IMPROVE STEERING COMMITTEE
2023 ANNUAL MEETING

Date: October 17-18, 2023
Location: Hampton Inn, Kalispell, MT

Time: 10/17 8:30am – 4:30pm
10/18 8:30am – 12:00pm

IMPROVE Steering Committee members present:

Scott Copeland (Chair)	CIRA/USFS	scott.copeland@colostate.edu
Bret Schichtel	NPS ARD	bret.schichtel@colostate.edu
Joann Rice	EPA	rice.joann@epa.gov
Jay Baker	WESTAR	jbaker@westar.org

Additional IMPROVE stakeholders present:

Ann Dillner	UC-Davis	amdillner@ucdavis.edu
Rhonda Payne	WESTAR	rpayne@westar.org
Genevieve Lariviere	Air Resource Specialists	glariviere@air-resource.com
Jenny Hand	Colorado State University	jlhand@colostate.edu
Bonne Ford (Hotmann)	Colorado State University	bonne.ford@colostate.edu
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Tony Prenni	NPS ARD	anthony_prenni@nps.gov
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Bill Malm	Colorado State University	wc.malm@colostate.edu
Katarina Lindskog	RTI	klindskog@rti.org
Hal Brunette	UC-Davis	hbrunette@ucdavis.edu

Remote Presenter:

Warren White	UC-Davis	whwhite@ucdavis.edu
Lawrence Tsai	UC-Davis	lttsai@ucdavis.edu
Satoshi Takahama	UC-Davis	satoshi.takahama@epfl.ch

WELCOME AND AGENDA REVIEW

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

NETWORK AND LABORATORY Review – part one

Optical & Scene Monitoring Network Status

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

- As of July 12, 2023, technical support for the remaining Optec NGN2 Nephelometers will be discontinued. Data will continue to be collected as long as the instruments continue to function but will not be processed or reviewed.
- Data for filtered B_{sp} over the course of the OPTEC NGN2 monitoring lifespan (25 – 30 years) were presented for three sites, showing a definitive decrease in visibility scattering due to particles over this time period.
- Network funds from support and data processing have been redirected to purchase, integrate, and install Ambilabs Two Wavelength Integrating Nephelometers (2-WIN) at ten sites. Four have been installed already, and the remainder will be installed throughout 2024.
- Efforts to improve air flow to 2WINS by modifying Ambilabs enclosures are currently being tested to mitigate heat impacts observed during initial testing of these instruments. A fan has been added to cool electronics, the front panel was remounted to allow heat to escape, and existing filters were replaced with more porous media to improve air flow.
- New web cameras are currently being deployed throughout the network. Cannon SLRs are being replaced by new Bosch Ultra 8000MPs. They have several advantages including a lower purchase price, simpler installation, less supporting hardware and significantly less maintenance, as well as remote focus adjustment capabilities. Disadvantages include less advanced color balance technology, poor night performance (especially in urban areas), lower sensitivity and more distortion (esp. at wide angles), limited lens selection, no image backup on the camera, and no raw output (only JPEG). Overall images generally appear clearer at a lower cost.

Question: *Can images still be enhanced with JPEG compression?*

Answer: *Will follow up with Scott Cismoski.*

Cismoski (post-meeting): *Bosch cameras were chosen not for their superior image quality (the Canon dSLR cameras capture better images), but for their ease of use and lower operational cost. They do capture high quality images, but don't have the same adjustable settings a dSLR has. They do support some contrast and color balance settings but can't replicate the way the dSLR does it. Also, the Bosch cameras are probably not suitable for a site with a recognizable night view (National Mall).*

IMPROVE Carbon Analysis

Judy Chow 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 has analyzed approximately 290,750 samples since 2016 (136,015 for IMPROVE).
- Samples received monthly varied from 0 to ~3,200 between October 2022 and September 2023, with an average of 1505. (15,979 total IMPROVE)
- Averaged 10-13 hours/day, 5 days per week except for June-August period (4-6 hours/day, 5 days per week during contract transition)
- 2022 sample analysis was completed in July 2023. Sample backlog and throughput remained stable from October 2022 through September 2023, with completion of 9/2023 sample analyses estimated in mid-January 2024.
- Winter holiday filters at sites that met RHR were not analyzed to save money; however, Judy is not sure how much money this saves and thinks the data may be important based on influxes from holiday traffic, wood burning, etc.
- Streamlined data processing and validation have reduced reanalysis rates by 40% and shortened the reporting time by 70%. This includes updated software that monitors analyzer status and tracks maintenance and calibration status.
- The lab is testing the use of a neural network to further streamline the data validation process by assisting in data flagging and gaining better understanding of analyzer behavior and/or deposit trends.
- The lab is also testing the comparability between Series I and II DRI Model 2015 Carbon Analyzers.
    - They show good correlation for TC, OC and EC and reasonable comparability among carbon fractions.
    - Series II requires temperature plateau and baseline adjustments
    - Testing and refinements for the Series II analyzer will continue including working through some noise in the system, refining integration thresholds and investigating positive intercepts, and conducting tests with an autoloader. They are currently working through power, cassette-loading and temperature/cooling issues related to the autoloader. The EC1 slope is biased by two points in fire season; if smoke samples are limited there may be better comparability.

Question: *How is the lab storing the quartz filter?*
Answer: *In a 40°F refrigerator*

Question: *Could the bias [in EC1] be the result of temperature differences?*
Answer: *We aren't sure yet. It would be helpful to do a weighted regression. It looks like there is a bias on high values. The Series II is outfitted with a cheaper laser, which may be contributing to the issue.*

Question: *Could TC be lower in Series II because of the temperature drop? (5% low)*
Answer: *We are still unsure of what the differences are.*

Question: *If the autoloader works well and can be used at lower temperature, would there be much cost savings?*

Answer: *No, they are not proposing to switch as it takes a lot of punches and is expensive. There are not a ton of advantages, this is just for testing purposes/publications for the manufacturer before the instrument is sold.*

