INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

1st Quarter 2010 | The IMPROVE Newsletter | Volume 19 / Number 1

Monitoring update

Feature Article: EPA report -- status and trends of our nation's air, Page 4

Network operation status

The IMPROVE (**I**nteragency **M**onitoring of **Pro**tected **V**isual **E**nvironments) Program consists of 110 aerosol visibility monitoring sites selected to provide regionally representative coverage and data for 155 Class I federally protected areas. Additional instrumentation that operates according to IMPROVE protocols in support of the program includes:

- 60 aerosol samplers
- 30 nephelometers
- 2 transmissometers
- 60 Webcamera systems
- 2 digital camera systems
- 5 interpretive displays

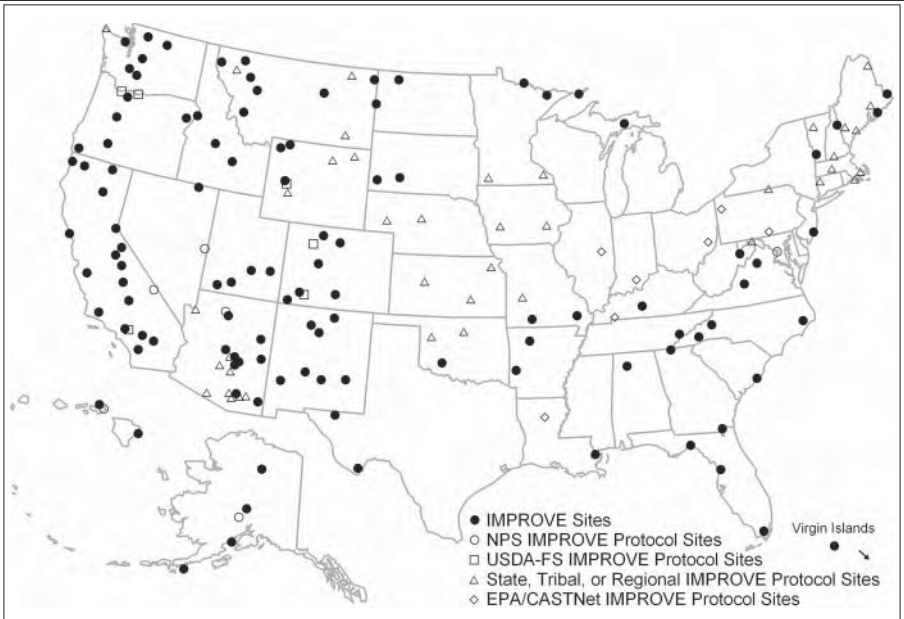
IMPROVE Program participants are listed on page 8. Federal land management agencies, states, tribes, regional air partnerships, and other agencies operate supporting instrumentation at monitoring sites as presented in the map below. Preliminary data collection statistics for the 1st Quarter 2010 (January, February, and March) are:

- Aerosol (channel A only) 95% collection
- Aerosol (all modules) 94% completeness
- Optical (nephelometer) 97% collection
- Optical (transmissometer) 99% collection

The USDA-Forest Service will soon post a newly designed image Web site. With 20 monitoring sites collecting and posting images, the response time for viewing had become slow for the site's users. The new Web site has been completely rewritten to improve its speed and more features have been added. It is scheduled to be available online in early June.

Data availability status

Data and photographic spectrums are available on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Data/data.htm* and on the VIEWS Web site at *http://vista.cira.colostate.edu/views*. Aerosol data are available through June 2009. Nephelometer and transmissometer data are available through December 2009 and December 2008, respectively. Webcamera displays that show near real-time images and data are available on agency-supported Web sites:



IMPROVE and IMPROVE Protocol Sites
1st Quarter 2010

- National Park Service *http://www.nature.nps.gov/air/WebCams/index.htm*
- 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, AZ, Visibility Network *http://www.phoenixvis.net*

The EPA AIRNow Web site *http://airnow.gov* includes many of these as well as additional visibility-related Webcameras. Click on View Other Visibility Webcams.

