IMPROVE Steering Committee Meeting Summary
October 23 & 24, 2012
Tahoe Environmental Research Center (TERC); Incline Village, NV
10/30/12 Draft by Gloria Mercer

Overview

The steering committee met at the Tahoe Environmental Research Center, at the Sierra Nevada College in Incline Village, NV, on October 23 and 24, 2012. A copy of the agenda and meeting participants is attached.

Major discussion topics included:

- Network operational status
- Field audit program
- Carbon and ion laboratory analyses
- Interlaboratory comparisons
- Operational changes and challenges
- New data processing approaches
- Carbon Artifact Committee findings
- Multiwavelength HIPS analysis
- Trends analyses
- Budget analysis and discussion
- The future of monitoring

The following summarizes meeting discussions in greater detail as shown in the agenda.

Welcome

Geoff Schladow, of UCDavis (UCD), welcomed the group and provided a historical overview of Lake Tahoe and its watershed. Glacial processes formed the lake 2 million years ago. It is the 11th deepest lake in the world, has a surface size of 500 km^2 with 63 inflowing streams and 1 outflowing stream, and is renowned for its clarity. Sierra Nevada College and UCD operate as a partnership at the Tahoe Environmental Research Center (TERC) and perform research involving lake clarity, air quality, and several other environmental factors important to the region. As partners, they manage the Tahoe Climate Information Management System. Three pollution sources affect the clarity of Lake Tahoe's waters:

1) Fine particles less than 20 microns (72% of these particles originate in the urban upland areas of the lake's watershed),
2) Total nitrogen in the amount of 400 million tons/year (55% of the total nitrogen is from atmospheric deposition), and
3) Total phosphorous, which is a smaller contributor to Tahoe's pollution.

Water pollution problems became noticeable beginning with the 1960 Winter Olympic Games, when urban construction increased rapidly. Another major source of pollution was the 3100-acre Angora Fire, which burned in the southwest portion of the Lake Tahoe Basin in 2007.

Introductions and Agenda Review
Attendees introduced themselves. Meeting presentations from the meeting will be posted on the IMPROVE Web site.

Network Review

Aerosol Monitoring Status Several sites changed monitoring locations or status; Columbia River Gorge, WA, and Haleakala, HI, ended monitoring operations (Haleakala Crater is now the IMPROVE site). San Gabriel, CA, had burnt down due to wildfire and was reinstated nearby as Wrightwood. Wrightwood is now decommissioned and the original San Gabriel site is back operating. Ripple Creek, CO, was relocated to Flat Tops, CO, and Lyebrook, VT, moved across the valley to a nearby location (the relocation was due to a land lease issue). IMPROVE's stance on site exchange is to have one year of overlap of data from both the original and relocated stations before decommissioning the original monitoring station. The program performed 28 audits in 2011; 2 audits resulted in flows >10%, one resulted in a faulty D Module, and one resulted in an unacceptably high B Module flow; the flow was readjusted and the module recalibrated without the need to replace equipment.

Aerosol data have been submitted to the Cooperative Institute for Research in the Atmosphere (CIRA) through October 2011. November and December 2011 data will be submitted by mid-November 2012. UCD is making headway in sample analysis and expects to reach a minimum lagtime between sample collection and sample analysis in late 2013. Sample recovery for 2011 for Channel A is 93%, 93%, 92%, 94%, and 93% (1st Qtr, 2nd Qtr, 3rd Qtr, 4th Qtr, and annual) and recovery for all channels is 90%, 90%, 90%, 93%, and 91% (1st Qtr, 2nd Qtr, 3rd Qtr, 4th Qtr, and annual). Seven sites failed Regional Haze Rule (RHR) requirements in 2011, mainly due to weather (sites inaccessible due to snow or lightning strikes) and operator issues. Additional RHR failures were realized due to anodizing dust occurring at 14 sites and affecting the D Module. This occurrence was first noted in April 2012, however, the incidences apparently began in 2011. UCD identified several solutions to the problem, including installing a tripod to stabilize the PM_{10} stack and avoid it twisting in the wind, adding an o-ring to avoid metal-to-metal contact, and labeling the stack inside the module indicating the proper height of the stack.

