INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

Spring 2000 | The IMPROVE Newsletter | Volume 9 / Number 2

Monitoring update

Network operation status

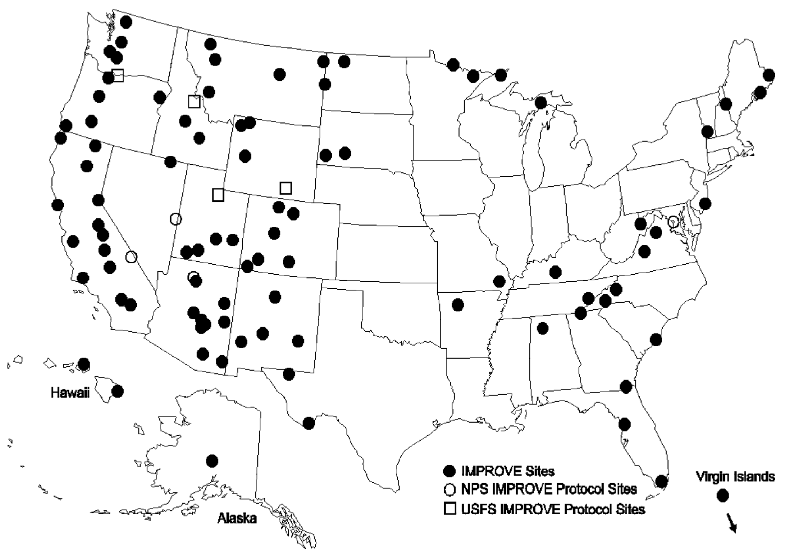
The IMPROVE network operated 90 aerosol samplers, 17 transmissometers, 8 nephelometers, and 5 camera systems during the Spring 2000 monitoring season (March, April, and May 2000).

Preliminary data collection statistics for the Spring 2000 season are:

- Aerosol 91% collection
- Optical (transmissometer) 91% collection
- Optical (nephelometer) 97% collection
- Scene (photographic) 79% collection

As of May 31, 2000, 81 new aerosol samplers have been installed. The following monitoring sites received the new, IMPROVE Version II aerosol sampler during Spring 2000:

Acadia NP
Bandelier NM
Big Bend NP
Bosque del Apache NWR
Brigantine NWR
Bryce Canyon NP
Canyonlands NP
Cape Romain NWR
Capitol Reef NP
Chassahowitzka NWR
Chiricahua NM
Cohutta W
Crater Lake NP
Glacier NP
Grand Canyon NP
Great Basin NP
Great Gulf W
Great Sand Dunes NM
Great Smoky Mountains NP
Guadalupe Mountains NP
Ike's Backbone
James River Face W
Jarbidge W
Kalmiopsis W
Lava Beds NM
Linville Gorge W
Lone Peak W
Lye Brook W
Mammoth Cave NP
Mesa Verde NP
Mingo NWR
Monture
Moosehorn NWR
Mount Baldy W
Mount Hood W
Okefenokee NWR
Petrified Forest NP
Salt Creek NWR
Shining Rock W
Sipsey W
Starkey
Sycamore Canyon W
Three Sisters W
Tonto NM
Upper Buffalo W
Virgin Islands NP
Zion NP



IMPROVE and IMPROVE Protocol Sites
Spring 2000

Data availability status

Particulate data for all measurements including carbon are available through November 1999 on the UC-Davis FTP site, at http://improve.cnl.ucdavis.edu. Seasonal summaries beginning with 1998 are also available on the site.

Optical data are available through May 1999 on the Cooperative Institute for Research in the Atmosphere (CIRA) FTP site, at ftp://alta_vista.cira.colostate.edu. Data files are being upgraded to reflect more information and should be complete by late summer.

Photographic slides are archived but are not routinely analyzed or reported. Complete photographic archives and slide spectrums (if completed) are available at Air Resource Specialists, Inc.

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. Standard operating procedures are available for site selection; instrument installation, operation, and servicing; and data collection, reduction, validation, reporting, and archiving.

