

IMPROVE STEERING COMMITTEE 2019 ANNUAL MEETING

Date: Tuesday, October 22-23, 2019
Location: Petaluma, California
Hotel Petaluma
Time: 8:30am – 5:00pm, 8:00am – 11:00am

IMPROVE stakeholders present:

Name	Organization	Email
Joe Adlhoch	Air Resource Specialists	jadlhoch@air-resource.com
Mark Tigges	Air Resource Specialists	mtigges@air-resource.com
Emily Vanden Hoek	Air Resource Specialists	evandenhoek@air-resource.com
Derek Day	CIRA	derek.day@colostate.edu
Gordon Pierce	Colorado Dept Public Health & Environment	gordon.pierce@state.co.us
Jenny Hand	Colorado State University	jlhand@colostate.edu
Mark Green	DRI	green@dri.edu
Joann Rice	EPA	rice.joann@epa.gov
Laurie Trinca	EPA	trinca.laurie@epa.gov
Melinda Beaver	EPA	beaver.melinda@epa.gov
Abigail Nastan	JPL	anastan@jpl.nasa.gov
David Krask	MD Department of Environment	david.krask@maryland.gov
Bret Schichtel	National Park Service - Air Resources Division	bret.schichtel@colostate.edu
John Vimont	National Park Service - Air Resources Division	john_vimont@nps.gov
Tony Prenni	National Park Service - Air Resources Division	anthony_prenni@nps.gov
Pius Lee	NOAA	pius.lee@noaa.gov
Tracy Dombek	RTI	tdombeck@rti.org
Ann Dillner	UC Davis	amdillner@ucdavis.edu
Dominique Young	UC Davis	deyou@ucdavis.edu
Jason Giacomo	UC Davis	jagiaco@ucdavis.edu
Josh Grant	UC Davis	jsgrant@ucdavis.edu
Katrine Gorham	UC Davis	kgorham@ucdavis.edu
Nick Spada	UC Davis	mjspada@ucdavis.edu
Nicole Hyslop	UC Davis	nmhyslop@ucdavis.edu
Sean Raffuse	UC Davis	sraffuse@ucdavis.edu
Tony Wexler	UC Davis	aswexler@ucdavis.edu
Warren White	UC Davis	whwhite@ucdavis.edu
Xialou Zhang	UC Davis	xluzhang@ucdavis.edu
Xiaoya Cheng	UC Davis	yxcheng@ucdavis.edu
Scott Copeland	USFS/CIRA	scott.copeland@colostate.edu
Bob Lebens	Westar	blebens@westar.org

WELCOME AND AGENDA REVIEW

Scott Copeland opened with welcoming comments, a review of the agenda, and introductions.

NETWORK AND LABORATORY REVIEW

Optical Monitoring Network Status

Mark Tigges presented an update regarding optical and scene network status. A copy of their PowerPoint presentation accompanies these minutes. Summary points are as follows:

- A new camera and limited service nephelometer were installed at Dinosaur National Monument.
- The National Capital camera was not operational for a time during building restoration.
- The Big Bend camera view was affected by expansion of the nearby parking lot in May 2019. A new solar powered system was installed in October 2019.

Aerosol Monitoring Network Status

Nicole Hyslop presented an overview of network status. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- There are currently 160 sites operational.
 - Three (3) new sites have been installed (DINO, TOOL, SOGP).
 - Two (2) sites were updated to full sites (previously Module C only).
 - All sites with new controllers have cellular or satellite service for hourly data collection. This has helped identify issues earlier to help save samples.
 - Data are delivered to AQS and FED monthly. Reviewed and revised annually, as necessary.
 - K, Mn, Zn spikes have been seen with smoke.
 - Phoenix is the only site that has a full suite of collocated modules.
- *Joann Rice asked what setting was used. Nicole replied the setting is PM_{2.5} outdoor*
- The government shutdown resulted in 9+ consecutive samples lost at most sites.
 - Nine other sites were lost due to this and additional issues.
 - The semi-annual quality assurance (QA) report was delivered.
 - Data advisories are available on the CIRA website.
 - The first automatic weighing chamber did not operate well, nor has the replacement. Contamination issues are common and have required extreme cleaning measures.
- *Bret Schichtel asked if the Teflon blanks need to equilibrate. The answer is that the CFR states "thou shall".*

