generally good air quality here."

"The refuge lies along the Rio Grande. We maintain seasonal wetlands for over 100,000 wintering sandhill cranes, snow geese, and ducks that migrate to or through the refuge. Our annual Festival of the Cranes occurs each November and attracts over 5,000 visitors to the refuge during a one-week period and generates over $1-million in revenues for the surrounding communities."

"In support of ecosystem management, the U.S. Fish and Wildlife Service seeks to protect and enhance air quality in and around national wildlife refuges. Refuges require that 'the biological integrity, diversity, and environmental health of the [refuge] system are maintained,' (Refuge System Improvement Act)."

Colin and Bernard are also responsible for conducting or facilitating other monitoring and research activities, such as the detection of population changes of birds, small mammals, reptiles, amphibians, and vegetation in various flood plain habitats; the measurement of habitat responses to management activities; the maintainance of communication with individuals from over 20 research projects that are being conducted by partner agencies; and, each fall during the Festival of the Cranes, the organization of a research poster symposium to highlight this work. They have also established three black-tailed prairie dog colonies on the refuge, which was in the historic range of this species, and assist in other tasks to maintain and manage approximately 2,000 acres of wetlands for migratory water birds.

Colin enjoys many outdoor pursuits, such as rock climbing, mountaineering, mountain biking, and backcountry skiing.

March

"Till now man has been up against Nature; from now on he will be up against his own nature."
- Dennis Gabor, *Inventing the Future*, 1964

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

Feb 2010

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Catastrophic Events in the IMPROVE Network

Catastrophic events, by definition, are sudden natural or man-made situations where change and destruction may occur without prior knowledge or preparation. Some examples of catastrophic events include thunderstorms, blizzards, sandstorms, hurricanes, tornadoes, windstorms, floods, typhoons, heat waves, flash floods, wildfires, mudslides, hail storms, cold spells, ice storms, earthquakes, volcanic eruptions, rainstorms, and snow storms. IMPROVE sampling sites have been and will continue to be impacted by catastrophic events. Some examples of events that have damaged sites in the past are highlighted below.

North Absaroka (NOAB1), 2000 -- The shed was blown over by high winds. The shed was later placed upright and stronger anchors were installed for guy wires.

North Absoroka, 2007 -- The shed was blown over again and completely destroyed this time by high winds. All equipment was severely damaged and had to be replaced. The shed was later rebuilt and new equipment was installed.

Santa Lucia Ranger District (RAFA1), 2008 -- The stand was blown over by high winds that caused it to roll down a hill. The stacks and controller were destroyed, but the modules remained operational. The stand was later corrected and stronger anchors were installed.

Breton Island (BRIS1), 2008 -- The area where the stand sits was flooded due to a hurricane. Prior to the arrival of the hurricane, the operator removed the modules and pumps from the stand and stored them at her house.

After the debris was cleared around the stand, the equipment was restored and recalibrated.

San Gabriel Mountains (SAGA), 2009 -- Wild fires burned down the shed and all equipment. A new temporary stand (WRIG1) was erected shortly after at a nearby location.

Wildfires occur every year throughout the United States. These fires can occur in clusters and are often regional in scope, blanketing hundreds of square miles with smoke for days at a time. Many IMPROVE sites are located in the forests and grasslands where these fires occur. IMPROVE samplers can be impacted by smoke from the fires. Moderate amounts of particulate material collected during these events can provide interesting insights into the behavior and composition of wildfire smoke. However, when the smoke becomes too thick, the sampler clogs and data are lost for those days.

Suggestions for operators in case of a foreseen emergency:

- Operators should first call the UC Davis Air Quality Group (AQG) lab and inform personnel of the situation. If they cannot contact a technician, they should leave a message with pertinent information such as the operator's name, the site name (printed on the side of each filter box), operator's phone number, and a brief description of the situation.
- Operators should assess the situation. If there is any possibility of danger, they should not attempt to visit the site. If it is safe to approach the site, it is preferred that the equipment be removed and stored in a secure and dry area. Note that in order to remove the equipment, a 5/32" and/or 1/8" hex L-key (Allen wrench) is required. The equipment is very heavy; modules weigh 45 lbs, while pumps weigh 22 lbs, so operators should be careful when lifting them out. The following steps are to ensure safe removal of the equipment:

1. If time allows, run through final filter readings as if it were a normal Tuesday sample change. Leave the filters in the modules; they will provide support to the inner structure during transportation.
2. After taking final readings, disconnect the power cord to the controller.
3. If the site's breaker is accessible, turn it off.
4. Disconnect all cables and vacuum hoses from underneath the modules and controller.
5. Remove stacks by loosening the stack collar. The D module stack will have an internal brace that needs to be loosened with the 5/32" Allen wrench.
6. Use the Allen wrench to free the module from the top bracket. This will allow the module to swing down and come off the wall. Modules are heavy (45 lbs), so be prepared for the weight.
7. Remove the pumps by first disconnecting all vacuum hoses and power cables.
8. If time allows, remove all cables and hoses. Some cables may be anchored to the stand or shed.
9. Contact the UC Davis AQG lab at the earliest convenience.

Cohutta Ranger District, Georgia

April

"Remember when atmospheric contaminants were romantically called stardust?"

- Lane Olinghouse

Ed Lang became the primary operator of the Cohutta IMPROVE site in January 2009. The site is located atop an observation area on Fort Mountain in the Chattahoochee National Forest. He moved to north Georgia to accept a wilderness / trails position with the US Forest Service and to be closer to family. He has been with the Forest Service for over seven years, many of those years working in the Monongahela National Forest in West Virginia as a recreation technician.

Ed says that sometimes there are challenges to keep the site up and running properly. He reports, "Our site has taken a couple of lightning strikes this summer since the site is exposed on a knoll with no trees around. We lost a lot of valuable data because of breakdowns, and the site threatened to be a total scratch this year. After several tries to fix the problem from our end with phone assistance from UC Davis, they sent a technician to finally get things running properly again."

Lang's other responsibilities with the Forest Service include wilderness management -- like making sure people follow rules and regulations, which he tries to ensure by patrolling the Cohutta Wilderness; maintenance of trails in and outside the wilderness such as maintaining or building erosion control features, brushing, slingblading, etc.; visitor contacts where he provides information about the forest; and other recreation-related duties. In his spare time, he likes to relax, spend time with his family, watch sports on TV such as football and NASCAR, and travel and hike.

Mar 2010

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May 2010

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Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			◆ Check for insect infestations in spring and summer (e.g., mud daubers in sampler inlet and spider webs). ◆ Check for melting ice on tops of sampler modules.	1 91 Julian day	2 92 IMPROVE particle sampling day	3 93
4 94	5 95 IMPROVE particle sampling day	6 96 Change IMPROVE particle cartridges.	7 97	8 98 IMPROVE particle sampling day	9 99	10 100
11 101 IMPROVE particle sampling day	12 102	13 103 Change IMPROVE particle cartridges.	14 104 IMPROVE particle sampling day	15 105	16 106	17 107 IMPROVE particle sampling day
18 108	19 109	20 110 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	21 111	22 112 Earth Day	23 113 IMPROVE particle sampling day	24 114
25 115	26 116 IMPROVE particle sampling day	27 117 Change IMPROVE particle cartridges.	28 118	29 119 IMPROVE particle sampling day	30 120 Arbor Day	**UC Davis**: *Sampler:* General Lab (530) 752-1123 **ARS**: *Optical:* Carter Blandford or Karen Rosener *Photography:* Karen Fischer (970) 484-7941

Clearing National Skies

Marc Pitchford, Air Resources Laboratory, National Oceanic and Atmospheric Administration, Las Vegas, NV

EPA Considering Nationwide Visibility Protection

As part of their periodic review of the Particulate Matter National Ambient Air Quality Standards (PM NAAQS), the Environmental Protection Agency (EPA) is considering a secondary standard based on the welfare effects of visibility impairment. The multi-year review process is nearing completion in 2010 and could result in secondary PM NAAQS that would for the first time define how much PM-caused haze is detrimental to public welfare throughout the country. To distinguish this potential standard from the regulations that have been promulgated to protect visibility in the 156 federal Class I areas (e.g., the Regional Haze Rule), the EPA has been characterizing it as urban-focused visibility. This doesn't imply that a new standard would only apply in urban areas. The intent is to focus on the welfare effects of visibility on people's everyday lives, in contrast to the desire for good visibility as an integral component of recreational enjoyment of remote natural areas.

The EPA has developed draft documents to support their PM NAAQS review process, including an Integrated Science Assessment (ISA) that summarizes the recent literature on health and welfare effects of PM, a health-based risk assessment, and welfare-based Urban Focused Visibility Assessment (UFVA) document. The draft UFVA reanalyzed summary data from urban visibility preference studies conducted in Denver, CO; Phoenix, AZ; Vancouver, BC; and Washington, DC. Each of these separately conducted public survey studies were similar in that they asked study participants to rate photographic displays of haze in an urban scene as acceptable or not acceptable.

Figure 1 is a summary plot of the refined composite preference data from these four locations. The vertical axis is the fraction of participants in each study that found the amount of haze acceptable. The horizontal axis is the amount of haze displayed in deciview (dv) units. Based on this assessment, the EPA has selected a range of candidate protective levels (CPL) for visibility from 20 dv to 30 dv with a mid-level of 25 dv.

