IMPROVE Steering Committee Meeting Summary
June 3 & 4, 2003
Arizona DEQ Southern Regional Office; 400 W. Congress, Suite 158; Tucson, AZ
Draft by Gloria Mercer, Edited by Marc Pitchford – June 16, 2003

Overview

The steering committee met at the Arizona DEQ Southern Regional Office building in Tucson, AZ, on June 3 and 4, 2003. A copy of the agenda and meeting participants is attached.

Major discussion topics included:

- Status of the particle monitoring network, data, and UC-Davis implementations
- Nitrate trends analysis and handling issue
- Status of the optical monitoring network and data
- State of Arizona $PM_{2.5}$ nephelometer project
- Site operator support issues and plans
- Ion, coarse, and Yosemite special studies
- STN/IMPROVE network comparisons
- VISTAS request for quartz filters
- Digital photography innovations

Welcome, Introductions, and Agenda Review

The meeting was called to order and the agenda was reviewed. Presenters of a couple of agenda items were changed and an agenda item was added concerning the VISTAS Regional Planning Organization's request for quartz filter from the IMPROVE archive.

Status of Network Operations

Particle Monitoring Network

There are currently 164 aerosol monitoring sites, 11 of which are tribal sites. During 2nd Qtr 2002, 12 sites were installed and during 3rd Qtr 2002 6 sites were installed. During 2003 to date, 4 sites have been added to the network (Martha's Vineyard, Meadview, Organ Pipe, and most recently, Walker River Paiute). Several sites will be relocated, including: Zion (February 2003), Mount Rainier (scheduled for Summer 2003), San Gorgonio (scheduled for Summer 2003), and possibly Badlands. The State of South Dakota is concerned that the Badlands aerosol sampler is being contaminated by park activities, so they have requested a special study to be conducted this summer and fall to determine if there is significant impacts by local sources. The four month study consists of operating a second IMPROVE aerosol sampler at a remote site several miles from the original site, which will continue to operate. If the second site produces significantly lower concentrations it will replace the original site, otherwise the original site will be continued. The transmissometer location at Badlands has not been called into question.

Year 2002 sample recovery for channel A is 94%. Recovery for quarters 1, 2, 3, and 4 is 92%, 94%, 94%, and 95% respectively. The 6% unrecoverable samples are due to: operator no-show (40%), power outages (24%), equipment problem (17%), incorrect

filter installation (15%), and damaged filters (4%). Six sites with recurrent poor recovery are: 1) Indian Gardens - unreliable operator (has been resolved); 2) Old Town, ME - operator unmotivated; 3) Capital Reef - power outages (end of power grid); 4) Kaiser - operator unmotivated and unreliable; 5) Breton - accessibility; and 6) Tuxedni - accessibility. Most site operators are enthusiastic and do excellent work; the best operators are involved with environmental work and are employed full-time.

Aerosol data (ions, carbon, and elements) are available through October 2002. November data should be available by mid-June, and December data should be available in July. UC-Davis is working to achieve a 6-month lag time between data collection and data delivery, and may be able to achieve a 5-month or 4-month lag time. It currently takes 3 weeks to analyze 1 month of samples on XRF and 2 days to do PESA. UC-Davis has two XRF systems now. Quality control comparisons of sulfur-times-three on Teflon filters vs. sulfate on nylon filters show good correlation with over 5,000 data points, and reconstructed mass vs. gravimetric mass at western sites also compares well.

Recent changes at UC-Davis include: 1) purchase of 20 new samplers, 2) data delivery to the central database has been changed from quarterly to monthly, 3) annual data reports have been resumed beginning with 2001 data, 4) collocated samplers (24 modules) have begun to be deployed to assess measurement precision, and 5) a new test site has been established at Davis. Upcoming changes will include: 1) collocated operation of samplers with STN (Speciation Trends Network) samplers will occur at 8 urban sites, 2) a coarse particle speciation study is scheduled (9 sites for 1 year, to begin Summer 2003), 3) comparison tests to the Berkeley XRF system will occur, 4) gray literature will be added to the IMPROVE Web site, and 5) the filter archiving approach (retain channel A, C, & D filters) will be upgraded. Recent/upcoming laboratory changes at UC-Davis include: 1) a second XRF system has been added, 2) the weighing lab temperature and relative humidity will be controlled (scheduled for Summer 2003), and 3) the carbon lab will change to TOR/TOT (Thermal Optical Reflectance/Thermal Optical Transmittance) analysis (scheduled for late 2003).

