INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS

IMPROVE

3rd Quarter 2006 | The IMPROVE Newsletter | Volume 15 / Number 3

Monitoring update

Feature Article: EPA adds independence to QA program, 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:

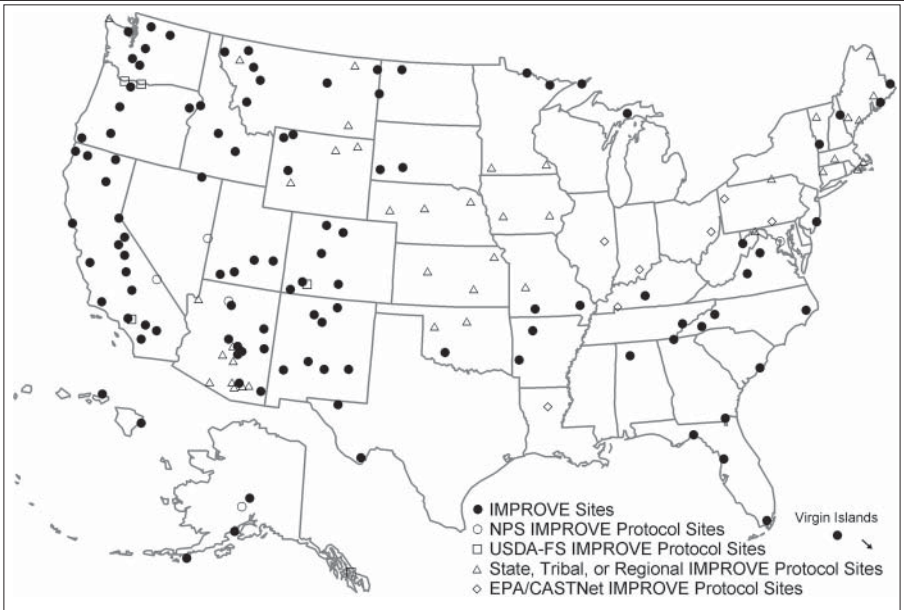
- 58 aerosol samplers
- 13 transmissometers
- 37 nephelometers
- 8 digital or film camera systems
- 56 Web camera systems
- 5 interpretive displays

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 3rd Quarter 2006 (July, August, and September) are:

- Aerosol (channel A only) 93% collection
- Aerosol (all modules) 91% completeness
- Optical (transmissometer) 96% collection
- Optical (nephelometer) 96% collection
- Scene (photographic) (does not include Webcameras) 99% collection

One new aerosol monitoring site started up this quarter; the Makah Tribe's one-year special study site was installed during August at Neah Bay, WA (see story on page 2). Two aerosol sites were removed in July: Connecticut Hill, NY, and Old Town, ME (replaced by the Penobscot, ME, monitoring site).

Optical instrumentation that ended monitoring this quarter include the transmissometer at San Gorgonio Wilderness, CA (operated by the USDA-Forest Service), temporarily terminated operations pending funding decisions, four nephelometer systems: Milwaukee, WI, and Seney Wilderness, MI (both operated by the Lake Michigan Air Directors Consortium); and Bliss State Park and South Lake Tahoe, NV (both operated by the Tahoe Regional Planning Agency).



IMPROVE and IMPROVE Protocol Sites
3rd Quarter 2006

Data availability status

Data are available on the IMPROVE Web site, at *http://vista.cira.colostate.edu/improve/Data/data.htm*. IMPROVE and other haze-related data are also available on the VIEWS Web site, at *http://vista.cira.colostate.edu/views*.

Aerosol data are available through March 2005. Transmissometer and nephelometer data are available through December 2005 and June 2006 respectively.

Photographic slide spectrums are also available on the IMPROVE Web site, under *Data*. Real-time Webcamera displays are available on a variety of agency-supported Web sites.