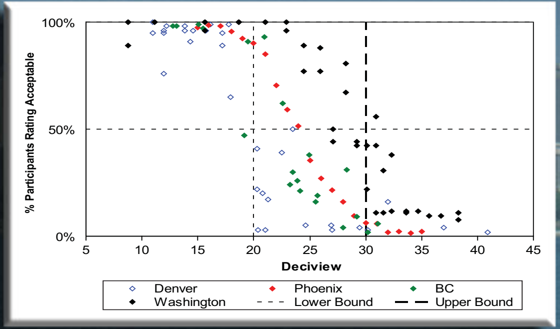

Figure 1

Figure 2 contains WinHaze-generated haze on photographs from Phoenix and Washington, DC, that illustrate the low, middle, and high CPL for those two cities.

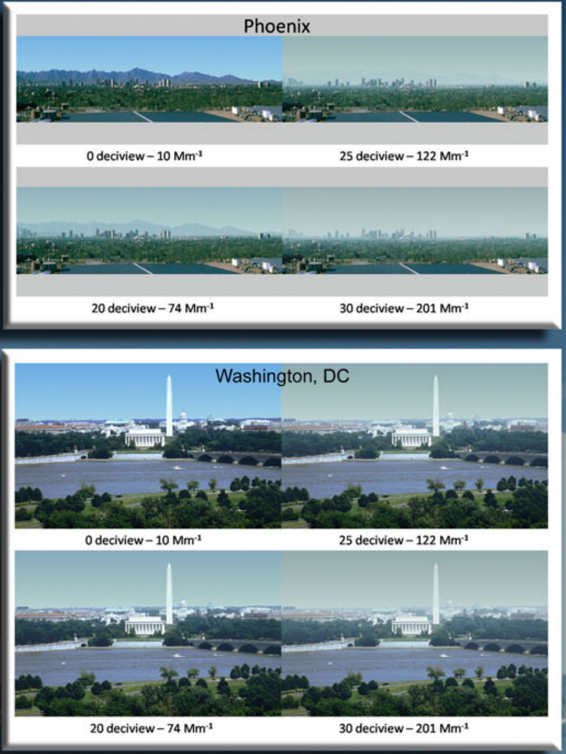

Figure 2

Traditionally, PM NAAQS use the mass concentration as the PM metric. While it is true that PM is the primary cause of visibility impacts, there is no single one-to-one correspondence between PM mass concentration and light extinction that is recognized as the most useful measure of visual air quality. PM composition and ambient humidity affect the size distribution of the particles in the atmosphere, which in turn determines the amount of light extinction. Because of this, the EPA is considering using PM light extinction (i.e., light extinction minus the light scattering by clean air and assuming the light absorption by NO_2 to be ignorable) as the metric for a secondary NAAQS.

As part of the UFVA, the EPA has estimated daylight hourly light extinction values for 15 urban areas across the country and compared them to the CPLs. All of the urban areas had estimated visibility conditions that exceeded even the highest CPL, as shown in the box and whisker plot in Figure 3. The western urban areas generally have fewer hours with these high light extinctions than those in the East.

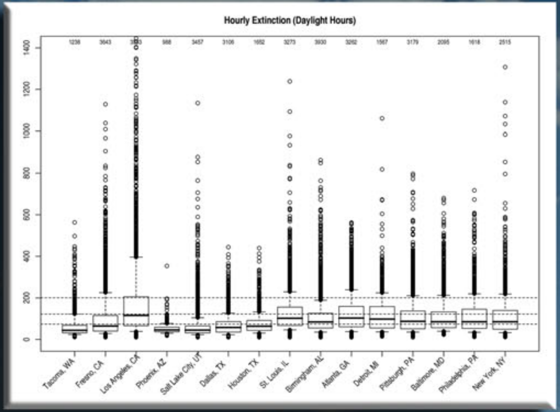

Figure 3

The EPA also evaluated a number of PM mass concentration and PM light extinction NAAQS scenarios by examining how changes in their implementation would cause changes in estimated hourly light extinction for 15 urban areas over a three-year period. Not surprisingly, the NAAQS scenarios using PM light extinction produced more uniform reduction in light extinction conditions that exceed the CPLs across all 15 cities than the PM-mass-concentration-based scenarios.

As this is being written, it remains to be seen whether the EPA will promulgate a secondary PM NAAQS specifically for visibility protection and what the form and level of that standard would be. However, should they do so, it would likely result in emission reductions that would help reduce visibility impacts for visibility-protected, remote Class I areas.

Hell's Canyon NRA, Wallowa-Whitman National Forest, Idaho

Arny Koski and her family have spent most of their lives in the Hell's Canyon area. They live in a place called Oxbow, on the Snake River. There are three hydropower plants in this area: Brownlee, Oxbow, and Hell's Canyon Dam. Amy's husband works for the Idaho Power Co., and they live in a small village with housing provided by the company.

Ms. Koski is the mother of two daughters. One is a sophomore in a high school in Halfway, and the other goes to college at EOU, located 17 miles away in Lagrande, OR. Amy and her husband both went to the same high school their daughters attended.

Arny says, "I have several jobs around the area. I sub at the school as needed, have coached volleyball at the high school on and off for the last eight years, and fill in for two employees at Idaho Power. It is such a small rural area, but it seems there is always something going on. We love to go boating on the Snake River. We fish and enjoy hunting as a family. We own horses and mules (my youngest daughter rodeos) and three dogs."

"My daughters and I have been doing the air monitoring job for about five years. We usually ride our 4-wheeler to the site right from our house, or sometimes we hike in. This last winter we received a lot of snow and we could only get the 4-wheeler part way in to the site, even with a plow on front. We never get fog, but Halfway, where the school is located, is fogged in a lot. Our air quality here is excellent as we have no nearby pollution sources. The biggest city close by is Boise, Idaho, a three-hour drive from here. It is a beautiful, secluded area, and we feel fortunate to have grown up here and to be able to raise our family here."

May

"Waste is a tax on the whole people."

- Albert W. Atwood

Apr 2010

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Jun 2010

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

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

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

Operator Involvement -- The Key to Network Success

Transpacific Transport of Aerosols

Duli Chand, Shawn McClure, Bret Schichtel, John Huddleston, William. C. Malm, Tom Moore, Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO

Eastern Asia is an important source region for a variety of natural and anthropogenic aerosols. China, the world's most populated country, has undergone rapid industrialization over the last two decades. As a result, during this time frame China has more than doubled its emissions to quickly become one of the largest emitters of aerosols and aerosol precursors in the world. These emissions of aerosols in eastern Asia may have substantial impacts on climate, ecosystems, and human health in Asia as well as remote marine and continental environments. Emissions from Asia experience relatively faster vertical transport than aerosols emitted in many other regions because eastern Asia is one of the main warm conveyor-belt inflow regions, where airstreams rapidly transport the atmospheric boundary layer air into the upper troposphere.

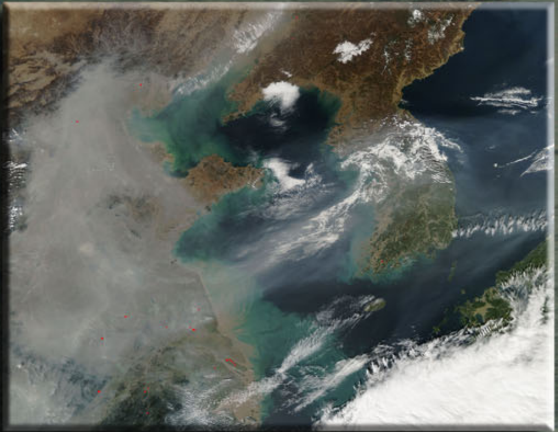

Figure 1. Satellite snapshot of the haze outflow over eastern China across the Yellow Sea and Korean Peninsula. Much of haze over eastern China comes from burning coal in industry, power plants, and densely populated households. Burning coal releases both particles and sulfates. Water condenses on the tiny particles creating a chemical fog or smog under the right weather conditions. The haze is a health concern because the tiny particles can reach deep into the lungs where they can cause damage. Haze also impacts climate by deflecting sunlight from the Earth's surface. The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite acquired this image on October 23, 2009 at 05:00 UTC.

*NASA image courtesy Jeff Schmaltz, MODIS Rapid Response Team at NASA GSFC.
Caption by Holli Riebeek.*

The polluted Asian air over the northeastern Pacific can then be transported downward to influence the North American atmospheric boundary layer by gradual subsidence associated with subtropical Pacific highs and mesoscale mountain circulations in western North America and through atmospheric boundary-layer outflow associated with cold fronts. Observations of elevated concentrations of many different species, including nitrates and sulfates over North America, have been traced to Asian sources. Figure 1 is a satellite image of haze over eastern China and of transport over the Pacific Ocean. There have been several large-scale international experiments focusing specifically on transpacific transport of air pollution [e.g. Intercontinental Chemical Transport Experiment (INTEX)]. By utilizing coordinated and multi-platform observations, these campaigns have provided comprehensive snapshots of regional aerosols and their transport across the Pacific Ocean. Despite their advantages and detailed case studies, field campaigns are limited to relatively short durations and small spatial coverage. Therefore, these campaigns alone are not adequate to assess the long-term temporal and spatial variations in the transpacific transport of aerosols. To fill the spatial and temporal gaps, we use satellite observed aerosol optical thickness (AOT) as a surrogate for aerosol concentration to assess the transpacific transport of aerosols. We aim to estimate the seasonal aerosol transport from eastern Asia to North America via the North Pacific basin, using 9 years of Moderate Resolution Imaging Spectroradiometer (MODIS) (Terra) observations. Monthly level-3 data files from all 9 years at a spatial resolution of 1^{o} x 1^{o} are integrated over each season. (Winter = December, January, February; Spring = March, April, May; Summer = June, July, August; Autumn = September, October, November).