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

Visibility news

Current status of regional haze planning

The U.S. Environmental Protection Agency's (EPA)'s 1999 Regional Haze Regulations call for states to establish goals for improving visibility in 156 Class I areas throughout the country, and to achieve reasonable progress to meet "natural conditions" by 2064. Regional planning organizations were also formed at that time to coordinate the effort.

To track this effort, states are required to submit State Implementation Plans (SIPs) to the EPA, beginning with the 2003-2007 timeframe. Subsequent revisions are then called for in 2018 and every 10 years thereafter. States must also submit progress reports to the EPA every 5 years. In these reports, states will compare current visibility conditions to baseline conditions (the average conditions during the years 2000 to 2004), describe changes in emissions of visibility-impairing pollutants, and include any mid-course corrections to management strategies.

Since implementation of the effort, technical strategies and analyses have been developed, yet completion of many SIPs is behind schedule. Figure 1 shows the SIPs that have been submitted to EPA as of March 19, 2010.

For more information contact Tom Moore at the Western Governors' Assoc./Western Regional Air Partnership. Telephone: 970/491-8837. Fax: 970/491-8598. E-mail: mooret@cira.colostate.edu.

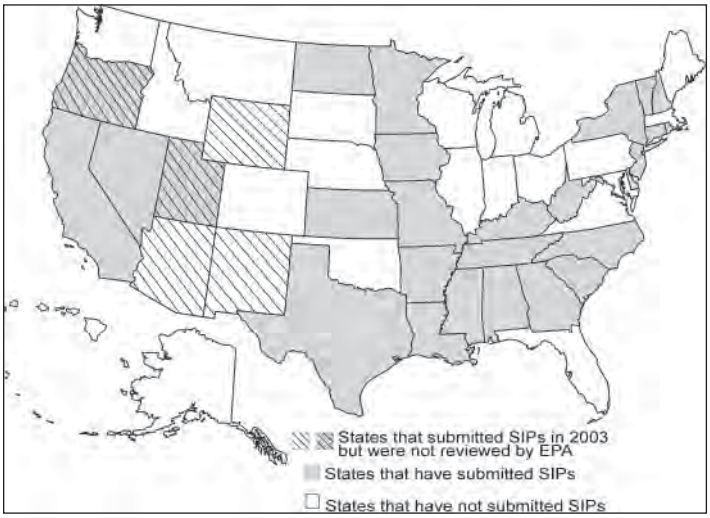


Figure 1. States that have submitted Final Regional Haze SIPs to EPA (as of March 19, 2010).

Testing the stability of elemental analysis

Scientists at UC-Davis are planning a series of laboratory experiments to evaluate the stability of IMPROVE elemental analysis over the multi-year history of the network. For a few selected sites, all of the available $PM_{2.5}$ Teflon® filters archived since 1994 will be reanalyzed by X-Ray Fluorescence (XRF) in a single analytical session. This session will apply the same analytical method and procedures to the entire historical series.

Changes in laboratory methods or protocols during the two decades of IMPROVE have sometimes introduced clear discontinuities in the data series. For example, the change from PIXE to XRF analysis in 2001 resulted in visible shifts in the data for some elements. Changes in protocols, such as changes in the way calibration data are applied, have also influenced the data series at times.

The reanalysis data will contain their own random uncertainties, but the systematic uncertainties associated with such factors as method, calibration, and instrument condition will no longer vary with sample date. Therefore, any time trend in the reanalysis data can be regarded as genuine if it falls outside the random fluctuations expected from documented analytical imprecision.

Reanalysis will not only elucidate the importance of time-varying errors at the selected sites, but can also support the interpretation of original data at other sites. If comparisons between reanalysis and original data at a few disparate sites were to give similar patterns of discrepancy, the average of these discrepancies could provide an estimate of the time-varying (non-stationary) error common to all sites. Analysts could then adjust original data from other sites to remove this time-varying bias, leaving a more stationary error structure less likely to yield spurious time trends.