There have been some outside requests to purchase IMPROVE samplers, but purchasing them one at a time is extremely costly. URG sells the samplers but not the filter cassettes. UC-Davis is considering an approach for “franchising” the sampler. Technical investigations to be performed include: 1) carbonate denuder field tests, 2) carbonate denuder lab tests (at CSU), 3) nylon filter investigations, 4) assessment of organic sampling (denuder, artifact correction approaches), 5) sample temperature evaluation (shelter installations, etc.), 6) Version I and Version II sampler collocations at Davis, 7) comparison of IMPROVE methods with other networks, and 8) consider alternative future methods (establish an IMPROVE supersite). Plans for the new UC-Davis test site include: 1) Version I vs. Version II comparison, 2) denuder tests, 3) 25mm vs. 35mm nylon filter tests, 4) differences in nylon filter lots tests, and 5) quartz filter tests, with and without a carbon denuder.

Trends Implications of Protocol Changes
UCD is conducting assessments of the possible affects of historic sampling/analysis protocol changes on trends analysis of the data. Nitrate changes at Mammoth Cave show a marked increase during Winter 2000 from previous years. Several sites show similar behavior. Sulfur was also high at all sites during the season; four collocated CASTNet sites concur. Several possible causes for these changes were suggested: 1) the high nitrates during 2000 may be due to the first cold winter after several mild ones; 2) something may be occurring in the measurements we don't understand; 3) an extraneous source of nitrate and sulfate may exist, maybe from across the Pacific Ocean, and 4) different factors may be responsible for the nitrate and sulfate spikes in the east and west. During discussion, it was suggested to look at the Winter 2000 season as individual months. More on this topic is summarized below.

Optical monitoring network
The transmissometer network currently includes 19 remote and 5 urban sites. The nephelometer network currently includes 30 remote and 10 urban sites. Other agencies are also now operating Optec NGN-2 and Radiance Research nephelometers. Use of protocols and instruments that are different from those used for IMPROVE can lead to inconsistencies with IMPROVE data.

All optical data generated by ARS are delivered to CIRA except for Wyoming sites (the state of Wyoming chooses to retain these data). Nephelometer data are delivered 90 days after the end of the previous quarter and transmissometer data are available 6 months after the end of the previous year. Optical data can be delivered in real-time, but this is costly; an additional person would be required for maintenance of the systems. Nephelometer data are currently available through March 31, 2003 and transmissometer data are currently available through December 31, 2002. Transmissometer data require various equations and calibrations that must be examined before validating the data. The use of transmissometer data for trends analysis is highly discouraged due tendency of the data to have variable biases related to issues like lamp calibrations. Aerosol reconstructed extinction are thought to be a better source of information for trends analysis. (See the discussion on this topic in the Gray Literature section on the IMPROVE web site.) Discussion ensued regarding whether a time limit exists regarding the term of transmissometer operation at particular sites. IMPROVE has installed more nephelometers than transmissometers since 1990 because they are easier to operate, but transmissometers can provide "closure" since unlike nephelometers they see the full effects of both light absorption and coarse particle scattering. The data are insightful and useful with continuous-based measurements vs. non-continuous filter-based measurements.

A scatter plot of transmissometer vs. aerosol reconstructed extinction with 13,000 data pairs shows that on the haziest days, reconstructed extinction underestimates the measurements by transmissometers, while on the clearest days it overestimates the transmissometer measurements. Analyzing transmissometer data is complicated due to different lamps being used, which have different brightening characteristics. ARS is generating a comprehensive report to include all transmissometer data collected between 1988 and 2002. The report will examine: 1) calibration procedures, 2) lamp

brightening, 3) window cleaning, 4) instrument effects, 5) transmissometer vs. aerosol, and 6) site-specific problems. A draft report will be distributed to various IMPROVE members for review by October 1, 2003. Nephelometer data will eventually have a similar report.