Visibility news

Remote high-resolution digital camera systems developed for the USFS

The United States Forest Service (USFS) plans to establish several new photographic monitoring sites later this summer to complement IMPROVE's expanding monitoring network. These monitoring sites will receive a remote, high-resolution digital camera system.

The new systems contain digital cameras instead of 35mm film cameras, to allow the collected photographic images to be readily available for distribution, presentation, or Internet applications. The new systems also operate on solar/battery power and require minimal user maintenance and servicing. As seen in the photograph below, the system approved by the USFS consists of five major components:

- Digital camera: A Kodak DC290 digital camera with integrated scripting places the camera in a specified state upon power-up and waits for commands from the controller. The custom script includes power-off functions to limit battery drain, sets the date and time, sets the zoom lens, and records image information on a memory card. The camera will store up to 120 high-resolution (1792 x 1200 pixel) images on its memory card, which can be downloaded to a personal computer.
- Controller: The custom-designed controller applies power to the camera, reads the current temperature and battery voltage, and initiates image capture.

Remote, high resolution digital camera system developed for USFS visibility monitoring sites, by Air Resource Specialists, Inc.

- Computer Interface: A palmtop computer interface allows the user to define the image acquisition schedule and camera settings, observe current operational status, and perform routine servicing and troubleshooting.
- Enclosure: A lockable environmental enclosure houses the system's components.
- Power System: A 12 volt gel battery, a regulator, and a solar panel provide power to the camera system.

The remote, high-resolution digital camera system is designed to operate for up to 30 days without operator intervention, at temperatures from 10°F to 110°F. At the end of 30 days, the operator exchanges the memory card and can download the images to a personal computer for immediate availability.

For more information contact Rich Fisher of the USFS. Telephone: 970/295-5981. Fax: 970/295-5959. E-mail: rfisher@lamar.colostate.edu

New MARAMA representative to IMPROVE

Charles O. Davis III recently joined the IMPROVE Steering Committee as the representative from MARAMA, the Mid-Atlantic Regional Air Management Association. Davis fills the position vacated by Charles Pietarinen.

Davis, an environmental chemist for North Carolina's Department of Air Quality, is involved with statewide ambient air quality monitoring including ozone monitoring, ambient hydrocarbon analysis, review of data sets, and determination of the Hazardous Air PollutantS (HAPS) metals content of Total Suspended Particles (TSP). He has also extensive experience with light duty mobile source emissions.

Davis is also involved with a special project outside of Raleigh, where ozone concentrations are continuously monitored at ground level, 250 feet, 420 feet, and 1,420 feet on a 2,000-foot television tower. A Photochemical Assessment Monitoring Station (PAMS) collects hydrocarbons at three levels at the same location.

Charles Davis can be contacted at his office in North Carolina. Telephone: 919/715-0664. Fax: 919/733-1812. E-mail: Charles.O.Davis@ncmail.net

***Visibility news** continued on page 7...*

Feature article

Third serial IMPROVE report continues to examine aerosol and visibility trends

Introduction

Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States, Report III, has been released. It is the third in a series of IMPROVE reports that examine the distribution of aerosols and trends in visibility using IMPROVE monitoring data. This article summarizes major chapters of the report.

Each of the three reports have built upon data collected and analyzed in the earlier reports. The three serial reports are:

> *Spatial and Temporal Patterns and the Chemical Composition of the Haze in the United States: An Analysis of Data from the IMPROVE Network, 1988-1991*, included data from 36 monitoring sites and covered the period March 1988 - February 1991.

> *Spatial and Seasonal Patterns and Long Term Variability of the Composition of the Haze in the United States: An Analysis of Data from the IMPROVE Network*, included data from 43 monitoring sites and covered the period March 1992 - February 1995.

> *Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States, Report III.* The report examines 49 sites (51 sites for extreme fine mass analysis) for the 3-year period (March 1996 through February 1999) and 29 sites for an 11-year trend analysis. Of the 49 sites, 31 have optical monitoring. Table 1 lists the sites, grouped into 21 regions, which are used for expressing analysis conclusions.