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IMPROVE Newsletters are also available on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Publications/news_letters.htm.*

Black carbon and ozone as short-lived climate forcers workshop

The EPA sponsored a workshop on Black Carbon and Ozone as Short-Lived Climate Forcers (SLCF) in Chapel Hill, NC, March 3-4, 2010. SLCF are components of the atmosphere which, like carbon dioxide, have an influence on the radiative energy balance of the earth (i.e., they can contribute to warming or cooling), but unlike carbon dioxide they are removed from the atmosphere relatively quickly (days to weeks as opposed to hundreds of years). In recent years, scientists have determined that black carbon contribution to global heating is substantial though not as great as that from carbon dioxide. The workshop's purpose was to begin a dialog among policy-makers and scientists, climate and air quality communities, and domestic and international experts concerning possible emission mitigation actions for SLCF that could make a difference for climate in the short term.

Congress tasked the EPA with preparation of a report by April, 2011, that includes an inventory of major sources of black carbon, assesses the impacts of black carbon on global and regional climate, compares its impacts on climate to that of carbon dioxide and other greenhouse gases, identifies the most cost effective approaches to reduce black carbon emissions, and assesses the climatic and other environmental/public health effects that might be associated with implementing black carbon emissions controls.

From 1988 to the present, the IMPROVE network has generated elemental carbon and filter-based optical absorption measurement data that are closely related to black carbon concentrations. Spatial and temporal trends and source attribution assessments conducted using the IMPROVE data may play an influential role in the development of U.S. policy with respect to emissions of black carbon. Appropriate uses of IMPROVE carbon data for climate change analysis will be discussed at the next IMPROVE Steering Committee meeting during Fall 2010.

More information on the EPA workshop is available at http://www.cleanairinfo.com/slcf/agenda.htm.

***Visibility news** continued on page 6....*

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

Operators of distinction

Casco Bay, Maine, is one of those "On Golden Pond" areas, as described by IMPROVE site operator Don Prince. That's one reason he plans on staying put when he makes his decision to retire. Until then, he is dedicated to working at the Maine Department of Environmental Protection (DEP) providing field service and data processing for the southern region's air quality stations.

Don has worked with the DEP for 15 years and is the primary operator for the Casco Bay monitoring station as well as the backup operator for the IMPROVE Bridgton station. He is also responsible for sites that run several types of samplers, including gaseous (ozone, sulfur dioxide, carbon monoxide, and nitrogen oxides), acid deposition and mercury, filter-based particulate, and hazardous pollutant. "I'm also responsible for being the 'first responder' to my backup sites if there's a maintenance issue," said Don. He keeps the instrumentation operating smoothly and is quick to correct any issues that arise.

In the office, Don polls data from the six stations in the region. Don assigns a flag to any missing parameter value describing the reason for the missing data. Then the data are forwarded onto the U.S. Environmental Protection Agency (EPA). "The DEP has changed their operations dramatically over the past few years," said Don, "Data collection involves more elaborate electronic methods, and methods of forwarding onto the EPA changes from year to year."

Long before joining the DEP, Don graduated from Cornell University with a B.S. degree in pomology (science of fruit cultivation), then joined his father on the family's apple orchard. He later took over management of the orchard, and in 1989 dissolved the 200-year-old family business to seek a change. He joined the state's Pesticide Control Board as a field inspector before coming to the DEP.

Don loves to spend time with his grandchildren, hike to mountaintops, and glide across a nearby pond in an old canoe. His semi-rustic cabin in the woods is only 10 minutes from his house. "You can hear the loons at dusk," said Don. No wonder he plans on living there when he retires.

Casco Bay (CABA1) IMPROVE site operator Don Prince has maintained air quality instrumentation for the state of Maine for 15 years.

