

Monitoring update

Network operation status

The IMPROVE Program monitoring network consisted of 110 aerosol samplers, 17 transmissometers, 8 nephelometers, and 5 camera systems during 3rd Quarter 2002 (July, August, and September). In addition, 52 aerosol samplers operated according to IMPROVE Protocols. Preliminary data collection statistics for the quarter are:

- Aerosol (channel A only) 93% collection
- Aerosol (all modules) 91% completeness
- Optical (transmissometer) 94% collection
- Optical (nephelometer) 97% collection
- Scene (photographic) 94% collection

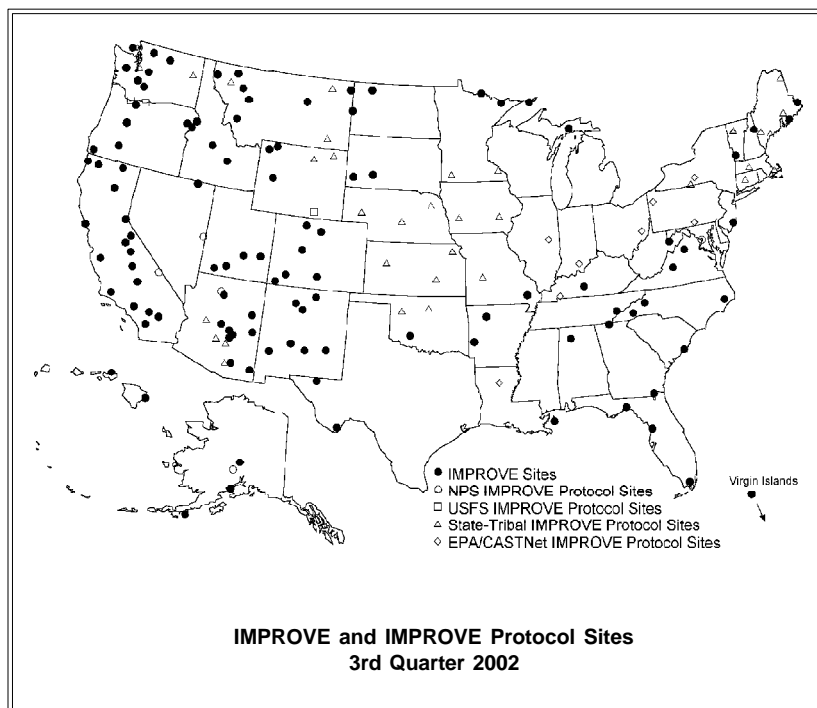
The aerosol monitoring site scheduled to be placed at North Platte National Wildlife Refuge, NE, was instead placed at Crescent Lake National Wildlife Refuge, NE. The proposed site near Niobrara River, Nebraska, will instead be moved to a location in Texas.

Scene monitoring at Chassahowitzka National Wildlife Refuge, SC, terminated in September, after five years of monitoring. The U.S. Fish and Wildlife Service determined that the refuge obtained sufficient documentation of visual conditions at the location.

The U.S. Fish and Wildlife Service began scene monitoring with digital camera systems in three of its refuges this quarter. The refuges are: Red Rock Lakes, MT; Bosque del Apache, NM; and Wichita Mountains, OK. Each of these systems will operate according to IMPROVE Protocols.

Data availability status

Data are available on the IMPROVE Web site, at <http://vista.cira.colostate.edu/improve/Data/data.htm>. Aerosol data are available through May 2002. Transmissometer data are available through September 2001 and nephelometer data are available through June 2002.



All data posted on the IMPROVE Web site have been subject to extensive data validation procedures and are thought to be of sufficient quality for use in support of federal visibility rules.

Photographic slides and digital images are archived but are not routinely analyzed or reported. Complete photographic archives and slide spectrums (if completed) are available at Air Resource Specialists, Inc. Slide spectrums are also available on the IMPROVE Web site, under *Data*.

