

THE IMPROVE PROGRAM

Interagency Monitoring of Protected Visual Environments



Jenny Hand
CIRA, Colorado State University

Photo : Scott Copeland
Green River Lake, WY



Overview

- Purpose
- Management & Organization
- Routine Monitoring
- Logistics
- Documentation
- Data Download & Tools
- Data Analysis



Capitol Reef, UT



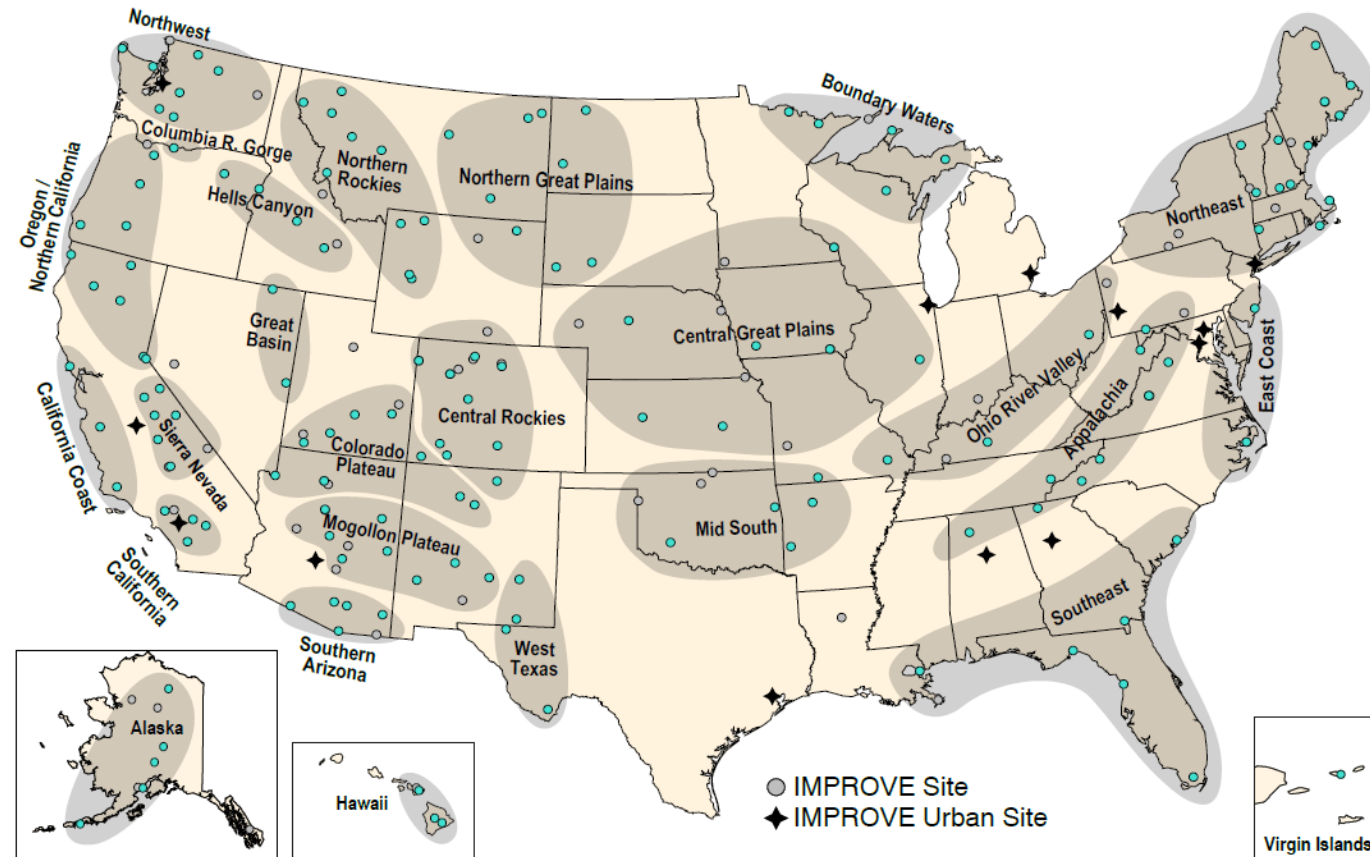
Purpose

- The 1977 Clean Air Act Amendments
 - Congress established a national goal that calls for “***the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I federal areas which impairment results from manmade air pollution.***”
- The 1999 Regional Haze Rule (RHR) expanded this mandate.
 - ***Required state and federal agencies to work together to improve visibility in all 156 federal Class I national parks and wilderness areas***
 - Established a goal of no “man-made impairment” in Class I areas by 2064.
 - ***Required visibility monitoring*** in locations representative of the 156 visibility-protected federal Class I areas. ***IMPROVE*** was designated as the monitoring network to carry out this responsibility.