To ensure sufficient availability of data, we selected 1^{o} x 1^{o} data grids that have data more than 70% of the total time in each season. This data screening is applied to avoid the biases caused by limited data. The screening removes few data grids over the Pacific basin in the summer season and some data to the higher latitudes (>50^{o}N) in the autumn season. Since our focus is the transport pathways in subdomain 20^{o}N-50^{o}N, 125^{o}E-130^{o}W, the missing grids are minimal in this study region.

Figure 2 shows the seasonal maps of AOT averaged over 9 years. High AOT (>0.5) is observed over eastern China and it decreases with distance away from the China coast over the Pacific Ocean. The zonal variation in AOT indicates that the transpacific transport of aerosols is at a maximum in the spring season and minimum in autumn. Elevated AOT values above background levels are observed over the Pacific Ocean during summer and winter seasons, but unlike spring, these elevated values do not extend to North America. The aerosol transport as represented by elevated AOT from eastern Asia to North America across the Pacific Ocean is highest in spring season, followed by summer, winter, and autumn. These AOT maps show that most of the aerosol transport over the Pacific basin is confined to domain 30N-50N in all seasons. This is consistent with the wind flow in springtime as shown in Figure 3.

The analysis implies that as a result of the transport of aerosols across the Pacific basin, the AOT at the West Coast of the United States is 0.09, which adds to a background AOT of 0.09 ± 0.01. This AOT (0.09) at the West Coast is about 34% of the AOT at the east coast of China in spring, while other seasons show lower transport, <10%. These results suggest that aerosol transport from Asia can impact the air quality and visibility at far remote Pacific marine and North American continental environments.

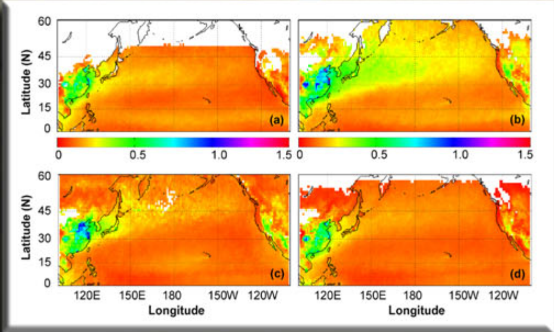

Figure 2. Maps of AOT at 550 nm, averaged over 9 years for the (a) winter, (b) spring, (c) summer, and (d) autumn seasons. The spatial resolution of each map is 1^{o} x 1^{o}. The missing or voided data are shown by white blocks. Horizontal color bars display the scale of AOT.

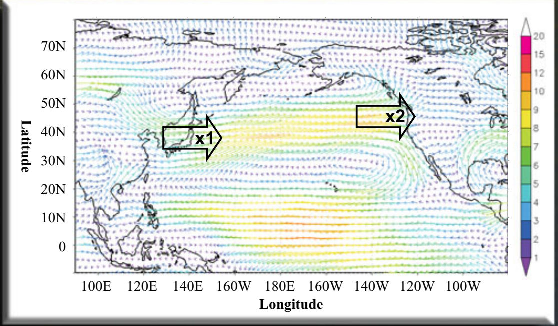

Figure 3. Nine years (2000-2008) of NCEP wind fields averaged over March, April, and May (northern hemispheric spring season) at 850 hPa. The large arrows show outflux over eastern Asia and influx over North America. The colors on vertical bar indicate wind speed ($m\ s^{-1}$).

Northern Cheyenne Reservation, Montana

Scott Williams has been the IMPROVE site operator at the Northern Cheyenne Reservation in Montana for the last six years. The site is on one of three Prevention of Significant Deterioration (PSD) monitoring sites sponsored by the Pennsylvania Power and Light Company of Montana, and run with help from the 144,000-acre Northern Cheyenne Reservation, which is home to about 6000 Cheyenne Native Americans. A coal-fired power plant is located 20 miles north of the monitoring site. Visibility is generally good in the area, although plumes from the power plant's stacks are occasionally visible from the site.

The IMPROVE sampler was set up in 2001 to measure NO$_X$ and SO$_2$. There is also a camera which faces south toward the Bighorn Mountains and takes pictures three times daily. The three PSD sites also measure wind speed and direction, humidity, barometric pressure, and solar radiation.

Scott received a degree in computer science in 1988 from the University of Idaho in Moscow. He worked for about six years in Moscow for the Appaloosa Horse Club keeping track of breed registrations and races, then took on a programming position at Boise Cascade for three years, followed by a short stint for Computers Unlimited in Billings, about a hundred miles away. But after a couple months, this proved to be an untenable commute, so he took the air quality technician position on the reservation.

Scott is a pleasant and mild-mannered 46-year-old who stays in excellent physical condition, enjoys participating in track and field events, and competes in the master's division in international track meets. He and his wife Carmie have six children ranging in age from 9 to 28, and two grandchildren who are 1 and 2 years old. One daughter was a cook in the navy until she left the service in July 2009. He still has one child at home.

June

> "There is hope if people will begin to awaken that spiritual part of themselves, that heartfelt knowledge that we are caretakers of this planet."
>
> - Brooke Medicine Eagle

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	◆ Check for insect infestations throughout the summer (e.g., mud daubers, flies, spider webs). ◆ Watch for lightning damage during the summer.	1 152 Julian day IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	2 153	3 154	4 155 IMPROVE particle sampling day	5 156 National Trails Day
6 157	7 158 IMPROVE particle sampling day	8 159 Change IMPROVE particle cartridges.	9 160	10 161 IMPROVE particle sampling day	11 162	12 163
13 164 IMPROVE particle sampling day	14 165 Flag Day	15 166 Change IMPROVE particle cartridges.	16 167 IMPROVE particle sampling day	17 168	18 169	19 170 IMPROVE particle sampling day
20 171 Father's Day	21 172	22 173 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	23 174	24 175	25 176 IMPROVE particle sampling day	26 177
27 178	28 179 IMPROVE particle sampling day	29 180 Change IMPROVE particle cartridges.	30 181			

May 2010

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Jul 2010

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Sea Salt in the Great Plains? (part 1)

Warren H. White[1], Brian P. Perley[1], and Richard L. Poirot[2]
(1) Crocker Nuclear Laboratory, University of California, Davis, California, and (2) Vermont Department of Environmental Conservation, Waterbury, VT

The sampling day December 14, 2008, brought snow and sub-zero (Fahrenheit) temperatures to the prairies of the northern Great Plains, as illustrated in Figure 1a. While these physical conditions were not out of line for the region and the season, the accompanying "chemical weather" was quite extraordinary, as seen in Figure 2. The arctic air extended over multiple states, and Figure 3 shows it to have carried uniformly high concentrations of chloride and sodium. Quantitative analyses of these and other constituents of seawater (part 2) show the sampled particulate matter to have been dominated by largely unreacted sea salt. The NAAQS-focused Chemical Speciation Network captured little of this multi-state episode, because the highest concentrations occurred in sparsely populated areas monitored only for their scenic value. The 13.4 μg/m^3 of total fine particle mass logged at Thunder Basin National Grasslands in northeast Wyoming, 72% of it sea salt, was the highest concentration recorded by any IMPROVE monitor on that date.

The data from December 2008 highlight some of the IMPROVE program's key strengths:

- Dedicated site operators who maintain high data capture rates at remote locations in challenging environmental conditions;
- A multiplicity of independent physical and chemical analyses to provide context and confirmation of novel results;
- Data of sufficient quality to allow quantitative comparison with known materials such as fresh sea salt;
- A successful push to reduce sample processing times to enable early recognition of novel phenomena.

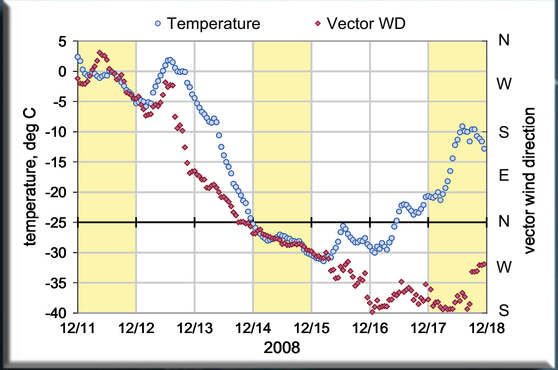
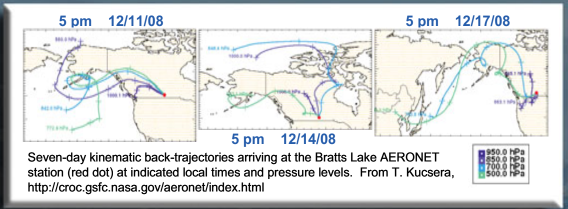


Figure 1a. (above) Hourly weather at the Theodore Roosevelt Natl. Park Visitors Center in western North Dakota (NPS data). The wind direction scale (right side) extends over 540 degrees in order to unwind the turning wind. IMPROVE sampling days are shaded.

Figure 1b. Back-trajectories at the 850 hPa transport level point to an Arctic origin for the airmass arriving on December 14, 2008.



