

IMPROVE STEERING COMMITTEE 2022 ANNUAL MEETING

Date: November 2-3, 2022
Location: Common Man Inn, Plymouth, NH
Time: 11/2 9:30am – 5:00pm
11/3 9:00am – 12:30pm

IMPROVE Steering Committee members present:

Scott Copeland (Chair)	CIRA/USFS	scott.copeland@colostate.edu
Bret Schichtel	NPS ARD	bret.schichtel@colostate.edu
Tim Allen (remote)	USFWS	tim_allen@fws.gov
Joann Rice	EPA	Rice.Joann@epa.gov
Jay Baker	WESTAR	jbaker@westar.org
David Krask:	MD DOE	david.krask@maryland.gov
<i>(for Charles Turner)</i>	<i>VDEQ/MARAMA</i>	charles.turner@deq.virginia.gov

Additional IMPROVE stakeholders present:

Ann Dillner	UC Davis	amdillner@ucdavis.edu
David Healy	NHDES	david.s.healy@des.nh.gov
Emily Vanden Hoek	Air Resource Specialists	evandenhoek@air-resource.com
Georgia Murray	AMC	gmurray@outdoors.org
Jenny Hand	Colorado State University	jlhand@colostate.edu
Jill McMurray	USDA Forest Service	jill.mcmurray@usda.gov
John Watson	DRI	john.watson@dri.edu
Judith Chow	DRI	judith.chow@dri.edu
Mark Tigges	Air Resource Specialists	mtigges@air-resource.com
Melinda Beaver	EPA	beaver.melinda@epa.gov
Nick Spada	UC Davis	mjspada@ucdavis.edu
Ralph Perron	USDA Forest Service	ralph.perron@usda.gov
Tony Prenni	NPS ARD	anthony_prenni@nps.gov
Tony Wexler	UC Davis	aswexler@ucdavis.edu
Tracy Dombek	RTI	tdombek@rti.org
Xinrong Ren	NOAA	xinrong.ren@noaa.gov

Additional IMPROVE stakeholders present remotely:

Nicole Hyslop	UC-Davis	hyslop@ucdavis.edu
Sean Raffuse	UC-Davis	sraffuse@ucdavis.edu

WELCOME AND AGENDA REVIEW

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

NETWORK AND LABORATORY REVIEW – PART ONE

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:

- Optec2 nephelometer to be replaced with newer instrumentation because:
 - Replacement parts are hard to acquire
 - Instrumentation no longer supported by manufacturer
 - Data storage capacity is low
- Testing of replacement instruments (Airphoton IN102 and Ambilabs 2-WIN)
- Airphoton is limited in support and data collection capabilities
- Ambilabs 2-WIN has remote data capture capabilities and manufacturer support is much better, making it a better option for replacement
- Both instruments operate at multiple wavelengths and include size selective inlets
- Ambilabs 2-WIN nephelometer was installed at Great Smoky Mountains – Look Rock in May 2022

Tony Prenni continued the presentation to update optical and scene network status. A copy of their PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Nephelometer data is used as a check on the IMPROVE data so new instruments need to be as close to Optec NGN measurements as possible for historical data comparisons
 - The 2-WIN is a reliable replacement with caveats:
 - Measurements limited to PM_{2.5} and *near* ambient conditions
 - Show good agreement with other nephelometers measuring fine mode at low relative humidity
 - Differences between 2-WIN and Optec NGN can be explained
 - 2-WINs currently in operation at ROMO, GRSM, and DINO
- *A question regarding the cost of a 2-WIN. Answer: \$20-25,000 plus an additional \$8,000 for the enclosure*
- *Question regarding the offset and a possible correction*
- *Bill Malm commented (via phone) that the loss of nitrates contribute to mass loss due to heating*