***Monitoring update** continued on page 6....*

Visibility news

Makah Tribe joins IMPROVE aerosol network

On August 24 of this year, the Makah Tribe's first air quality monitoring site started operations with the completion of a fenced monitoring shed and the installation of IMPROVE aerosol monitoring equipment by members of the UC-Davis IMPROVE team.

Located in Washington state at the northwest tip of the Olympic Peninsula, the Makah Nation is situated at the most northwestern point in the contiguous United States. "We like to refer to our location here as the 'beginning of the world,'" said Jim Woods, Manager of the Sustainable Resources Division of the tribe. "We have lived here for thousands of years."

In 1855, the Makah Tribe ceded much of its "usual and accustomed" whaling, fishing, hunting, and gathering territory to the U.S. by treaty. Today, the Makah Nation is home to about 1,700 residents and consists of about 30,000 acres bounded to the west by the Pacific Ocean, to the north by the Strait of Juan De Fuca, and to the south and east by Olympic National Park and privately owned forest lands. The Nation is located within the Temperate Coastal Rainforest ecosystem, and much of the Olympic Peninsula is national forest or national park land. "We live in the only rainforest in the northern half of our hemisphere," said Woods. "It is unique." The Makah Tribe is the largest treaty fishery tribe in the United States. As a tribe whose livelihood has historically depended on natural resources, especially the sea, the Makah value their relationship to the sea, the earth, and to the sky.

Dana Sarff, Air Quality Specialist with the Tribe, says that "Although part of our air quality program is committed to indoor air quality issues, the majority of our resources will be used to focus on ambient air monitoring and on keeping our outdoor air clean for future generations of Makah." Even though the sports fishing market has been big in the past, more and more eco-tourists are visiting the Makah Nation. "Just as with the national parks and forests, these tourists come here to enjoy the clean air and the breathtaking views and panoramic landscapes and seascapes," Sarff said. "Clean air is not only an environment and health issue here. Good visibility is an economic resource."

Along with Olympic National Park's IMPROVE monitoring site, located about 80 miles east of Neah Bay, the Makah's IMPROVE site will be only the second IMPROVE monitor along the entire Olympic Peninsula. The Makah site is only one of ten current tribal IMPROVE sites in the entire United States. In addition, it is the only site on or near the Pacific shoreline from the Canadian border south to the Kalmiopsis Wilderness, almost 600 miles down the Oregon Coast (based on information provided on the IMPROVE Web site).

Funding for the site was made possible under the Federal Clean Air Act Title 103 Grant Program through EPA's Region 10 Office. Immediate plans for the site include the installation of a nephelometer and meteorological equipment, including a video camera that will provide continuous visual monitoring. "EPA's Region 10 monitoring group, under the direction of Mr. Keith Rose, has been very helpful and supportive in assisting us in getting this site up and running," said Woods.

Makah air quality monitoring site Neah Bay, Washington. Photo by Dana Sarff.

For more information contact Dana Sarff, Makah Air Quality Specialist. Telephone: 360/645-3273. Fax: 360/645-2323. E-mail: mtcairqual@centurytel.net.

Sea salt shown to be a factor at some sites

The new IMPROVE algorithm for determining aerosol extinction includes a term for sea salt (as discussed in *The IMPROVE Newsletter 4th Quarter 2005*). This natural material is a factor in regional-haze calculations at some sites.

Sodium chloride is the main constituent of sea salt. With time, the chloride anion can be replaced by nitrate and sulfate in reactions with atmospheric acids, leaving only the sodium cation in the particle phase. Sodium, therefore, is the more conserved particulate marker for aged sea salt, but sodium is not reliably determined by current IMPROVE measurement methods.