IMPROVE data are available to interested parties for use in presentations, management plans, and other projects. All data are validated using IMPROVE protocols, which are documented in standard operating procedures. Procedures are written for site selection; instrument installation, operation, and servicing; and data collection, reduction, validation, reporting, and archive. IMPROVE standard operating procedures are available on the IMPROVE Web site at <http://vista.cira.colostate.edu/improve/Publications/publications.htm>.

Visibility news

Proposed power plant near Mammoth Cave National Park is under review

A proposed power plant, to be operated by Peabody Energy, is planned to be located approximately 74 kilometers west of Mammoth Cave National Park, Kentucky. In late August, the Department of the Interior sent comments on a Prevention of Significant Deterioration (PSD) preliminary determination for the proposed facility (Thoroughbred Generating Station) to the Kentucky Department for Environmental Protection. In the letter, the Assistant Secretary of the Interior withdrew his February 15, 2002, adverse impact finding because that finding was based on an incorrect modeling analysis submitted by Peabody. Subsequent analyses showed the actual visibility impacts at Mammoth Cave National Park to be much less.

Peabody wants to build the 1,500 megawatt Thoroughbred Generating Station, and then find an operator to run it. The plant would burn Peabody's high sulfur coal and emit approximately 11,000 tons of sulfur dioxide into the atmosphere every year. Originally, Peabody had proposed to emit approximately 19,000 tons per year, however, through National Park Service involvement, they reduced emissions by approximately 8,000 tons per year.

The Kentucky Department for Environmental Protection has issued a final PSD permit but several environmental groups are appealing this permit.

Mammoth Cave was established as a National Park in 1941 to preserve the cave system, the longest recorded cave system in the world. More than 300 miles of cave have been mapped. Most park visitors, however, do not enter the cave, but instead enjoy Mammoth Cave's above-ground resources such as its dense forests, woodlands, scenic rivers, and wildlife.

For more information contact Dee Morse at the National Park Service Air Resources Division. Telephone: 303/969-2817. Fax: 303/969-2822. E-mail: dee_morse@nps.gov.

WinHaze version 2.9.0 released

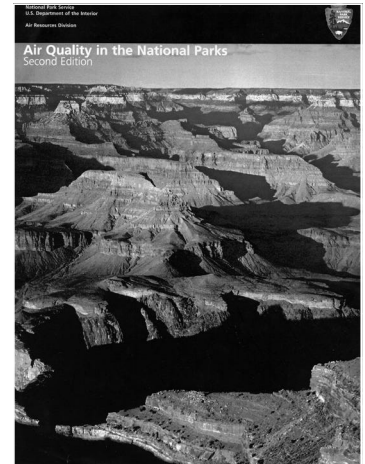
WinHaze, the visual air quality model, has been updated to include 101 national parks, wildernesses, and urban area scenes. The freeware allows desktop viewing of various visual air quality scenarios. Users can model the visual effects of user-selected optical parameters or aerosol species.

WinHaze is available at <http://www.air-resource.com>. Click on What's New for system information and download.

Air Quality in the National Parks released

The National Park Service Air Resources Division has released *Air Quality in the National Parks - Second Edition*. This 59-page document discusses the importance of the air quality resource in our nation's parks as well as future challenges and strategies the National Park Service will have to face.

The document summarizes National Park Service air quality findings based on data collected from 1990-1999, presents current air quality conditions and trends, and discusses the various ways air quality is measured. Individual chapters discuss visibility, atmospheric deposition, and ozone and other gaseous pollutants. This second edition is now available on the Internet at <http://www2.nature.nps.gov/ard/pubs/aqnps.htm>.



Printed copies can be obtained by contacting Dee Morse at the National Park Service. Telephone: 303/969-2817. Fax: 303/969-2822. E-mail: dee_morse@nps.gov.

USFWS funds cameras in Class I areas

The U.S. Fish and Wildlife Service (USFWS) recently installed high-resolution digital camera systems to monitor scenic conditions in three of its Class I areas. In the past, the FWS concentrated scene monitoring efforts in the East, where visibility impairment is the worst. With several coastal sites now well documented, the FWS looked for new sites in the West. The three national wildlife refuges (NWRs) that received these systems are:

- Red Rock Lakes NWR, Montana
- Bosque del Apache NWR, New Mexico
- Wichita Mountains WR, Oklahoma

The system at Red Rock Lakes was installed in July. Systems at Bosque del Apache and Wichita Mountains were installed in October. Each of the camera systems take three images daily of scenic refuge vistas.