- *Tony commented that semi-volatiles, as well as nitrates, burn off during heating which is important to scattering, especially during winter*
- *Bret Schichtel commented total scattering vs fine scattering measurements should be discussed and coarse mass is becoming a larger portion of scattering*
- *Tony commented that another manufacturer does offer a total scattering instrument which could be considered at a future time*
- *A question was asked if the data set is large enough to split seasonally*
- *Tony answered yes, but that analysis has not been completed yet*

Carbon Analysis

Judy Chow presented of the status of carbon analysis from DRI. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- The lab has analyzed approximately 261,800 samples since 2016 (120,000 for IMPROVE)
- Monthly samples vary from 0 to ~2,800 samples per month
- Until April 2022 the lab operated 15-18 hours per day, 7 days per week
- Now operating 6-8 hours per day, 3-5 days per week
- January 2021 through October 2022 backlog has improved
- On average 57 runs per day are dedicated to multiple quality control checks
- A better insulated stranded wire replaced thermoplastic-insulated copper wire in connections to sample oven which can withstand temperatures up to 450°C
- Revised data validation protocols were established
 - Processing data by multiple sets simultaneously instead of in small batches
 - Created software to identify and invalidate unusual sample runs to reduce sample re-analysis rates
- Streamline data processing has shortened the reporting time
- Improved machine-learning to validate accuracy

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:

- Instruments are calibrated daily using primary stock standards
- Quality control checks are performed before and after every ten samples using secondary source standards
- Duplicates occur at a rate of 3 per batch of 50 samples
- Random reanalysis of 5% of the sample total is performed
- Percent differences are calculated and verified against DQO requirements
- Any samples failing to meet DQO's are reanalyzed a third time

- Extraction efficiencies were evaluated on ~120 samples
 - New instruments were purchased for automated extractions to validate mass measurements, and to test for contamination. These were placed into service in June 2022
 - Research and development included studying total sulfur measurement by ICP-OES indicative of organic sulfur in CSN samples collected during August 2019
 - The differences between ICP-OES and IC correlate well for all sites
 - Patterns are geographically similar to those observed for IMPROVE samples collected during summer, with highest differences occurring in the Southeastern sites
 - Other research efforts to evaluate organic sulfur included validation methods using UPLC/MS to perform non-targeted and targeted analysis to measure organic sulfur, organic nitrogen, carboxylic acids, and sugars in PM samples
- *Dave Healy asked how recovery statistics could be greater than 100%*
 - *Tracy answered that $\pm 10\%$ uncertainty can result in greater than 100% recovery*
 - *Georgia asked if climate change is responsible for the concentrations in the southeast*
 - *Tracy answered that isoprene emissions (from trees and vegetation) are heavy in the southeast and the gas to particulate phase forms secondary reaction for sulfur*
 - *Q: is this an increasing trend?*
 - *Tracy answered that this hasn't been measured for a long enough time to establish a trend. Jason Surat has a paper that discuss this issue further*
 - *Bret Schichtel commented that Bill Malm published a paper looking at the carbon and sulfur relationship*
 - *Tracy commented that urban environments and warmer trends extend growing seasons and higher VOC concentrations could be expected. Sulfur and nitrate become absorbers instead of scatterers*
 - *Tony Wexler asked about the magnitude of organic nitrogen*
 - *Tracy commented that it is challenging with nylon filters, but that analysis has not been performed yet. Non-targeted analysis may offer a ballpark, looking at total nitrogen analysis on CSN filters. IMPROVE does not currently measure ammonia*
 - *Scott Copeland asked is the lab is seeing an increase in operational costs, downstream supplies, employees, etc.*
 - *Tracy answered yes, shortages of pipettes, resins, etc. and that costs are up as well*

Quality Assurance – Field Audits

Scott Copeland (on behalf of Derek Day who has retired) presented updates regarding field audits. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- All but five (7) IMPROVE sites have been audited since 2016. All Regional Haze Tracking sites have been audited.
- QAPP states all sites shall be audited once every ten (10) years