- *Bret also asked if any water gain is to be expected on an unexposed filter or if the ring absorbing something. Answer: it should not.*
- Unknown why MTL filters (field blanks) are gaining mass. Possible contamination on the main weighing arm. An instability was discovered during a few weeks in April 2019. Impacts on PM data are being assessed by data validators.
- Following this April period longer equilibration times (4-40+ hours) were employed during weekends and found no dependence on differences in equilibration times.
- A new XRF Analysis Protocol has been applied to data post October 2018 (see data advisory on IMPROVE website). This includes longer exposure time for certain elements. Archived filters from GRSM, MORA, and PORE were reanalyzed with new method.
- There was disagreement between sulfur and sulfate on high nitrate days with the CSN network, likely caused by heavily loaded filters and filter size. Larger filters are used at the Korean site and show better sulfur/sulfate agreement.
- *Bret commented the issues seem to occur with other elements as well.*
- *Scott Copeland replied that OC differences were also seen.*

Quality Assurance – Field Audits

Derek Day presented updates regarding field audits. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Audits were conducted in the Spring and Fall.
- Spring audits included sites in southern Arizona and California.
- Fall audits included northern California, Montana, Wyoming, and Colorado.
- Written reports of auditing findings were prepared. No defined mechanism of delivery is in place yet.
- The Mesa Verde site will move due to the installation of a helipad.
- Flathead 4 was missing several samples due to road conditions.
- *Scott Copeland asked if the Glacier site should receive a new site code designation since the new location is much closer to the ground. A group discussion concluded that a new site code is not required as it does not meet distance criteria for a new code.*
- The Makah Tribe site shelter should be replaced. The tribe may need assistance to complete the replacement.
- Many Module C leak check failures are likely due to a leak in the thermistor portion of the system.1
- Many Purple Air sensors have been installed at IMPROVE sites.
- *John Vimont asked what kind of differences were seen. Derek answered there was a great deal of difference between collocated Purple Air sensors, though 7 of 8 compared well in*

the lab (especially at lower concentrations). Joann commented that the presence of a spider influenced readings at one of their sensors.

- *Bret commented that the fans in the sensors can fail easily. The sensors are not as reliable for PM2.5 measurements but do operate well as nephelometers.*

Ion Analysis

Tracy Dombek presented of the status of ion analysis. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- On track to analyze 18,000 samples which is similar to the previous year.
 - Detection limits have not changed.
 - Continue to try and identify areas that might lead to chloride contamination.
 - Nitrate field blanks are getting better over time likely due to better filter handling and better instrumentation, such as an auto diluting system that came on-line in 2014 instead of manual pipetting.
 - RTI is collaborating with UNC using HILIC method to separate species and Mass Spectrometry to identify species observed in extracts. The goal is to identify if Organic S is in the extracts.
- *Brest asked what fraction of difference between the sulfur and sulfate can be explained in the total water-soluble organics.*
 - *Tracy replied non-water-soluble compounds are not detected by RTI analysis.*

Carbon Analysis

Mark Green presented of the status of carbon analysis from RTI. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- The lab analyzed approximately 18,000 IMPROVE samples between July 2018 and July 2019.
 - The lab utilizes thirteen (13) Model 2015 Multiwavelength Carbon Analyzers.
 - Multiple Quality Control (QC) checks are performed daily, weekly, semi-annual, and as needed.
 - Reporting time continues to improve.
 - Effective January 2019 there are new carbon calibration levels.
- *John Vimont asked about a special study at Pinnacles. Bret answered they were looking at “atmospheric rivers”*
 - *Warren White asked about the size of a filter punch. Mark replied that the filter punches are ½ cm in size.*
 - *Bret asked if there were any soluble carbon standards. Mark replied that he was not aware of any.*