Network Update

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

- Review of RHR completeness failures in 2023 consisted of 11 sites due to late/no sample changes, limited accessibility due to snow or fire, damage to sites, or lack of an operator.
- 2 decommissioned sites in Iowa and 1 in South Korea. An Iowa site could potentially come back online, but the site operator retired, and it's been difficult to find a replacement.
- Field maintenance season is ongoing with several shelters that needed to be rebuilt and several more that need to be rebuilt/moved. All moves are minor and don't require site name changes
- The lab is catching up on data delivery from issues during the pandemic and the laboratory move that took place during this time. XRF analysis has been creating the bottleneck, but they're hoping to get caught up in the next six months.
- IMPROVE has always run passive flow control, but variable speed pumps are being tested; currently there are nine sites running active flow control and more to follow. Comparisons between (nearby) actively and passively controlled sites on a medium/heavy filter loading day demonstrate that while actively controlled sites maintain a constant flow longer, filter clogging will still occur with heavy loading.
    - Samples were being lost/invalidated on heavy loading days due to clogged flow, samples sticking to filter backing, and tearing. A new clogging protocol has been put in place to help mitigate sample loss due to heavy loading.
        - If the flow rate falls below 15 LPM for more than 15 minutes:
            - If ≥ 18 hrs into sample: shut of all modules, data are still valid for RHR
            - Else: shut off clogged module, shut of the companion module for PM coarse calc, data are invalid for RHR but will be delivered with an accurate concentration and qualifier flag indicating short sample time
    - This has been deployed at several sites and will be networkwide by the end of 2023
- A new, more intuitive Daily Balance QC Review page has been rolled out; it's helped to identify how close to limits of detection samples are. In addition, routine replicates have been added to the XRF QC pages which help identify points outside of criteria, and more.
- Review of 2022 data:

- Early onset of spring dust – dust season for Ca, Fe, Rb, Sr were higher than usual.
- There is an intermittent issue with collocated data at PHOE and MEVE1 (inlet, inlet seating, destruction in flow path?), but it's not fully understood. MEVE1 A-module had poor collocated agreement for some XRF elements; field staff were unable to pinpoint the issue during visit. It is not known yet if this is occurring at other sites. This issue may be from very localized source. Fe, Si and soil have higher uncertainty(~12%) because of this issue.

Question: *Why use data that we know is flawed?*
Answer: *Collocated data is used to estimate uncertainty in sites. For $PM_{2.5}$, in general, it's around 4%.*

Question: *Should we flag collocated data?*
Answer: *In samples where $PM_{2.5} > PM_{10}$, they've likely been flagged.*

- Investigations into cross-module ratios show drop in fAbs/ ECR ratio in both June 2021 and June 2022. This triggered an exploration into the HIPS instrument. Two significant changes occurred: 1) filter manufacturer changed in June 2021, 2) HIPs was modified. The drop is not isolated to the HIPs instrument, ratios of light absorption (BC) to EC on the quartz filters show a drop in June 2021. Is this something in the atmosphere?
  - A new collimating/focusing lens was installed on the HIPs instrument and all samples back to June 2021 were reanalyzed, yielding the same results.
  - Now collecting with both Pall and MTL filters at collocated sites to see if results are significantly different between two manufacturers. Plan to run experiments on both types of filters.

- UC Davis is receiving a lot of archived filter requests. Biologists are interested in phosphorus deposition in lakes and are asking to reanalyze old filters to look at trends.
- In the past phosphorus (P) was below detection limits on old instruments; lab is currently evaluating the reliability/accuracy of XRF P measurements. Comparison between ICP and XRF shows reasonably good agreement. More testing will be done and a calibration will be developed for P measurements on XRF.
- Element long-term trends are also being analyzed to investigate the stability of element measurements and provide guidance to the community on trends analyses.
- Current XRF instrumentation is aging. New instruments have been purchased to replace, but are still in development. Need a long-term plan and investment for replacing XRF instruments.
- Annual site reports for 2021 have been posted; 2022 will post soon.

Question: *How much are the new XRF instruments?*
Answer: *The Bruker Pumas (of which 3 have been purchase so far) are ~$100k, the Panalyticals are ~$150k. The old Panalyticals are under a service contract but will be cut off – there are new models, but they won't work for this application.*

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:

- Some staff changes at RTI lab; Kat is training to manage.
- Review of Process:
    - Nylon filters extracted in DI water
    - 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
    - Perform matrix spikes at a rate of 2 per batch of 50 samples
    - Random reanalysis of 5% of the sample total is performed
    - Re-extraction of filters to evaluate extraction efficiencies
- Control charts are used to identify outliers; if there's an outlier, reanalysis is done, and new data is reported. Roughly 5% of each batch of 400 NPS samples are reanalyzed. The Relative Percent Differences are calculated and verified against the DQO requirements. Any samples failing to meet DQO requirements are reanalyzed a third time to check.
- Extraction efficiencies were evaluated on ~349 samples
- Improvements to the quality system include:
    - Participation in PE evaluation conducted by Environment Canada. 10 samples were analyzed and received a perfect score
    - Obtained a laboratory accreditation through Industrial Hygiene for analysis of ions from the $PM_{2.5}$ filters in samples.

ANALYTICAL DEVELOPMENT – PART ONE

Carbon Research Update

John Watson presented an update on carbon and particulate sensor testing for fire science applications. A copy of the PowerPoint presentation accompanies these minutes. Summary points are as follows:

- Testing DST black/brown carbon and ARA particulate monitoring instruments. They can be used for quick deployment in a fresh part of a plume.

  DST samplers:
    - Operation of monitors at high temps affects the short wavelength laser; keeping monitor in shade appears to be an effective solution.
    - The short wavelength reference drifts; alternative lasers are being explored but they are expensive.
    - Comparisons show consistent bias, which has been traced to inconsistent tightening of filter clamp. A torque disk can be used to remedy.

- Company that manufactures is currently on hiatus and seeking investors.

ARA samplers:

- Operate well on solar power
- Quartz filters are submitted to multiwavelength IMPROVE_A
- Light attenuation by black carbon and brown carbon collected before, during and after the Mosquito Fire to test. Brown carbon is estimated as the difference between the EC split for 405 nm and 980 nm.

- Alternative TOR TC only and OC/EC only protocols reduce analysis times by ~50% and ~25%, respectively, resulting in ~20% cost savings for the TC protocol and ~10% cost savings for the OC/EC protocol.
- TC concentrations are the same for the TC, OC/EC, and IMPROVE_A protocols
- TC, OC, and EC are equivalent to IMPROVE_A for the OC/EC protocol
- As shown in Nicole Hyslop's Network update, fAbs/EC ratio showed differences around June 2021 and July 2022. Is this due to fAbs or EC changes?
  - bAtt/EC derived from IMPROVE_A (quartz) analysis does not show similar changes from the longer-term patterns
  - For Teflon, fAbs / EC, the 6/21–9/22 data seem to have a different pattern from previous years
  - For Quartz, bAtt / EC, the 6/21–9/22 data have a similar pattern as previous years
- NSF has approved DRI acquisition of a Photoionization-Time of Flight Mass Spectrometer (PI-TOFMS) coupled to a Model 2015 Multi-wavelength Carbon Analyzer. Photoionization minimizes fragmentation and allows to relate identifiable compounds with those from a mass spectrometer. Advantages of PI-TOFMS include:
  - Measures particle (with thermal desorption) and gas (VOC) organic compounds
  - Resonance Enhanced Multiphoton Ionization (REMPI) quantifies aromatic compounds, including PAHs
  - Single photon ionization (SPI) coupled to a fast gas chromatograph allows additional detection of aliphatic and oxygenated compounds
  - Electron Impact (EI) ionization creates molecular fragments corresponding to those of the Aerosol Mass Spectrometer (AMS)
  - Low detection limits allow for small sample sizes
  - Temporal resolution of several seconds permits monitoring of changes with combustion conditions and aerosol aging
- The PI-TOFMS is being used for several ongoing and proposed projects, including:
  - Evolution of wildfire smoke
  - Detection of micro- and nano-plastics in air, water, soil and ecosystems
  - Emission characterization of spacecraft fires
  - Brown carbon components in thermal carbon fractions
- The collaborative nature of the IMPROVE program has helped to make it an incredibly successful program in the aerosol/visibility world and beyond. Continued testing of new technologies is vital to continuation of the program.
- We need to discuss better ways to manage database of samples.