Seven-day kinematic back-trajectories arriving at the Bratts Lake AERONET station (red dot) at indicated local times and pressure levels. From T. Kucsera, http://croc.gsfc.nasa.gov/aeronet/index.html

Figure 1c. Web cam photos of Theodore Roosevelt NP, ND

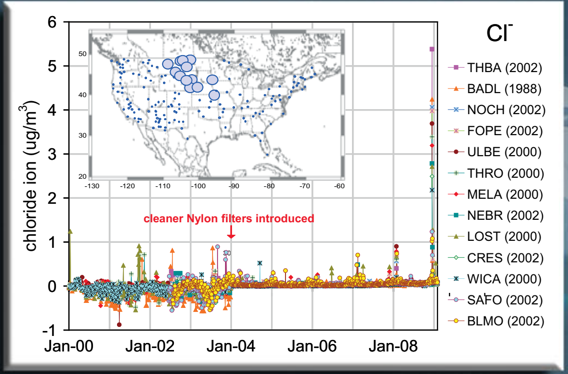


Figure 2. Historical chloride ion concentrations at the monitoring sites most affected by the December 14, 2008 event (locations mapped in insert): Thunder Basin (THBA), Badlands (BADL), Northern Cheyenne (NOCH), Fort Peck (FOPE), UL Bend (ULBE), Theodore Roosevelt (THRO), Medicine Lake (MELA), Nebraska NF (NEBR), Lostwood (LOST), Crescent Lake (CRES), Wind Cave (WICA), Sac and Fox (SAFO), and Blue Mounds (BLMO). The start of monitoring at each site is shown in parentheses; the highest concentration recorded at Badlands before 2000 was 0.3 μg/m^3. The concentrations on December 14, 2008 were without precedent in our record of this region.

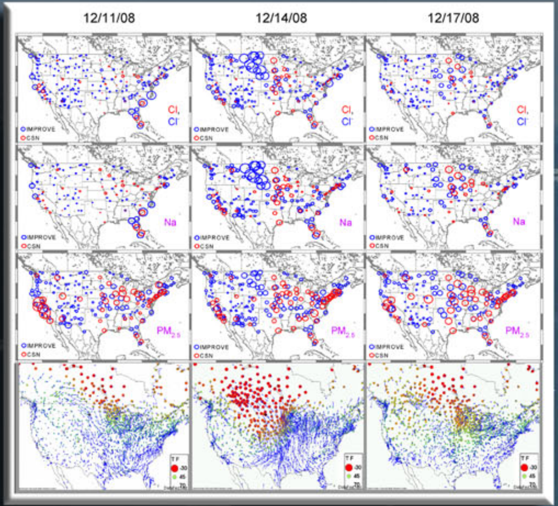


Figure 3. Distribution of salt and low temperatures over the contiguous U.S. in mid-December 2008. The top three rows combine IMPROVE measurements with data from the EPA's population-oriented Chemical Speciation Network. Concentrations of chloride ion (IMPROVE) or elemental chlorine (CSN), sodium (both networks), and PM2.5 (both networks) are indicated by bubble areas. The concentration/area scaling differs between species but is consistent across networks and days. The bottom row maps surface wind vectors and temperatures, with the coldest locations shown in red. Measurements from independent sampling trains, analytical methods, and reporting networks showed the arrival in the northern U.S. prairie of a frigid airmass carrying high concentrations of fine-particle sea salt. The 13.4 μg/m^3 concentration of total fine particle mass logged at Thunder Basin National Grasslands in northeastern Wyoming was the highest recorded by any IMPROVE monitor on that date. (Datafed.net)

Saguaro National Park, Arizona

Rene Richins operates the IMPROVE station at Rincon Mountain District of Saguaro National Park. She received a bachelor of science in natural resources from the University of Arizona. Currently she is working as an administrative support assistant, spending most of her time providing administrative and clerical support to Saguaro NP. Fortunately, managing the IMPROVE station gets her out of the office at least once a week. Rene and her husband, Mike, are both outdoor enthusiasts who love to go hiking, hunting, and camping.

While Saguaro Natl. Park is known for its giant saguaro cacti, the park preserves 91,327 acres of the Sonoran Desert which is home to many different desert plant and animal species. One of the park's main priorities is combating the invasive, non-native buffel grass (cenchrus ciliaris, also called African foxtail grass) that contributes to negative ecological impacts such as displacing native plants and increasing fuel for fires.

The park has two units that sit like bookends to the east and west of Tucson, a city of more than a million people. Although there is not much heavy industry in the area, vehicle exhaust and blowing dust from mines, agriculture, and development create the most serious visibility concerns. Because these are non-point sources, emissions control is a challenge. Staff at the park partner with the Pima County Department of Environmental Quality (PDEQ) to address air quality concerns, and they and the Arizona DEQ maintain ozone and IMPROVE samplers in the east district and another IMPROVE sampler and nephelometer in the west district. The park, PDEQ, AZ DEQ, and the EPA address concerns related to ground-level ozone, its precursors (NOx and VOCs), and particulates, and collaborate in developing a State Implementation Plan for Visibility and a Natural Events Action Plan for controlling particulates when high winds are predicted. The park, state, and local entities also regulate wildland fires to ensure that smoke from management fires moves away from sensitive targets.

July

> "The human race is challenged more than ever before to demonstrate our mastery - not over nature but of ourselves."
>
> - Rachel Carson

Jun 2010

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Aug 2010

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29	30	31				

UC Davis: *Sampler:*
General Lab
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ARS: *Optical:*
Carter Blandford or
Karen Rosener
Photography:
Karen Fischer
(970) 484-7941

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

Operator Involvement -- The Key to Network Success

Sea Salt in the Great Plains? (part 2)

Warren H. White[1], Brian P. Perley[1], and Richard L. Poirot[2]
(1) Crocker Nuclear Laboratory, University of California, Davis, California, and (2) Vermont Department of Environmental Conservation, Waterbury, VT

The Arctic has long attracted the attention of atmospheric chemists. Once imagined as a pristine environment, it is now more often studied as an over-the-horizon receptor of air pollutants emitted from the more industrialized latitudes. Recently, the IMPROVE network documented an exceptional example of significant material transport in the reverse direction.

As seen in part 1, December 14, 2008, brought arctic air carrying high concentrations of chloride and sodium to the northern Great Plains. These species are familiar chemical markers for the marine aerosol at coastal locations, but high concentrations of this aerosol would not be expected in the continental interior. Quantitative comparisons with other elements, illustrated in Figures 4 and 5, nevertheless confirm that the sampled particulate matter was dominated by largely-unreacted sea salt. Even calcium, an element that Regional Haze Rule guidance uses as an indicator of soil dust, was predominantly marine.

It may seem strange to attribute airborne sea salt to a region where the seas are frozen, but the role of this aerosol in winter air chemistry is an active topic of polar research. Production mechanisms currently under study include blowing snow that has wicked up salt ions from underlying sea ice, and the shattering by winds of "frost flowers", which are dendritic growths on newly-formed sea ice (Figure 6). Because they are associated with young sea ice, frost flowers are thought to be the more episodic of the candidate mechanisms, and it is tempting to "explain" the unprecedented magnitude of the December 14 event as a coincidence of widespread new-ice creation with an episode of sustained transport to the south (Figure 7). Other meteorological analyses suggest possible transport from the northern Pacific Ocean. We invite feedback on this subject from calendar-readers whose expertise extends farther north than ours does!

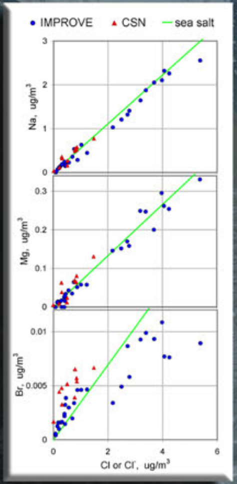


Figure 4. Correlation of chemical markers for sea salt with chlorine or chloride ion concentrations on 12/14/08. The sloping green lines indicate the relationships expected in fresh sea salt, based on standard characterizations of seawater composition. All IMPROVE and CSN data from Montana, Wyoming, North and South Dakota, Nebraska, Kansas, Iowa, and Minnesota are shown. Na and Mg are plotted without adjustments normally made to IMPROVE data for generic matrix effects, which are unrepresentative of sea-salt aerosols.

Figure 5. (right) Correlation of fine-particle mass and trace elements with chlorine or chloride ion concentrations, for the samples shown in composition Figure 4. The sloping green lines indicate the relationships expected in fresh sea salt, based on standard characterizations of seawater composition. Open symbols contrast estimates of mineral dust contributions, based on measured Fe and standard estimates for the average composition of continental crust. Sea salt accounts for most of the observed fine particle mass, K, Ca, and Sr.

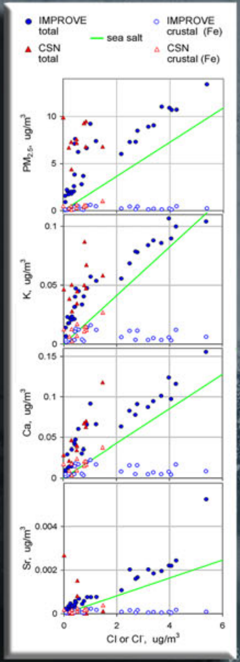


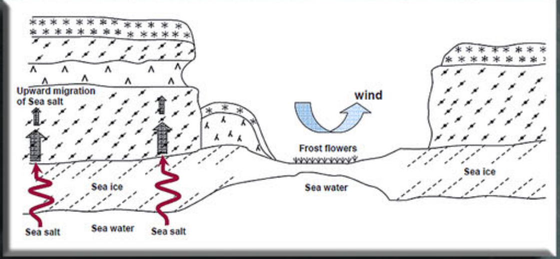
Figure 6a. Frost flower close-up

Figure 6b. Multiple frost flowers

Figures 6a-b. (above) Frost flowers on the ice shelf near Barrow, AK.