ANALYTICAL DEVELOPMENT

HIPS Analysis

Jason Giacomo presented an update regarding HIPS analysis performed by UCD. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Upgrades to HIPS analysis include updates to control software, new sample changer design, and a multi-wavelength laser source.
 - Software updates include moving from Macros Enabled Excel files to LabView.
 - The new sampler changer led to faster analysis time by utilizing bar codes on the filter.
 - The MTL weigh chamber filter trays can be loaded in silos without loading and unloading from slides.
- *Ann Dillner asked if petri dishes are involved in the process. Jason answered no, the filters stay in the same housing through the analysis process.*
- *Joann Rice asked if any tests are performed to make sure particles are not removed from the filter. Jason replied no, that the filter handling process is slow by design to minimize rough handling of filters.*
- *Joann then asked why a wavelength of 800 nm was not used. Jason responded a wavelength combiner will only allow a range of 450-730 nm.*
- *Joann asked if the wavelength for helium-neon is 633 nm. Jason answered yes.*

Warren White then presented additional updates from the HIPS analysis team performed by UCD. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Controlled soot deposits were analyzed with companion quartz filters to compare TOR versus HIPS and if HIPS measurements are affected by filter loading.
 - To test if absorption was affected by loading, long singular samples were compared against multiple shorter samples.
 - Optical properties of particles changes from suspended in air versus when collected on a filter.
 - During multi-year reanalysis, archived filters from 2003-2017 from different manufacturers were analyzed. Field blanks matched by lot number were pulled for comparison.
 - Rather than re-release data, a data advisory will be posted to document the difference between historical Fabs data and the new HIPS system (5-6% difference from 2018 forward when a larger sphere was used with the installation of new detectors).
- *Bret asked if the sum of HIPS field and lab blanks should be greater than one. Warren answered they should be close to one if properly calibrated.*

Estimation of Light Attenuation from Brown Using Filter Loading Adjusted Light Attenuation

Mark Green presented a PowerPoint regarding estimating brown carbon using filter loading adjusted light attenuation. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Seven wavelength filter light attenuation is used to separate brown and black carbon from IMPROVE and CSN samples.
 - Higher EC concentrations showed a reduced response in attenuation.
 - Shorter wavelengths are more affected by filter loading and thus alter the attribution of brown and black carbon.
 - Average change in attenuation by EC is calculated for different ranges of EC filter loading. Attenuation is adjusted upwards as response declines.
 - Changes in AAE (Absorption Angstrom Exponent) is more apparent in CSN samples than in IMPROVE because most EC levels for IMPROVE fell below the adjustment threshold of $3 \mu\text{g}/\text{cm}^2$.
 - Fires during the summer of 2018 showed elevated brown carbon attenuation after filter loading adjustment.
 - CSN sites see more carbon from diesel sources, while IMPROVE sees carbon from fires.
- *Bret asked how the reflection is defined. Mark answered it is by transmission.*
- *Warren asked how attenuation is attributed to black and brown carbon. Mark answered that black carbon is assumed to be equal to one, and the remainder is attributed to brown. Warren commented that ideally you would want to separate brown and black carbon before accounting for loading effect. Mark answered that is not likely possible because saturation levels affects AAE used to portion.*

FT-IR OC and EC Predictions in IMPROVE and CSN Networks

Bruno Debus presented a PowerPoint providing an overview of FTIR work done by UCD to study OC and EC predictions in the IMPROVE and CSN networks. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- The benefits of FT-IR analysis are that it is non-destructive, fast, low-cost, and information rich.
- The drawbacks for FT-IR analysis are complex calibration methods, relies on consistent and uniform filters, and there are currently no other similar methods to use for data validation.
- Work is being done to develop a set of sites that can be used to compare TOR results against the Teflon/nylon filters to make predictions network wide. This includes 22 IMPROVE sites and 20 CSN sites (14% of each network)
- Next steps are to develop an alternate method that is not dependent on TOR.

- Also working to develop separate calibration curves for high filter loading.
- *Bret commented that the selection of sites might not produce the same results, as future years may have different “best” sites. Bruno replied that ten to fifteen combinations of other sites have similar results. They are working on developing procedures with the goal of making it reproducible for other years. The number of sites that start up and shut down each year makes that challenging.*

FT-IR OC and EC: Reevaluating Biases and Calibration

Andy Weakley presented a PowerPoint providing an overview of FT-IR work done by UCD to study OC and EC biases and improve calibration procedures. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Following up on the 2018 presentation on FT-IR bias, the analysis shows FT-IR bias against TOR shows a false trend based on geometry of least squares.
- A moving window method for calibration is proposed.
- A three-month moving window adjusts the calibration to instrument drift and accounts for seasonality.
- A twelve-month moving window works best, shifting in one-month increments.