- Scott suggested discussing if the next five (5) years should be spent auditing again, or directed to other resources
- *Discussion included that the money contributed to the program has been useful for audits since they have identified safety concerns, operational issues, and serves as a good independent check and a good opportunity to engage with field staff*
- *Most agreed that it makes sense to keep performing audits.*
- *Funds could/would otherwise be used for additional data QA*

ANALYTICAL DEVELOPMENT – PART ONE

Application of Micro- and Bio-Sensors for Forest Fire Smoke

John Watson presented an update regarding sensors which could be used to relate fire exposure to non-invasive health pattern. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Wearable sensors have the ability to quantify health-related biomarkers such as heart rate, body/skin temperature, blood pressure, and blood oxygen content
- Stationary and personal air quality monitors for human exposure can measure PM, NO₂, O₃, CO, VOCs and black/brown carbon
- Goal is to apply data mining and artificial intelligence techniques to indicate adverse environmental effect and create wearable software that combine sensor data and transmit warnings to individuals and health providers
- Limitations include software incompatibility and the need for cell service
- Combine personal monitoring with Atmotube, indoor measurements, and high exposure mapped locations to assimilate data
- Data are uploaded to a cloud-based website showing time series and downloads, indicating fire episodes
- Follow up testing includes:
 - Software modifications to adjust flow rate
 - Apply temperature/humidity measurement adjustments for CO electrochemical sensitivity
 - Evaluating performance for different combustion source emissions
 - Evaluate more precise calibration methods
- *John commented that operating these sensors in wide temperature ranges is an issue and needs to be addressed*
- *Georgia asked if anyone is thinking of an environmental justice application*
- *John answered yes, that is one of the goals*

Field Testing PurpleAir Sensors at IMPROVE Monitoring Sites

Nicholas Spada presented an overview of purple air and optical measurements in a collocated study. Summary points are as follows:

- Goals are to determine potential benefits of low-cost sensors at IMPROVE sites, explore the feasibility of real-time PM_{2.5} concentrations, and assess durability and longevity at remote sites
 - Data were initially collected using the default EPA corrections
 - Site specific corrections were able to be determined
 - Sensors were installed at eight (8) remote sites and left unattended to see how long they would operate
 - Some ended early due to unintended communication reconfigurations
 - Several ran successfully for multiple years
 - The collocated sensors at Great Smoky Mountains operated with wide variability from deployment through March 2021 and then changed dramatically with no operational changes (but could be due to insect intrusion). The presence/absence of SD card will change data stream.
 - One test site looked at train traffic and AI showing increases in concentrations
 - Sensors can be coupled to identify periods of data that should be flagged, for example dust activity due to running dogs or lawn mowers
- *Brest Schichtel commented that longevity experiments showed fan failures, coating of the inside of the sensors, and asked if there is a drift in the sensor itself. Do A/B sensors show the same drift?*
- *Nicholas answered it is better to compare data to the nephelometer rather than gravimetric results*
- *Jenny Hand asked about data corrections*
- *Nicholas answered data were only corrected on a 24-hour average basis. 24-hour purple air data vs 24-hour speciated data to create reconstructed fine mass*

Robust and Low Cost Drag Anemometer

Tony Wexler presented an overview of adding low cost wind sensors to the IMPROVE network. Summary points are as follows:

- Only a few IMPROVE sites currently measure meteorology
- Low cost sensors can add temperature, relative humidity, and barometric pressure
 - Relative humidity is in the regional haze rule
 - Temperature and pressure can help better understand data
- Adding wind measurements are helpful in source apportionment
- Developed an anemometer with no moving parts for less than \$100