For more information contact Kristi Morris at the U.S. Fish and Wildlife Service. Telephone: 303/987-6941. Fax: 303/969-2822. E-mail: kristi_morris@nps.gov.

Operators of distinction

Those associated with the IMPROVE Program understand that data collection begins with those who operate, service, and maintain monitoring instrumentation. IMPROVE managers and contractors thank all site operators, for their efforts in operating the IMPROVE and IMPROVE Protocol networks. Sites that achieved 100% data collection for 3rd Qtr 2002 are:



Aerosol

Acadia	Kalmiopsis
Addison Pinnacle	Lake Seguma
Arendtsville	Lava Beds
Badlands	Lostwood
Bandelier	Mammoth Cave
Big Bend	Medicine Lake
Bliss	MK Goddard
Bondville	Mohawk Mountain
Bosque del Apache	Moosehorn
Boundary Waters	Mount Hood
Bridgton	Okefenokee
Cabinet Mountains	Olympic
Cadiz	Petrified Forest
Caney Creek	Proctor Research Center
Chiricahua	Quabbin Reservoir
Cohutta	Quaker City
Columbia Gorge East	Queen Valley (Superstition)
Denali	Rocky Mountain
Flathead	Sac and Fox
Fort Peck	Saguaro west
Gates of the Mountains	Sequoia
Gila	Simeonof
Grand Canyon	Three Sisters
Great Basin	Thunder Basin
Great Smoky Mountains	Tonto
Guadalupe Mountains	Trapper Creek-Denali
Haleakala	Virgin Islands
Hawaii Volcanoes	Washington DC
Hells Canyon	White River
Hercules-Glades	Wind Cave
Isle Royale	Yosemite
Joshua Tree	Zion

Transmissometer

Grand Canyon

Nephelometer

Mammoth Cave
Quaker City

Shenandoah
Virgin Islands

Photographic

Chassahowitzka
Grand Canyon

Red Rock Lakes
San Juan Islands

Several new IMPROVE and IMPROVE Protocol monitoring sites were installed during this calendar quarter. One such site is the Fort Peck, Montana, aerosol monitoring site. This IMPROVE Protocol site, on the Fort Peck Assiniboine & Sioux Reservation, is located in extreme northeast Montana, near the U.L. Bend and Medicine Lake Wildernesses, both Class I areas. The Fort Peck Tribes will operate their IMPROVE Protocol site as part of their clean air network. In addition to the IMPROVE aerosol sampler, the tribe operates additional PM₁₀ samplers, a Climatological Research Network station, and a USDA UV-B monitoring station, and participates in the Surface Radiation Study and the National Atmospheric Deposition Program.

Linda Connor, the primary site operator, and Ken Heathman (summer intern) and Deb Madison (Environmental Programs Manager), backup operators at the Fort Peck site, achieved 100% data collection for the IMPROVE aerosol sampler during the 3rd Quarter 2002.

Linda is an Environmental Specialist for the Fort Peck Tribes. "In addition to maintaining and servicing the air quality network, I serve as the Fort Peck Tribes FEMA representative and the Fort Peck Tribes Emergency Response Coordinator. I also fill in some time being a member of the Beautification Task Force Committee and the Fort Peck Tribes Operation & Maintenance Solid Waste Program Board," said Linda.

In 1985, she began working with the Fort Peck Tribes Office of Environmental Programs and holds an Associate of Arts degree from Haskell Indian Junior College. "After I began working with environmental programs, I took many additional classroom hours and training in the environmental field," said Linda. She spends her free time reading, being with family and friends, walking, and spending time with her six grandchildren.



Linda Connor takes charge in servicing the IMPROVE aerosol sampler at the Fort Peck Indian Reservation in Montana.