(Fig. 6a by Carlye Calvin / University Corporation for Atmospheric Research, from New Scientist, May 20, 2009. Fig. 6b by Spencer Brown, www.spencerbrownphoto.com.)

Figure 7. (below) Schematic illustration of two processes suspected of supplying sea salt to the arctic atmosphere: upward migration from sea ice into unconsolidated snow, and wind-blown frost flowers. Adapted from Domine et al., Atmos. Chem. Phys. Discuss. 4, 4737-4776, 2004.



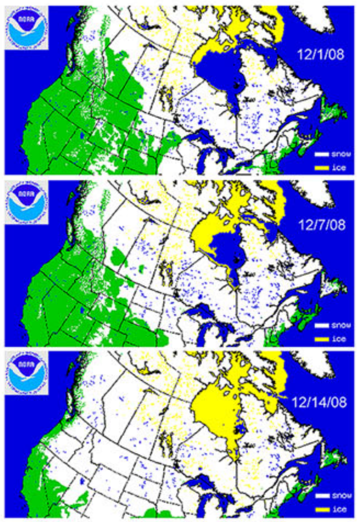
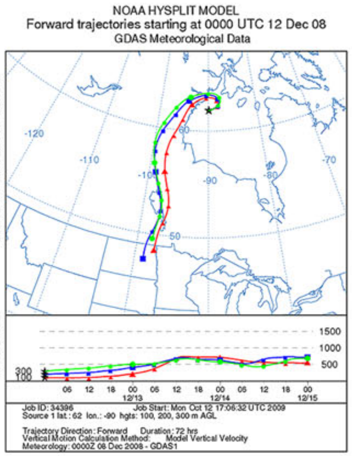


Figure 8. Ice and snow cover in likely source areas for sea salt observed in the northern plains on Dec. 14, 2008. Hudson Bay froze over in the two weeks before the episode. Snow and ice cover data are from the NOAA Interactive Multisensor Snow and Ice Mapping System (IMS).



Forward trajectories from NOAA HYSPLIT model: Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY at http://www.arl.noaa.gov/HYSPLIT.php. NOAA Air Resources Laboratory, Silver Spring, MD.

Virgin Islands National Park, St. John, Virgin Islands

Located on St. John, Virgin Islands National Park was established in 1956 and comprises more than half the mountainous island's land area. The park includes most of the north shore and central and southeastern portions of the island, including 7,259 acres of terrestrial and shoreline habitat and 5,650 acres of adjacent submerged lands (offshore underwater habitat, added to the park in 1962). The park also includes Hassel Island, located in Charlotte Amalie harbor on St. Thomas, which was added in 1978. In 2001, Virgin Islands Coral Reef National Monument was established to protect an additional 12,708 acres of submerged lands and associated marine resources around the island.

Devon Tyson is a park ranger in the resource management division at Virgin Islands National Park / Coral Reef National Monument. His major responsibility is the management of the park and monument moorings and regulatory buoys. His additional duties include the operation of the air quality station, which includes the IMPROVE samplers and National Atmospheric Deposition Program (NADP) equipment that collects precipitation data. He also assists with feral animal reductions and other projects. He acquired the position of IMPROVE site operator for Virgin Islands National Park in 2007, and currently shares the responsibilities with two other park rangers (David Sapio and Jessica Hornbeck). In his spare time, he enjoys photography, going to the beach, scuba diving, and spending time with his wife and three-year-old daughter.

Devon says, "I enjoy island life because of its beauty, its people, and the plush green hillsides sloping toward a welcoming, turquoise blue ocean. Park vistas are preserved throughout most of the island."

"There are no nearby pollution sources and the visibility in the park is great. We can usually see neighboring islands over 40 miles away. The major visibility impediment occurs when Sahara dust or volcanic particulates from other Caribbean islands arrive in our area."

August

"It's hard for the modern generation to understand Thoreau, who lived beside a pond but didn't own water skis or a snorkel."

- Loudon Wainwright

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1 213 Julian day	2 214	3 215 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	4 216	5 217	6 218 IMPROVE particle sampling day	7 219
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15 227 IMPROVE particle sampling day	16 228	17 229 Change IMPROVE particle cartridges.	18 230 IMPROVE particle sampling day	19 231	20 232	21 233 IMPROVE particle sampling day
22 234	23 235	24 236 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	25 237	26 238	27 239 IMPROVE particle sampling day	28 240
29 241	30 242 IMPROVE particle sampling day	31 243 Change IMPROVE particle cartridges.				

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

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

Jul 2010

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Sep 2010

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Best Available Retrofit Technology (BART)

Tom Moore, Coordinator, Western Regional Air Partnership, Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO

In the western United States, the Western Regional Air Partnership (WRAP - www.wrapair.org) provides regional air quality analysis and planning support to tribal governments, state governments, and various federal agencies to assist western states and tribes in complying with the U.S. EPA's regional haze regulations. The Best Available Retrofit Technology (BART) requirement is an integral part of regional haze planning and must be included in regional haze implementation plans. Western BART sources are not covered under the EPA Clean Air Interstate Rule (CAIR). Significant work to determine control technologies for individual sources "subject-to-BART" has been completed in western states. SO_2 and NO_X emissions magnitudes for BART sources in the West are dominated by coal-fired electrical generating units (EGUs). The BART program applies to 26 industrial source types built between 1962 and 1977.

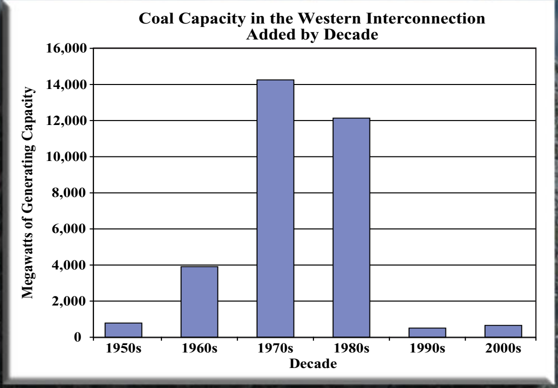

Figure 1. This graph demonstrates a significant fraction of the operational coal EGU capacity is subject to BART. Operational coal-fired EGU generating capacity (megawatts) is shown added by decade in the West from the 1950s through the 2000s.

Over the past 30 years, western states have applied retrofit controls to existing stationary sources through permits for major plant modifications as well as requiring installation of Best Available Control Technology (BACT) on newer EGUs and industrial sources built after 1977. Additional emissions reductions on existing plants (through consent decrees and settlement agreements) have also been required through permits, to reduce visibility impacts attributable to specific large EGU point sources.

The trend in SO_2 and NO_X emissions and for total generating capacity for the 11-state western electrical interconnection is shown in Figure 2. From 1995 through 2008, fossil-fuel-fired generating capacity has increased from about 275,000 to almost 400,000 Megawatts. Between 1997 and 2008, SO_2 emissions have fallen 53% and NO_X emissions have decreased 20%.

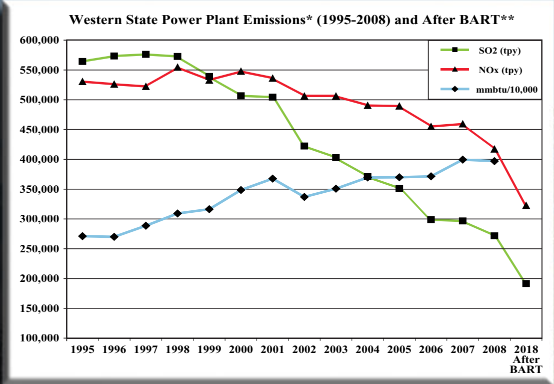

Figure 2. Trends in SO_2 and NO_x emissions 1995-2008 and projected 2018 emissions after BART is installed, contrasted with generating capacity, for fossil fuel-fired EGUs in the 11-state western electrical interconnection.

* *Currently operating coal, gas, and fuel oil-fired plants in the 11-state Western Interconnection*
** *Estimates for BART controls are from WRAP PRP18b emissions analysis available at: http://www.wrapair.org/forums/ssjf/pivot.html*

Installation of best available retrofit control technologies (BART) for EGUs, as they are projected for installation and become operational by 2018, could result in a decrease of 381,786 tons/year (67%) for SO_2 and 203,516 tons/year (39%) for NO_X emissions, a significant increase in the level of control from 1996.

The WRAP region is home to 116 Class I areas with a broad array of visibility impairment and emission impacts. Included are 75 percent of the nation's 156 mandatory federal Class I areas, half the land mass of the United States (excluding Alaska), a very large portion of publicly-owned lands, and numerous tribal jurisdictions (many with large land areas). It also emits a minority of total U.S. emissions, borders both Canada and Mexico, and receives pollution from Asia. Most WRAP members are faced with rapid population growth and other challenges to preventing deterioration of air quality, including regionally-important environmental issues, such as fire and drought.

The regional analysis work and planning support of WRAP has assisted the western states, the EPA, and the federal land managers with regional haze planning, as the states complete their individual BART determinations and regional haze plans that document the emissions controls to be achieved by 2018 to improve visibility in our national parks and wilderness areas.