UCD produced Quarterly Site Status Reports and e-mailed to 47 recipients at the end of each calendar quarter, to provide a more immediate notification to concerned parties of site issues that may affect data collection. The implementation of these reports last year has resulted in good responses from the recipients and sites are taking action to improve. UCD is also developing a set of training videos for site operators, which will detail servicing tasks including weekly sample changes, interpreting/evaluating flow rate results, and replacing a module, pump, or controller. In addition, as of Fall 2012, UCD directed all sites to begin sampling on Local Standard Time. In Spring 2013 when Daylight Saving Time begins in most areas of the country, UCD will remind operators to NOT change to Daylight Saving Time, but remain on Standard Time.

➔ Gloria Mercer will write an article for the February 2013 issue of the IMPROVE Newsletter, to alert operators and site managers of the sampling time protocol change.

Finally, safety issues exist at 16-17 sites, which may cause injury to operators servicing the stations. At these sites, either the shelter is too high to access safety, site access is difficult, the stack roof is too steep, or there are other roofing concerns that may be hazardous when operators must climb to service the stacks. UCD is working to develop solutions to these safety concerns on a site by site basis.

Optical / Scene Monitoring Status Optical monitoring currently includes 31 monitors throughout the country (30 nephelometers and 1 transmissometer). This is slightly more than last year, generally due to the increase in development of the energy industry in the West and sponsored by federal, regional, or state agencies. Nephelometer data have been submitted to CIRA through June 2012 and transmissometer data have been submitted through December 2011. All standard operating procedures (SOPs) for optical and scene monitoring are updated and current.

Several researchers published a paper that used in-situ data of long-term IMPROVE optical sites to discover trends. Data include several European, Antarctic, and IMPROVE sites in North America. The study found a downward trend in optical aerosol pollution at Acadia, Big Bend, and Great Smoky Mountains; an upward trend at Ike's Backbone and Mt. Zirkel (both sites have been decommissioned); and no trend at Grand Canyon, Mammoth Cave, Mount Rainier, and Shenandoah.

The National Park Service Webcamera network includes 16 monitoring sites with Shenandoah and Grand Tetons joining the network this year. From November 2008 through October 2011 the National Park Service partnered with Olympus camera manufacturers to upgrade the hardware in the network. Air Resource Specialists, Inc. (ARS) developed mobile apps for operators to access on-site; these apps display images and data to assist the site operators in servicing their Webcamera systems. ARS collects statistics for all Webcamera sites including page views and image download counts. Denali and Grand Canyon receive far more page views and downloads than the other sites.

ARS is now developing a night-sky camera system, which will be deployed and tested in Bryce Canyon, UT. Bryce Canyon is northeast of the Alton Coal Mine, which may expand from its current 300 acres to nearly 3,000 acres. The system will monitor night-sky conditions using a DSLR camera, operating on a low-power solar/battery system, and controlled by custom software on an Android tablet. It will collect radiance measurements, to quantitatively derive the spectral radiance field of the night sky. Researchers in Hungary have performed these measurements also; the collected images were calibrated and mapped the visible color wavelengths (red-orange-yellow-green-blue-violet) from the collected camera images. ARS is currently testing the system at its offices and is working on calibration techniques.

Quality Assurance – Field Audits and Auditor Training IMPROVE's goal is to have 25% of the network audited annually (about 40 site audits), however, in 2011, only 28 audits were performed. Generally, the goal was not realized due to a reduced budget and funding. The U.S. Environmental Protection Agency (EPA) received little to no audit information from the northern, northeastern, and northwestern states, some of the West and Great Plains states, south-central states, southeastern states, and Alaska. Adequate audit information has been received from Colorado, Arizona, Missouri, and Maryland. EPA is scheduled to purchase three audit standards for federal auditors next year, has produced an audit video, and will reassess and reorient auditor training. An outstanding goal is still the development of a Quality Assurance Web page. In addition, EPA is developing a methodology for challenging data storage cards, and may implement a spot check of downloaded data for deviations from average values.

EPA is making great efforts to collect audit information and make it available, so data users should utilize this collected information, including comparing historical data to newly collected data. Since the network has continued difficulty obtaining a 25% audit rate, perhaps the program should review its criteria as stated in the Quality Assurance Project Plan. Some sites never receive an audit while other sites receive more frequent audits – the program has not detailed specific, regional audit requirements. UCD is developing an internal audit summary and is collecting data in one database for computation and development of graphical statistics.