IMPROVE Visibility Monitoring

- The IMPROVE Program began in 1985.
- Long term monitoring began in 1988 with 20 monitoring sites.
- Currently 155 sites.





Purpose

The **IMPROVE** program is a cooperative measurement effort designed to

1. Establish **current visibility and aerosol conditions** in mandatory Class I areas (CIAs);
2. Identify **chemical species** and emission sources responsible for existing anthropogenic and natural visibility impairment;
3. Document **long-term trends** for assessing progress toward the national visibility goal;
4. Provide **regional haze monitoring** representing all visibility-protected federal CIAs where practical.



Big Bend, TX



156 Class I Areas

International parks, national wilderness areas, and national memorial parks that exceed 5000 acres in size and national parks that exceed 6000 acres in size that were in existence on the date of enactment of the 1977 Clean Air Act Amendments





Purpose

- **IMPROVE is an open and collaborative program** that involves stakeholders in all decisions, and where consensus among stakeholders is sought but not required. Input from other organizations involved in IMPROVE and data users are also sought and taken into consideration.
- The IMPROVE Steering Committee **provides guidance and recommendations to EPA** and the contracting agency on how to best meet the program's mission and objectives.
- IMPROVE is a regulatory network, **operated in support of the requirements of the Regional Haze Rule**. IMPROVE data also **support additional scientific and regulatory inquiries** and the program is operated to foster these additional endeavors.
- Recommendations for **changes in the monitoring program are based upon sound scientific justification** within resource constraints. Changes are implemented in a manner that **minimizes discontinuities in long term trends**.



Management and Organization

IMPROVE Steering Committee

- Guides the management and evolution of the monitoring network:
 - Oversees all program activities, develops guidance and procedures governing IMPROVE samples and data,
 - Makes recommendations to EPA and NPS related to funding, expansion/reduction of the network and all technical and non-technical issues,
 - Interacts directly with the laboratories,
 - Seeks input from the broader community.



Management and Organization

IMPROVE Steering Committee

- Chair, Vice Chair, Secretary
- Representatives from NPS, USFS, FWS, BLM, NOAA, state organizations (WESTAR, NESCAUM, MARAMA, NACAA)
- Associate members: State of Arizona, Environment and Climate Change Canada, Republic of Korea Ministry of Environment

Current Members

NPS: Bret Schichtel
EPA: Melinda Beaver
USFS: Scott Copeland (Chair)
FWS: Tim Allen (Vice Chair)
BLM: Bret Anderson
NOAA: Xinrong Ren
WESTAR: Jay Baker
NESCAUM: Heidi Hales
MARAMA: Charles Turner
NACAA: Farrah Fatemi