IMPROVE and CASTNet Nitrate Trends

The nitrates increase seen during the winter of 2000-2001 at the IMPROVE sites is also seen at the CASTNet sites, especially in a region extending from Illinois to NY. High PM2.5 mass in the urban Federal Reference Monitor urban network observed during the first calendar quarter of 2001 can also be explained in part by higher nitrates. Although the CASTNet filter pack nitrate measurement is potentially biased low, because of volatilization during sampling, these measurements agree very well with those from the collocated IMPROVE site during 2002 at Bondville IL. The IMPROVE nitrates are relatively higher than collocated CASTNET as locations move to the east. Discussion ensued on nitrate volatilization, availability of ammonia and other conditions related to nitrate formation.

The winter of 2000-2001 was one of the coldest winters in recent years, and it followed several years of abnormally warm winters. The priors two winters, in particular, were among the warmest on record. There also was an especially persistent snow cover in the northern states during the 2000-2001 winter, resulting from storms in November and December 2000. This snow cover was slow to melt in the northern Midwest and in the Northeast. These colder temperatures in 2000-2001 may have diminished the volatilization of nitrate, possibly resulting in larger observed particulate nitrate concentrations.

Urban and Rural Comparisons

Fine particle chemical composition for EPA's urban "Speciation Trends Network (STN) sites were compared to those at nearby IMPROVE sites. Sulfate concentrations were very similar, especially after adjusting the rural concentrations for altitude. This is consistent with the regional nature of this pollutant. Although carbon is also regional, concentrations show a large urban-rural gradient. This suggests urban sources contributing to carbon aerosols. The carbon measurements were presented as estimated total carbon mass to handle the known difference in analytical techniques between the networks. The STN carbon data were blank adjusted using network-wide factors as used by IMPROVE.

Handling the Nitrate Trends Issue

Abrupt changes occurred in nitrate data at many IMPROVE sites, which affected both magnitude and variability. The addition of glycerin to the Module B denuder in 1996 corresponds roughly to the time of the first nitrate change. The second change occurred in 2000 data, but no known change in the denuder protocol occurred at that time. The amount of change varies by site. Both NPS ARD and CIRA personnel worked on this issue and compared results. The current solution is to replace the nitrate values with arbitrary, constant values, and test other variables to see if missing values can be replaced. Then generate daily aerosol extinction and sort into quintiles (10-30-50-70-90) based upon reconstructed extinction. Then replace the arbitrary nitrate values with

estimated constant nitrate values by group, and recalculate the budgets. The current procedure for nitrate substitution value generation is: 1) assume the nitrate data are "good" after 1996, 2) generate budgets for 1997-1999 and sort into annual 10-30-50-70-90 groups, and 3) compute average nitrate by site, group, and year. Unresolved issues are: 1) budget generation procedures have changed since nitrate substitution values were first generated – we need to recalculate, 2) which are "good" data, and when should we substitute, 3) should we generate new substitution values when we get new data, 4) should we apply substitutions at sites that began after 1996, 5) what should we use for nitrate during the initial sort, 6) how can we substitute without altering the seasonal distribution of clean/hazy days, 7) do we need four years of data prior to "good" data to generate substitution values for missing values of all variables, and 8) at what point can we stop substituting for nitrate? This is not an important issue for the regional haze regulations, which use baseline data from 2000-2005. It is an issue, however, for historical trends work. Discussion resulted in a sub-committee being formed to look into the nitrate issue.

➔ A sub-committee to examine the nitrate issue (N. Frank, W. White, M. Pitchford, and D. Miller).

IMPROVE and VIEWS Web Site Updates

New data and a new data query tool are available. Changes and additions to the Web sites are apparent if you're a regular user. VIEWS includes IMPROVE and other data. Both Web sites receive approximately 1,000 users per month from 24 countries. CERD, a supersite with related data, will be added to the Web sites this fall.