Question: *When using a mass spectrometer, what's the lower gas range?*
Answer: *They report carboxylic acid and other diacids in wood smoke.*

Question: *Has a PMF analysis been done on microplastics?*
Answer: *No, just preliminary testing.*

Question: *How much do microplastics contribute to mass?*
Answer: *Not a lot, but it accumulates over time. Micro are long and tubular, nano are chopped up. There is a growing interest from NSF and private grants to fund studies. FWS has shown interest.*

Question: *Can you do TC measurements without helium?*
Answer: *It's pretty expensive, but there is reduced production of helium so we're exploring other alternatives.*

HIPS Update

- When measuring sample absorptance with HIPS, the PTFE filters used provide precise, consistent measurements in uniform samples; however, IMPROVE deposits aren't typically uniform.
- PTFE filters are optically variable from filter to filter. The filters are thin films that require metal support screens, so deposit patterns become thick where holes are and thin where support screen blocks air transmission. Sample deposition becomes "pixelated".
- The most efficient absorption comes from a uniform sample, if we have this, we can consider the HIPS measurement to be a definitive estimate of an atmospheric cross-section.
- When looking at absorbing cross-sections deposited uniformly and an optical model for pixelated deposits, we can estimate the pixelation bias.
- As sample absorptance increases so does the pixelation bias. For typical IMPROVE loadings, reported Fabs values are biased roughly 5-15% low compared to atmospheric in-situ absorption. Higher bias is expected at very high absorptances.
- CSN and IMPROVE have been subject to HIPS since 2018. CSN has lighter deposits so filter absorptance levels are lower. When compared to collocated IMPROVE data at urban sites, we see reported CSN Fabs consistently higher due to the smaller pixelation bias for CSN samples.

Low-Cost Wind Sensors

Lawrence Tsai presented an update on developing low-cost anemometers into the IMPROVE network. Summary points are as follows:

- IMPROVE currently does not collect wind data. Implementing low-cost anemometers into the network could improve pollutant source apportionment.

- Anemometers on the market are durable, but expensive and require semi-annual maintenance.
- UC Davis is performing prototype testing on a low-cost anemometer that relates drag force to air velocity. The design is simple and has no moving parts (drag body panels are used to measure drag force), is easy to assemble, weatherproof and costs only $50-60.
- Drag anemometers are being collocated with Young 8100 3-Axis Ultrasonic (reference) anemometers for testing at HOOV1, PINN1 and SULA1.
    - Testing shows 95% of wind velocity values falling within ±0.2 m/s of the reference.
    - 95% of direction values fall within ±15° of reference, but only at wind speeds greater than 1 m/s. Results below this are poor; however, a calibration has been developed to improve the wind direction results at low speeds and standard deviations for this years' model are better.
- A web application with database integration has been developed to work in conjunction with the drag anemometer that allows for automated data processing, scalability and access to data and visualization tools.
- AirPhoton is interested in integrating low-cost wind sensors into a mobile air sampler and have ordered several units for testing. Further commercial interest may substantiate obtaining a patent in the future.
- Still need to work on defining measurement specifications for wind speed and direction, implementing better weather protection for electronics and streamlining the assembly process.

XRF vs. ICP/MS

Nicole Hyslop presented an interlaboratory comparison of elemental loadings on CSN $PM_{2.5}$ samples via energy dispersive XRF and single quadrupole ICP-MS. Summary points are as follows:

- Pollutant concentrations have decreased since the initiation of CSN and many elements are at or below the detection limits of current analytical instruments. This study was performed to determine if ICPMS can be used to achieve better detection at a relatively low cost.
- ICPMS measures all but four elements that XRF measures (SI, S, CL, Br), and can measure several elements regularly below the XRF MDL; however, ICPMS can be expensive due to the labor involved in sample preparation, calibrations, and disposal.

This comparison analysis was performed using archived samples.

- A comparison of detection rates for 33 elements showed a much higher percentage of measurements above MDL for almost all elements with ICPMS vs XRF. SI, S, Cl an BR cannot be measured using the applied ICPMS protocol.
- Reliability of elemental concentrations was performed by comparing XRF to ICPMS and performing inter-elemental comparisons for collocated samples.

- Some lighter elements show good collocated-routine agreement for both ICPMS and XRF.
- Collocated measurements for many elements agree at much lower concentrations for ICP-MS than XRF.
- ICPMS measurements were greater than the MDL more than 10% but less than 50% of the time for Cr or Cs; recovery was not acceptable or not evaluated for Ba, P, Sn, or Ce.
- Comparison is poor above the MDL for Ni with XRF or ICP-MS; measurements may not be quantifiable by one or both methods, or the extraction (leaching) is incomplete.
- With regards to Standard Reference Materials recoveries with ICPMS:
  - Some elements cannot be extracted with only HNO_3
  - Some elements did not have good recoveries, but XRF –ICPMS intercomparison is good/acceptable

- Next steps include: evaluating extraction efficiency, performing an ICP-MS analysis on nylon filters, performing a quantitative comparison of the data and evaluating the current list of elements being measured.

Question: *Why is XRF sensitive but ICPMS is not for Pb?*
Answer: *Nicole believes this is just noise.*

Question: *What's the underlying cause of that?*
Answer: *There's no Pb interference, but there may be an interference with another element not measured in this study.*

Measuring Carbon with FT-IR Updates

Ann Dillner presented an update on FTIR measurements associated with various projects across the IMPROVE, CSN, ASCENT, MAIA and SPARTAN monitoring networks. Summary points are as follows:

- All IMPROVE samples were analyzed by FTIR from January 2015 – Summer 2022.
  - A limited number of sites are still being analyzed.
  - In 2018, they switched from using Pall filters to MTL filters.
  - Calibration standards are currently under development.