Although IMPROVE is a regulatory network operating under RHR requirements, the Chemical Speciation Network (CSN) achieved an audit rate of over 50% of its sites last year. The network operates over 180 monitoring stations. The US Forest Service will try to audit one site this year; perhaps other federal land managers can also commit to auditing a site.

➔ UCD will provide the IMPROVE Steering Committee, before the next meeting, a report that contains statistical distribution of audit flow data and the geographical representativeness of audits.

Laboratory Review & Methods Development

Carbon Analysis Desert Research Institute (DRI) is developing the Model 20XX as the next generation carbon analyzer. The lab analyzes approximately 1,900 samples per month and operates 6-7 days per week, 24-hours per day. Approximately 21,000 IMPROVE samples are analyzed per year; samples for January through June 2012 will be analyzed by the end of October 2012.

The Model 2001 carbon analyzer now has an improved oven relay to ensure heat dissipation and minimize outages. The lab also installed a new coupler on the analyzer, to increase stability and reduce laser drift. These changes are reflected in a revised SOP for carbon analysis, which was finalized earlier this month. Because of a worldwide helium shortage, DRI is developing a plan to reduce helium consumption in its operations by 50%, and will eventually replace helium with another non-oxidizing gas (nitrogen or argon). With the Model 2001, DRI will be able to implement EUSAAR-II

protocol (European Supersites for Atmospheric Aerosol Research), which uses a hotter analysis chamber for each carbon fraction.

DRI scientists are involved with several research studies: 1) conducting experiments with the Model 20XX, 2) investigating changes in filter mass that may be related to organic vapor adsorption, 3) characterizing source and chemical structures of brown carbon and compounds in thermal fractions, 4) examining data trends between elemental carbon (EC) and filter reflectance to resolve questions about consistency after the instrument upgrade in 2005 with IMPROVE-A protocol.

Trend analysis shows consistent, decreasing trends in EC and reflectance at 65 IMPROVE sites during the period 2000-2009. EC has been decreasing 4.5% per year and reflectance has been decreasing 4.1% per year. Several other studies involved various topics: a study to quantify C, H, N, S, and O via mass spectrometry produced elemental concentrations comparable with other detectors; seasonal variations in elemental composition was studied using Fresno data. Elemental composition of the carbon fractions were different in summer when $(NH_4)_2SO_4$ is abundant and winter when NH_4NO_3 was abundant. Compositional differences in carbon fractions were also seen with gasoline and diesel fuels. An experimental configuration using a xenon multi-wavelength light source showed that spectral reflectance distinguishes native and charred light-absorbing carbon in wood smoke. DRI also produced 33 publications in the last year. Canada and China have adopted IMPROVE-A protocol for their long-term networks.

Future projects at DRI include evaluating differences in EUSAAR II vs. IMPROVE-A protocol, retrofitting new valves and circuitboards to reduce helium consumption, participating in European efforts for round-robin carbon intercomparison and standard reference material development, developing an algorithm to convert the reflectance/ transmission signal to absorption to quantify organic carbon (OC), brown carbon, and EC; and integrating C, H, N, S, with O analysis.

Ion Analysis Dr. Prakesh Doraiswamy (post-doctorate for Judy Chow), has joined Research Triangle Institute (RTI) and brings a new dimension in air quality modeling to the lab. RTI analyzes 21,000 nylon filters annually for anions, and have analyzed 1500 H_3PO_3-coated cellulose filters for ammonia for the NH_x Pilot Study.

In July 2012, the lab also participated in a Technical Systems Audit by NAREL, which documented excellent results. The audit included levoglucosan analysis of $PM_{2.5}$ Teflon filters. Ion chromatography (IC) analysis for levoglucosan was confounded by interference from the ethanol used to extract the sample. The ethanol can be removed by freezedrying, but it is expensive and is the only known method at this time. Both RTI and NAREL conducted experiments using exposed filters; some filters were pre-wetted with ethanol and some were not. Analysis results from both groups of filters were similar, indicating that pre-wetting filters with ethanol is probably not necessary. Ethanol also affects Cl, NO_2, and NO_3 peaks.