Visibility news continued on page 6...

Feature article

IEWS - A new national air quality resource

(by Fox, Schichtel, Ames, McClure, and Malm)

Introduction

Over the past two years, CIRA has been developing a Web site for the Western Regional Air Partnership (WRAP) Ambient Monitoring & Reporting Forum. This site will provide WRAP partners, state and local air agencies, Indian tribes, and federal land managers with data and information resources to help identify common regional air management issues, develop and implement strategies to address these common regional issues, and formulate and advance regional policy positions on air quality.

Recently, the five regional planning organizations (RPOs) and the Environmental Protection Agency agreed that the WRAP site should be expanded to cover the entire United States. Thus, the Visibility Information Exchange Web System (IEWS) came into existence, built on the WRAP Data Delivery and Analysis Web System platform. The primary purpose of IEWS is to aid the RPOs in the analysis and interpretation of air quality data to satisfy the Regional Haze Regulations. The scope of work for IEWS includes four tasks:

- 1) Develop a new IEWS Web site interface to replace the WRAP ambient monitoring online database Web site.
- 2) Prepare an annual data summary of IMPROVE and IMPROVE Protocol data.
- 3) Expand the online integrated database by adding data from monitoring networks throughout the U.S.
- 4) Enhance and add new data access and analysis tools.

IEWS Web site

The IEWS Web site came online in September 2002, replacing the WRAP ambient monitoring online database. The IEWS home page is located at <http://vista.cira.colostate.edu/iews>. The IEWS Web site employs a new look and feel and was implemented using a flat architecture to facilitate navigation (Figure 1). The Web site consists of four main sections:

- A data section for accessing *raw data and its metadata* (i.e., data describing the measured data values such as the monitoring site's latitude and longitude).
- A summary section to access *graphical products, tabular data, and descriptions of the results from the annual data summary*.
- A catalog section containing *links to online air quality, meteorological, and emission data resources* relevant to the RPOs. New data sets will be added as they become available and as they are requested by the RPOs.

- An imagery section providing access to the *spectrum of photographs* corresponding to different levels of haze at IMPROVE and Forest Service sites and links to *Webcams* at rural and urban locations throughout the United States.

To facilitate usage of the various tools, "quick user guides" have been created on a number of the pages to provide tips and instructions on how to use the Web site. Users can now register to be notified by e-mail of major additions or updates to the IEWS Web site, including the addition of new datasets to the IEWS integrated database.



Figure 1. The home page of the new Visibility Information Exchange Web System.

Integrated Haze Database

The central feature of the Web site is an integrated ambient monitoring database containing data relevant to regional haze regulations, with tools to access, explore, and aggregate these data across multiple networks and annual air quality data summaries.

Aerosol and optical data sets included on the IEWS site as of October 2002 are:

- IMPROVE and IMPROVE Protocol - $PM_{2.5}$ and PM_{10} mass, speciated $PM_{2.5}$, and light scattering and extinction data.
- CASTNet - Total aerosol mass ion concentrations collected as part of the dry deposition network.

- EPA Federal Reference Method (FRM) - PM_{2.5} mass data.
- EPA Speciation Trend Network (STN) - PM_{2.5} mass and speciated PM_{2.5} mass data.
- ARS - Data from nephelometers and transmissometers operated by Air Resource Specialists, Inc. for various cooperating government agencies.
- IMPROVE Special Studies (MOHAVE, PREVENT, REVEAL) - Speciated aerosol data.
- NPS-SFU - Speciated fine and coarse aerosol mass collected by the National Park Service. This network was the predecessor of IMPROVE.

In addition, composite fine mass components, light extinction (b_{ext}) components, and total b_{ext} derived from the IMPROVE aerosol data; and the monthly relative humidity and light extinction growth values ($f(RH)$) used to reconstruct (b_{ext}) for the Regional Haze Regulations, are provided. The fine mass components consist of ammonium sulfate, ammonium nitrate, organics, elemental carbon, and soil, while the b_{ext} components are the contribution of each of these fine mass components to b_{ext} .