IMPROVE - ORGANOSULFUR

- Research is underway to assess the stability of organosulfur and organosulfates on IMPROVE (PTFE) filters, to assess the suitability of non-destructive measurement by FTIR, and timescales and storage relevant to IMPROVE.
  - Hydroxymethanesulfonate (HMS) mass loss analyses show that mass decreases but stabilizes after approximately one month. Conversion from HMS to sulfate/bisulfate corresponds to a 40% loss. HMS can't be measured on IMPROVE filters.

- Methanesulfuric acid (MSA) can be measured, but all lower bound
- Methyl sulfate can be measured and is stable in mass and composition
- 2-methyltetrol sulfate can be measured in IMPROVE filters, although there is mass loss (gravimetric) and composition change (FTIR); it likely converts to other organosulfate.
- Next step is to determine the influence of other compounds on measurements by FTIR, analyze additional organosulfates and calibrate.

IMPROVE – DOE PROJECT ON WATER UPTAKE BY ORGANICS

- This research was done to measure hygroscopicity and CCN potential of organic aerosol functional groups. Hygroscopicity of aerosols historically driven by inorganics but decreases in SOx and NOx have increased organic fraction.
- The goal of this project was to validate a model for sugars and carboxylic acids in the laboratory, chamber, and ambient samples at IMPROVE sites.
- The results will be used to improve the DOE models and e-AIM.
  - The method was verified by measuring water uptake by tartaric acid and looks to be working well.
  - Next steps will be to measure water uptake for samples using FTIR to determine functional group mass for collected mixtures in the lab, chamber, and ambient IMPROVE samples.

CSN OC AND EC

- This research was done to measure CSN OC/EC. This can be difficult because CSN filters have a lower aerial density of PM on the filter than IMPROVE, and CSN filters are optically thicker than IMPROVE causing more interference. Additionally, aerosols are more complex and variable in urban environments.
- Requires grouping of sites with similar carbonaceous, inorganic and elemental composition.
- Recently identified samples with black dust on quartz filter and samples with no OP removed from the data set.
- Data was split into pre-COVID, COVID and post-COVID and used in prediction models. OC and EC predictions were made for selected sites (mix of EC typical/atypical and OC typical/atypical).
  - OC predictions for all three time periods show relatively low biases – OC fairly well-predicted.
  - EC predictions were split into typical sites, atypical sites and an aggregate. Typical samples showed low bias, atypical samples were a little worse, and aggregated samples showed a reasonable bias and R^2.
  - The next step is to compare to IMPROVE results, extrapolate through the end of the year with the most recent one year of data to mimic network ops and document methods for possible future use.

ASCENT – NEW NETWORK AT IMPROVE AND CSN SITES

- This is a new long-term, ground-based high time-resolution air quality monitoring network focused on $PM_{2.5}$. The network is funded by NSF and will be fully operational after four years, then passed off to NCAR to run.
- The network consists of twelve sites collocated at several IMPROVE and CSN sites.
- Each site has an aerosol chemical speciation monitor ($PM_{2.5}$), Xact, Aethalometer ($PM_{2.5}$) and Scanning Mobility Particle Sizer (PM_1). Purple Air sensors have been deployed at selected sites for comparison.
- The annual ASCENT meeting had good attendance and good collaboration with ACTRIS, MAIA, SPARTAN, and DOE.
- Currently UC Davis is working on increasing the chemical resolution of ACSM by measuring organic functional groups by FT-IR in parallel with ACSM and developing parameterizations of ACSM data.

MAIA AND SPARTAN

- MAIA's (Multi-Angle Imager for Aerosols) objective is to link exposure to different PM types with human health around the earth. Data will be collected on the MAIA Observatory instrument mounted on a spacecraft provided by the Italian Space Agency to measure the composition of aerosols. Launch hopefully in 2025.
- SPARTAN (Surface PARTiculate mAtter Network) is an international PM network with sites located in densely populated cities to evaluate satellite remote sensing estimates of $PM_{2.5}$ and connect $PM_{2.5}$ composition to health outcomes.
    - UC Davis measures OC and EC using IMPROVE filters and collocated AMOD samples as calibration, evaluates and improves FTIR functional group measurements for international sites.
    - Evaluated chemical composition and sources of PM at Pretoria, South Africa SPARTAN site.
        - Organic mass at Pretoria is dominated by aCH and COOH; the next step is to evaluate seasonality of composition and source apportionment.

Satoshi Takahama presented on the limitations and challenges of filter based measurements of aerosols with FTIR and potential solutions. Summary points are as follows:

- Current challenges include the need for many calibration models for each task: separate models built with lab standards, ambient samplers, separate models for each species, PTFE interference.
- Currently focused on extracting particle spectra and relating them relating to collocated measurements to develop a single model for all species, and to enable the use of external data for calibrations.
- Interference from the PTFE filter is complex and a simple blank substitution does not resolve the issue. One potential solution is modeling substrate interactions.
    - Build statistical models for PTFE spectrum trained on blanks.
    - Refractive indices can be used to constrain aerosol calibrations
    - An extracted solution electrosprayed onto crystal can be measured with no PTFE interference

- Can apply constrained matrix factorization to constrain contributions of some components

Question: *Will we see better relationships?*

Answer: *[Anne] Once we have spectra, we can reanalyze and recalibrate; will calibrate differently.*

DATA ANALYSIS

Trends in Seasonal Mean Speciated Aerosol Composition

Jenny Hand presented current concentrations of major aerosol species (2018-2021) and seasonal and spatial trends analyses from 2000 to 2021. Summary points are as follows:

- Current spatial trends show highest sulfate concentrations now seen west of the Appalachian region; nitrate is high in the middle of the country due to agriculture; OC and EC trends have been impacted by fires; there is a N-S gradient for fine dust due to SW dust sources and topography.
- Ammonium sulfate has decreased across the country since 2002, especially in eastern regions.
- Current seasonal mean FM decreases across the country in winter and spring (especially in the east), and increases in the summer and fall in fire impacted parts of the west.
- Current seasonal mean sulfate trends show decreases across the country in all seasons, with the most dramatic decreases in the east, especially during the summer, fall and spring months due to the decline SO_2 emissions.
- Nitrate is decreasing in the central US in most seasons and in southern California where there have been significant NO_X reductions
- OC trends are heavily influenced by smoke, so we see increases in summer and fall in some western states and generally decreasing trends elsewhere and in winter and spring.
- EC trends are also impacted by smoke in the west. Significant decreases have been seen in So. Cal. EC, and EC has decreased in most seasons in the east.
- There are few statistically significant trends for fine dust other than a decrease in northeastern and some Appalachian states.
- Decreases in mean sulfate and nitrate over this period of time appear to be directly correlated with NEI decreases in SO_2 and NO_X emissions.
- OC concentrations appear to have modest correlation with burn area but high correlation with VOC emissions.
- The effects of ENSO and PDO amplify each other, resulting in increased variability in precipitation over the southwest.
- There appears to be a strong correlation between southwest fine dust and PDO in the spring; it looks like PDO is influencing dust trends in the southwest.