Spatial Distribution of Aerosols and Chemical Composition

Coarse mass (the difference between PM_{10} and $PM_{2.5}$), fine aerosols, and specific components of the aerosol concentrations were examined for the 3-year period (March 1996 through February 1999). Findings include:

- Coarse mass concentrations are highest in the:
  - Southeast
  - West Texas
  - Pacific Coastal Mountains
  - Sonoran Desert
- Coarse mass concentrations are lowest in the:
  - Cascade Mountains
  - Sierra-Humboldt

Table 1. IMPROVE monitoring sites listed according to region

Alaska
Denali NPP *st*

Appalachian Mountains
Great Smoky Mountains NP *sote*
Shenandoah NP *sote*
Dolly Sods W *soe*
James River Face W *se*
Shining Rock W *soe*

Boundary Waters
Boundary Waters Canoe Area *soe*

Cascade Mountains
Columbia River NSA *oe*
Mount Rainier NP *sote*
Snoqualmie Pass W *soe*
Three Sisters W *soe*

Central Rocky Mountains
Bridger W *sote*
Great Sand Dunes NM *ste*
Mount Zirkel W *oe*
Rocky Mountain NP *sote*
Weminuche W *ste*
Yellowstone NP *ste*

Colorado Plateau
Bandelier NM *sote*
Bryce Canyon NP *ste*
Canyonlands NP *sote*
Grand Canyon NP *soe*
Mesa Verde NP *ste*
Petrified Forest NP *sote*

Great Basin
Jarbidge W *sote*
Great Basin NP *se*

Mid-Atlantic
Edwin B. Forsythe NWR *se*

Mid-South
Upper Buffalo W *soe*
Sipsey W *se*
Mammoth Cave NP *soe*

Northeast
Acadia NP *sote*
Lye Brook W *se*
Moosehorn NWR *se*

Northern Great Plains
Badlands NP *sote*

Northern Rocky Mountains
Glacier NP *sote*

Pacific Coastal Mountains
Pinnacles NM *ste*
Point Reyes NS *ste*
Redwood NP *ste*

Sierra Nevada
Yosemite NP *sote*
Sequoia NP *se*

Sierra-Humboldt
Crater Lake NP *ste*
Lassen Volcanic NP *ste*

Sonoran Desert
Chiricahua NM *sote*
Gila W *oe*
Tonto NM *ste*

Southeast
Chassahowitzka NWR *se*
Okefenokee NWR *soe*
Cape Romain NWR *se*

Southern California
San Gorgonio W *sote*

Wasatch
Lone Peak W *soe*

Washington, D.C.
Washington, D.C. *e*

West Texas
Big Bend NP *sote*
Guadalupe Mountains NP *sote*

NM	National Monument
NP	National Park
NPP	National Park and Preserve
NS	National Seashore
NSA	National Scenic Area
NWR	National Wildlife Refuge
W	Wilderness

s	fine mass/extinction spatial analysis
o	optical monitoring
t	trend analysis
e	extreme fine mass analysis

- Fine aerosol concentrations are highest in the:
  - Appalachian Mountains
  - Mid-Atlantic
  - Mid-South
  - Washington, D.C.
- Fine aerosol concentrations are lowest in the:
  - Great Basin
  - Wyoming
  - Colorado Plateau
  - Alaska

Specific components of fine aerosols show that:

- Carbon (organic and light-absorbing carbon) is the largest single component in the:
  - Cascade Mountains
  - Great Basin
  - Alaska
  - Colorado Plateau
  - Central Rocky Mountains
  - Sierra-Nevada
  - Northern Rocky Mountains
  - Sierra-Humboldt
  - Pacific Coastal Mountains
  - Wasatch
- Sulfate is the largest single component in the:
  - Appalachian Mountains
  - Northeast
  - Boundary Waters
  - Sonoran Desert
  - Mid-Atlantic
  - Southeast
  - Mid-South
  - Washington, D.C.
  - Northern Great Plains
  - West Texas
- Organics is the largest single component in the:
  - Pacific Northwest
- Nitrates is the largest single component in:
  - Southern California