Annual Data Summaries

Every year, routine and some novel data aggregations will be conducted on the data in the VIEWS database to summarize the previous year of data. The first data summary will be based on IMPROVE and IMPROVE Protocol aerosol data beginning with the year 2000. All calculations, where applicable, will follow the EPA guidance document for Tracking Progress Under the Regional Haze Rule. The data summaries will include aerosol and light extinction spatial maps, trends, and budgets. Data summaries of aerosol composition and their contribution to light extinction for the 20% best and worst visibility days will also be included. In addition, air mass histories will be available. The specific data summaries will be:

Spatial analyses

Colored contour or isopleth maps will be created for fine and coarse mass, the fine mass composite components and their contribution to light extinction, as well as total light extinction. These contour maps will be created for absolute and fractional contributions of the annual and seasonal averages, and average of the best and worst 20% visibility days. Approximately 30 individual maps will be generated.

Aerosol and Light Extinction Budgets

Time charts, bar charts, and pie charts will be used to display the fine aerosol and light extinction budgets for each IMPROVE and Protocol monitoring site. Absolute and relative aerosol and light extinction budgets will be created for annual and seasonal averages and average of the best and worst 20% visibility days. Twenty-four graphs per site will be generated.

Long-Term Trends

Long-term trend plots will be created for the average of the best, middle, and worst 20% of the visibility days of the fine and coarse mass, fine mass composite aerosol components and their contribution to light extinction, and the reconstructed light extinction and deciview. The aggregations will follow the methodologies specified in the EPA guidance document for Tracking Progress Under the Regional Haze Rule. About 28 graphs per site will be generated.

Aerosol and Light Extinction Budgets for the Individual Best and Worst 20% of the Visibility Days

Aerosol and light extinction budgets will be generated for each day comprising the best and worst 20% of the visibility days for each IMPROVE and IMPROVE Protocol monitoring site. Two graphs per site will be generated.

Airmass Histories

Airmass histories will be generated for the 20% best and 20% worst days at each IMPROVE and IMPROVE Protocol site for 2000. The airmass histories will include the airmass location, precipitation, temperature, and humidity experienced by the air parcels in route to the receptor. Approximately 40 plots/site will be generated.

Each annual data summary will consist of over 10,000 individual color graphics. Making this many results available in a single document or report would be burdensome on the user. Instead, an interactive browser is being developed, allowing the user to navigate through the graphics by selecting different locations, aggregation methods, metrics, parameters, and time period. The data used to generate the graphics, as well as a full description of the methodologies for generating each result, will be available. Any interpretation and analysis of results for particular issues, however, will be left to the user. Therefore, the annual data summary can be thought of as a set of resources from which a user can search, browse, and draw material to quickly generate an individual data analysis report that addresses specific issues.

Future Capabilities for Data Access and Analysis

The current data access and analysis tools on VIEWS are: 1) the metadata browser (to explore contents and histories of all the monitoring networks) in the VIEWS integrated database, 2) the database access tool (queries the database returning subsets of data), and 3) the graphic viewer (browsing preprocessed graphical and tabular data products). In the future, the graphic viewer will be replaced with tools developed to access the contents of the annual data analysis summaries previously discussed.

The current database access tool allows ad hoc queries to the database based upon monitoring networks, sites, measured parameters, and time range. In addition, access to calculated

parameters, such as the aerosol composite components and f(RH) factors are available. Currently, a user has to individually select monitoring sites. Allowing automatic selection of groups of sites based upon selected RPOs, states, and/or proximity to Class I areas will enhance the monitoring site selection capabilities. Allowing the user to specify which years and months to select will enhance the time range selection. For instance, a user could return only summertime data for multiple years. In addition, the output format options of the returned data will be expanded allowing the merging of monitoring site location information (e.g., latitude and longitude) into the main data table.