- We're seeing reductions in FM in the east and as we move west we're seeing only winter/spring reductions.
- Regulatory activity has been successful in reducing FM, especially in the East.
- Unregulated anthropogenic emissions, such as oil and gas and agricultural emissions, are likely influencing FM trends.
- Impacts from natural sources- such as dust and smoke- are likely going to increase with climate change.

Nitrate Trends on Most Impaired Days

Scott Copeland presented a summary of changes in eastern U.S. NOx emissions and IMROVE fine nitrate concentrations between 2002 and 2021. Summary points are as follows:

- Strong evidence that past NOx reductions are linked to lower particle nitrate concentrations broadly across the Eastern US.
    - NO_X has trended down steadily in eastern states over the past 15-20 years; we're seeing consistent 50-75% reductions across all of these states.
    - Measured fine nitrate concentrations decreased steadily across eastern US IMPROVE sites.
    - 66% reduction in eastern US NOx results in 32% reduction in annual mean fine NH_4NO_3 concentrations. An increase in reported NH3 emissions is reported because the data was readily available.
        - Although total light extinction went way down on most impaired days over the same period, light scattering on most impaired days for nitrate increased.
- The resulting changes in measured fine nitrate concentrations are not necessarily reflected in Most Impaired Day (MID) *composition*, but still affect MID dv, which is the metric.
    - The result is that significant NO_X and nitrate reductions led to an increase in nitrate extinction on the most impaired days.
    - A majority of sites experienced a significant shift in the seasonality of MID, with the broader trend being more MID in the winter and fewer MID in the summer. This is the cause of increased nitrate concentrations on the MID, even at sites when winter nitrate concentrations decreased.
- Simulated data suggests that past NOx reductions have improved current MID dv and that future NOx reductions will reduce measured nitrate concentrations, and consequently reduce MID dv.
    - The MID algorithm can be used to simulate past and future conditions.
        - Past 66% reduction in eastern US NOx results in 32% reduction in annual mean fine NH_4NO_3 concentrations. This results in 5.6 Mm-1 more nitrate and 0.39 dv 5-year average increase in MID compared to no reduction in NH_4NO_3.
        - If we zero out eastern US NOx, and extrapolate previous trend yields 22% additional reduction in annual mean NO_3 concentrations. This results in 2.6 Mm-1 less nitrate and 0.58 dv 5-year average improvement in MID compared to no reduction in NH_4NO_3.

Bret Schichtel presented a summary of the shift in secondary inorganic aerosol formation in the rural CONUS from 2011-2020. Summary points are as follows:

- Interested in whether particulate nitrate formation is NH_3, NO_X limited, or both
- Nitrogen emissions in oxidized (NO_X) and reduced (NH_3) have significant effects on $PM_{2.5}$ and ozone formation, and nitrogen deposition. Increasing N deposition results in increased ecological effects; more than 50% of reactive N deposition is reduced N compounds throughout the rural United States
- Atmospheric NOx is oxidized forming nitric acid (HNO_3) gas. Nitric acid is generally neutralized by ammonia forming particulate ammonium nitrates. This reaction is temperature and humidity dependent
- In ammonia limited conditions, ammonia preferentially neutralizes sulfate acids over nitric acid. In a NH_3 limited regime, reductions in SO_2 or increases in NH_3 can increase the formation of ammonium nitrate particles.
- Over the last 10-20 years, there have been rapid changes in emissions and aerosol composition due to SO_2 and NO_X emission reductions. There are large uncertainties in NH3 emissions and contributions of NH_3 and SIA formation. Chemical transport models have large uncertainties in emission inventories and deposition processes.
    - Can predict ammonia gas against observed using the ISORROPIA-II thermodynamic model which partitions total nitrate (HNO_3 and PNO_3) and total ammonia (NH_3 and NH_4) between the gas and aerosol phases.
    - Ammonia gas has been increasing over time while nitrate increases.
- In the last two decades, monitoring networks have gone through tremendous improvements: with AMoN, multiple networks can be integrated at sites in rural regions. Observations of precursor concentrations, aerosol composition, and meteorological conditions are available resulting in improved aerosol formation modeling and uncertainty estimates.
- The SIA (NO_3+SO_4) formation regime is changing. SIA formation became less sensitive to NH_4^T changes. NH_3 controls became less effective than NOx controls.
- Throughout the Southeastern US particulate nitrate formation is more sensitive to changes in NO_3^T today than in the early to mid 2000's
- NOx controls today should be more effective than in past years
- At most sites, SIA is equally sensitive to changes in NH_4^T and NO_3^T, but sites like Dolly Sods, WV are still more sensitive to changes in NH_4^T
- Additional research is needed to understand the changing sensitivity and interplay of SIA to NH_3 and NO_x emissions.
- Bret is proposing a collaborative special study to assess the sensitivity of particulate matter, haze and reactive nitrogen and sulfur deposition to changes in NOx and NH3 emissions in Southeastern Class I Areas.

Optical Monitoring Update

Bill Malm and Bret Schichtel presented an update on the Christman Field optical monitoring study that includes identifying a replacement for the NGN nephelometer and cost-effective methods of estimating PM levels in National Park units. Summary points are as follows:

NEPHELOMETERS

- The NGN open air nephelometer was designed in early 90's and is no longer manufactured and spare parts are no longer available for repair. Three nephelometers were collocated for this study: TSI 3-wavelength nephelometer, 2WIN 2-wavelength nephelometer, Optec 1-wavelength nephelometer
- In determining what to replace the NGN with, there are a number of design issues to consider including:
    1. Electronic noise
    2. Uncertain calibration numbers
    3. Not Lambertian light source
    4. Truncation error
    5. Wavelength uncertainty
    6. Inlet uncertainty
    7. Temp and pressure variability
    8. Inadvertent heating and modification of sample
- Issues 1-7 are well characterized for TSI and partially characterized for NGN and 2WIN. Issue 8 has not been addressed for TSI and 2WIN (important for NPS).
- Objectives of nephelometer measurements are to:
    - Track changes in bsp (visibility) over time and space
    - Verify optical models relating bsp to atmospheric particle concentrations
    - Track changes in $f(RH)$=b_sp (RH)/b_sp (dry) (climate forcing and visibility) over time and space
- Problem and Design criteria
    - Verify optical models:
        - Don't know the chemical and physical properties of aerosol – primarily chamber RH issue
        - Volatilization of particles from heating.
    - Track bsp:
        - If goal is to link bsp changes to atmospheric aerosol concentration, then f(RH) in chamber should be near one. RH variability confounds relationship.
        - If goal is to link bsp changes to visibility, RH in chamber should be ambient.
        - At very least RH should be held at some predetermined level (RH<40%)
    - Track f(RH): Reference bsp should be at f(RH) near 1 and no inadvertent heating.
- Nephelometer Issues from NPS Perspective
    - NPS and IMPROVE primarily use the nephelometer to verify the link between measured speciated particle concentrations and bsp (visibility)
    - Need to make bsp measurements at near ambient RH which requires precise measurement of scattering chamber RH
    - Tracking trends using nephelometer measurements is a secondary objective.
- Operated 5 nephelometers
    - TSI – inadvertent heating RH<35% - 2.5 um inlet
    - 2WIN dry - RH<40% - 2.5 um inlet
    - 2WIN ambient – Some heating – 2.5 um inlet
    - NGN dry - heating to reduce RH – 2.5 um inlet
    - NGN open
- For the time period that particle size and composition were measured it appears that the NGN_{heated} nephelometer which was heated to reduce RH to less than 20% volatilized significant fraction of ammonium nitrate.

- We were able to resolve all differences between integrating nephelometers based on varying chemical and physical properties in neph scattering chamber.
- Differences in bsp from nephelometer measurements made at the same time but varying chemical and physical characteristics of the aerosol.
- Conclusions:
    - Confidence in all nephelometers to accurately measure bsp of aerosol in chamber but with varying precision and MDL (Can model if you know the chemical and physical properties of the aerosol in the chamber)
    - Nephelometers to measure truly ambient air are not manufactured
    - All commercially available nephelometers heat (reduce humidity) to some extent
    - All commercially available nephelometers will require an inlet (2.5 um)
    - 2WIN instrument is accurate and precise with a very low MDL
- Decision
    - Run 2WIN with 2.5 um inlet at near ambient conditions as possible
    - Measure temperature and RH in or near the sampling chamber with high degree of accuracy

PM MEASUREMENTS

- This study was conducted to determine the potential for using low-cost Purple Air (PA) sensors to measure PM in National Parks. The PurpleAir sensor consists of two Plantower PMS5003 “laser particle counters”, RH and temperature sensor, and data logger.
- Issues to be addressed during the study include:
    - Standard Operating Procedures
    - Acceptance testing
    - Accuracy of reported parameters (PM2.5, AQI ……)
    - How to use PA readings – Important to NPS
- What did we learn about the PA:
    - Which parameters are reported (listed in accompanying presentation)
    - The plantower scattering geometry is such that the laser is focused and polarized perpendicular to the plane of incidence.
        - Only pulse heights detected at x, y and z = 0 and associated with particles 0.3 um or greater are counted.
        - Larger particles detected at x, y, z ≥ 0 generate pulse heights equal to or greater than a 0.3 um particle and consequently are over-counted.
    - The PA underestimates number concentration based on pressure differential.
    - A model was developed to account for PAs shortcomings that works reasonably well.
    - RH reported by all PA’s are systematically low by about 20%-30%
    - Very sensitive to meteorological conditions (wind speed and direction)
    - All variables are derived from a single sensor output – does not count particles
    - High level of precision
    - Measures primarily fine particles
    - PA relationship to bsp and PM vary by factors of 3 to 4 (300% to 400% uncertainty)

    - Uncertainty in estimating bsp and PM varies with particle size which may be a function of mass concentration (Is this true for all areas of US and ambient conditions?)
    - f(RH) from PA very close to Nephelometer f(RH)
- Recommendations
    - Calibrate RH sensors before deployment
    - Establish acceptable variability for "routine" monitoring
    - Deploy only with wind shield (inverted bucket)
    - Establish pre deployment calibration protocol
    - Develop procedure for measuring "dry" scattering with known accuracy and precision
- Develop recommendations to NPS users as to how to interpret PA data
    - Recommendations to park visitors
    - Closure of NPS unit

Question: How is the Purple Air so well correlated at the collocated site for $PM_{2.5}$?
Answer: It correlates empirically but if you compare dust, it's less.

DATA PROCESSING, DISTRIBUTION, AND QUALITY

IMPROVE Data and RHR Metrics

Scott Copeland presented a summary of the status of 2022 IMPROVE data. Summary points are as follows:

- Latest IMPROVE data delivered is December 2022. RHR metrics through 2022 posted on my Google Drive, and available through FED now. Nothing noteworthy and no reprocess required.
    - Local increases in most impaired day nitrate, but still decreasing
    - Haziest days composition maps show decreased wildfire activity in 2022.
    - Clearest days are clear and getting clearer
    - Filter clogging is still somewhat common with wildfire events, but first "SD" Short Duration sample delivered 12/25/22. SD samples were shut off during sampling to prevent clogging and make incomplete samples usable.

- A number of FS sites are offline for a various reasons, no operator, inaccessible location, etc.

Question: [Margaret McCourtney] Have there been any changes to calculation of tracking metrics, especially adjusting for wildfire on a regional basis? Which days get put into most impaired days based on carbon function?

Answer: No one's working on that now.

Question: [Margaret McCourtney] How is the tracking metric being used in the Regional Haze program? Modeled results get tacked on end-point to raise endpoints?

Answer: [Scott] There are no current efforts in IMPROVE to address this; those are EPA Regional Haze Rule and Guidance issues.

[Bret] That is something we could look into if there's interest and guidance. What's the interest? Do all states feel that this is vital information?

[Margaret McCourtney] If states are meeting their endpoint goal then they won't be interested, but if the endpoint gets raised because of international transport then most states say they're done with RHR.

[Jay Baker] Several states used endpoint adjustment and were skeptical about using it (project to 2064); I think some of those states may be interested in adjusting. We should bring questions to the EPA; I think they will engage in this.

Quality Assurance – New QA Analyst Introduction

Bonne Ford is the new QA Analyst at CIRA. She provided some background on her research and goals for the upcoming year. Summary points are as follows:

Her background includes:

- Work with CALIPSO using satellite observations for air quality and comparing models to observations.
- Research on smoke impacts on air quality, air quality trends, and health (also crime and productivity).
- Studies on communication surrounding air quality and how people recognize air quality; whether it changes their behavior and health outcomes.
- Low-cost sensor and citizen science projects.