Spatial Distribution of Reconstructed Light Extinction

The light extinction coefficient is calculated from the measured aerosol species' concentrations by multiplying the concentration of a species by its light extinction efficiency and summing over all species. To show the effect of aerosols on visibility, the deciview (dv) scale is applied to total reconstructed aerosol extinction. A dv value of zero indicates pristine conditions. Figures 1 and 2 are isopleths of deciview and extinction using IMPROVE data. Findings include:

- The greatest light extinction occurs in the:
  - Eastern United States
  - Southern California
- The least light extinction occurs in the:
  - Great Basin (nonurban)
  - Alaska
  - Colorado Plateau (nonurban)
- Fine aerosols are the major contributors to light extinction. Sulfates are the largest contributor to light extinction in 17 of the 21 regions.

Seasonal Distribution

Figures 3 and 4 are summary plots of reconstructed fine mass and reconstructed light extinction, and the contribution of each species for all regions except Washington, D.C., respectively. Seasonal findings for the 3-year period (March 1996 through February 1999) include:

- Summer shows the highest fine mass in 19 regions.
- Fall shows the highest fine mass in the Northern Rocky Mountains region.
- Summer extinction is highest in the:
  - Sonoran Desert
  - Great Basin
  - West Texas
  - Sierra-Humboldt
  - Colorado Plateau
  - Sierra-Nevada
  - Pacific Coastal Mountains
  - Cascade Mountains
- Spring extinction is highest in the:
  - Northern Rocky Mountains
  - Southern California
  - Central Rocky Mountains
  - Northern Great Plains
- Winter extinction is highest in the:
  - Cascade Mountains
  - Boundary Waters

Temporal Trends in Visibility and Aerosol Concentrations

The haziest days are defined as those with the highest 20% of fine mass concentrations. Findings for 29 sites included in the 11-year analysis include:

- Visibility is worsening at:
  - Great Smoky Mountains NP
  - Big Bend NP
  - Chiricahua NM
  - Bandelier NM
  - Great Sand Dunes NP
  - Badlands NP
  - Mesa Verde NP
  - Jarbidge W
  - Bryce Canyon NP
- Visibility is improving at:
  - Petrified Forest NP
  - Glacier NP
  - Mount Rainier NP
  - Acadia NP
  - Redwood NP
  - Point Reyes NS
  - Canyonlands NP
  - Yellowstone NP
  - Pinnacles NM
  - Weminuche W
  - San Gorgonio W
- Visibility is remaining constant at:
  - Denali NPP
  - Bridger W
  - Shenandoah NP
  - Crater Lake NP
  - Guadalupe Mountains NP
  - Tonto NM
  - Lassen Volcanic NP
  - Yosemite NP
  - Rocky Mountain NP