Trends in Organic Matter and Functional Groups using FTIR Measurements

Ann Dillner presented a PowerPoint providing an overview of trends in Organic Matter and Functional Groups using FT-IR Measurements. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Measuring functional groups can provide new, atmospherically relevant compositional data.
- OM concentrations in the southeastern U.S. were studied to see how OM and functional groups changed from 2009 and 2016 and what monthly variation could be seen.
- Sites from the SEARCH network were used to include both rural and urban locations.
- Annual concentrations of OM decreased at all sites overall. The composition of organics showed summertime events were likely due to biogenics.
- Site from the SPARTAN and MAIA networks might also be used in future analysis.
- *Bret asked if there was a change in methodology following a change in the type of filter and would past OM/OC ratios increase. Ann answered yes to both.*
- *Scott Copeland asked if the SEARCH network had collocated TOR analysis. Ann answered yes.*

Network Status Moving Forward

Tony Wexler presented a PowerPoint providing suggestions for upgrades and enhancements in the network. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Meteorological measurements are useful when collecting visibility measurements but are not currently operating at many IMPROVE sites.
- Relative humidity is a key component in visibility, and wind speed and direction can be used to track source locations.
- Low cost sensors can be incorporated at sites, including Purple Air or the Aeromet Project.
- Suggested upgrades to the network include improved flow control, real-time particulate and meteorological measurements, and possible incorporation of satellite data.

DATA ANALYSIS

Lab QC Tools Update and Demonstration

Sean Raffuse demonstrated the new web-based tools developed for timely review and comparison of data across the IMPROVE and CSN networks. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Previous developments included tools for improving data validation and analysis.
- Current developments focus on improving laboratory operations with new software and interfaces.
- Web-based displays show the current status of a variety of laboratory procedures.
- New analysis tools can show back trajectories, crossplots, and maps.

Comparison of CSN and IMPROVE Speciated PM_{2.5} Through Collocated Measurements

Katrine Gorham presented a Power Point discussing comparison of PM_{2.5} measurements from the CSN and IMPROVE networks. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Data collected from the CSN and IMPROVE networks from January 2016 through September 2018 were compared to better understand the comparability of the data and evaluate strengths and limitations of a combined data set.
- During the study period collocated sites met completeness requirements and used the same analyzing laboratory.

- Difference between networks include the make and model of samplers, operational flow rates, filter sizes, analytical methods, transport temperatures, and operator practices.
- *Joann commented that each network also uses a different type of denuder on the nylon filter.*
 - Overall data agreed well, especially at higher concentrations.
 - MDLs are different for each network, so care should be taken when comparing data near the MDL.
 - Both networks are effective at quantifying bulk species.
- *Joann asked if the difference in soil at the Fresno site was due to no active flow control. Katrine answered they looked at flow rates but did not see a correlation. It could be a size cut issue – getting particles larger than 2.5 microns on IMPROVE filters.*

Urban and Rural Coarse Mass

Jenny Hand presented a PowerPoint discussing urban and remote coarse aerosol mass across the United States. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Coarse mass is important to study due to its impact on air quality, visibility, health, hydrology, and climate.
- Fine dust sources can be local or long range, natural or anthropogenic.
- Coarse mass sources have far reaching impacts.
- Coarse mass measurements are a part of the EPA and IMPROVE networks.
- Collocated data from 2000 through 2016 from both networks were compared.
- Data showed good agreement, but EPA was biased high by approximately 10%.
- Rural coarse mass is about half of urban coarse mass.
- Seasonality and weekly patterns suggest anthropogenic influence at rural sites.
- While PM_{2.5} concentrations have decreased, Coarse Mass and PM₁₀ have increased across the U.S. especially in the east.
- *Sean Raffuse asked why the northwest saw decreasing concentrations. Jenny answered some of the fugitive dust regulations may have played a role.*
- *Tony Wexler commented that dried up sea salt will continue to increase impact on coarse mass.*