Projects over the past year include:

- Population-level smoke exposure estimates for NM 2022
- Automated Text Message and Email Air Quality Alert System for outdoor workers in Fort Collins
- Tools and Dashboards for visualizing/managing PurpleAir Sensors

Goals for this upcoming year

- Develop a thorough understanding of the historical record and scientific findings from the IMPROVE network
- Use IMPROVE data to understand and recreate essential data products and trends
- Help improve and update documentation

Practices that are important in my work

- Creating shareable, easy to follow code (https://gist.github.com/bonneford)
- User-friendly data products
- Documentation
- Building tools and procedures for efficiency

Question: In the Facebook study you worked on in the past, did you explore the threshold of when people respond to air quality?

Answer: We saw a response only where people were aware of a big event downwind. Facebook terms make it difficult to get a large dataset

Question: What ozone instrument did you use in the citizen science study?
Answer: 2B AQLite

IMPROVE BUSINESS

IMPROVE Steering Committee Charter – Year 1

Scott Copeland discussed IMPROVE Steering Committee Charter implementation. Summary points are as follows:

- Year 1 of 3 for current Chair.
- 3 sub-committees formed, with Chairs and members.
- I will get the annual spring Steering Committee update meeting to April or May, and provide more notice.
- Main issues of concern:
    - Continue to not analyze end of December filters (cost savings measure from ca 2013)
    - Natural conditions and endpoints
    - Trends across relocated sites
    - IMPROVE Equation 3
    - QMP/QAPP updates

Question: Is the mid-year check-in (Spring) meeting worth it? We want sub-committees and everyone to attend.

Answer: Consensus is that it's worth it, but we should have different goals, not just repeat the fall meeting. The purpose of the spring meeting should be:

1) *Maintain enhanced participation*
2) *To follow up on the fall presentation meeting*

The emphasis will be on providing updates and keeping people engaged, not on presenting regardless of whether you have an update or not.

Question: Can subcommittees have working group meetings? Could one meeting per year be science-oriented and one process-oriented? Is the second meeting beneficial to stakeholders?

Answer: [Jay] Yes, he likes the idea of focusing on subcommittees to coordinate at the spring meeting to make sure subcommittee chairs are moving in the right direction.

- With shifting emphasis on nitrate on worst days we should reconsider analyzing end of December filters; we are introducing bias.

- The QMP/QAPP from 2016 is out of date. We need to identify a process for revising/updating.

Network Operations Subcommittee

Joann Rice provided an update from the Network Operations subcommittee. Summary points are as follows:

Activities for this group from the Charter include:

- Network Operations
    - Oversee changes to IMPROVE monitoring operations and sample analysis
    - Conduct analyses to inform decisions on network changes
    - Help resolve issues resulting from loss of site operators, monitoring equipment, or site relocations
- QA/QC
    - Review all QA/QC documents
    - Ensure requirements of the QAPP are being met
- Contracting
    - Review and provide feedback to NPS on technical requirements of RFPs

- Documentation
    - Oversee update of Quality Management Plan (QMP) and QAPP (Quality Assurance Project Plan (QAPP)
    - Maintain policies concerning network operations including site selection and relocation

- State of Iowa requested discontinuation of VILA1 and LASU2 on 7/1/23. After EPA's 2015 assessment, both sites were kept based on feedback from the state for background and transport information. State feels that CSN at other two NCore sites would provide the needed information. EPA Region 7 plans to approve through the annual monitoring network plan review.
- Plans for Coming Year
    - Site shutdowns or possible moves
        - Frostburg (FRRE1) IMPROVE protocol site
    - Quality Management Plan (QMP) and Quality Assurance Project Plan (QAPP) updates are needed. Per EPA, can use a graded approach to fit the nature of work of IMPROVE program.
        - QMP
            - Describes the quality system in terms of the organizational structure, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, assessing and reporting activities to support the objectives
        - QAPP
            - A formal document describing, in sufficient detail, the quality system that must be implemented to ensure that the results of work performed will satisfy the stated objectives.

- Melinda will be taking over leadership from Joann. Are there others that are interested in assisting with QA documentation efforts. Bonnie? Marcus? We'd like to have a draft of QMP ready for the spring meeting and need to make a formal plan for who will lead, write, etc. Make a plan for December.

  Question: The sites being shut down in Iowa are in a nitrate bulge. This is an area of concern. Can you use the CSN data at nearby sites to fill in for lost IMPROVE sites? Can someone work on this?

  Answer: CSN measures the same, but no PM10. Same target list but different in sample collection (47 mm filters and very similar carbon measurements).

  Question: Viking/Seguma are a good urban/rural pair and have been valuable in the past. Is there additional value in keeping these sites (look at funding)? The loss is a big deal spatially.

  Answer: We need to at least get nitrate (NCore) data from CSN into IMPROVE dataset as there will be a gap in this dataset in the nitrate bubble. More analysis will be needed to decide.

  Question: Can IMPROVE use the CSN QMP?
  Answer: Joanne will ask QA people at EPA if this will work for IMPROVE. Updating QA documents in the next year is a priority.

  Tony: We haven't written a statement of work; requirement to review and provide feedback to NPS on technical requirements of RFPs.

Data Analysis Subcommittee

Jenny Hand provided an update from the Data Analysis subcommittee. Please let Jenny know if you're interested in being part of the subcommittee. Summary points are as follows:

- Duties include data compilation, analysis, and reporting, including:
  - Developing the policies for generating and distributing the IMPROVE data, metadata, and data products to EPA AQS and CIRA FED
  - Reviewing and overseeing all quality control assessments as defined in the QAPP and each year reviews irregular/suspect data and makes recommendations for its disposition
  - Overseeing the generation of the routine reports and data products, e.g. the RHR metrics for tracking progress in visibility improvements
  - Helping with the unique IMPROVE data analyses and assessments.
  - Hold one virtual meeting per year (June 2023)

- IMPROVE Report for 2023 is available via the CIRA website (see link in power point). We need to think about how we want to put this together in the future as it's a big effort.
- The 2023 IMPROVE Data User Guide will be available on the website at the end of the month and is geared toward new users. It will be updated regularly.

Discussion of the need for QMP and QAPP updates and to which subcommittee group this responsibility falls upon. This will likely be the Network Operations group.

Outreach & Communication Subcommittee

Jay Baker (subcommittee chair) provided an update from the Outreach and Communication subcommittee. Note there is no accompanying presentation. Summary points are as follows:

- Jay would like a little more clarity from the charter on the purpose of this subcommittee and would like to see more coordination on writing a report. His focus is letting the IMPROVE community know what's going on.
- At the last meeting the subcommittee discussed:
    - Using automated notifications for IMPROVE and having people sign up for a listserv on the website.
    - Improving communication with site operators to help them understand how they fit in and the importance of their work (looked at how NADP does things).
    - Educational materials on how to easily access data and present it to users/stakeholders as well as how to interact with and use data.
    - Identify what information isn't being communicated well to the larger community.
    - How to involve more RPOs, states (and others?) in more meetings.
- Annual site reports to operators haven't been sent out lately because people weren't reading them.
- Jay would like to define a topic for this subcommittee to focus on in the coming months to report on in June:
    - Communication to broader IMPROVE community, or
    - Site operator engagement

Nicole, and others, still think it's worth it to send annual reports out.