A question arises if extraction is complete if filters are not pre-wetted with ethanol. To study this, UCD loaded Teflon filters with known quantities of $(NH_4)_2SO_4$. Teflon filters with and without ethanol pre-wetting showed consistent ability to measure NH_4 and SO_4 within about 10%, however both NO_2 and NO_3 measurements showed large variability. Filter blanks were then used, which also showed significant NO_2 and NO_3 variability. The amount of the NO_2 and NO_3 were variable and random. This was not due to the ethanol, nor laboratory contamination, however, it is unknown where the contamination originated from. The contamination may be on the filter material or it may be on the filter ring. The filter rings have never been analyzed. The analyses did not measure the corresponding cation.

UCD Operational Changes & Challenges In 2011, analysis with new XRF systems caused a delay in data delivery, but data delivery is now getting back on schedule. Operational changes at UCD over the past year include a new laboratory location, new Mettler balances, new barcoded filters, and all three X-Ray Fluorescence (XRF) systems became operational. All 2011 samples were analyzed using the PANalytical XRF systems. Current needs include new lab software (scheduled for 2013-2014), a new temperature/humidity weighing chamber system (scheduled for 2014-2015), an automated weighing system, new data validation and delivery software, implementation of multiwavelength laser absorption, and new pre-cut inlets for $PM_{2.5}$ cyclone cutpoint irregularities.

The barcode is a miniscule (2-dimentional matrix code) on filters, which contain consistency checks within the code itself. UCD is working on getting the code into a useable format.

The XRFs operate continuously 24/7, and UCD is continuing on developing further automation of the processes. Blank corrections, detection limits, and uncertainties are now based on field blanks and collocated data. New XRF data can be compared to data from prior instruments. Analyses results of several elements brought the following findings: there may be a seasonal pattern of sulfur vs. sulfate; the silicon/iron and Al/Fe ratios show a shift in analysis instruments including a large difference with the PANalytical system currently used; the Si/Al ratio uncovered that the diaphragm was installed upside down in the 3rd XRF system. Finally, the legacy of XRF data greatly overcorrects for matrix attenuation of the Na signal, giving the appearance of Cl depletion where it does not exist.

The Version II IMPROVE aerosol sampler is currently undergoing a redesign of its electronics system, which is 13 years old. The current module controller system will be discontinued and a new system with digital sensors, is being developed. The current controller system has electrical noise, a limited display size, and shipping of data cards result in a 3-4 week delay in getting feedback on sampler performance. UCD is working on a new, cellular-based or satellite-based data transmission system to obtain real-time data. A prototype of the new controller/modem system is being built, and is scheduled to be deployed for testing during Winter 2013-Spring 2014. Flashcards will probably continue to be used as a backup of data storage. The new e-box may also alleviate the need for on-site calibration and technician visits.

Development of new data management software is now being conducted by a new team of developers. Applications are being developed for field operations, laboratory operations, and data processing and validation. Data will be consolidated into SQL Server.
Lab staff have identified $PM_{2.5}$ cut-point discrepancies in data from seven collocated sites. The data display much larger differences in soil-derived elements than expected. Experiments were conducted at the Phoenix site using 2.5 cut-points; the filters had particles >20µm on them, resulting in a collection efficiency of >100%. Some very large particles are getting through the cut-point system. Leak testing using HEPA filters concluded that leaks in the system were not the cause. Testing is continuing using two modules connected to one inlet, and a module with a greased cyclone to see if other particles are "bouncing" inside the cyclone.

Laboratory Intercomparisons & Issues NAREL performs laboratory intercomparisons as well as Technical Systems Audits and special studies. NAREL headed a performance testing intercomparison involving seven laboratories: the California Air Resources Board, DRI, Oregon DEQ, RTI, California's South Coast Air Quality Management District, EPA's National Exposure Research Lab, UCD, and NAREL. PM2.5 measurements were consistently good across the labs. IC analysis of nylon filters using the CSN technique performed on samples collected in March and June compared well among all labs, though AQMD failed to detect potassium in all samples and sodium in the June replicates. IC analysis on nylon filters using the IMPROVE method showed good agreement between RTI and NAREL, the only participating labs. IC analysis of Teflon filters found the same evidence of contamination of NO3 seen at RTI. NAREL also found that XRF results from replicate filters for each element compared well among each lab.

EPA is using a new MTL Teflon filter, which NAREL studied. The filters are coded with ink, which NAREL found dissolves in ethanol which is a possible explanation of the NO3 artifact.