***Monitoring update** continued on page 7....*

Feature article

EPA releases report -- the status and trends of our nation's air

Introduction

The U.S. Environmental Protection Agency (EPA) has released a 54-page report summarizing the status of our nation's air quality. Data collected since 1990, when the Clean Air Act Amendments were passed, were used in this national evaluation. This article summarizes the report's findings of pollutant trends and climate change discussion.

Six common pollutants

Air pollution is known to be linked to a variety of health problems and environmental damage, hence the EPA has set, and regularly reviews, National Ambient Air Quality Standards (NAAQS) to protect both our health and our environment. Standards exist for the following six common pollutants, and as seen in Figure 1, levels of these pollutants are declining.

Ozone

Ground-level ozone concentrations were 10% lower in 2008 than in 2001, although many areas measured concentrations above the NAAQS. Significant improvement in the levels of ozone pollution have been seen in many areas in recent years, largely due to controls of local volatile organic compound (VOC) emissions and local and regional nitrogen oxides emissions.

Particle pollution

Particulate matter $\leq 10\ \mu m$ (PM_{10}) measured over 24 hours show a 19 percent drop between 2001 and 2008. Particulate matter $\leq 2.5\ \mu m$ ($PM_{2.5}$) show either a decline or little change for the three-year periods of 2001-2003 and 2006-2008.

Lead

Airborne concentrations of lead decreased by 40 percent between 2001 and 2008. Monitoring locations that exceeded the 2008 NAAQS for lead are all located near stationary sources of this pollutant. In 2010, approximately 250 new locations will monitor lead concentrations.

Nitrogen dioxide, carbon monoxide, and sulfur dioxide

The last three common pollutants, nitrogen dioxide, carbon monoxide, and sulfur dioxide, all decreased significantly between 2001 and 2008. Nitrogen dioxide concentrations decreased 27 percent, 8-hour carbon monoxide concentrations decreased 41 percent, and sulfur dioxide concentrations decreased 30 percent. The EPA is currently reviewing the NAAQS for each of these pollutants, and changes in the standards may be seen later this year.

Toxic air pollutants

The EPA's report also studied the 187 regulated toxic air pollutants. Benzene and diesel exhaust are the two most significant pollutants linked to cancer risk; both these chemicals are found to be declining in our atmosphere. Over 300 toxic air pollutant monitoring stations collect data in the U.S., and are operated by the EPA, state, local, and tribal agencies.

Atmospheric deposition

Acid deposition in the U.S. declined significantly between 1989-1991 and again between 2006-2008. Reduced acid deposition leads to better water quality, healthier lakes and streams, and healthier aquatic wildlife. Sulfur dioxide emissions have decreased by about 52 percent from 1990 levels and nitrogen oxide emissions have decreased as well. The EPA is currently reviewing these secondary NAAQS and looking at the relationship between acid deposition and ecological effects. The review is scheduled to be completed in 2012.