Secretary: ARS



Management and Organization

The IMPROVE Program

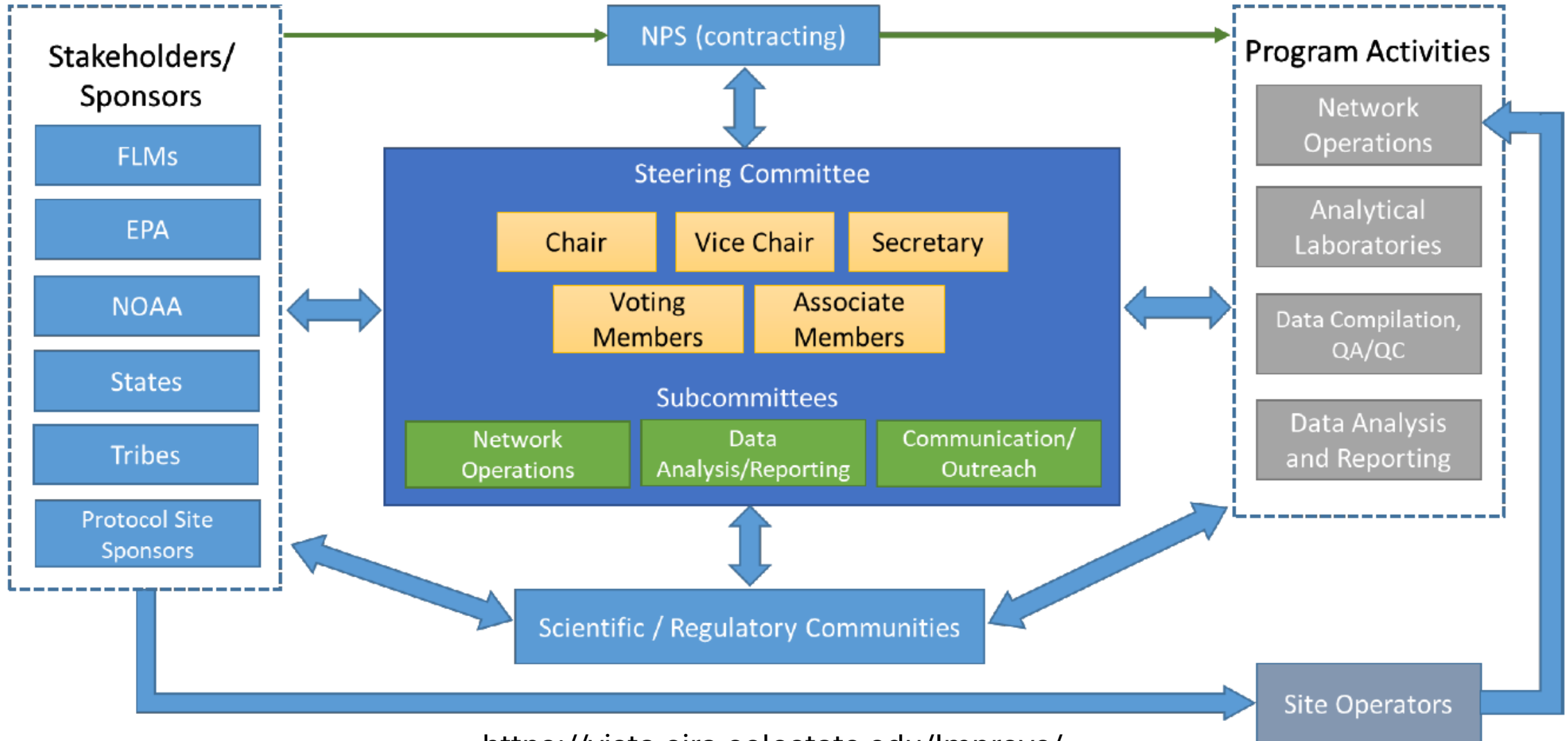
- Is governed by a Charter.
- Hosts an annual fall meeting (hybrid) and virtual spring meeting to report on the state of the network.
- Code of Conduct (see Charter).



White River, CO



Management and Organization





Management and Organization

Program Activities

1. Network operations: filter handling and shipping, and site maintenance
2. Laboratory activities: filter analyses
3. Data Compilation and QA/QC
4. Data Analysis and Reporting: higher level QA, data synthesis and generation of RHR metrics.

The details of these activities are discussed in the IMPROVE quality management plan (QMP), quality assurance project plan (QAPP), and standard operating procedures (all available on the IMPROVE website).



Management and Organization

IMPROVE Subcommittees

- Network Operations (Melinda Beaver, EPA)
- Data Analysis & Reporting (Jenny Hand, CSU)
- Outreach/Communication (Jay Baker, WESTAR)

- Provide the technical guidance needed to evaluate and adapt the IMPROVE monitoring program to ensure it meets its mission and objectives.

- Ad-hoc workgroups may also be formed to work on timely issues related to the IMPROVE program.