Aerosol Chamber and Standards UCD is conducting research to evaluate and improve XRF measurements. Research projects include: 1) using single element standards for the PANalytical system, 2) determining error in silicon and aluminum historical data, and 3) estimating the sample area for reporting XRF data.

Making single element standards is desirable because it allows standards to be used that have similar properties (e.g. substrate and chemical composition) to IMPROVE samples. Using the aerosol chamber at Davis, standards have been made for S, Na, Cl, Si, and P. While the S, Na, and Cl standards are producing consistent and good results, calibrating the P and Si standards is more problematic. UCD has a number of tests to perform to increase their understanding of these standards.

UCD is also working on an EPA project to create lead deposits on Teflon filters for Federal Equivalency Method testing and approval, using quarterly audit analysis

samples, and with possible uses as standard reference material. Initial experiments show promise, but further work is being done.

A data advisory will be posted to the IMPROVE Web site regarding the use of Si and Al values when S/Fe ratios are high. (>8). Generally this applies to sites in east, south, and midwest. The results do not apply to sites with urban influence.

UCD is also evaluating the effective area of teflon filters used for XRF. The nominal unmasked cassette area used for measurement is 3.53 cm^2 and the nominal masked area is 2.20 cm^2. Unmasked filters consistently show higher median sulfur measurements than masked filters. New measurements of the effective area of the filter explain some of the observed bias between masked and unmasked filters.

New XRF Data Processing Approaches The old (legacy) reporting metric was to measure the detection limit with a theoretical estimate of the spectral background. The new, empirical reporting method is based on the observed distribution of field blank loadings. The old approach to measure the error/uncertainties is based on the quality of the spectral peak and estimates of uncertainty in analytical calibrations and sample volume determination. The new, empirical method is based on observed differences between collocated measurements. The new method, developed by UCD, has been tested using collocated, Sac and Fox Nation data from 2010-2011.

Multi-Wavelength HIPS The current HIPS system uses a single wavelength and red laser at 633nm. The new, multi-wavelength HIPs system has no laser, but instead uses a broadband visible light source. Comparison tests will quantify performance at 633nm and at 5nm. UCD is currently refining the system and model to simulate radiative losses and spectral resolution. Final testing, design, and implementation is scheduled for 2013.

Additional research UCD is conducting includes reanalyzing 15 years of elemental data from Great Smoky Mountains, Mount Rainier, and Point Reyes. A light, mid-range, and heavy element were selected for use (sulfur, valadium, and nickel) to compare analysis methods starting with the PIXE to the Mo and Cu XRFs to the Cu vacuum XRF to the newer PANalytical system. Trends analysis indicates similar results for sulfur among the instrumentation but vanadium shows dramatically different results.

Mauna Loa has over 20 years of data, which has been mostly ignored by the air quality community. Data from 2002-2010 were recently analyzed on the Cu XRF and Mo XRF and will be reported soon. Mauna Loa has two A modules; one runs 24-hours/day and the other runs during nighttime hours only. It is known that the airflow surrounding the monitoring area is different during the day than during the night. Analyses results show much more sulfate on the 24-hour samples. UCD will introduce the dataset in a new publication.

FTIR Measurements FTIR (Fourier Transform Infrared) spectroscopy is used to analyze organic mass on samples, which in turn, is used for the RHR. Organic Mass includes C, O, H, N, and S. The current method of estimating OM is OM = (measured OC) x (OM/OC). FTIR is a non-destructive method of analysis on Teflon filters. IR

absorbances correspond to organic functional groups. The sum of functional groups = organic mass. Limitations of FTIR include: it cannot be used on quartz filters, it is not organic-compound specific, it identifies interferents, and it needs organic laboratory standards. Using Partial Least Squares Regression, many spectral data points can be reduced to a few principle components. Absorbance is directly proportional to the functional group mass on the filter. Results of 8 sites (Trapper Creek, Olympic, Phoenix, Mesa Verde, Sac and Fox, St. Marks, and Proctor Research Maple Facility) show a correlation of 0.7741 using FTIR OC vs. artifact-corrected Thermal Optical Reflectance (TOR) OC.