- Prototype tested at the UC Davis campus and the on-campus experimental IMPROVE site
 - Results show good agreement between prototype and ultrasonic anemometer, though lower speeds show larger errors
 - Next steps are to deploy to IMPROVE site(s) for real-world testing
- *Bret Schichtel asked if force vs wind speed were being added together*
 - *Tony answered that the average of the two forces were being used*
 - *Bret asked if the offset axis was accounted for*
 - *Tony answered no. Two axis strain gauge were developed as initial prototype with spherical design had limitations*
 - *Tony Prenni asked how long they have been tested*
 - *Tony Wexler answered they have been tested for a couple of months, not deployed to sites yet*
 - *Georgia Murray asked with no moving parts could it be deployed on the top of a location like Mount Washington, NH? Sensors located there have addressed icing and extreme temperature conditions*
 - *Tony commented they could add heaters and/or other considerations*
 - *A question related to the range of speed sensors was asked*
 - *Tony answered that errors were seen at speeds less than 1 m/s, testing has only occurred on campus, could be tested in a wind tunnel*

NETWORK AND LABORATORY REVIEW – PART TWO

Aerosol Monitoring Network Status

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

Network Updates:

- 157 sites operated in 2021
- Shamrock Mine restarted in August 2022
- The Northern Cheyenne site was destroyed by fire and is currently being rebuilt
- Three (3) sites not active due to operator unavailability (IKBA, TRIN, ULBE)
- 81 sites were visited for maintenance
- Nearly 20 sites did not meet completeness criteria
- Active flow control development continues:
 - Interface design was finalized
 - Software modification and beta testing finalized
 - Active flow vs passive flow tested at UCD
 - Audit instructions and worksheets for operators are being updated
- ~320 pumps capable of active flow control have been deployed into network
- Two (2) sites are running active flow control (FRES1 and BLIS1)

- More will be deployed after bug fixes and additional testing
- Filter clogging is delayed with active flow control, but inevitable with heavy loading even with active flow control.
- Protocols were designed to minimize data loss in the event of a clog, even if data might not be used for RHR purposes, they could still have value for model/satellite validation, exposure modeling, communication, etc.
 - Flow rates that fall below 15 LPM for > 15 minutes will be shut off if sample has run for ≥ 18 hours, preserving data for RHR use
 - Otherwise the flow for companion modules will also be shut off and data will be reported as not valid for RHR, but provide an accurate concentration and a qualifier flag indicating short sample time
 - Clogging protocol software code is currently in testing

QA Updates:

- A dedicated QA Engineer was hired
 - Introduced a structured system with standard forms for tracking, documentation and issue reporting
 - An integrated QMP covering IMPROVE, CSN, and other networks was developed
 - Performed a comprehensive review of QA and data analysis practices
 - The filter blank mass gain issue is on-going, which began five years ago when filter types were change from PALL to MTL
 - PALL filters are no longer produced
 - Following the servicing of the HIPS machine, issues were seen in the fabs data
 - Nickel and vanadium concentrations were lower in early 2020 due to COVID
 - Cargo ships were required to change fuel type which likely led to improved emissions
 - Phosphorus is hard to measure, but collaborative work with RTI to validate the XRF measurement is being performed. High values may be due to wildfires and dust
-
- *Bret Schichtel questioned if the decrease in Ni/V emissions were due to cargo ships since many were backlogged waiting for ports*
 - *Nicole commented that most backups were in 2021 and significant decrease in production activity in China in early 2020 led to a decrease in shipping activity. They were trying to see COVID effects in the data and nothing striking was found in the PM data. It is possible there are other sources of Ni that are contributing*
 - *Sean Raffuse commented that the CSN network also saw lower vanadium concentrations*
 - *Nicole commented that both coasts saw similar results when looking at fuel type*

Data Management Updates:

- Data were delivered more than one year after sampling due to:
 - Lingering issues related to COVID
 - Relocation of lab
 - Aging XRF instruments
- Recently data are being delivered closer to 270 days, long term goal is 200 days after end of sample month
- Preliminary data are delivered to FED monthly. This is RAW data, use with caution
- New system for flagging conditions allows for more complete information for each sample and preserves data that can be saved
- Flags are now parameter specific
- Working on a filter archive system to make requests for data, filters, information easier
- *Bret Schichtel asked if data delivery goal should be 180 days instead of 200 days*
- *Sean Raffuse answered that the lab is still working through backlogs and scheduling issues. XRF instruments are outdated and in need of repair and/or service. Capacity will increase in the next few months when CSN starts using new instruments and the bottleneck should ease*
- *Scott Copeland asked what kind of issues the lab is facing related to staffing, costs, supplies, etc.*
- *Sean answered that staffing is not as much of an issue, but cost of travel is*
- *Nicole commented that equipment is getting more expensive*
- *Joann Rice commented that many contracts are seeing proposed 30-40% increases*

ANALYTICAL DEVELOPMENT – PART TWO

Comparison of Automated vs Manual Mass Measurements

Nicole presented a comparison of methods used by EPA and IMPROVE for mass measurements. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- EPA mass measurements are laid out in 40 CFR Part 50 Appendix L
 - Temperature/RH and equilibration requirements
- IMPROVE mass measurements were performed manually prior to 2018. In 2018 a robotic chamber enclosed balance with control for temperature/RH was implemented
- Older IMPROVE process were subject to changes in room RH and temperature
- Differences in sampling before and after 2018 were investigated
- Blank filter masses stable during equilibrium and with RH changes
- Samples show changes in mass; higher loading showed bigger changes
- Comparison does not show large impact of humidity differences

- *Tony Prenni asked if lower humidity leads to a buildup of static charge*
- *Nicole answered that is not likely. The effect seems to be reduced on the 25mm filters but the blanks filters would be the primary source*
- *Georgia Murray asked is the equilibration issue could be causing a loss of compounds off the filters the longer they sit. Should filters loaded by species be used instead of sample filters?*
- *Nicole answered those type of experiments have been discussed but question if they will behave the same as real samples*
- *Bret Schichtel asked if filters shipped cold would help limit these losses?*
- *Nicole commented that filter sit in ambient conditions while waiting collection in the field*
- *Scott Copeland commented that it would be operationally too expensive to store and ship filters cold to minimize concentrations that might not be as important because IMPROVE only uses the difference between PM10 and PM2.5*
- *Nicole commented that investigated sampled were selected based on high concentration days, so high nitrate could also have been present. It is not likely anything volatile would remain on the filter since they have already undergone XRF analysis (heated). PORE samples may have gained mass from the lab environment. Samples were not put back into Petri slide between measurements*

Purple Air/Optical Instrument Studies

Bret Schichtel presented an overview of PurpleAir sensors in the NPS network. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- PurpleAir sensors work well as a nephelometer and not a particle counter
- Individual particles cannot be separated
- Only useful for particles greater than 0.3 μ m
- Included humidity sensors are typically off by 30-40% and a correction should be used
- As relative humidity increases about 15% of light scattering is lost, suggesting PurpleAir sensors are responding to changes in humidity
- A test configuration was built with a very well controlled RH inlet and delivering sample air to the 2-WIN and PurpleAir sensors for comparison
- Test showed inconsistencies within sensors, so change were made to siting, wind shield, buckets to determine cause
- Winds caused PurpleAir to under/overestimate scattering depending on speed and/or direction
- Tower interference and influence from sun and wind conditions were also possible
- Sensors can be used to provide better park experiences if the data are of good quality
- There are currently over 100 PurpleAir sensors in use at parks, some with live web displays

- The ability to calibrate the sensors is needed. This work is in development
- *Tony Wexler asked if there is a plan to deploy to all IMPROVE sites*
- *Bret answered no that is not cost feasible*
- *Jay Baker asked if EPA or other entities have investigated the wind issue*
- *Bret answered no*