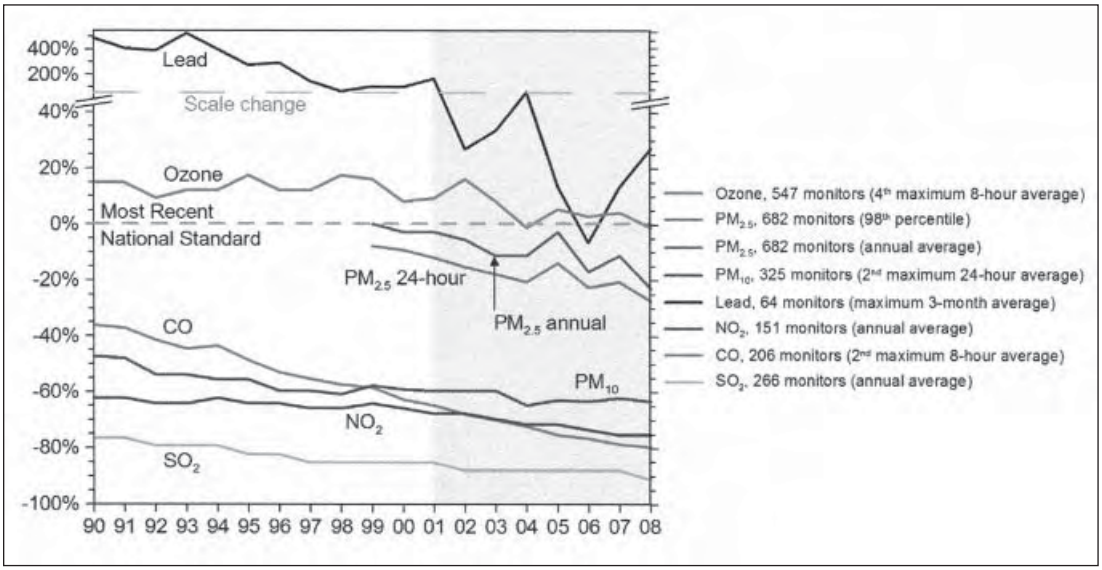

Figure 1. National levels of the six common pollutants are compared to the most recent NAAQS, using complete data sets from 1990-2008.

Visibility in scenic areas

The EPA and the National Park Service, along with other federal land managers, jointly operate a long-term visibility program, with stations in 155 national parks and wilderness areas nationwide. The Regional Haze Rule, issued by the EPA in 1999, mandates that natural background conditions be achieved before 2064. These natural background conditions are visibility conditions that existed before human-caused pollution. As seen in Figure 2, long-term visibility trends indicate that visibility is improving, on both the 20% worst days and the 20% best days. Yet considerable progress is still needed to reach the goal.

Climate change and air quality

Our climate may be changing as well -- most of the solar radiation Earth receives is radiated back toward space. Some of this radiative energy, however, can be trapped in our atmosphere by greenhouse gases such as carbon dioxide and methane, which can prevent the heat from escaping. Other pollutants, such as black carbon, absorb the solar radiation and prevent reflection of sunlight off snow and ice. Recent studies suggest that black carbon may have an impact on Earth's climate as well. Some of these pollutants stay in the atmosphere for only a few days or weeks, while others, like carbon dioxide, can remain aloft for decades to centuries.

According to the EPA, domestic greenhouse gas emissions increased 17 percent from 1990-2007, most likely due to increased consumption of fossil fuels to generate electricity.

International transport of air pollution

The U.S. must deal with domestic-released air pollution sources as well as foreign-released sources. International flow of pollutants into the U.S. came in the form of ozone, fine particles, deposition of mercury, organic pollutants, and acid deposition. Increased levels of these pollutants may cause difficulties for states and regional agencies to maintain their NAAQS compliance and long-term visibility goals. The EPA and other agencies are working through cooperative efforts to address the international transport of air pollution across the country.

The report, "Our Nation's Air -- Status and Trends Through 2008" can be found at: *http://www.epa.gov/airtrends/2010/index.html*.