IMPROVE measures chloride reliably, by ion chromatography on a nylon filter sampling behind a denuder. Chloride ions are good markers for fresh (unreacted) sea salt, which is expected to be the dominant form at remote coastal sites where sea salt is significant. Chloride concentrations indicating fresh sea salt concentrations of 1 $\mu g/m^3$ or more are frequently recorded at several such sites, including Point Reyes NS, CA; Redwood NP, CA; Simeonof W, AK; Cape Cod NS, MA; Martha's Vineyard,

MA; and Virgin Islands NP, USVI (Figure 1). Chloride is also a good predictor of conserved trace sea salt constituents such as non-crustal strontium (Figure 2), calcium, and potassium, confirming that reactive losses are minor at these sites.

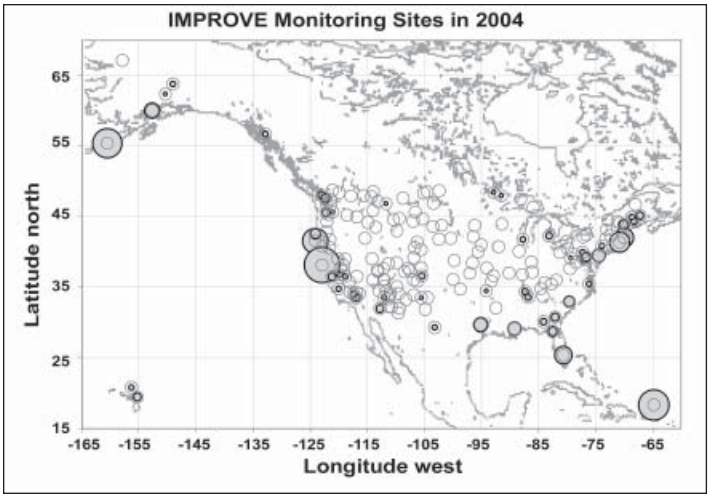


Figure 1. IMPROVE monitoring sites in 2004 (identified with open circles). Areas of filled circles are proportional to numbers of days in which 24h chloride ion concentrations implied at least one microgram per cubic meter of fresh sea salt.

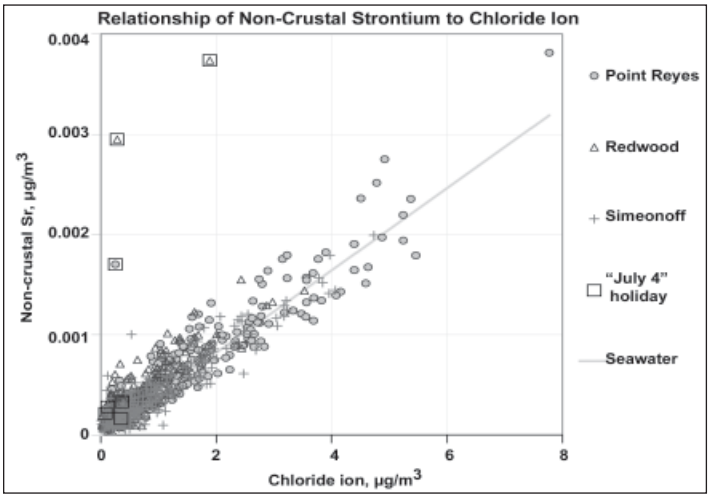


Figure 2. Observed and expected relationship of non-crustal (presumed sea salt) strontium to chloride ion. Strontium compounds are also used in fireworks.

For more information contact Warren White at the University of California-Davis. Telephone: 530/752-1213Fax: 530/752-4107. E-mail: white@crocker.ucdavis.edu.

IMPROVE meeting presentations available

The IMPROVE Program's steering committee gathered at Mammoth Cave National Park, KY, in September, to discuss network operations, research studies, future direction, and other topics relevant to the program. Presentations, meeting minutes, and the discussed agenda are available on the IMPROVE Web site at *http://vista.cira.colostate.edu/improve/Activities/activities.htm*.

Data advisories added to IMPROVE Web site

A data advisories page has been added to the IMPROVE Web site, which documents interesting findings from the IMPROVE database, including data anomalies, potential problems, and new uses for the data. The table below summarizes the currently available data advisories. Summaries of new advisories will be included in subsequent issues of the IMPROVE Newsletter.