Arizona's $PM_{2.5}$ Nephelometer Project

Arizona has 17 Class I visibility sites. The nephelometer project includes 13 sites that will record real-time data by July 12, 2003. All sites will be operationally standardized and fully automated (7 Class I sites and all 6 urban sites (3 in Phoenix and 3 in Tucson). The automated sites will not require a site operator every 2 weeks, as is normally required. Future work may be more IMPROVE monitors along the southern part of the state, 13 new $PM_{2.5}$ FRMs, and 5 BAMs. All data are reported to AIRNow.

Site Operator Support Issues and Plans

EPA and the Regional Planning Organizations are planning to send letters to the FLMs indicating the importance of the IMPROVE monitoring program, thanking them for past support in providing site operators, and asking for their continued support. This is being done in hopes of heading off any potential problems that might result from the USDA-FS changed policy of distributing the resources for site operation directly to the forest units instead of the past policy of having the resources distributed by the program office. The concern is that during periods of conflicting priorities (e.g. forest fire season) operators may be more likely to be temporarily reassigned because of the less obvious linkage between the resources and site operation performance. Another approach that is underway to strengthen site operator support involves having a USDA-FS staff person visit all 50 FS IMPROVE sites, to re-educate and invigorate operators and their supervisors to the importance of the program. The USDA-FS resources for optical and scene monitoring at about 50 sites is expected to continue.

As discussed at last year's meeting, IMPROVE has instituted a program of operator recognition by including a site and operator feature article in each of the IMPROVE quarterly newsletters, and by sending out calendars to each site that features a site and operator for each month, and provides tips in site servicing procedures. IMPROVE continues to look for new ways to motivate operators.

For sites with operator related sample collection problems, the host agency should be notified as soon as possible by UCD. If the problem is not resolved, the IMPROVE steering committee should then be notified. Regarding data losses and how to prevent them, one suggestion was to have UCD provide an emergency substitute operator. The substitute operators could be part of a central or regional rapid response team. However, there are concerns that the FLMs might come to expect the substitute operator to fill in often or to be a routine replacement for their staff. IMPROVE needs a responsive system to keep in touch with operators and supervisors in advance of operator problems. UCD should analyze the previous year's records to see what could have been done to prevent loss of data, and to draft a plan to minimize such loses in the future.

➔ UC-Davis will assess the response system and get a plan in place by mid-summer.

Special Studies

Ion, Coarse, and Yosemite Studies

The ion special study goals are to determine: 1) the chemical form of the nitrate aerosol, 2) the size distributions of chemical species, 3) the biases due to nitrate volatilization from denuded or un-denuded Teflon filters, 4) if water extraction of nylon filters efficiently recovers NO_3, 5) if NH_3 is volatilized from nylon filters, 6) the gas/particle partioning of HNO_3/NO_3- and NH_3/NH_4+, and 7) if sodium compounds are important contributors to natural conditions. Nine sites will participate in the UC-Davis special study, for one month at each site. The timeline and participating sites is: Bondville (February 2003), San Gorgonio (April 2003), Grand Canyon (May 2003), San Gorgonio (July 2003), Brigantine (November 2003), Sequoia (February 2004). Point Reyes may also be named a site in the study. The study will use PILS (particle into liquid sampler), MOUDI (Micro Orifice Uniform Deposit Impactor), and other instrumentation. So far, results show that San Gorgonio ammonium sulfate and ammonium nitrate track well.

An overview was presented regarding the 2002 Yosemite visibility study. The area, near the San Joaquin Valley, has consistent diurnal wind patterns that are influential in explaining the high time resolution data. Study results indicate that auto emissions contributed about 5% to the atmosphere, and wood smoke may have contributed from <5% to 90%, depending on what tracer and profile was used.

STN/IMPROVE Network Comparisons

This comparison study has been operating for about one year. It includes 3 pairs of sites (in the East, Arizona, and the Northwest). There are many differences between the operations, analysis and processing of data between the two networks. All aspects of monitoring (sample shipping, collection, analysis, data manipulations, filter handling, etc.) by the two networks are being compared by this study since operation, analysis,

and data processing protocols for the collocated samplers at these six sites are the same as those used in their respective networks. The study objective is to determine, given all these differences, if the networks provide similar results for particle mass and composition. Comparative results include temporal analysis of data from October 2001 through May 2002. Preliminary results show that mass, nitrate, silicone, and organic carbon compare well and sulfate compares relatively well. IMPROVE sites are a little higher in nitrate and a little lower in elemental carbon. Regression analysis results are good but elemental carbon regressions are not. Additional data analyses of an expanded data set are planned.