The group discussed site operator engagement and touched upon:

- *Good response to photo contests for IMPROVE, but this may not be enough.*
- *NADP offers milestones to operators, but this may not work for IMPROVE as contractors can't give gifts.*
- *Recognizing site operators in calendars (used to do, but difficult to get bios).*

The group identified moving to MailChimp, or something similar, to manage email contact groups as a top priority. This can be easily integrated into the website so people can subscribe/unsubscribe.

Requests for Archived IMPROVE Filters

Scott Copeland discussed recent requests for archived IMPROVE filters, implications, and where responsibility lies. Summary points are as follows:

- There have been a lot of requests for archived filters and more than one publication based on their analysis; we expect to see more requests in the future.
- Typically, permission from the Steering Committee is required to fill filter requests when it involves: The distribution of 10 or more filters and/or extracts from IMPROVE sites to third parties for additional analyses. These analyses may or may not be destructive. Approval for more than 10 filters from protocol sites requires approval from the site sponsor.
- Recent studies/requests include:
    - Analysis to determine evidence of microbial transport in smoke plumes
    - Detection of pesticides in/near Yellowstone
    - Biodiversity changes determined by DNA

  DNA has been destroyed by x-rays and biological matter may be larger, so UC Davis is now sending PM_{10} filters rather than $PM_{2.5}$.

- Archived filters are potentially very valuable to future studies in a variety of fields. Are we doing enough to preserve filters? Should we seek grant funding to archive? Are we ok with sending them out and not getting them back?

  Question: Can FRM filters be requested?
  Answer: From the State; the State has the option to dispose of them after five years.

  Question: Are there other avenues to get filters from other networks?
  Answer: Yes: CASTNet, CSN and others

  If these studies are successful, then there will be a lot more requests; this may spur opportunities for more funding for things like dedicated cold storage facilities, etc. Ideally, filters would be stored at room temperature or cooler, be organized for easy access and have an accompanying database to display what filters are available (Sean was working on this piece). We need to put a process in place to request/approve and allow people access to metadata as well (land-use, etc.).

CSN Filter Archive and Long-Term Storage

Joann Rice provided an update related to CSN archive and long-term storage. Summary points are as follows:

- CSN began sample collection in 2000
- Teflon, Nylon, and Quartz filters are collected for every sampling event at every site
- The CSN repository has close to 450,000 filters
- The rental rate for cold storage has gone up significantly; UCD has space for 5-7 years of cold storage
- Considering two options:
    - Keep at least 5 years of both Teflon and quartz filters in cold storage for 5 years; rotate old ones out to make room for new ones. Keep old filters in room temperature-controlled storage.

- Keep 1 year of Teflon filters and at least 5 years of quartz filters in cold storage. Keep remaining filters in room temperature-controlled storage. This is based on the CFR requirements for PM2.5 FRM Teflon filters to be kept cold for 1 year.

Question: What is the cost of cold storage?
Answer: Currently UC Davis has room for 5-7 years, but no room to expand.

Question: Do Teflon filters need to be cold stored? Quartz is cold stored because of carbon. Could we pull Teflon to make room for quartz in cold storage?
Answer: Agreed that it's worth holding onto all CSN and putting Teflon into room temperature storage to make room for quartz in cold.

Question: Do we think there's an opportunity to get funding from the Smithsonian/Library of Congress? If we could have them fund the storage and get it out of the hands of contractors, that may be helpful
Answer: We'd need a good system for documenting chain-of-custody. We could put a call out to gauge interest in filters.

Question: In the case of requests for filters that are destructive: we could consider cutting the filter in half, rather than destroying the whole thing.

Question: Could we add a request list to the website and add information about results, conclusions, etc. so people could follow the work being done and outcomes?
Answer: Currently, there is no electronic archive. Scott will compile a list of all requests and post it.

Question: Can total nitrogen (from $PM_{2.5}$) be measured? Are there archived samples that can help?
Answer: On Teflon filters, ammonium nitrate is evaporated off. Soluble fraction could be done on nylon filters, but it's not cheap and would require extra funding. This is not directly related to visibility, so IMPROVE could not fund it. We could do a potential pilot study to measure total (non-volatile) nitrogen. There are no plans for routine work like this.
Think there is interest because it's challenging to set a standard with ambient deposition monitoring.

BUDGET

Budget Analysis & Discussion

Tony Prenni led a discussion regarding the IMPROVE budget. Summary points follow:

- IMPROVE Carbon 5-year Contract Awarded to DRI
- DOE Interagency Agreement (Southern Great Plains)
  - DOE did not submit the paperwork in time for funds transfer this year; Working on getting this resolved
- BLM Interagency Agreement (Toolik Lake)
  - Working to get a new agreement in place
- USFS Interagency Agreement

    - May be updating how we do this agreement due to new overhead costs at NPS
- No funding from BLM this year
- NPS is adding 10.5% tax to interagency agreements
- IMPROVE funding shown is just enough to run the network; it doesn't include site operations or nephelometers (which NPS also pays for)
- Next year:
    - Additional Funds from DOE and BLM
    - Additional Savings from Carbon Contract
    - No additional funding for IMPROVE Report
    - Increase contract costs
    - Full time QA/QC position
    - Government Shutdown?
        - In previous years, contracts were largely unaffected
        - In September, Tony had to submit a justification that life and/or property would be put at risk if contracts were to stop
        - He does not know what to expect if there is a government shutdown in November

Question: If Southern Great Plains site isn't funded by DOE, will the site continue to operate?
Answer: Yes, NPS will pick up short-term to continue running.

The group discussed creating a contingency plan for the shutdown in November.

IMPROVE Steering Committee Business

Scott Copeland led a discussion regarding IMPROVE business updates.

The group discussed the potential of shifting the in-person meeting timing to spring due to frequent government shutdowns during the fall (spring > in-person, fall > virtual). Since there are already a lot of other meetings in the spring, it was decided to keep the in-person meeting in the fall, but perhaps tack the in-person meeting onto the spring 2025 AWMA Visibility meeting.

Plan for the next in-person meeting in early-to-mid November of 2024. The group is thinking about Socorro, NM with a site visit to Bosque del Apache National Wildlife Refuge (BOAP1). Scott will contact Bosque to inquire and follow up with the group.