The table below contrasts 2002 emissions and 2018 emissions (after implementation of currently adopted control programs) to pollution in the West. With the addition of BART controls, a greater incremental visibility improvement will be achieved by 2018. At the same time, uncontrollable and/or natural sources are significant by comparison. Present emission forecasts suggest increases for ocean shipping and from the expansion of oil and gas production area sources resulting from leases already issued for public lands in the West. (Data source: http://vista.cira.colostate.edu/tss/)

WRAP		Point	Mobile	Area	Anthropogenic Fire (typical)	Natural Fire (typical)	Fugitive / Windblown Dust
SO_2	2002	781,204	97,532	86,298	5,879	49,913	0
	2018	535,311	10,007	110,860	3,942	49,914	0
	% change	-31%	-90%	28%	-33%	0%	0%
NO_X	2002	898,441	2,638,423	378,560	28,459	184,370	0
	2018	896,129	1,113,419	512,076	17,840	184,376	0
	% change	0%	-58%	35%	-37%	0%	0%
POM+EC (PM2.5)	2002	12,197	101,097	112,630	55,358	543,339	7,906
	2018	9,095	59,555	121,228	32,825	543,353	8,873
	% change	-25%	-41%	8%	-41%	0%	12%
Crustal PM2.5	2002	39,522	58,351	72,758	11,135	31,735	334,505
	2018	42,394	67,148	84,772	6,195	31,741	353,185
	% change	7%	15%	17%	-44%	0%	6%

Figure 3. WRAP emissions totals (tons/year) between 2002 and 2018, assuming implementation of existing state and federal regulations (no BART controls included).

Why Control SO2 and NOx?

On March 10, 2005, the EPA issued the Clean Air Interstate Rule (CAIR), a rule that seeks to achieve the largest reduction in air pollution in more than a decade. CAIR will permanently cap emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_X) in the eastern United States, and (as of 2008) in the Midwest, Southeast, and Northeast. CAIR seeks large reductions of SO_2 and/or NO_X emissions across 28 eastern states and the District of Columbia. When fully implemented, CAIR will reduce SO_2 emissions in these states by over 70 percent and NO_X emissions by over 60 percent from 2003 levels.

Cabinet Mountains, Kootenai Natl. Forest, Montana

In the Cabinet Mtns. of Montana, **Terry Hightower** describes the deep winter snows that can create 'access nightmares', "We receive lots of snow at the air quality site, and when the wind blows we have huge drifts created in several spots on the road. The two-mile 'Jeep trail' to the site was originally the route to the Green Mtn. Lookout tower. It is very steep in several spots with a couple of switchbacks on talus. Of course, the best part of the job is getting out of the office and enjoying the trip up the mountain ... you never know what you will see. But when the snow is wet and heavy and we snowshoe in, it does lose some of its glamour because it's so much work, but that is the nature of the beast."

The Green Mountain site, located about 3 miles from the Cabinet Wilderness Area, is a TV translator station and houses the IMPROVE sampling equipment. It's located in one of the wettest parts of Montana. Heron, close to the Idaho border, receives an average of 34 inches of precipitation a year. Visibility is often hazy or cloudy, but on a cold, clear day, you can see the Schweitzer Mtn. ski runs in Sandpoint, ID, (about 60 miles away), and the northwest portion of the Bitterroot Mountains near the Idaho-Montana border.

"My other responsibilities on the Cabinet Ranger District include the botany, archaeology and weed programs," Terry says. "I have an M.S. in plant ecology (prairie). I've been an EMT on the Noxon Ambulance since 1988 and can only say that it's been a very exciting time and learning experience! I actually consider it my second job because it requires so much."

Terry lives in Billings in eastern Montana and has been a Montana resident all his life, even when he was in the Army back in the 70s. A long-time hunter, he particularly enjoys pheasant hunting with his dog. "Dogs RULE!!!" he quips.

September

"Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist."

- Kenneth Boulding

Aug 2010

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Oct 2010

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Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
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5 248 IMPROVE particle sampling day	6 249 Labor Day	7 250 Change IMPROVE particle cartridges.	8 251 IMPROVE particle sampling day	9 252	10 253	11 254 IMPROVE particle sampling day
12 255	13 256	14 257 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	15 258	16 259	17 260 IMPROVE particle sampling day	18 261 National Public Lands Day
19 262	20 263 Pollution Prevention Week IMPROVE particle sampling day	21 264 Change IMPROVE particle cartridges.	22 265	23 266 IMPROVE particle sampling day	24 267	25 268
26 269 IMPROVE particle sampling day	27 270	28 271 Change IMPROVE particle cartridges.	29 272 IMPROVE particle sampling day	30 273	◆ Check for rodent infestations in the fall and winter.	**UC Davis**: *Sampler*: General Lab (530) 752-1123 **ARS**: *Optical*: Carter Blandford or Karen Rosener *Photography*: Karen Fischer (970) 484-7941

Air Quality and the National Wildlife Refuges

Jill Webster, US Fish and Wildlife Service, National Wildlife Refuge System, Branch of Air Quality, Lakewood, CO

The mission of the National Wildlife Refuge System is to administer a national network of lands and water for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of the present and future generations of Americans.

From one-ton bison to half-ounce warblers, the National Wildlife Refuge System contains a priceless gift -- the heritage of a wild America that was, and is. If it is a bird, mammal, reptile, amphibian, fish, insect, or plant, it is probably found in the system.

The system supports at least 700 species of birds, 220 mammals, 250 reptiles and amphibians, over 1,000 fish, and countless species of invertebrates and plants. Nearly 260 threatened or endangered species are found on refuges, and it is here they often begin their recovery or hold their own against extinction.

The smallest refuge is the half-acre Mille Lacs National Wildlife Refuge (NWR) in Minnesota; the largest is the Arctic NWR in Alaska at 19.2 million acres. Superimposed over the lower 48 states, the 3.6 million acres of islands in Alaska Maritime NWR would stretch from California to Florida.

The refuge system attracts more than 34 million visits annually to engage in wildlife-dependent recreation.

In addition, the system encompasses 21 Class I areas designated in the Clean Air Act to receive the highest levels of protection.

The ways in which the system nurtures this diversity of life and the habitat on which it depends is the very foundation of its mission. Without healthy and diverse habitat, there is no wildlife; without wildlife, the mission set forth in law is not achieved and the trust with the American people is broken.

Healthy air and watersheds are necessary to sustain quality habitats on lands in the system. A refuge does not exist in isolation of its surrounding air and water sheds. Habitats on many refuges can be threatened by external factors, such as contaminated air and water and other land, water, and air -use factors within the air and watershed. The growing complexity of external threats requires that a systematic, interdisciplinary assessment be conducted at appropriate scales.

The IMPROVE network is a valuable tool for collecting information in a standardized manner that supports a national effort to address external threats to air and water quality and ultimately leads to land management decision making that improves the health and integrity of the system as a whole. There are 18 IMPROVE monitors located on FWS-managed lands; they provide representative data for many of refuge system's varied ecosystems.

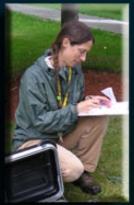
Every refuge is unique in its own right. Some ecosystems are more sensitive to certain chemical species than others. IMPROVE data collected in these and surrounding areas give us the site-specific information we can use to protect and hopefully restore a healthy habitat. The IMPROVE data also help the FWS track long-term trends in visibility in Class I areas and assess progress toward the national visibility goal of ultimately reaching natural conditions in these areas by 2064. Time and time again, visitors rank clean air and good visibility conditions as attributes they value most when visiting wild areas.

Proctor Maple Research Center, Vermont

There are four operators, all State of Vermont Air Pollution Control Division (VTAPCD) employees, at this Vermont Dept. of Environmental Conservation IMPROVE site located three miles southwest of the summit of Mount Mansfield, at the north end of Underhill in northern Vermont. **Greg Sharon** (left) is an environmental technician born and raised in Vermont, who competes at the semi-professional level in regional and national arm wrestling competitions. He also enjoys hunting and the great outdoors.

Carl Anderson is an environmental technician. When not maintaining the state's network of air pollution monitors, he spends his time hiking, biking, and kayaking in the Green Mountains and Lake Champlain. He also has an affinity for avifauna, earning him the official title of 'bird nerd'.

Amy Shedrick is an environmental analyst. She is the utility infielder, filling in for lab and field staff whenever there is a need, and handling a variety of data, administrative, and web-based tasks. Amy holds a national record for women's competitive weightlifting, competes in Highland Games, and is our local Crème Brulee connoisseur.



Jenny Berschling is also an environmental analyst. She maintains the only continuous toxics monitor in the network for benzene, toluene, ethylbenzene, and xylenes (BTEX), and is currently working to convert the data collection infrastructure to accommodate Agilaire's AirVision air monitoring software. She spends her free time on the ice playing hockey, in the garden growing healthy local food, or cheering on Pittsburg sports teams.

The Proctor Maple Research Center is a University of Vermont research facility dedicated to the science of maple syrup production, and is an approved Vermont and EPA Region 1 National Core (NCore) multi-pollutant air monitoring network location. In addition to IMPROVE sampling, future trace-level criteria pollutants are also monitored, along with volatile organic compounds (VOCs), carbonyl, polycyclic aromatic hydrocarbons (PAHs), metals, hexavalent chromium (CR6+), acid precipitation, mercury, and UV radiation. Also present is a suite of meteorological sensors mounted atop a 32-foot tower to assist with modeling and pollutant transport analyses.