Data Substitution for WRAP

Emily Vanden Hoek presented a PowerPoint discussing data substitution performed for WRAP. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- To support states in Regional Haze SIP Preparations, WRAP contracted with Air Resource Specialists (ARS) to perform data substitution for sites not meeting completeness requirements for the years 2008, 2011, and 2013-2017.
- ARS was also tasked with providing recommendations on data handling for sites that have relocated since the last round of SIPs
- Four (4) WRAP sites moved locations (Sycamore Canyon, Zion, Haleakala, Tuxedni)
- The Sycamore Canyon site did not move far and combining the data from the original site (SYCA1) and the new site (SYCA2) was recommended.
- The three (3) other sites that relocated were not good candidates for a combined data set.
- Approximately 30 site years were suitable for substitution
- Sites that were missing more than 50% data or had no suitable donor site were not included.
- All missing data were substituted to make the year complete and avoid undue bias.
 - Three sites (KPBO, BALD, PORE) received partial substitutions after consultation with the individual states.
- Mass data were compared annually and seasonally between donor and recipient sites, using Kendall-Theil statistics, over 5-year periods centered around the year of interest.
- Geographical and airshed differences were taken into consideration, as well as input from state agencies.
- Following data substitution RHR2 and MID metrics were applied, and the updated dataset was made available on the FED and WRAP TSS websites.

DAY 2 – OCTOBER 23, 2019

DATA ANALYSIS (CONTINUED)

Dinosaur National Monument

Tony Prenni presented a PowerPoint summarizing the preliminary data from the special study at Dinosaur National Monument. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- In response to oil and gas development in the area, Dinosaur National monument requested additional monitoring.
 - Instrumentation includes an ozone analyzer, IMPROVE samplers, a limited support nephelometer and a digital camera.
 - Monitoring was originally scheduled to occur from winter 2018 through winter 2019 but was extended through Spring 2020.
 - Wintertime inversions contributed to elevated ozone readings.
 - High ozone concentrations and high scattering were seen on days where air was coming from the south and west (near oil and gas activity).
 - On lower scattering days air came from northwest of the park.
 - On lower ozone days air came from south of the park.
 - Study suggest wintertime haze often coincides with periods of high ozone.
 - IMPROVE data suggest AmnNO_3 and coarse mass are primary contributors to haze.
 - The site may become a permanent protocol site.
 - NOAA, NCAR, and universities are writing proposals for a larger study to focus on wintertime haze and particle formation.
- *Mark Green commented that coarse mass could be due to water growth on AmnNO_3 cloud formation by either ammonium nitrate or calcium nitrate growing into the coarse size.*

Multi-Angle Imager for Aerosols (MAIA)

Abbey Nastan with JPL presented a PowerPoint describing a new satellite-based aerosol surveillance. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- MAIA instrument provides georectified image data for retrieval of aerosol properties.
- These measurements provide more data coverage than ground-based measurements to better understand the species in $\text{PM}_{2.5}$ related to human health effects.
- Surface PM monitors are used to calibrate the column PM relationships
- A chemical transport model assists with spatial and temporal gap-filling.

- Speciated PM_{2.5} mass fractions from laboratory analyses are used from a variety of monitoring networks.
 - Target areas across the globe will have PM mass and chemical components mapped by MAIA.
- *Mark Green asked if clouding conditions will limit data capture. Abby answered yes level 2 data will have holes on cloudy days.*
 - *A question asked about how optical depth to surface concentration is dependent on vertical resolution. The equation is presented on slide #5 and relies on meteorological data using chemical transport model. One dedicated staff person is responsible for optimization of the CTM for each target area.*
 - *Katrine Gorham asked how close to real time data is necessary to be useful. Abby answered that they recognize the latency of filter-based data so two years of historical data will produce the initial version of modeled data at launch. The model will be refined and reprocessed as new data are available.*
 - *Joann Rice asked which years will be included in the initial data set. Abby answered the goal is to begin with the 2020 data.*
 - *Bret suggested preliminary data could be provided sooner if helpful. While recognizing the benefits of health studies, Bret inquired which other areas might benefit – fires? Oil sands? Abby noted that some regions are too consistently cloudy to collect good data.*
 - *Tony Prenni asked if the Arizona target could be expanded to include the Grand Canyon. Abby responded that the regions are chosen for their population centers.*
 - *Ann Dillner noted there is now an IMPROVE site in South Korea. Abby stated South Korea is becoming a primary target area.*