Accomplishments realized include the development of 1, 2, and 3-layer standards with four functional groups, and the development of PLSR calibrations and application to the 8 sites. Is FTIR feasible for use in the IMPROVE Network? All Teflon filters can be analyzed with one FTIR instrument, but it needs further automation, more standards, and quality control of data analysis. Funding has ended for FTIR but before all operations cease and to preserve the entire effort, UCD has developed SOPs for creating and analyzing standards. The balances will be maintained by others for use elsewhere. UCD will write an SOP for the computer code to analyze spectra, and the code, spectra, and data will be backed up by IT staff. UCD will also write a paper describing the FTIR methods. If future funding becomes available, UCD would analyze one year of data, make additional standards, and evaluate the accuracy, precision, and MDLs of FTIR.

Data Processing, Distribution, and Quality

IMPROVE/CSN Carbon Artifact Committee Findings The committee was tasked to recommend a method to artifact-correct OC for IMPROVE and CSN, and plan to implement the change in IMPROVE. CSN is currently not correcting for artifacts. IMPROVE is considering the use of blank filters instead of backup filters to correct for artifacts, as blanks are more consistent and less variable over time. Blanks for both networks are similar but backups are not. IC and XRF both use blanks for artifact correction. Blanks are simple to use, are low-cost, don't over-correct, and decrease additive artifacts. UCD tested three hypotheses: 1) DRI filter manufacturing changes, 2) UCD change of airflow through blanks (pulled air through blanks for 14 seconds prior to August 2008 but no air flow after August 2008), and 3) UCD switch from single to double quartz filters, also in August 2008. Hypotheses #3 is the probable cause. UCD tested the hypothesis with an experiment using double and single quartz filters, operated in parallel at six sites to determine if the change in artifact correction makes a difference. After findings are compiled, UCD will prepare a report with data analyses through 2011, and will likely recommend to the IMPROVE Committee to use single blank correction for both networks.

UCD will continue to use backups and blanks to obtain a 5-year dataset. IMPROVE will collect single blanks and add collocated backup filters at Hercules-Glades. CSN will continue using a 10% correction rate. Reporting of data will include correction of artifacts using the monthly median blank. Historic data will be reported using field blank

correction for OC to January 1, 2005. CSN in the future will artifact-correct using monthly median blanks, identical to the IMPROVE network.

Do particles impact the evolution of gases from backups and blanks? Backups and blanks typically don't have OP. Is the observed difference due to particles on the front filter, with no particles on the backup or blanks? An experiment with backups and blanks, using OC concentrations, was performed to answer these questions. Some filters had ammonium sulfate added to them. Analysis results showed OC increases when more particles are added to the filter, and OC3 decreases. Blanks show no OP. Treated filters lost OC1. Backup and blank fractions may not represent artifact fractions on front filters.

IMPROVE Data Analysis Visibility improved in Great Smoky Mountains from 1990-2010. Sulfate trends were developed using Thiel Regression and data from 1989-2010 and from 2000-2010. The worst visibility occurred in Big Bend, California, Nevada, Utah, and Arizona (using 20% worst days), but trends show haze improving at most other monitoring sites. The annual US mean of ammonium sulfate, ammonium nitrate, total carbon, and soil mass has been dropping since 1990, especially from 2005-2010. The annual mean (1989-2010) sulfate decreased nationwide at both IMPROVE and CSN sites.

SO_2 emissions from two databases (EPA's Acid Rain Program and the National Emissions Inventory) for the period 1970-2010 showed a four-fold decrease during the period. December data for 2006-2010 for sulfate and iron both, show increases in the Great Plains, perhaps due to oil and gas development in the West and in Canada. Trends in annual mean nitrate show significant improvement in most areas of US during 1989 to 2010. Trends in soil are much more variable relative to other species. Nitrate levels may be due to oil and gas and international influences, soil and land use change, manmade sources, long-range transport, and drought.

Urban excess maps showing ammonium sulfate, ammonium nitrate, particulate organic matter, and light absorbing carbon. High urban excess occurs in winter throughout the US. Ammonium nitrate hotspots are Denver, Los Angeles, Washington DC, and Great Smoky Mountains in July. Future study will include seasonal sulfate trends, nitrate and soil trends, and urban excess.