October

> "Most of the luxuries and many of the so-called comforts of life are not only not indispensable, but positive hindrances to the elevation of mankind."
>
> - Henry David Thoreau

Sep 2010

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Nov 2010

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17 290 IMPROVE particle sampling day	18 291	19 292 Change IMPROVE particle cartridges.	20 293 IMPROVE particle sampling day	21 294	22 295	23 296 IMPROVE particle sampling day
24 297	25 298	26 299 IMPROVE particle sampling day Special IMPROVE particle change. Move cassette 3 from old cartridge to new.	27 300	28 301	29 302 IMPROVE particle sampling day	30 303
31 304 Halloween	◆ Call UC Davis at 530-752-1123 to figure out how holidays affect sample change schedules.				**UC Davis**: *Sampler*: General Lab (530) 752-1123	**ARS**: *Optical*: Carter Blandford or Karen Rosener *Photography*: Karen Fischer (970) 484-7941

Model Diagnosis Using Process Analysis

Marco Rodriguez, Mike Barna, Cooperative Institute for Research in the Atmosphere, Colorado State University, Ft. Collins, CO

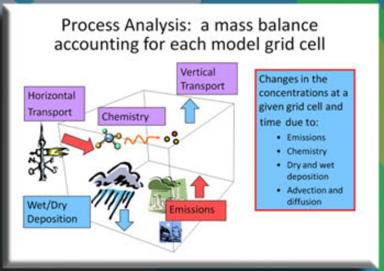
Regional air quality models are routinely used to simulate the fate in the atmosphere of different pollutants, such as ozone in photochemical smog, or fine particles that reduce visibility. These 'one atmosphere' models attempt to simulate all of the important chemical and physical processes that govern the fate of these species in the atmosphere. For example, a simulation might involve sulfur dioxide (SO_2) emitted from a smoke stack at a coal-fired power plant, transported and dispersed by the wind, chemically transformed into the haze-causing particle ammonium sulfate ($(NH_4)_2SO_4$), and deposited to the earth's surface.

The growing complexity of these models, however, has often resulted in them being treated as 'black boxes'. Since the predicted pollutant concentrations often do not match observed values, there is little recourse for improving the simulation if the underlying deficiencies of the model are unknown. A potentially worse scenario occurs when the agreement between predicted and measured concentrations is due to compensating errors within the model. Emissions from a source may be underestimated, but this is offset by enhanced chemical kinetics, yielding predicted pollutant levels that coincidentally match observations. In this case, the value of future model runs to evaluate emission control options would be questionable. A more rigorous evaluation of the dynamics within the model is needed.

Process Analysis

Process analysis (PA) has been incorporated into current air quality models to examine model predictions in more detail. PA tracks the physical and chemical processes that affect concentrations estimated by the model, including advective and diffusive transport, gas and particle chemistry, emissions, and wet and dry deposition. PA also accounts for the influence of boundary conditions that are typically provided by a global chemical transport model. Simply put, PA is an hourly mass balance of each model grid cell (Figure 1).

The amount of additional information provided by PA requires new analytical tools and methods of visualization. It also places demands on existing computer processing and storage, since invoking PA can result in several terabytes of additional information as compared to a standard model run.



Changes in the concentrations at a given grid cell and time due to:

- Emissions
- Chemistry
- Dry and wet deposition
- Advection and diffusion

Figure 1. Important processes that determine the estimated concentration in an individual model grid.

Case Study: Ammonia Simulations

The Comprehensive Air quality Model with extensions (CAMx) regional air quality model was used in the Rocky Mountain Atmospheric Nitrogen and Sulfur study (RoMANS) to estimate which pollutant sources have an impact on Rocky Mountain National Park. A primary goal was to understand the contribution of ammonia, which is presumed to play a significant role in the overall nitrogen deposition budget but is not routinely measured. Ammonia emission sources include confined animal feedlot operations, fertilizer application, motor vehicle emissions, and forest fires.

In Figure 2, ammonia concentrations estimated by CAMx at Rocky Mountain National Park were typically lower than observed values. This is when PA plays a significant role in model evaluation, since it elucidates the relative importance of the individual processes that contributed to the final estimated concentration.

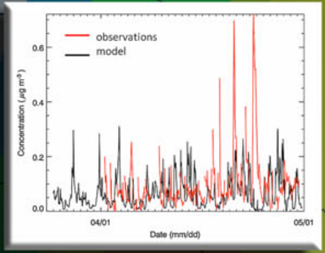


Figure 2. Measured (red) and predicted (black) ammonia concentrations at Rocky Mountain National Park during the spring 2006 RoMANS field campaign. Generally, the model underestimates ammonia concentrations, especially the larger peaks that were observed during the latter half of April.

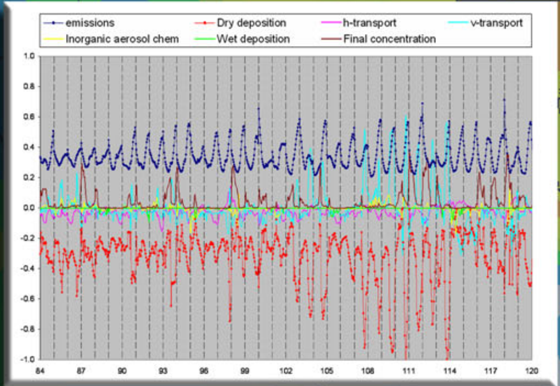


Figure 3. The contribution of individual processes (e.g., emissions, deposition, transport) to simulated ammonia concentrations at Rocky Mountain National Park. Positive contributions indicate mass being added to the grid volume, while negative contributions show mass being removed.

In Figure 3, dry deposition is the major loss mechanism for ammonia in this grid cell, while local emissions are the primary source. It is clear, then, that evaluating the dynamics of dry deposition, and in particular the calculation of the dry deposition velocity, is critical for understanding a model's predictions. On a more regional scale, PA illustrates that dry deposition and vertical diffusion are the principal mechanisms for removing ammonia within the model domain. Interestingly, aerosol chemistry is both a source and sink of ammonia, depending on which portion of the domain is being evaluated (Figure 4). Figure 5 provides additional insight into the role of dry deposition by indicating which fraction of emitted ammonia is immediately dry deposited within the same grid cell. In northern Colorado, which surrounds Rocky Mountain National Park, a relatively small fraction of emitted ammonia is transported out of the emitting grid cell. This again indicates the need to further evaluate the role of dry deposition within CAMx.

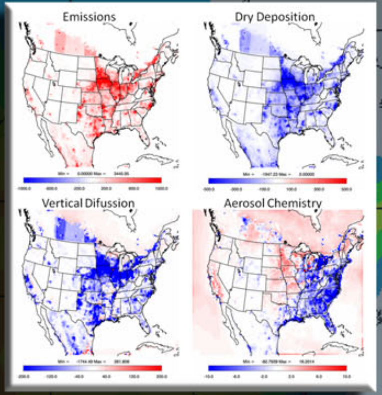


Figure 4. Example sources and sinks throughout the CAMx model domain. Processes that result as a net gain in mass (e.g., emissions) are shown in red, while processes that yield a net loss (e.g., dry deposition) are shown in blue.

The utility of PA for model evaluation is clear, but many details regarding its application remain unresolved. For example, the sheer volume of additional information provided by PA requires a new perspective to apply it effectively. The end result of this effort should be more confidence in the model's predictions, and new insights as to how to improve the underlying formulation of the models.

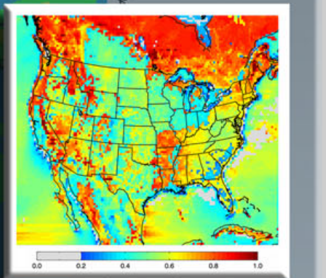


Figure 5. Fraction of emitted ammonia that is dry deposited within the same grid cell. Warmer colors indicate that locally-emitted ammonia is largely confined to the grid cell in which it was emitted and is not transported further downwind.

Birmingham, Alabama

Anthoneria "Ann" Bobbs is a graduate of Miles College, has a B. S. in biology and chemistry, and a juris doctorate from Miles Law School. She has been instrumental in efforts to measure and track Birmingham's air pollution. As an environmental health specialist with the Jefferson County Dept. of Health, Anthoneria has been involved in ambient air monitoring for 21 years. During that time she has performed every aspect of air monitoring, data analysis, quality control, quality assurance, and even some equipment repair. Her primary duties include running samplers for ozone, SO_2, PM10 and PM2.5 (for both hourly and daily measurements); SASS PM2.5 and URG carbon samplers for the STN (Speciation Trends Network); and alpha, beta, and gamma radiation detectors for RADNET (Radiation Network).

The goal of the Jefferson County Department of Health Air Pollution Control Program is to ensure that the air within Jefferson County meets the National Ambient Air Quality Standards established by the U. S. Environmental Protection Agency (EPA). The Jefferson County Board of Health adopts regulations that meet all Federal Clean Air Act (CAA) requirements, along with those mandated through the Alabama Dept. of Environmental Management (ADEM).

The Air Pollution Control Program measures criteria air pollutant levels and uses the resulting concentration data as the basis for developing control strategies necessary to ensure that health standards are met and maintained. They are currently completing an air toxics study, per EPA directive, with several schools in and around the area. Although there are several local industrial sources, including a nearby steel pipe manufacturer, Jefferson County currently meets all ambient air quality standards except for fine particulates (PM 2.5). For more information regarding the PM 2.5 problem in the Birmingham area, visit the Voluntary Air Quality Program web page. To view real time ozone and PM 2.5 concentration maps, go to EPA's AirNow web page.

Ann's hobbies include being an independent, 'do-it-yourselfer' at home, and coaching her son's Little League baseball team. She loves to participate in any activities that her son is involved in, from baseball to karate to the Science Olympic Team at his school. She considers him her greatest gift from God.

November

> "You must be the change you wish to see in the world."
> \- Mahatma Gandhi

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

- Check sampler inlets every 3 months.
- Call UC Davis at 530-752-1123 to figure out how holidays affect sample change schedules.