A new data analysis tool will be created based upon the Microsoft pivot table. This is an Excel Workbook in which

both the spreadsheet and associated charts are linked to the VIEWS database via a URL. The pivot tables require Microsoft Office 2000 or later. As well, subsets of the database, for example by state, RPO, or parameters of interest, can be provided as local pivot tables. These client applications are transportable and do not require access to Internet connection. The pivot tables allow one to browse and aggregate the data via drop-down menus containing monitoring networks, monitoring sites, variables, and time ranges, while taking advantage of the generally familiar plotting and analysis tools in Excel.

For more information contact Rodger Ames at Colorado State University. Telephone: 970/491-3700. Fax: 970/491-8598. E-mail: rames@cira.colostate.edu.

Visibility news *continued from page 3*

Wyoming network continues to expand

The success of the Green River Basin Visibility Study in southwest Wyoming and interest in visibility issues in other areas of the state prompted the Wyoming Department of Environmental Quality – Air Quality Division (AQD) to establish a Wyoming Visibility Monitoring Network to more fully understand regional haze visibility impairment. As part of the Wyoming Visibility Monitoring Network, an air quality study has been initiated in northeast Wyoming that collects aerosol, optical, scene, meteorological, and gaseous data. Study results will be a valuable asset in making future decisions about air quality in the region, and will be useful in developing Wyoming's Regional Haze State Implementation Plan.

The AQD established two visibility monitoring stations in early 2001 at two Class II areas in Wyoming near the Cloud Peak Wilderness Area (in northcentral Wyoming) and at the Thunder Basin National Grasslands (in northeast Wyoming). Data collected at the stations will be utilized to characterize the extent, frequency of occurrence, and magnitude of visual air quality. To ensure data comparability to the IMPROVE monitoring network and the long-term operation of the station's aerosol monitors, the AQD requested that they be designated as IMPROVE Protocol sites. With the installation of the version II IMPROVE aerosol samplers in June 2002, the sites became two of the latest additions to the network of aerosol monitors that operate in the IMPROVE Program. The data collected at these two sites should greatly add to the expanding IMPROVE monitoring network by filling the existing data gap between the IMPROVE sites in northwestern Wyoming and southwestern South Dakota.

In the near future, the Wyoming Visibility Monitoring Network will be supplemented by the development of a Web site to allow public access to monitored visibility and concurrent corresponding air quality conditions. With the transition to Starband satellite communication systems at both stations, the AQD has the capability to create a Web site that will be updated every 15 minutes with images from the high-resolution digital camera systems and accompanying visibility and air quality data.

For more information or questions regarding the Wyoming Visibility Monitoring Network, contact Darla Potter at the Wyoming DEQ. Telephone: 307/777-7346. Fax: 307/777-5616. E-mail: dpotte@state.wy.us.

Chuck McDade joins UC-Davis

Chuck McDade recently joined the University of California at Davis to manage UCD's participation in IMPROVE, which includes laboratory analysis of filter samples and oversight of the aerosol monitoring network. Chuck has been involved in aerosol and visibility research for over 20 years and has participated in many field studies during that time, including a stint as the independent quality assurance auditor for IMPROVE. Most recently, he served as field manager for the California Regional PM₁₀/PM_{2.5} Air Quality Study (CRPAQS), a multi-year study in California's Central Valley designed to increase understanding of the characteristics and sources of atmospheric aerosols in that region. Chuck holds a Ph.D. in physical chemistry from UCLA.

Chuck McDade can be reached at the University of California Davis. Telephone: 530/752-7119. Fax: 530/752-4107. E-mail: mcdade@crocker.ucdavis.edu.

Sac and Fox Nation sponsor monitoring in Midwest

For many years, visibility monitoring by federal agencies was non-existent in the Midwest due to lack of Class I areas in the region. During the past few years, however, the Central States Regional Air Planning Association (CENRAP) has worked with the IMPROVE Program to install monitoring sites in the central U.S., and in 2002, 19 sites became operational as IMPROVE Protocol aerosol monitoring sites. One of these sites is the Sac and Fox Nation site in Reserve, Kansas.