IMPROVE, CSN, FRM, ASCENT, SPARTAN, MAIA FTIR Update

Ann Dillner presented an overview of various air quality networks. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- IMPROVE measures organics, ions, and other soil related compounds using FT-IR spectra well. Trace elements and sea salt are not measured as accurately
- Comparing Teflon to nylon filters is difficult and the available standards are not very good. The goal is to improve lab standards
- IMPROVE sites were clustered across the US to develop calibrations for each component
- *Tony Wexler asked if the titanium composition is different for the site in Oregon*
- *Ann answered they looked at soil composition, but nothing was found*
- CSN network analysis work looked at organic and elemental carbon
- Hard to compare to IMPROVE due to difference in flow rate, filter size, and more complex aerosols found in urban environments
- Currently using 7 calibrations with varying quality and MDLs to work on QC in the network
- Predicting species using CSN data and functional groups in FRM data
- Soil composition differences do not allow for good comparisons for some components
- ASCENT is a new long-term, ground-based high-time resolution air quality monitoring network
- Three years are funded by a NSF infrastructure grant. This is an outreach grant, and not a research grant. The hope is it will also be used by researchers.
- Ten additional years are expected to be funded by the NSF.
- Twelve monitoring sites measure PM_{2.5} in existing networks, such as IMPROVE, NCore/PAMs, SCAQMD, NEON, and HNET.
- Using existing sites leverages personnel, infrastructure and provides additional data for these sites.

- SPARTAN is an international network monitoring particulate and light scattering in densely populated cities
- The mission of the network is to enhance satellite remote sensing estimates of PM_{2.5} to connect PM_{2.5} composition to health outcomes worldwide

- MAIA (Multi-Angle Imager for Aerosols) will attempt to link exposure to different PM types with human health
- Needs ground based data for validation
- Deployment was delayed due to COVID and other issues with hopes to launch in ~2024

- *Jenny Hand asked if the fabs dropout is affecting the SPARTAN sites?*
- *Ann answered yes they are seeing that as well. Filter issues are confounding*
- *Bret Schichtel asked which network is using for calibration*
- *Ann answered they are using mass from IMPROVE filters. Functional groups are overestimated but they will have a year of TOR data for international sites for comparison*
- *Bret commented the ability to reproduce sulfur and other things measured by IMPROVE can be used in SPARTAN*
- *Bret asked are the sites for MAIA adjustable?*
- *Ann answered that once the satellite is launched the sites are fixed*
- *Bret suggested Ukraine*
- *Jay Baker said the sites may be able to shift for short periods of time if necessary*
- *Scott Copeland asked if any ASCENT sites are operational*
- *Ann answered that five sites run in the lab as step one, then taken to the field. Sean's group is working on getting data into a database. European network that is similar and has been running for a decade helping Sean's group with software as a starting point*
- *Sean commented that four sites have successfully connected aetholometers with data flowing to a central system. Three are testing in the lab. One site in Colorado has been deployed*
- *Tony Prenni asked what the size cut is for AMS*
- *Ann answered the size cut is PM_{2.5} for regulatory data, but not great at a size cut of > 1*
- *Warren White asked if there is interference from ammonia at high relative concentrations*
- *Ann answered they can measure ammonia but need to include it in the calibration data. The range of high to low does not influence the carbon measurement*
- *Warren asked if this occurs in IMPROVE and CSN?*
- *Ann answered that it occurs everywhere. There is a need to make sure calibration accurately captures the carbon ratio*