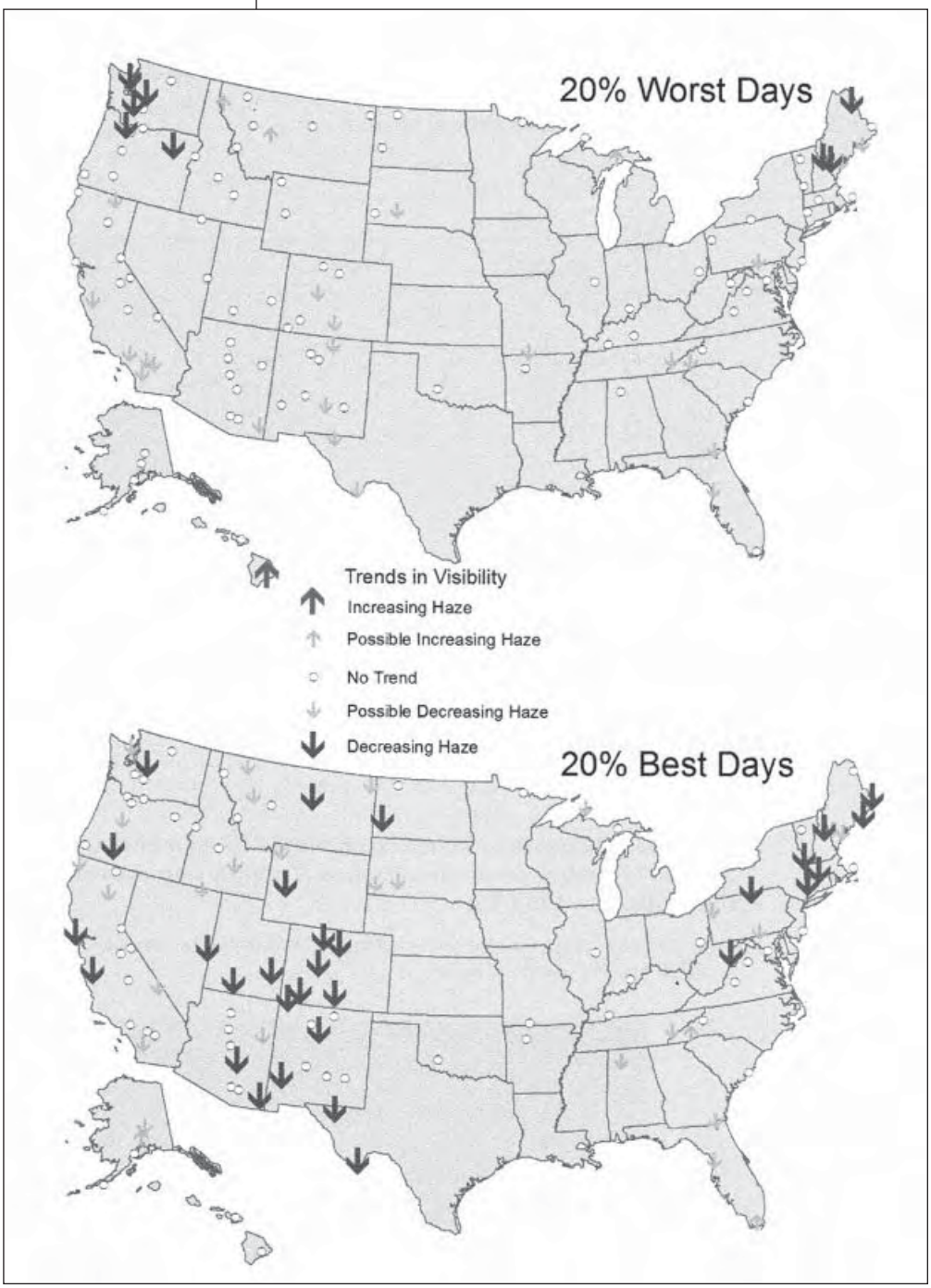

Figure 2. Visibility trends using the 20 percent worst and best days from 1998-2007. Trends are based on aerosol measurements collected at IMPROVE monitoring sites. Sites having at least six years of complete data were used to compute the change over the trend period.

Visibility news continued from page 3 ....

Data advisories released

Arcane flagging of early hydrogen and fine mass data

- Affects: Module A - fine mass (MF), hydrogen (H)
- Period: September 1, 1990 - February 26, 1992

Analysts may choose to work only with "normal" data having no qualifications (those with native flag *NM* and VIEWS status flag *V0*). In most years, very few data are qualified. From 9/1/90 through 2/26/92, however, *all* fine mass and hydrogen data are flagged to reflect concerns for sporadic contamination that are described on page 2 of the Winter 1992 IMPROVE Newsletter.

For this period, all non-missing MF and H values carry native flags *AA* or *AP* and VIEWS status flag *V5*. The *AA* flag denotes observations that were retrospectively invalidated. The *AP* flag denotes observations that were retrospectively judged valid as described in the newsletter. It is recommended to include the non-zero data with a native flag *AP* as valid and exclude data with a native flag *AA* as invalid.