The site was chosen as representative of rural agricultural lands in Kansas, Nebraska, Missouri, and Iowa. The IMPROVE Protocol site is collocated with the St. Louis - Midwest "Satellite" Supersite, which will operate for two six-week periods in 2002. This is a special intensive study to collect six weeks of continuous and near continuous summer/fall data in September and October and six weeks of continuous and near continuous wintertime data in November and December.

The Environmental Protection Agency and Washington University at St. Louis (as the lead university of 9 universities and research institutes), will operate the satellite supersite. The supersite includes various instrumentation to monitor high time resolution fine particulates and associated parameters, including daily 24-hour integrated substrate-based measurements, semicontinuous measurements, and meteorology.

For more information contact Ray Bishop at the State of Oklahoma Department of Environmental Quality. Telephone: 405/720-3162. Fax: 405/720-4101. E-mail: ray.bishop@deq.state.ok.us.



Researchers from several universities and agencies tour the Sac and Fox IMPROVE aerosol monitoring station in Reserve, Kansas, collocated with the larger St. Louis-Midwest "Satellite" Supersite shelter, operated by Washington University - St. Louis.

Critical visibility review published

The 2002 Air and Waste Management Association critical review and discussion of Visibility, Science and Regulation was presented at the June 26, 2002, annual meeting and was published in the June and September issues^{1,2} of the *Journal*.

The review author, Dr. John Watson of the Desert Research Institute, concluded that the metric selected to track progress (the deciview, derived from 24-hour chemical contributions to light extinction) was an objective measure (with some time-resolution limitations) of what people see near the perceived visual range. The review found the definition of natural visibility conditions to be sufficient for current planning, but concluded that increasing emissions outside the U.S. may set an effective global background level higher than natural conditions. Examples of natural wildfire and dust storm events that cause poor visibility were cited that are not represented by annual averages. Visibility trends from the IMPROVE network show improvements in the eastern U.S., but degradation at some sites in the west and southwest. Dr. Watson characterized the review and discussion as a "time capsule," providing perspective for dealing with current decisions in future decades.

In the discussion, Mr. John Bachman of the U.S. EPA traced the evolution of visibility rules and regulations and discussed their effect on federal research funding. Ms. Susan Wiermann of the MANE-VU regional planning organization (RPO) outlined the challenges faced by regional planning agencies and cited several examples of previous successes and failures. Dr. C.V. Mathai of Pinnacle West Capital Corporation clarified the importance of the Grand Canyon Visibility Transport Commission in the formulation of the Regional Haze Rule. Dr. William Malm of the National Park Service provided additional technical documentation of the dry extinction efficiencies and humidity dependences that are used to track progress and estimate natural visibility conditions. Dr. Warren White of Washington University criticized the 24-hour chemical extinction metric, noting that daytime visibility and actual measures of extinction would be better indicators of what people actually perceive.

¹Watson, J.G. Visibility: Science and regulation; *JAWMA* **2002**, 52(6), 628-713.

²Chow, J.C. 2002 Critical review discussion - Visibility: Science and regulation; *JAWMA* **2002**, 52(9), 973-999.

Copies of the review and discussion articles and presentation graphics can be obtained from critical review committee chair, Dr. Judith C. Chow. Telephone: 775/674-7050. Fax: 775/673-3316. E-mail judyc@dri.edu.

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Associate Membership in the IMPROVE Steering Committee is designed to foster additional IMPROVE-comparable visibility monitoring that will aid in understanding Class I area visibility, without upsetting the balance of organizational interests obtained by the steering committee participants. Associate Member representatives are:

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member for information.

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The IMPROVE Program was designed in response to the visibility provisions of the Clean Air Act of 1977, which affords visibility protection to 156 federal Class I areas. The program objectives are to provide data needed to: assess the impacts of new emission sources, identify existing human-made visibility impairments, and assess progress toward the national visibility goals as established by Congress.

To submit an article, to receive the IMPROVE Newsletter, or for address corrections, contact:

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IMPROVE Newsletters are also available on the IMPROVE Web site at <http://vista.cira.colostate.edu/improve/Publications/publications.htm>, and on the National Park Service Web site at: <http://www.aqd.nps.gov/ard/impr/index.htm>



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