Subject	Applicable Sites/Period	Comments
Changed reporting for XRF sulfur	All sites from Jan 1, 2005	A change in the use of the sulfur calibration standard will change the values by 15%
Suspect B-module data for Virgin Islands site	VIIS from June 1, 2001 to May 31, 2003	Ratios of chloride ion to chlorine, and sulfate to sulfur are inconsistent over the affected period for unknown reasons.
1 day in 6 copper contamination	five sites various time periods	Measurable copper is from collocated samplers with brush-type blower motors operated on a 1 day in 6 sample frequency
Wildfire smoke at Point Reyes	PORE Oct 12, 2004	High K and OC/EC correspond to satellite photo and newspaper accounts of wildfire
Sporadic zinc contamination	Various sites and samples	High zinc contamination of some field blanks are higher than many ambient levels
Under-reporting of sulfate ion concentrations	Various sites prior to Mar 15, 1989	Sulfate ion values are low despite high sulfur values on a number of filters especially during the winter of 1988
Nylon filter clogging	Eastern sites Summer 1998	Changes to the nylon filter promoted clogging during high concentrations resulting in loss of valid ion data
Discontinuity in nitrate time-series	Many sites starting 1996	Long-term nitrate time series shows a drop in concentrations at many sites starting 1996
Under-measured elemental sulfur	Eastern sites Summers 1991 to 1993	Sample periods with high sulfur and relative humidity for sites that had filter masking seem to be most affected

The data advisory page can be viewed 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.

Feature article

EPA adds independence to IMPROVE's quality assurance program

(by Dennis Crumpler, Jeff Lantz, and Jewell Smiley; Environmental Protection Agency)

Introduction

The Environmental Protection Agency (EPA) continues to build an independent auditing program that provides assessments of IMPROVE's field and laboratory analytical operations. The field component focuses on challenging the sampler's calibration, flow, temperature, and clock settings. In 2006, a more thorough check of siting criteria was added to the audit procedures and operator performance.The program's goal is to perform an audit on 25% of the network's samplers each year. The analytical component involves submitting single-blind filter samples to the laboratory for analysis using a variety of analytical techniques.

Field component of audits

2005 field audit summary

In 2005, a 21% audit rate was achieved of the IMPROVE aerosol program (34 samplers). Generally the samplers are doing well, but a variety of problems was discovered. UC-Davis was notified promptly so they could take corrective action to fix the problems, which included:

- One sampler was improperly positioned near an adjacent shelter, allowing water to infiltrate the sample train.
- Two leaks that caused low vacuum readings.
- Four flow rates calculated from the vacuum reading were greater than 10% different from the reference standard.
- Five actual flow rates were 10% higher than the theoretical flow rate.
- One sampler module had insect eggs on an exposed filter cassette.
- Two clocks were greater than one hour off the reference standard.
- Three sites reported operator errors with respect to handling filter cassettes or reading the temperature sensor.
- Two sites had calibration plugs missing.
- Three sites had temperature sensor readings greater than 10°C from the reference standard.

Changes for 2006

Several changes were made to the audit program in 2006, including implementing an auditor training program, creating a new audit manual, revising on site audit procedures, and a move to compare design and reference flow rates.

EPA launched a newly revised comprehensive training course in 2006 that certified over 30 EPA, state, and tribal auditors. Eight regional training courses were held across the U.S. (trainings are scheduled for December in Florida). In addition, all trained auditors are required to be recertified annually to maintain up-to-date information on procedures and program changes.

All auditors received new training and field audit manuals to promote proficiency of the auditors and consistency in how the audits are conducted and reported. These new manuals were prepared by EPA with contributions from UC-Davis, and include all standard operating procedures for the auditing program and electronic audit forms on CD.