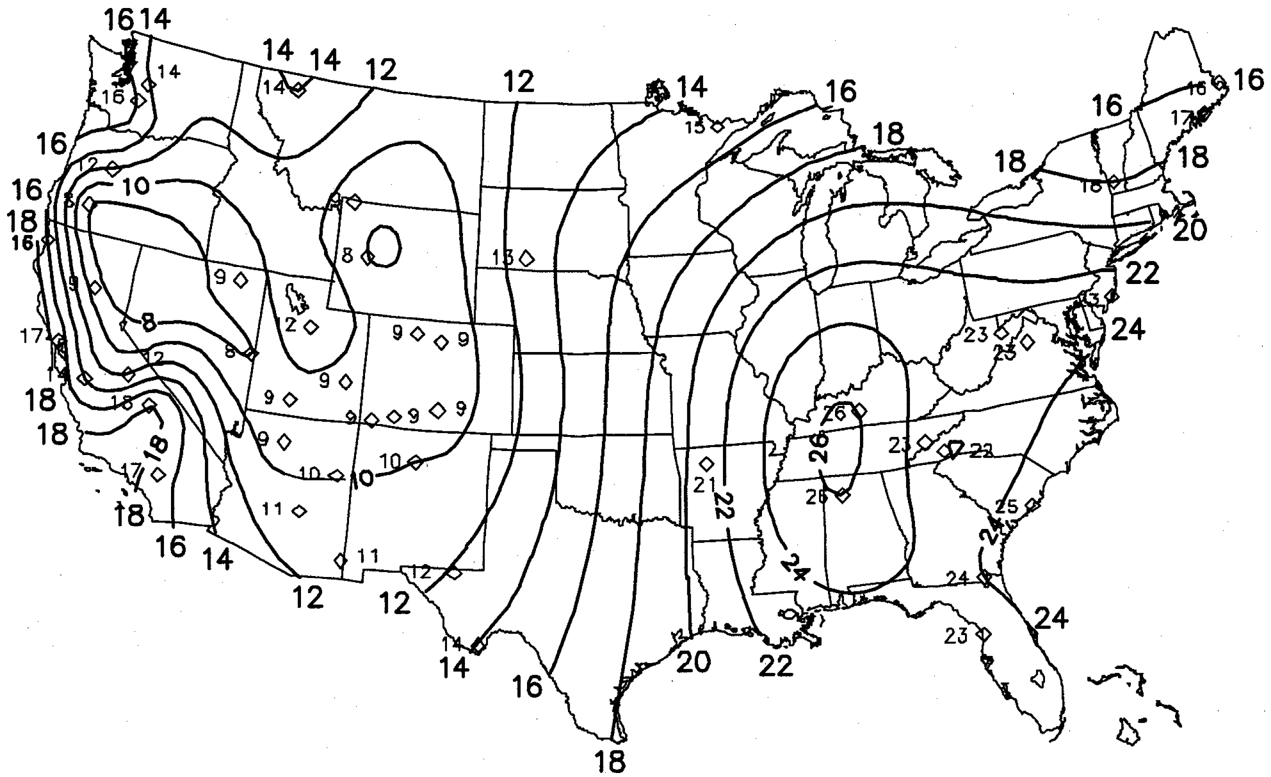


Figure 1. Three-year averages of deciview values using only data collected in the IMPROVE Network (March 1996 - February 1999).