Bias between masked and unmasked light absorption measurements

- Affects: Module A - f_{abs}
- Period: Before 2008

Masks were historically used at many sites to reduce the nominal collection area of Module A filters from 3.53 cm^2 to 2.20 cm^2. As recently as 2003, masks were employed at approximately half of all sites, and by the end of 2007, all masks had been removed.

IMPROVE's Hybrid Integrating Plate/Sphere (HIPS) measures the absorption thickness of a filter sample. Absorption thickness can be thought of as the cross-section of the absorbing material multiplied by the material's areal mass loading on the filter. Well-recognized artifacts of the method cause measured absorption to increase less than proportionately with the mass loading. Because masking generates higher areal loadings at the same atmospheric conditions, some bias toward lower absorption readings for masked samples can be expected to result from this loading dependence. Another, less recognized artifact of masking, is even when the filters yield *equal* areal loadings (from lower atmospheric concentrations), masked samples give slightly lower absorption readings. It is recommended that data users recognize the effect of mask removal on reported absorption.

Suspect light-absorption data from three months in 2000

- Affects: Module A - f_{abs}
- Period: September 1, 2000 - November 30, 2000

Reported light-absorption values dropped sharply across the entire network at the start of September 2000, and remained low for three months. The drop was abrupt relative to other aerosol indices (Figure 1), and was evident only in f_{abs}. The anomalous three months coincide with a meteorological quarter, by which laboratory operations were at that time organized, suggests the divergence reflects an unidentified problem in the HIPS analysis for f_{abs}. Absorption was below HIPS detection limits in many of the fall quarter samples. It is recommended these data be excluded from analysis.

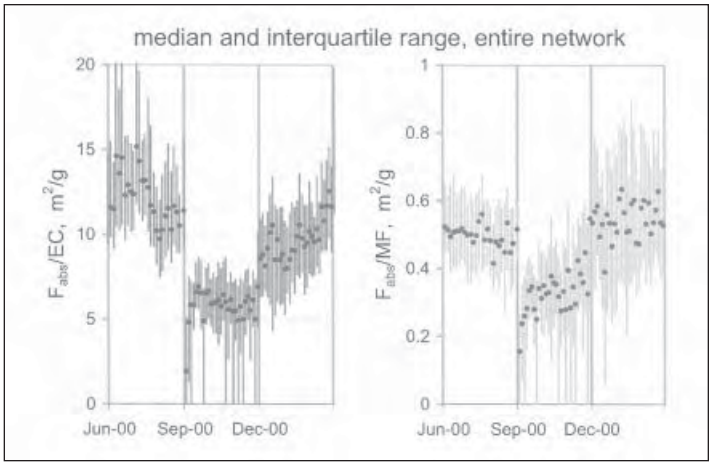

Figure 1. Time series of absorption relative to species concentrations. The September discontinuities in absorption/mass ratios are similar for elemental carbon and $PM_{2.5}$, which are measured independently of each other on different filters.

Marginal detection of heavy elements by PIXE analysis

- Affects: Module A - Pb, Sr, Se, and Rb
- Period: Before June 1, 1992

The heavy elements in samples collected since June 1, 1992, have been determined by X-Ray Fluorescence (XRF). In earlier samples, those elements were determined by Proton-Induced X-ray Emission (PIXE). The PIXE analysis was considerably less sensitive for lead, strontium, selenium, and rubindium. The concentration statistics of marginally detected elements are known to be distorted by the censoring of undetected amounts. It is recommended that data users recognize the trend artifacts introduced by the PIXE-XRF transition.

A complete discussion of these and all other data advisories can be found on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Data/QA_QC/Advisory.htm.*

For more information or to submit an advisory, contact Bret Schichtel at CIRA. Telephone: 970/491-8581. Fax: 970/491-8598. E-mail: schichtel@cira.colostate.edu.