Several on-site audit procedures changed during 2006. The audits now use a site's routine, unexposed sampling event cartridge for each audit, and audit worksheets were revised to record the filter cassette position for each audit to prevent contamination or damage to an exposed filter. In addition, site calibration coefficients and site data are now transferred from UC-Davis spreadsheets directly to the audit forms to eliminate transcription errors.

The worksheets were further revised to reflect the temperature measurement quality objective (MQO) as specified by UC-Davis to have an acceptance criteria of ± 10°C. The sampler's reported sampling event date was added to document that actual sampling dates coincide with the scheduled sampling dates. Also, site conditions are now evaluated against the siting criteria contained in IMPROVE's Quality Assurance Project Plan.

A final change made in 2006 was that EPA recognized that previous audits had failed to compare the sampler module's theoretical (design) flow rate to the reference standard's indicated actual flow rate. Previously, the program challenged the magnehelic and vacuum readings which were an assessment of the calibration. This oversight was corrected; the comparison is now reflected on the audit form and in current and future audit reports.

Future development

EPA in conjunction with UC-Davis has identified a number of auditing procedural issues that will be addressed in 2007. Items currently under development include:

- Development of a list of critical measurement quality objectives for routine audits.
- Development of a location on the IMPROVE Web site for posting of key pre-audit information, audit reports, and reports of follow-up activities.
- A mechanism to immediately provide UC-Davis with critical audit findings.
- Electronic reporting of audit results.
- A procedure to track follow-up actions.
- Preparing updated audit manuals every year.

Analytical component of audits

Independent laboratory QA support is provided to the IMPROVE Program through EPA's National Air and Radiation Environmental Laboratory (NAREL) in Montgomery, AL. NAREL coordinates with several laboratories across the country to crosscheck various analytical methods, including gravimetric mass analysis, ion chemistry, thermal-optical carbon, and x-ray fluorescence (XRF) analysis. Each participating laboratory receives a replicate set of single-blind filters for analysis, and analytical results are compared. Each lab receives Teflon®, Nylon®, and quartz filters that have been loaded with $PM_{2.5}$ captured from the ambient air at NAREL, and each set of filters contains hidden duplicates and blanks.

An experimental inter-lab comparison study is currently in progress. Figure 1 is an example of how recent results from six different labs have been compared. Ten replicate filters were analyzed by EPA and filter pairs were subsequently distributed to each of the five other participating labs for analysis. This normalized stacked-bar graph shows at a glance, the level of agreement among the participating labs for several elements determined by the XRF analysis. Each bar in the graph would have equal segments if all of the results were in perfect agreement. A complete report from the current study will be available later this year. The final report from last year's study is available at *http://www.epa.gov/ttn/amtic/files/ambient/pm25/spec/multilab06.pdf.*

For more information contact Dennis Crumpler of EPA. Telephone: 919/541-0871. E-mail: crumpler.dennis@epa.gov, or Jewell Smiley of NAREL. Telephone: 334/270-7073. Fax: 334/270-3454. E-mail: smiley.jewell@epa.gov.