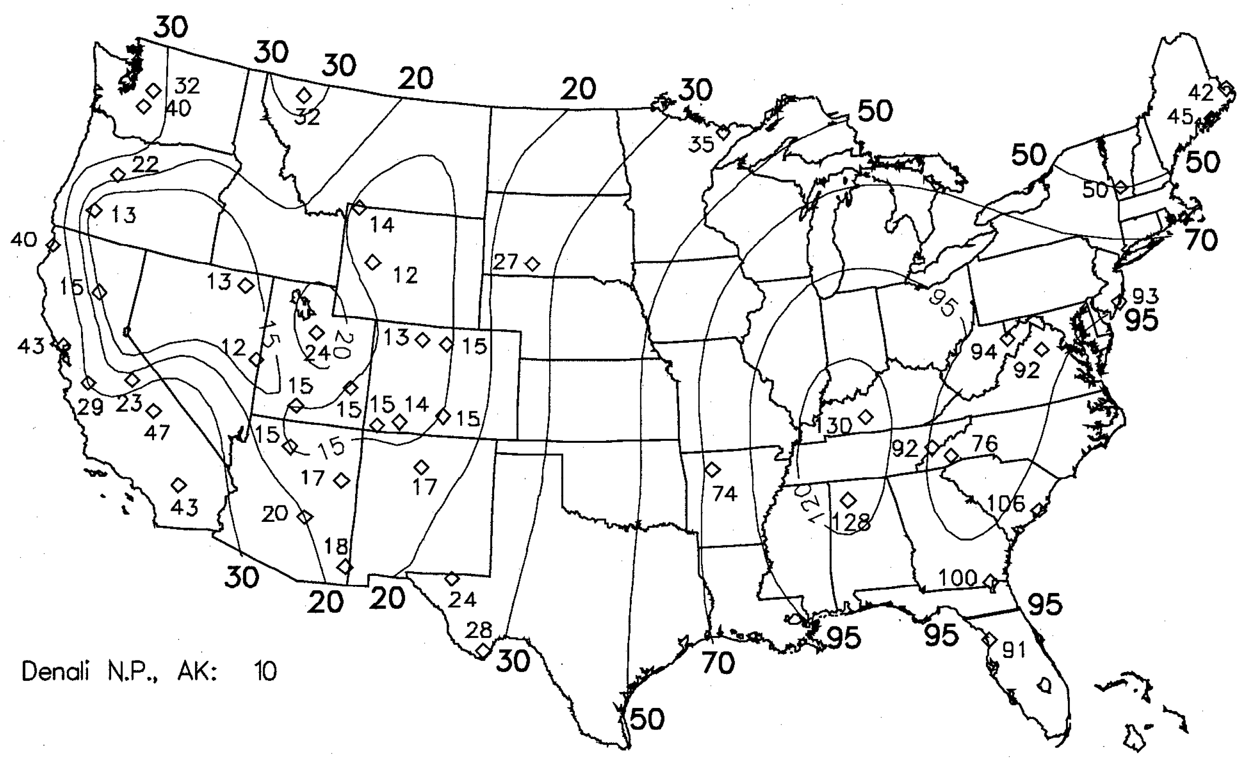


Figure 2. Three-year averages of total reconstructed aerosol light extinction coefficient (Mm^{-1}) using only data collected in the IMPROVE Network (March 1996 - February 1999).