Carbon Apportionment Total carbon in the period 1996-2006 during winter and spring decreased while the summer and fall seasons increased. Trajectory analysis (qualitative) and chemical transport (quantitative) models are currently used. To bridge the gap between these two models, a semi-quantitative total carbon source type apportionment model can be used. The new "chemical" transport model to apportion total carbon uses the Capita Monte Carlo particle dispersion model and back airmass histories with simulated contributions of other sources. The model was fitted to total carbon from 162 IMPROVE sites in 2008. The model captures the temporal variability in the IMPROVE Network. This CIRA/NPS work resulted in a simulated vs. measured total carbon analysis of 2008 data showing peaks in June, July, and August. Different source categories (for all IMPROVE sites) show seasonal variation. Seasonal source

apportionment was developed for the source categories of fire, mobile, area, oil, point, vegetation, and other. To see if there are other biases, sources, or if results can be refined, CIRA/NPS looked at the Hybrid Receptor Model. Total carbon was used but source contributions were mulled by error and scaling coefficient. Use Bayesian Least Squares to reduce instabilities. Scaling factors such as oil, point, and other have little influence on regressions. The model underestimates vegetation by 10% on average, and 15% to 30% in summer. Area and fire are overestimated up to 15%. Improvements (reduced biases) were seen in the refined model using 2006-2008 data. Mobile sources are a very small contributor at rural locations, especially in the East, while biomass burning is a large contributor in the West.

Total carbon is much worse in summer in the West. Seasonal trends for 1996-2006 show the best visibility occurs in spring. Scatterplots of several western wildfires show other measured nitrogen species (NO_x/NO_y) increase with smoke.

Newsletter and Calendar The Steering Committee decided one year ago to discontinue printed newsletters and opted instead for electronic distribution only. This move resulted in annual savings of over 50% to the program (~$2,000 per quarter). The hardcopy distribution of 600 was reduced to 120 (plus operators). The current distribution is 120 recipients across the country, which includes 69 new recipients during the past year. Electronic distribution also enabled full-color graphics without additional cost. The 2013 IMPROVE calendar is now being developed; CIRA staff are working on several technical articles and distribution is expected late December.

Other Topics

IMPROVE Steering Committee Business UCD field technicians have done a fantastic job reinstalling the second Breton Island monitoring site. A Memorandum of Understanding (MOU) was introduced to the Steering Committee circa 1994 but never ratified. The USFS is inquiring about updating the document. The MOU agreement, to be approved by all IMPROVE funding agencies, was passed to corresponding agency lawyers in the 1980s. It was given a second chance for approval in the 1990s but again never was approved or finalized due to legal requirements with specific agencies. Therefore, no current document exists showing how the steering committee is run. Running the MOU a third time probably won't be a successful task.

UCD plans to revise the program Quality Assurance Project Plan (QAPP) in 2013. This document could be a substitute for an MOU. Another idea is that the USFS and each other agency, could ratify a Memorandum of Commitment. On another point, there was no motion to elect a new Committee chair for the coming year; Scott Copeland will continue to chair the IMPROVE Steering Committee and its actions for another year.

Budget Analysis & Discussion Operating costs are approximately $36,000 per site. Because of tight federal and state budgets, it is likely that some IMPROVE Protocol sites may be decommissioned; this will increase the cost-per-site. EPA is required to fund 110 sites with 105 funds. Discussion of EPA funding operations. SIPs maintain that states will provide monitoring in Class I Areas (this is a form of an MOU). EPA funds

approximately 170+ IMPROVE sites for approximately $6 million. Options for future funding include: reduction of sites with similar characteristics (this idea has been entertained previously), operational options (reducing site visit frequency and delaying maintenance), analysis options (already ended PESA and may reduce analysis of some elements), and reduction of sampling frequency or analysis frequency (may affect trends).

The general plan is to form a subgroup to identify options, analyze effect on RHR trends, and understand ramifications of changes to data quality. UCD believes if trace elements are cut from analysis, it would only save the program approximately $100,000/year. IMPROVE needs to consider options now, in the event EPA decides to reduce funding.

- ➔ A subgroup was formed and will schedule a meeting soon, to identify future operational plans in the event of funding cuts: Neil Frank, Bob Lebens, Rich Poirot, and Laurie Trinca.
- ➔ David Krask will try to attend the EPA Monitoring Steering Committee meeting in January.

IMPROVE 2020: Future Monitoring The future of aerosol monitoring for both IMPROVE and CSN was presented at the recent A&WMA conference in Glacier, MT. Future needs include evaluating and refining existing analysis methods. Future monitoring studies may include an IMPROVE supersite to test, evaluate, and develop the next generation of sampling systems; utilize the Bondville, IL, supersite; perform special studies; and operate more optical instrumentation (to revise and recheck the IMPROVE algorithm). Continuous mass measurements may be necessary, but no instrument is currently on the market that has what IMPROVE requires for monitoring.