Spatial and Temporal Trends Assessment
Various maps and plots were presented. Time plots according to region were presented showing species.

IMPROVE and STN Carbon Fractions
To make carbon fractions (OC and EC) comparable between the IMPROVE and Speciation Trends networks, thermal evolution protocols were compared. Both networks use thermal optical analysis, with IMPROVE using optical reflectance (TOR) and STN using optical transmittance (TOT) and each having their own temperature protocols. Heavily loaded filters may take more analysis time for the carbon to evolve from the filter than is currently allowed for by the STN analysis that has fixed time for each temperature step. IMPROVE and STN temperature profiles applied to replicate samples using TOT do not compare well, but when using TOR they do compare well. TOR measures primarily what is on the surface of the filter where most particles are trapped, while TOT analysis penetrates through the entire thickness of the filter so it apparently sees the charring of the organic vapor artifact, which is throughout the entire depth of the filter. IMPROVE is expected to change its analysis to include results from both TOR and TOT while keeping the temperature protocol the same.

VISTAS Request for Quartz Filters
John Jensen (Southern Company) and Mei Zheng (Georgia Tech.) presented the VISTAS Regional Planning Organization request to use IMPROVE filters from the archive. Their study goal is to identify sources of primary organic carbon at several VISTAS/IMPROVE sites using organic tracers and CMB (chemical mass balance), using a new technique. They requested filter samples of 3 IMPROVE sites (Cape Romain, Shining Rock, and Mammoth Cave) for April 1999 through March 2000, to perform organic tracer analysis and CMB modeling to characterize both ambient pollutant concentrations and major emission sources. Discussion followed regarding the amount of filter material available. The filters are 3.8 cm and IMPROVE uses a 1 cm punch from each filter for analysis. Occasionally a second punch is taken out for quality assurance analysis and rarely a third punch is taken out. The filters have enough material for only 3 punches. The current IMPROVE policy is to give up no more than one-half of the remaining filter for any sampler period. The point was made that we should refrain from sharing the quartz archived filters for the most recent three years, so that if we find that we need to reanalyze the filters for any problems or issues we will be sure to have the filters available.

M. Pitchford recommended and B. Malm seconded that IMPROVE provide VISTAS with one-half of the remaining pre-year 2000 filters. For year 2000 and more recent filters, IMPROVE would retain one punch and provide VISTAS with one-half of the remaining material. There were no objections to this request and it was carried by vote. The original policy needs to be changed to state that IMPROVE will retain one punch and may release one-half of what's left. It was also recommended that DRI (the carbon analysis contractor) develop a quartz filter archive database that would show what remained of each site/sample period.

Digital Photography Innovations

Digital photography is used extensively across the network now. In 1998 Great Smoky Mountains received the first digital camera in the network. In 1999 CAMNET began and includes 6 cameras in their current network. Existing networks include: CAMNET, NPS, USDA-FS, LADCO, Arizona, and more. Digital camera networks can: 1) display real-time images and associated air quality and meteorology data on the Web, 2) capture high-quality images for print and future analyses, and 3) provide public outreach and education. System components include a camera, computer, communications links, and software to control the camera. ARS is currently testing the concept of using images to generate visibility information. The first part of the project is to develop an image registration process. The images must be registered to a known target, to account for camera movement. Registration challenges include hourly and seasonal lighting, and physical changes in the images. Algorithms for clear sky identification are also being developed and tested against human perceptions.

Part two of the project, implementation, will occur first at Great Smoky Mountains and Grand Canyon. Advanced image metrics will be implemented as they are developed. A prototype system should be completed this fall. One of the metrics that is being developed is very similar to the observer visual range approach used for over 50 years at airports across the country, where the distance to the farthest visible marker is recorded for each observation. A summary of the spectral sensitivities and other specifications for available digital cameras was presented. A paper describing digital camera uncertainties is available in the gray literature section of the IMPROVE Web site.