Monitoring update *continued from page 3 ....*

Outstanding sites

Data collection begins with those who operate, service, and maintain monitoring instrumentation. IMPROVE managers and contractors thank all site operators for their efforts in caring for IMPROVE and IMPROVE Protocol networks. Sites that achieved 100% data collection for 1st Quarter 2010 are:

Aerosol (Channel A)

Acadia
Addison Pinnacle
Agua Tibia
Arendtsville

Badlands
Bliss
Bondville
Boulder Lake

Bridger
Bridgton
Brigantine
Bryce Canyon

Cabinet Mountains
Cadiz
Caney Creek
Canyonlands

Cape Cod
Capitol Reef
Casco Bay
Cedar Bluff

Chassahowitzka
Cherokee
Chiricahua
Columbia Gorge East

Crater Lake
Craters of the Moon
Crescent Lake
Death Valley

Dolly Sods
Dome Land
Douglas
Egbert

El Dorado Springs
Ellis
Everglades
Flathead

Gates of the Arctic
Gila
Glacier
Great Basin

Great River Bluffs
Great Sand Dunes
Great Smoky Mtns.
Hawaii Volcanoes

Hercules-Glades
Jarbidge
Lake Sugema
Lassen Volcanic

Lava Beds
Livonia
Lye Brook
Martha's Vineyard

MK Goddard
Mohawk Mountain
Moosehorn
Mount Hood

Mount Rainier
Mount Zirkel
North Absaroka
North Cascades

Northern Cheyenne
Okefenokee
Olympic

Pack Monadnock
Pasayten
Petrified Forest
Phoenix

Pinnacles
Point Reyes
Presque Isle
Proctor Research Ctr.

Quabbin Reservoir
Quaker City
Rocky Mountain
Salt Creek

Seney
Sequoia
Sikes
Snoqualmie Pass

St. Marks
Starkey
Sycamore Canyon
Tallgrass

Three Sisters
Tuxedni
UL Bend
Viking Lake

Virgin Islands
Voyageurs
Weminuche
White River

Wind Cave
Wrightwood
Yellowstone

Nephelometer

Big Bend
Estrella
Great Basin

Greer
Indian Gardens
Mount Rainier

Sycamore Canyon
Tucson Mountain

Transmissometer

Bridger

Photographic

Gates of the Mountains

Sites that achieved at least 95% data collection for 1st Quarter 2010 are:

Aerosol (Channel A)

Cape Romain
Puget Sound
Saguaro

San Rafael
Simeonof

Trapper Creek - Denali
White Pass

Nephelometer

Acadia
Children's Park
Chiricahua

Cloud Peak
Craycroft
Dysart

Ike's Backbone
Glacier
Mammoth Cave

National Capital
Organ Pipe
Petrified Forest

Queen Valley
Rocky Mountain
Shenandoah

Sierra Ancha
Vehicle Emissions

Transmissometer

San Gorgonio

Photographic

-- none --

Sites that achieved at least 90% data collection for 1st Quarter 2010 are:

Aerosol (Channel A)

Bandelier
Birmingham
Bosque del Apache
Columbia Gorge West
Gates of the Mountains

Haleakala Crater
Hells Canon
Joshua Tree
Kaiser
Linville Gorge
Mammoth Cave

Meadview
Monture
Mount Baldy
Nebraska
Organ Pipe

Penobscot
Queen Valley
Redwood
Sac and Fox
Sawtooth

Shamrock Mines
Sipsey
Sula
Swanquarter
Trinity

Upper Buffalo
Wheeler Peak
Wichita Mountain
Yosemite
Zion Canyon

Nephelometer

Great Smoky Mtns.

Hance

Thunder Basin

Transmissometer

-- none --

Photographic

-- none --

Monitoring Site Assistance:

Aerosol sites: contact University of California-Davis
telephone: 530/752-7119 (Pacific time)

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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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