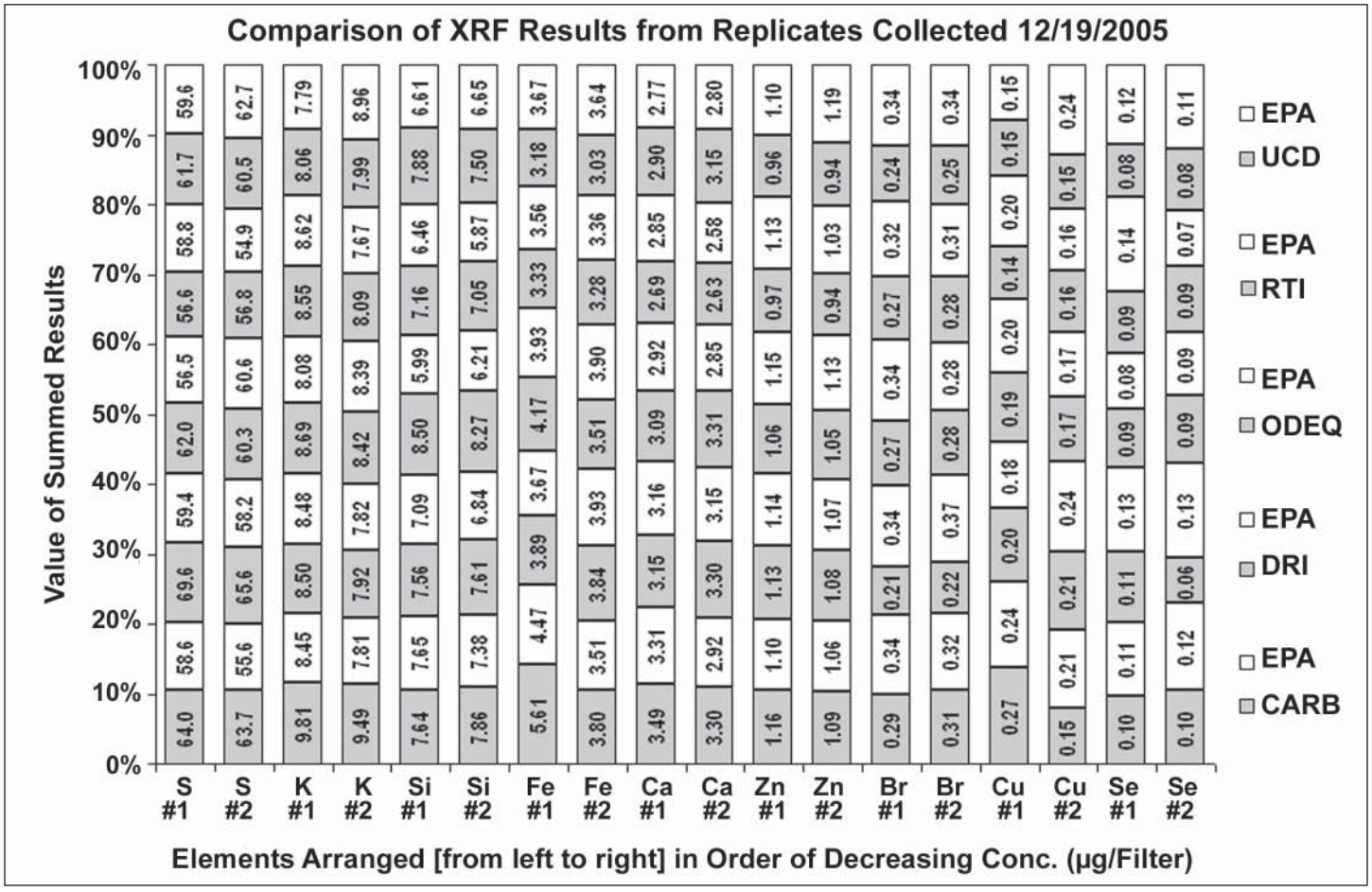


Figure 1. Comparison results of filter analysis from six laboratories: Environmental Protection Agency (EPA), University of California - Davis (UCD), Research Triangle Institute (RTI), Oregon Department of Environmental Quality (ODEQ), Desert Research Institute (DRI), and the California Air Resources Board (CARB). Numbers in each bar segment are the concentrations in micrograms per filter.

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

Operators of distinction

Tina Bernier, the Virgin Islands National Park primary site operator for the VIIS air quality station, is a native Virgin Islander. Her main responsibilities as a biological science technician include a number of ongoing resource management projects, as well as maintaining the park's air quality station.

Tina stepped up from backup operator to primary IMPROVE operator in the summer of 2005. She has worked for the park since the summer of 2003, beginning as a Student Temporary Employment Program (STEP) intern, and is currently a full-time park employee under the Student Career Experience Program (SCEP). Current backup operators Sheri Caseau and Devon Tyson step in when Tina is unavailable to service the station.