IMPROVE Carbonaceous Aerosol Data

Bret Schichtel presented a discussion of IMPROVE Carbonaceous aerosol data and the estimation of elemental carbon using TC-fabs. Summary points are as follows:

- Light absorbing carbon (LAC) is important in health impacts and climate change.
 - It is possible LAC measured by TOR is underestimated by as much as 30%.
 - The ratio used to convert organic carbon to organic matter is currently 1.8.
 - TC and fabs are being explored as alternatives to TOR OC and LAC measurements.
 - TC and fabs analysis methods are stable, accurate and cost effective.
 - Substitution of the method causes little to no changes on the haze metrics.
- *Joann Rice noted the difference between TOR OC and calculated OC. Bret commented that OC is a large portion of TC and he has not looked at this in the CSN data.*
 - *John Vimont noted the 2003 trends were going in the opposite direction. Warren White responded that 2003 is a year of marginal quality for TOR and HIPS. Something changed in HIPS in 2002, TOR instruments were starting to fail in 2003 and 2004 which Bret commented would lead to lower LAC.*

- *Ann Dillner suggested AAAR would be a good audience for a discussion of changing method. Need input from stakeholders outside of epidemiology. Ann also noted that lower concentrations will push against the limits of detection by analyzers*
- *John Vimont commented that the IMPROVE community directive is Regional Haze, so the analysis needs to go back to include 2000.*
- *Donna Kenski noted that IMPROVE is concerned with total light extinction and this change would not likely have a large influence on the Regional Haze data.*
- *Melinda Beaver asked if the 12.5 value for mass absorption is widely accepted. Bret answered no – that is a calibration value which can and maybe should change.*
- *Ann stated the FT-IR analysis suggests that one calibration number is not appropriate for every location. EC has different properties on the filter in different collection locations.*
- *Warren White asked how important absorption is for the Regional Haze Rule. Bret answered that it is often important for an anthropogenic source. It follows ammonium sulfate and ammonium nitrate in terms of what is controllable.*

IMPROVE Data and RHR Metrics

Scott Copeland presented a PowerPoint summarizing the status of 2018 IMPROVE data. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- 2018 data are available on the FED and WRAP TSSv2 websites, including substituted data for 2008, 2011, and 2013-2017.
- *Bret Schichtel noted that substituted data are included in the RHR data sets and not in the raw data sets.*
 - Slight changes to data based on chloride below MDL and sea salt patch coding.
 - The multiple-patching algorithm is recommended.
 - Lostwood and Wind Cave sites are considered provisional for 2018.
 - Baseline calculations will not be updated following 2017 updates to Section 51.308 without further discussion.
- *Melinda Beaver noted that the 2028 modeling effort to include US and International contributions would be used to readdress natural conditions, but there is no current timeline of progress.*

BUDGET

Budget Analysis & Discussion

Tony Prenni led a discussion regarding the IMPROVE budget. He indicated that the best guess for future funding indicated that there would likely be decreased funding next fiscal year, so estimates for cost reduction or funding increases may be necessary again to offset rising costs.

- The new site in Alaska was installed and funded by the BLM for five years.
- An agreement was reached with the DOE for a site at the Southern Great Plains Research Station in Oklahoma (one-year agreement to be renewed annually).
- Dinosaur pilot study commenced in October 2018.
- There is outside interest in international sites in Bahrain and Italy.
- Potential changes to the network include the purchase of an AirPhoton nephelometer.
- Due to expected funding shortfalls an evaluation of sites and/or measurements may be necessary.

IMPROVE Steering Committee Business

Scott Copeland led a discussion regarding IMPROVE business updates.

- *Scott Copeland will continue to serve as IMPROVE Steering Committee Chair*
- *Suggested locations for the 2020 meeting include Saint Marks, FL in early December. Many IMPROVE participants plan to attend the AWMA Visibility Conference at Bryce Canyon in October 2020.*

Review Agenda and Wrap Up

The IMPROVE business meeting was adjourned at 11:00am. The business meeting was followed by a visit to the Point Reyes National Seashore monitoring station.