DAY TWO – November 3, 2022

DATA ANALYSIS

IMPROVE Report IV Overview

Jenny Hand presented a PowerPoint discussing the IMPROVE Report. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- The purpose of the report historically has been to provide updates on the network and its data.
 - Previously distributed every five years. The last report was produced eleven years ago.
 - Data from IMPROVE and CSN are included
 - IMPROVE sees a little higher mass due to differences in instrumentation and size cut
 - Spatial variability in annual mean mass shows higher fine mass concentrations shifted from the Ohio River Valley to the Midwest
 - Nitrate concentrations due to agriculture
 - Urban hotspots in the west were seen in Denver and Salt Lake City
 - Dust and coarse mass patterns were more north/south rather than east/west like ammonium sulfate, ammonium nitrate, and organic matter
 - Southeast regions were influenced by north African dust transport
 - Seasonal and regional variability patterns in the eastern US show differences in urban and rural areas. Ammonium sulfate seen as low and flat across both networks
 - The high summer peak in the east is no longer seen
 - Seasonality of organic carbon concentrations is similar between networks
- *Bret Schichtel asked with organic trends going down is increased fire activity impacting things now. Could you look at high values including clogged filters and see the effect*
- *Jenny answered yes we could look at that*
- *Bret commented it is a loss to not include data from clogged filters (similar to detection limit)*
- *Scott Copeland commented that he did an analysis of clogged filters but that would not change selection of most impaired days (MID). More clogged filters were seen recently than in the past*
- *Jenny commented that outliers were already addressed*

DATA PROCESSING, DISTRIBUTION, AND QUALITY

IMPROVE Data and RHR Metrics

Scott Copeland presented a PowerPoint summarizing the status of 2021 IMPROVE data. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Expect to deliver 2021 data with RHR metrics to be available in December 2022.
 - First meeting of data analysis workgroup convened in March 2022
 - There are still a number of Forest Service sites offline for various reasons
 - There is a request to relocate the GAMO site, work with MT DEG and EPA Region 8 will help identify options
 - Site operators are sometimes difficult to retain and replacement options are not necessarily easy to find
 - Many sites in 2020 saw lower concentrations due to COVID and many did not meet completeness requirements
 - Determining human caused impairment can be uncertain based on the estimates of natural haze
 - During SIP process states must justify why URP is or is not being met. In some cases, failing to be below URP may be caused by changes in natural haze, and/or issues with 2064 end point values
-
- *Georgia Murray asked if the natural background can shift with climate change?*
 - *Scott answered NC is the best estimate for conditions in 2064 and haven't been recalculated*
 - *Margaret asked if the anthropogenic/natural split needs to be revisited*
 - *Scott replied no the issue is not with the split but what is happening in the atmosphere. If the split is changed it might change 2-3 days selected as most impaired but would not have a large effect on other most impaired days*
 - *Bret commented that this is a good topic of discussion for the Data Analysis Subcommittee. It is possible that natural conditions could increase*
 - *Scott commented that conditions are consistent with modeling which have a lot of uncertainty. States must include results in their SIPs*
 - *John Vimont commented that for individual sites it might not be as easy to dismiss changes. Something like fire at SAWT is worth looking at. Internal debates over things like sulfur could be useful but might not make a difference in the larger scheme. There has always been a struggle to define what is "natural"*
 - *Scott commented there are many avenues for discussion. At the end of the day IMPROVE measures concentrations*
 - *John Vimont commented that IMPROVE provides data to users and if there are other or better ways to process data for end-users is it worth the discussion*
 - *Scott replied better data use and analysis is certainly the goal*
 - *John responded the new method helped limit the impact of fires in metrics*

IMPROVE BUSINESS

Steering Committee Charter

Bret Schichtel presented a PowerPoint discussing the IMPROVE Steering Committee Charter. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Large structural changes are being proposed, including the formalization of subcommittees and election of chairs
 - IMPROVE originated as a science organization with clear boundaries between monitoring and regulatory roles
 - Goals are to:
 - Inform people about the program and function of the steering committee.
 - Codify and formalize activities of steering committee.
 - Increase involvement of steering committee members and stakeholders.
 - Formalize subcommittees and workshops.
- *Georgia Murray commented that the mission statement refers to mass-based measurements and asked if IMPROVE would entertain light-based extinction measurements and expand the mission statement*
- *Bret answered yes we already supplement with optical measurements but would not replace mass-based data*
- *Georgia asked if the human impact of visibility are parallel assessments or is that something to work on?*
- *Bret stated the objective is measuring species causing haze. Deeper analysis like modeling is outside of IMPROVE's purview. Members have done that on their own, but funding is not likely available for that type of work*