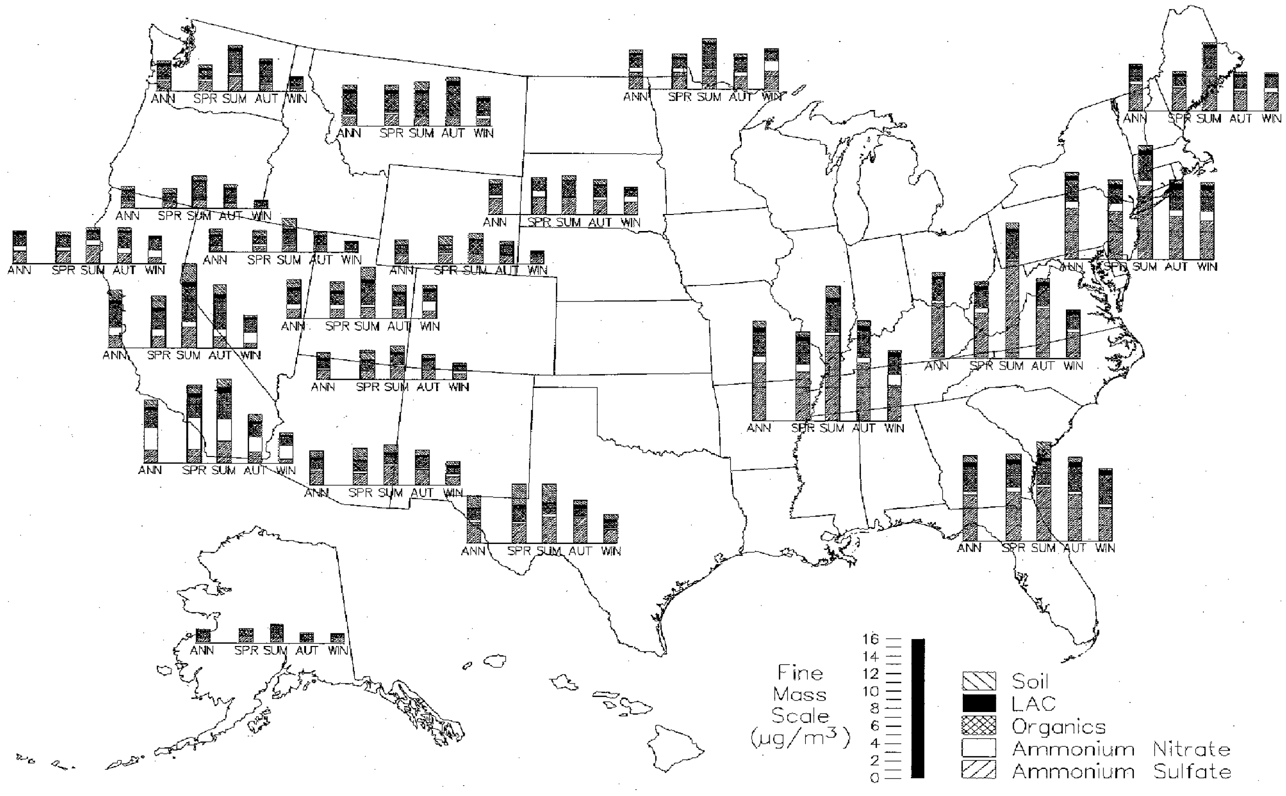


Figure 3. Summary plot of reconstructed fine mass and the fractional contribution of each species for the 20 monitoring regions in the IMPROVE Network, excluding Washington, D.C. (March 1996 - February 1999).

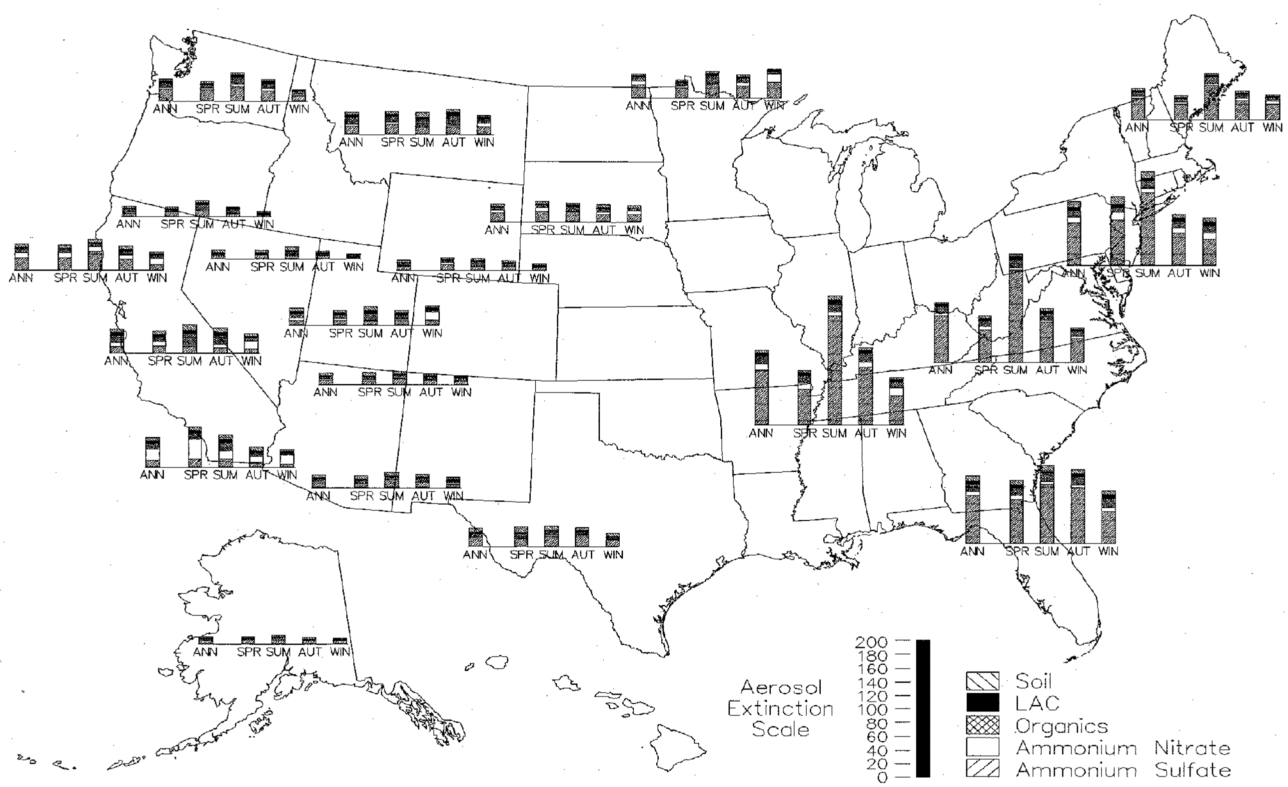


Figure 4. Summary plot of reconstructed light extinction and the fractional contribution of each species for the 20 monitoring regions in the IMPROVE Network, excluding Washington, D.C. (March 1996 - February 1999).