MANE-VU Regional Haze Supersites

The MANE-VU Regional Planning Organization plans to sponsor aerosol/visibility related rural transport supersites in the northeast. The high-elevation, rural sites are studied to characterize aerosols and their transport. Particulate matter and visibility-related measurements are collected. SO_4 plots show some short, high spikes at Mount Washington, NH. A site near Philadelphia and Washington DC shows organic carbon and ozone spiking at the same times. Current measurement plans include continuous sulfate, hourly black carbon/total carbon, and light scattering. Future instrument additions are planned, including NGN-3, NO/NOy, carbon monoxide, ozone, PM_{10}, and more. Planned sites for additional monitoring are expected at Acadia, ME; Mohawk Mountain, CT; and Frostburg, MD. These three sites are about equally spaced on a NE-SW line.

WRAP
Emissions inventories in and near Class I areas in the West will be provided on the WRAP Web site. Maps to be added to the site include land use maps, population density maps, stationary source maps, information tables, and more, using 2002 collected data. The project will be discussed in a conference call June 16, 2003.

General Interest Items

IMPROVE Budget Summary
Two interagency agreements between EPA and NPS that fund most of the aerosol monitoring as well as some other activities are currently in place, with the older one being phased out. The new 2002 agreement currently includes resources to cover calendar year 2002. The next funding increment is expected to cover January 2003 through June 2004. The funds pay for UC-Davis, Desert Research Institute, Air Resource Specialists, CIRA/Colorado State University, and Research Triangle Institute. Of the funds, 92% goes into technical aspects of the program and 8% for administrative costs. The cost for operation and maintenance per site is $32,535.00 (excluding site operator salary). Both IMPROVE and FLMs (as individuals) fund the program. Any budgetary questions should be posed to D. Maxwell.

Quarterly Newsletter
The IMPROVE Newsletter is distributed in February, May, August, and November. It is distributed to 430 individuals and all site operators. It also is available on the IMPROVE and NPS Web sites.

Plans for Next Meeting and Action Items
Draft meeting minutes will be out shortly. It was suggested the next meeting be held in the northeast, perhaps the Acadia supersite, or Mount Washington, NH, next summer.

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Tuesday, June 3

Morning visit to Saguaro NP monitoring sites (east site operated by IMPROVE and west site operated by Pima Co), and the Arizona Sonora Desert Museum.

Time	Topic	Discussion Leader
1:15pm	Welcome, introductions, & agenda review	Marc Pitchford
	Status of network operations:	
1:45pm	Particle monitoring network (site maps, sample, & data recovery stats, analyses issues, operator performance, etc.)	Chuck McDade & Lowell Ashbaugh
2:45pm	Trends implications of protocol changes	Warren White
3:45pm	Break	
4:00pm	Optical monitoring network (data recovery, data quality issues)	John Molenar
5:00pm	Adjourn for the day	

Wednesday, June 4

Time	Topic	Discussion Leader
8:00am	IMPROVE & CASTNet nitrate trends	Neil Frank
8:20am	Handling the nitrate trends issue	Jim Sisler & Debbie Miller
8:40am	IMPROVE & VIEWS Website updates	Bret Schichtel
9:00am	Arizona's $PM_{2.5}$ nephelometer project	Darcy Anderson
9:20am	Site operator support issues & plans	Marc Pitchford
10:00am	Break	
	Special Studies:	
10;15am	Ion, coarse, & Yosemite studies	Bill Malm
11:15am	Spatial & temporal trends assessment	Bill Malm
11:45am	Lunch	
1:00pm	IMPROVE & STN carbon fractions	John Watson
1:30pm	STN/IMPROVE network comparisons	Paul Solomon
1:50pm	Digital photography innovations	John Molenar
2:50pm	Break	
3:10pm	MANE-VU regional haze supersites	George Allen
	General Interest Items:	
3:30pm	IMPROVE budget summary	David Maxwell
3:50pm	Quarterly newsletter	Gloria Mercer
4:10pm	Plans for next meeting & action items	Marc Pitchford
4:30pm	Adjourn meeting	
Added:	*VISTAS quartz filter request*	*John Jensen & Mei Zheng*

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