Oct 2010

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Dec 2010

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Investigating the Link Between Air Quality and Night Sky Visibility

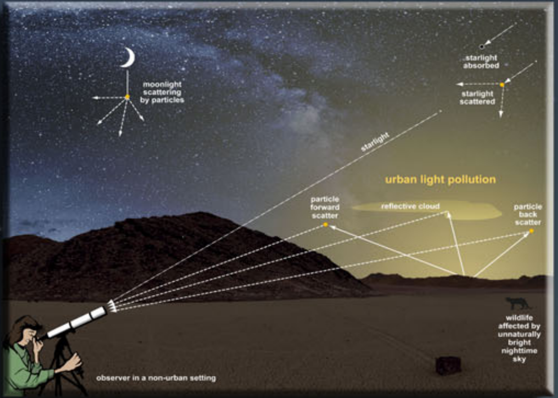
National Park Service Night Sky Program, Cooperative Institute for Research in the Atmosphere, Ft. Collins, CO

National parks are protective harbors for some of the last remaining dark skies in this country. The agency has come to embrace night skies as one of the many scenic vistas to be preserved for future generations. While city-weary people travel to parks in part to seek out views of the cosmos, they often can't escape the porchlight they left on at home. Almost every surveyed park has noticeable effects from light pollution, stemming from population centers and energy development facilities near and far. The dark, starry skies of our nation's parks are a precious natural resource, one that visitors are increasingly seeking out, and one which requires active management to maintain.

The National Park Service Night Sky Program was initiated to investigate the influence of artificial lights upon the nocturnal lightscape. Instruments have been developed to inventory night sky quality and 75 individual parks have been monitored. Special cameras image the entire celestial hemisphere to create a panoramic map of precise sky brightness values. Data shows variations in sky brightness, with the character of urban light domes changing from night to night. Most likely this variation is due to changing aerosol and particulate content in the atmosphere. Night sky visibility depends on how light is being scattered and absorbed in the atmosphere.

In a dark sky with minimal scattering aerosols, faint stars can be observed down to the horizon and features like the Milky Way can be seen with the naked eye. In areas such as the American Southwest, with its clear and dry conditions, the scattered light from distant cities can be seen up to 300 km away. This "light dome," may be small and only extend across a few degrees of view, or it may completely dominate the celestial hemisphere. Increasing aerosols can suppress the light of distant light domes while diminishing the visibility of stars and other faint features. At the same time, light from nearby sources can be amplified. There may not be a simple linear relationship between scattering, artificial light, and night sky visibility.

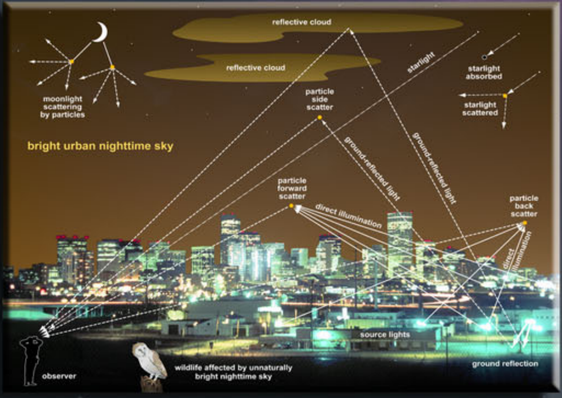
Figure 1. A night sky observer in a non-urban setting sees less of the Milky Way as the light pollution from the distant city (aka a light dome) brightens the horizon and artificial light invades nocturnal wildlife habitat.



Urban settings typically have poor outdoor lighting that projects a tremendous amount of light upwards into the atmosphere. Increased urban aerosols scatter this artificial light downward toward the observer, dramatically brightening the appearance of the urban night sky. This brightening of the sky greatly reduces the contrast between the sky background and starlight, rendering the Milky Way and other faint, extended features invisible, with only a few bright stars and planets remaining visible through the murk.

Figure 2. A mosaic of nighttime satellite images reveals the emission of artificial light across the USA. This image provides a perspective on the scope and severity of the problem and the associated energy inefficiency.

Figure 3. From a city dwellers point of view the artificial light is thrown upwards then scattered back from clouds and anthropogenic aerosols.



Most sample locations are in parks that typically have good air quality and conditions optimal for photometric measures. Occasionally these data sets exhibit dramatic variations during episodes of wildfires, dust storms, or hazy conditions, which affect light domes from surrounding cities.

Below is a sample of data taken from the North Rim at the Grand Canyon on the consecutive nights of June 27 and June 28, 2008. The upper image shows that the light dome of Las Vegas is clearly seen from over 177 miles distant. Smoke from a nearby fuels reduction fire is drifting to the northeast, extinguishing the light dome of Page, AZ, 59 miles away, and Tuba City, AZ, 45 miles away. The visual range for this night is 47 miles.

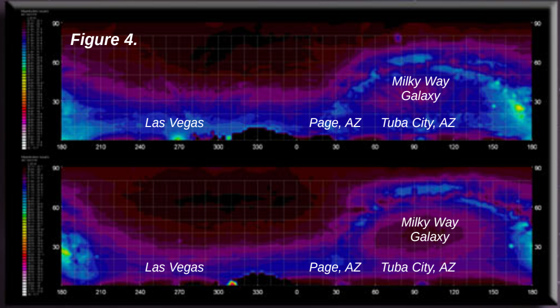


Figure 4.

On the next night the Las Vegas light dome is greatly reduced from smoke now drifting heavily to the southwest. The light dome of Tuba City is barely visible and the visual range is 24 miles. The Milky Way is also dimmer, and fewer stars are visible due to extinction.

With each data set, the observed brightness of standard stars is individually calibrated against their known brightness. The extinction coefficient is then calculated in magnitude/airmass and converted to an optical depth parameter. This complementary data on atmospheric conditions may help distinguish the causal factors of night sky degradations. The National Park Service and Air Resource Specialists are developing a radiation transfer computer model to address nighttime conditions and light propagation in urban environments that may provide an opportunity to untangle the relationships between scattering aerosols and night time visibility.

The Clean Air Act provides protection for visibility, but the interpretation and implementation of this legislation has only addressed daytime visibility. Further study may show that visibility degradation and associated increments of air pollution is greater at night than in the day. Besides the policy ramifications, a more thorough understanding of the propagation of artificial light will help guide the protection and restoration of natural night skies.

December

"It seems to me that we all look at Nature too much, and live with her too little."
- Oscar Wilde, "De Profundis", 1905"

Bondville, Illinois

In the midst of fertile Midwestern fields around the Bondville site are many clusters of monitoring instruments belonging to an alphabet soup of agencies and programs, such as NADP, WARM, ESRL, SURFRAD, USDA, AIRMoN-Dry, EPA, AERONET, CASTNET, GPIC, the state of Illinois, and of course, IMPROVE. The nearest major point sources are the University of Illinois Abbott power plant in Champaign, 10 miles away, and the Archer Daniels Midland facility in Decatur, 30 miles distant. **Mike Snider** became involved at the site in January 1986, collecting aerosol samples prior to the installation of scrubbers at the power plant. He became the NADP site operator in July 1986 and the CASTNET operator in February 1987. He has been responsible on a daily basis for operating most of the projects, both long and short term, that have followed.

Mike says, "I moved to a house less than one mile south of the site in May 1991 to be closer to my work. This has been a mixed bag as the demands of project maintenance and crisis management are not easy to ignore when I can see them out my kitchen window. As I'm sure most operators know, problems such as power and equipment failures due to weather or varmints, flooding, and towers collapsing will occur at the most inconvenient times. Rising to meet these challenges has been both educational and rewarding. I am extremely grateful for the help I have received."

Mike adds, "I have also been responsible for 25 rain gauges in Chicago since 1995. Driving 300 miles through Cook County each month has given me a greater appreciation for the rural lifestyle."

"I enjoy reading, singing, sailing, motorcycling, car collecting, and sharing my life with Sonya and our menagerie."

For more information about the many forms of monitoring performed at this site, visit http://www.isws.illinois.edu/atmos/bears/.

Nov 2010

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Jan 2011

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

Tapestry of Stars Over Delicate Arch

Photographers: Dan and Cindy Duriscoe

edited by Jeff Lemke, CIRA, NPS

A billion-star sunrise is seen behind Delicate Arch, in Arches National Park, Utah. The starry cloud is our own Milky Way Galaxy seen edge on. Many national parks still possess dark skies relatively free of light pollution and clear air of low extinction, enabling such views of the cosmos. Such vistas are increasingly sought out by park visitors. Colorado State University, Air Resource Specialists, and the National Park Service Night Sky Program are jointly working on a model to describe and predict the interplay between atmospheric pollution and artificial light. As with many environmental issues, there are solutions that can be implemented to safeguard the aesthetic quality of parks. Arches National Park has undertaken an extensive outdoor lighting inventory and is in the process of reducing its "light footprint."

For questions or problems with optical or scene monitoring equipment, contact Mark Tigges, Air Resource Specialists, Ft. Collins, CO, at 970-224-9300.

For questions or problems with air sampler controllers, filters, or audits, contact Jose Mojica, UC Davis, at 530-752-1123.

We would like to thank all the contributing IMPROVE sampler operators who took time out of their busy schedules to send us their site descriptions, photos, and personal stories and insights. These efforts help to enrich this publication and put a human face on our program.

IMPROVE STEERING COMMITTEE

IMPROVE Steering Committee members represent their respective agencies and meet periodically to establish and evaluate program goals and actions.
IMPROVE-related questions within agencies should be directed to the agency's steering committee representative.

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Front cover photo: Yosemite National Park, California. Photographer: Jeff Lemke