Recommended Future Research

The report concludes by discussing the uncertainties in the relationship between aerosol species concentrations and atmospheric extinction. Primary key concerns requiring further research are:

- Carbon mass measurements need refinement.
- Absorption estimation needs to be more accurate.
- Attribution of smoke to fine mass and/or extinction needs methodology development.
- Relative humidity correction terms need further study.
- Coarse particle chemical and optical characteristics need further examination.

Additional data analysis is also recommended, such as back trajectory analysis and spatial/temporal pattern analysis, to determine the source regions of aerosols.

Copies of the report are available from the Cooperative Institute for Research in the Atmosphere. Telephone: 970/491-8292. Fax: 970/491-8598. E-mail: lucero@cira.colostate.edu

Visibility news *continued from page 2 ....*

FLAG to release report

FLAG, the Federal Land Managers AQRV Work Group, plans to release its final Phase I report this summer, which provides recommendations and guidelines for preparing New Source Review permit applications in Class I and Class II areas. It is intended for federal land managers (FLMs), state permitting authorities, permit applicants, and other interested parties.

FLAG is comprised of air resource managers who represent the United States Forest Service, National Park Service, and the Fish and Wildlife Service. As FLMs, these agencies have an affirmative responsibility to protect air quality related values (AQRVs) from the adverse effects of air pollution, and to define the levels at which adverse impacts will occur. The group formed in 1997 to develop a more consistent manner among the agencies for identifying and evaluating effects of air pollution on their resources.

The report recommends that permit applicants consult with the appropriate permitting agencies and FLM to obtain information on background visibility and air quality conditions. It also presents guidelines for evaluating emission impacts of new and existing sources on visibility, ozone, and deposition, and the resulting impacts on AQRVs using appropriate air quality models. In addition, it describes the recommended process for completing New Source Review permit applications.

The FLMs discussed the draft Phase I report at a December 1999 public meeting and solicited public input during a 90-day public comment period. The FLMs will announce in the *Federal Register* the availability of the final Phase I report, as well as a Response to Comments document. A future issue of the *IMPROVE Newsletter* will feature the Phase I report and present its recommendations and guidelines in greater detail. Phase II, which has not yet begun, will address issues that require additional research and data.

For more information contact John Bunyak at the National Park Service. Telephone: 303/969-2818. Fax: 303/969-2822. E-mail:john_bunyak@nps.gov

WRAP initiates Web database development

The Ambient Monitoring and Reporting Forum of the Western Regional Air Partnership (WRAP) is contracting with the Cooperative Institute for Research in the Atmosphere (CIRA) to design, develop, implement, and maintain an air quality and meteorological data integration, analysis, and delivery system, accessible on the World Wide Web.

The database will contain data collected at IMPROVE and IMPROVE Protocol monitoring sites west of the 100th meridian, and from special studies. It will contain aerosol and optical data, meteorological data (National Weather Service meteorological surface and upper air data and Remote Automated Weather Station surface data), and additional air quality data (Acid Rain Emissions Tracking System, Aerometric Information Retrieval System), and others as determined by WRAP.

The database is scheduled to be operational by the end of this year.

For more information contact Doug Fox at CIRA. Telephone: 970/491-3983. Fax: 970/491-8598. E-mail: DFox@CIRA.colostate.edu

University of Vienna to host conference

The "Conference on Visibility, Aerosols, and Atmospheric Optics" will be held in Vienna, Austria, September 11-15, 2000. The conference will be held at the Institute of Experimental Physics of the University of Vienna, and is sponsored by Chemisch-Physikalische Gesellschaft and co-sponsored by the Clean Air Commission of the Austrian Academy of Sciences and Gesellschaft für Aerosolforschung, GAeF, Germany.

Information and topics to be presented at the conference can be found at: http://www.ap.univie.ac.at/users/Visibility.2000 or at http://visibility.exp.univie.ac.at

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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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Government organizations interested in becoming Associate Members may contact any Steering Committee 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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