"I feel blessed to be surrounded by the rich tapestry of natural and cultural resources here at the park," said Tina. "In addition to servicing the IMPROVE aerosol sampler and NADP instrumentation, I conduct endangered sea turtle nest monitoring through field observations, conduct water quality monitoring using USGS protocols to collect biological data pertinent to coastal ecological monitoring, and I am involved in the processing and cataloging of natural history specimens for the Natural History Museum Collection here at the park."

Tina's Caribbean background and interests in the environment have directed her education. She holds a BS degree in biology from the University of the Virgin Islands, and is currently pursuing a Master's degree in environmental policy and management. "With this and an eventual doctorate degree, I hope to alleviate environmental concerns in the most needed areas within the U.S. Virgin Islands and the Caribbean," said Tina.

Tina Bernier, Biological Science Technician and IMPROVE site operator, hopes to protect the environmental quality of the Caribbean region now and well into the future.

In addition to loving the outdoors and all it offers, Tina reads mystery novels when she has the chance, and ponders ideas for possible inventions. She has several such ideas in mind that she would eventually like to see come to reality.

Virgin Islands National Park covers three-fifths of the island of St. John. Its crystal-clear waters support a diverse marine ecosystem and its beaches frame an abundance of terrestrial life. The park will celebrate its 50th anniversary this fall.

Transmissometer data reprocessed

In August, ARS reprocessed all historical Optec LPV-2 transmissometer data to reflect additional quality assurance (QA) performed on the dataset. Raw Level-A transmissometer files were blank-filled to provide complete quarterly files regardless of instrument begin/end time. Level-A files were also adjusted to exclude air temperature (AT) and relative humidity (RH) values for time period when these sensors were not functioning correctly. This additional QA affected AT and/or RH values for 5,298 out of 2,520,625 hourly values (0.2%).

Occasionally, transmissometer calibration, lamp change, or other diagnostic information is received after data have been reported and instrument-specific calibration and lamp databases are revised. These revisions affect the application of lamp brightening curves and other processing algorithms. Due to these revisions, reprocessing the transmissometer data introduced changes in reported extinction values for 35,147 out of 2,520,625 hourly values (1.4%). Figure 1 presents a distribution of the differences observed between previously reported and reprocessed extinction values for the values that changed.

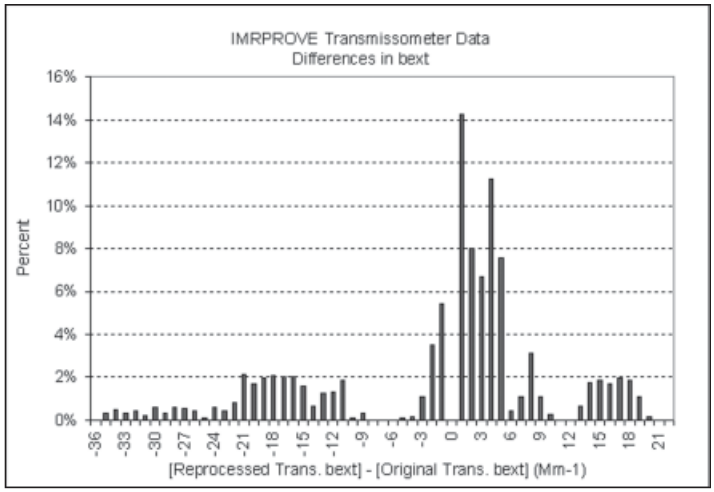


Figure 1. Distribution of the difference between reprocessed transmissometer b_{ext} and originally reported transmissometer b_{ext}. Distribution counts only b_{ext} values with differences. Most values (98.6%) were unaffected by reprocessing, and 58% of these differences were within ± 5 Mm^{-1}.