Charter Discussion

- Identify issues to resolve:
 - *Jay Baker expressed expanding the committee to include tribal or other federal agencies. Asked if the language should be more inclusive for tribes without Class 1 Areas but that operate optical monitors, not just particulate mass*
- Vote on Charter:
 - A quorum was present (BLM and NACA positions vacant)
 - Roll call vote:
 - Jay Baker – yes

- Xinrong Ren – yes
 - Joann Rice – yes
 - David Trask (for Chuck Turner) – yes
 - Bret Schichtel – yes
 - Scott Copeland – yes
 - Tim Allen (via phone) – yes
 - Charter adopted
- Elect Vice Chair:
 - Tim Allen nominated by Bret Schichtel
 - Seconded by Jay Baker
 - Vote passed unanimously
- Elect Chairs for Three Subcommittees:
 - Network Operations and Sample Analysis
 - Joann Rice nominated by Bret Schichtel
 - Seconded by Jay Baker
 - Vote passed unanimously
 - Data Compilation, Analysis, and Reporting
 - Jenny Hand nominated by Bret Schichtel
 - Seconded by Xinrong Ren
 - Vote passed unanimously
 - Outreach and Communication
 - Jay Baker nominated by Bret Schichtel
 - Seconded by Xinrong Ren
 - Vote passed unanimously

CIRES Request for Archived IMPROVE PM₁₀ Filters

Noah from the University of Colorado - Boulder presented a PowerPoint asking for archived PM₁₀ filters for use in a bio-aerosol analysis project. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- UC Boulder would like access to archived PM₁₀ filters to analyze for temporal and spatial patterns for bio-aerosol broad bacterial, fungal, and seasonal patterns
- Requested filters would come from 14 sites that span broad climatic regions

- DNA from all samples would be extracted (~1700 samples) looking at allergens and plant pathogens
 - This is new work that has never been done before at scale. A test site (BOLA) was used as a test case with good results
- *Bret Schichtel asked if a subset of samples (fewer than 1700) would be useful to test proof of concept before performing destructive analysis*
 - *Noah stated they achieved good results the BOLA site and is confident they would get good data. The process is iterative, starting with bacteria, then fungi, etc. A smaller sample size could work, but spatial representation is desired. Offered to cut filters in half to preserve as a backup stored in freezer*
 - *Ann Dillner commented that once analysis begins the filters are considered destroyed. Cutting and storing cold would not add benefit*
 - *Joann Rice asked what would otherwise happen to the filters*
 - *Scott Copeland replied that they would remain in archived storage. These are PM₁₀ filters which would not likely ever be reanalyzed (unlike PM_{2.5} archived filters). Unsure of how much the bacteria or fungi contribute to mass, but in interest of larger good it is a worthwhile effort*
 - *Bret asked of the NPS sites selected how many would have module X. Using module X filters would be preferred*
 - *Noah replied they are looking for a wide range of climatic conditions and are flexible on the site chosen*
 - *Tony Prenni asked if annual updates could be provided for interest*
 - *Ann Dillner offered filters following weighing so that samplers would be fresher if helpful*
 - *Bret asked if filters could be frozen before delivery*
 - *Ann answered no there is not sufficient storage space*
 - *Tony Prenni asked if there is a cost associated with filter recovery and delivery*
 - *Ann answered yes but that CU Boulder has agreed to pay*
- Bret Schichtel presented a motion to fulfill the request
 - Seconded by Joann Rice
 - Vote passed unanimously

BUDGET

Budget Analysis & Discussion

- Tony Prenni led a discussion regarding the IMPROVE budget.
- Contracting remains delayed and uncertain.
- No immediate cuts needed, but small surplus not likely to last beyond a year or so.
- IMPROVE Protocol Sites to cost \$40k per year.

IMPROVE Steering Committee Business

Scott Copeland led a discussion regarding IMPROVE business updates
Fall meeting in 2023. Great Smoky Mountains suggested as location