Suzanne Herring is developing automated sampling systems, including a low-cost instrument that is returned in its entirely to a laboratory for analysis. IMPROVE may seek out new, future monitoring systems either ad hoc, or by formalizing efforts by sending out specifications seeking manufacturing sources. Does future monitoring require daily data collection, or continue with 1 in 3 day schedule? Thermo makes a continuous sulfur analyzer, but no continuous analyzers are available at a lower cost than IMPROVE, and they also need more frequent servicing than current IMPROVE samplers. We believe no state has questioned the integrity and accuracy of IMPROVE data, and we need to keep it that way when monitoring in the future.

Next Meeting: Location & Timing Choices for the next meeting location include Grand Canyon, Voyageurs, or Isle Royale. Perhaps collocate with the National Atmospheric Deposition Program/Clean Air Status and Trends Network (NADP/CASTNET) meeting in an effort to build interactions with other monitoring programs. NADP will meet in Park City, UT, the second week of October. May be difficult for EPA to send several representatives. Schedule one day of joint meetings, one day of NADP topics, and one day of IMPROVE topics.

➔ Scott Copeland will investigate the idea of collocating the IMPROVE meeting with the NADP meeting next October. Then would like to visit the upper Midwest the following year.

-- meeting adjourned --

DRI Reno Laboratory Visit

Tour DRI Reno Lab Following meeting adjournment, the group travelled to Reno to tour the laboratory facilities. Laboratories toured included the Environmental Analysis Facility, the Organic Analysis Laboratory, the Source Characterization Laboratory, and the Carter Family Optics and Acoustic Laboratory.

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IMPROVE Steering Committee Meeting Participants
October 23 & 24, 2012
Tahoe Environmental Research Center; Incline Village, NV

Time	Topic	Discussion Leader
	Tuesday, October 23	
8:00am	Welcome	Geoff Schladow
8:15am	Introductions and agenda review	Scott Copeland
	Network Review	
8:30am	Aerosol monitoring network status	Chuck McDade & Nicole Hyslop
9:30am	Optical and scene monitoring	John Molenar
10:00am	Break	
10:15am	Quality assurance – field audits & auditor training	Dennis Crumpler & Jeff Lantz
	Laboratory Review & Methods Development	
10:45am	Carbon analysis	Judy Chow
11:15am	Ion analysis	Eva Hardison
11:45am	Lunch	
1:00pm	UCD operational changes & challenges	Nicole Hyslop
2:00pm	Laboratory intercomparisons and issues	Jewell Smiley
2:30pm	Aerosol chamber and standards	Ann Dillner
3:00pm	Break	
3:15pm	New XRF data processing approaches	Warren White
3:45pm	FTIR measurements	Ann DIllner
4:15pm	Multi-wavelength HIPS	Chuck McDade
	Data Processing, Distribution, and Quality	
4:30pm	Data analysis and uncertainty	Nicole Hyslop
5:00pm	Review agenda and wrap up	Scott Copeland
5:15pm	Adjourn for the day (group dinner for those interested)	
	Wednesday, October 24	
	Data Processing, Distribution, and Quality (continued)	
8:00am	IMPROVE/CSN carbon artifact committee findings	Ann Dillner
	Data Analysis	
8:30am	IMPROVE data analysis	Jenny Hand
9:00am	Carbon Apportionment	Bret Schichtel
9:30am	Newsletter and calendar	Gloria Mercer
9:45am	IMPROVE Steering Committee business	Scott Copeland
10:00am	Break	
	Other Topics	
10:15am	Budget analysis & discussion	John Vimont/ Bret Schichtel
11:15am	IMPROVE 2020: Future monitoring	TBD
11:45am	Next meeting: location & timing	Scott Copeland
Noon	Adjourn for field trip	
	DRI Reno Laboratory Visit	
2:30pm-4:00pm	Tour DRI Reno Lab	Judy Chow/ Marc Pitchford
4:00pm	Adjourn. DRI Reno Lab is about 6 miles from Reno Airport	

IMPROVE Steering Committee Meeting Participants
October 23 & 24, 2012
Tahoe Environmental Research Center; Incline Village, NV

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