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 3rd Quarter 2006 are:

Aerosol (Channel A)

Acadia	Guadalupe Mountains	Olympic
Badlands	Hawaii Volcanoes	Organ Pipe
Bosque del Apache	Hercules-Glades	Pinnacles
Brigantine	Ike's Backbone	Presque Isle
Bryce Canyon	Indian Gardens	Proctor Research Ctr
Cabinet Mountains	Kalmiopsis	Queen Valley
Cadiz	Lava Beds	Redwood
Caney Creek	Livonia	Rocky Mountain
Cape Romain	Lostwood	San Gabriel
Cedar Bluff	Medicine Lake	San Rafael
Cherokee	Mesa Verde	Shamrock Mine
Cloud Peak	Mingo	Sikes
Columbia Gorge East	MK Goddard	Snoqualmie Pass
Crater Lake	Mohawk Mountain	Theodore Roosevelt
Crescent Lake	Moosehorn	Tonto
Denali	Mount Hood	Trapper Creek-Denali
Dolly Sods	Mount Rainier	UL Bend
Fresno	Nebraska	Upper Buffalo
Frostburg Reservoir	New York	Weminuche
Fort Peck	North Cascades	White Pass
Grand Canyon	Northern Cheyenne	Wind Cave
Great Gulf	Okefenokee	Yosemite

Transmissometer

Cloud Peak

Nephelometer

Grand Canyon (Hance)
Greer

Photographic

Bryce Canyon
Cucamonga
Grand Canyon
Monture
Shamrock Mine

Monitoring Site Assistance:

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

Optical/Scene sites: contact Air Resource Specialists, Inc.
telephone: 970/484-7941 (Mountain time)

Sites that achieved at least 95% data collection for 3rd Quarter 2006 are:

Aerosol (Channel A)

Addison Pinnacle	Great Smoky Mountains	Petersburg
Arendtsville	Haleakala	Point Reyes
Baltimore	Hoover	Quaker City
Big Bend	James River	Sac and Fox
Birmingham	Jarbidge	Sequoia
Bondville	Lassen Volcanic	Shining Rock
Bridgton	Lye Brook	Sipsey
Douglas	Mammoth Cave	Tuxedni
Flathead	Martha's Vineyard	Virgin Islands
Glacier	Pasayten	

Transmissometer

Badlands	Grand Canyon (South Rim)	Rocky Mountain
Bandelier	Guadalupe Mountains	Thunder Basin
Canyonlands		Yosemite
Glacier		

Nephelometer

Acadia	Estrella	Petrified Forest
Big Bend	Grand Canyon (Indian Gardens)	Phoenix
Boulder	Ike's Backbone	Queen Valley
Children's Park	Mammoth Cave	Sierra Ancha
Chiricahua	Mayville	Sycamore Canyon
Cloud Peak	Mount Zirkel	Tucson Central
Cohutta	National Capital	Tucson Mountain
Craycroft	Organ Pipe	Wichita Mountain
Dysart		

Photographic

Agua Tibia	Agua Tibia North	Gates of the Mtns

Sites that achieved at least 90% data collection for 3rd Quarter 2006 are:

Aerosol (Channel A)

Bridger	Joshua Tree	San Pedro Parks
Cape Cod	Lake Sugema	Shenandoah
Casco Bay	Meadview	Starkey
Death Valley	Monture	Tallgrass
Douglas	Mount Zirkel	Three Sisters
Ellis	North Absaroka	Viking Lake
Great Basin	Petrified Forest	Wheeler Peak
Great Sand Dunes	Quabbin Reservoir	Wichita Mountain
Hells Canyon	Salt Creek	Zion Canyon
Isle Royale	San Gorgonio	

Transmissometer

--none--

Nephelometer

Dolly Sods	Nebraska	Thunder Basin
Great Smoky Mtns	Rocky Mountain	Upper Buffalo
Mount Rainier	Shenandoah	Vehicle Emissions

Photographic

--none--

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First Class Mail

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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. Steering Committee representatives are:

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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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