Hoover, CA



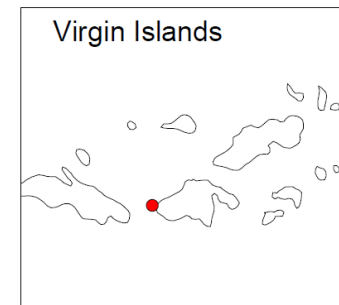
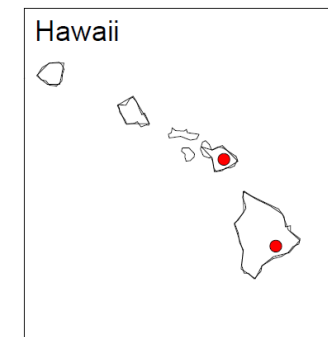
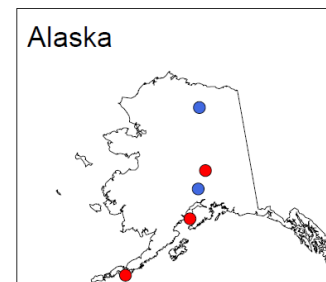
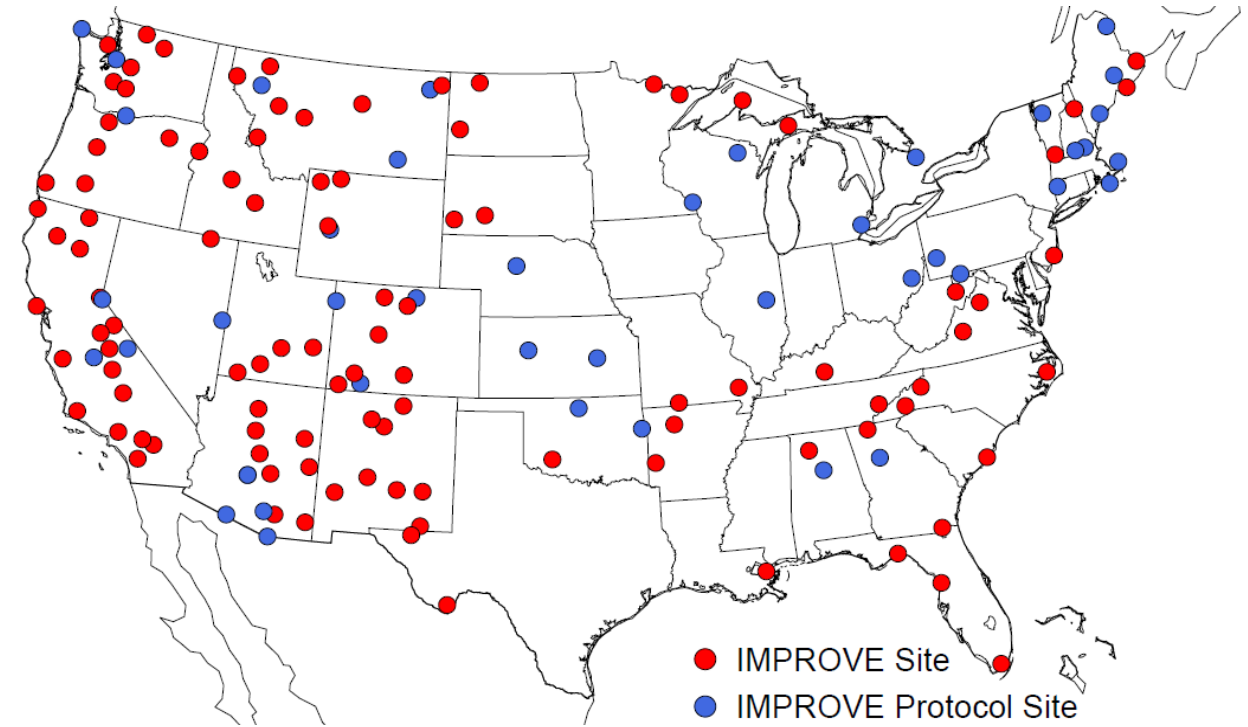
Management and Organization

Funding

EPA funds laboratory costs of the 110 IMPROVE sites on behalf of the states.

Protocol sites are funded by various state, regional, tribal, and federal organizations as well as international organizations. Protocol sites are operated similarly to network sites.

Protocol sites: 40k





Management and Organization

Laboratory Contracts

The NPS administers all IMPROVE contracts for routine IMPROVE operations:

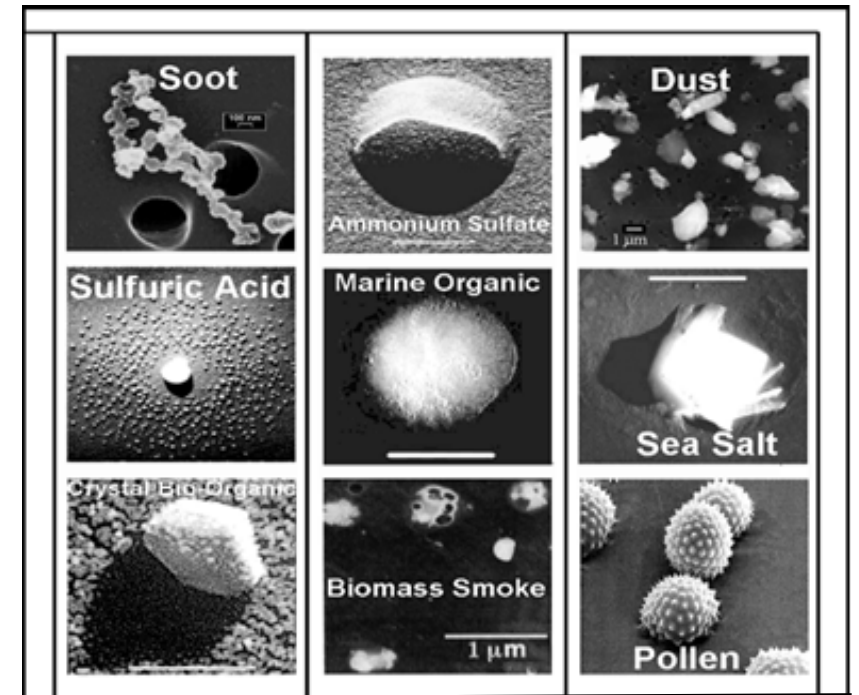
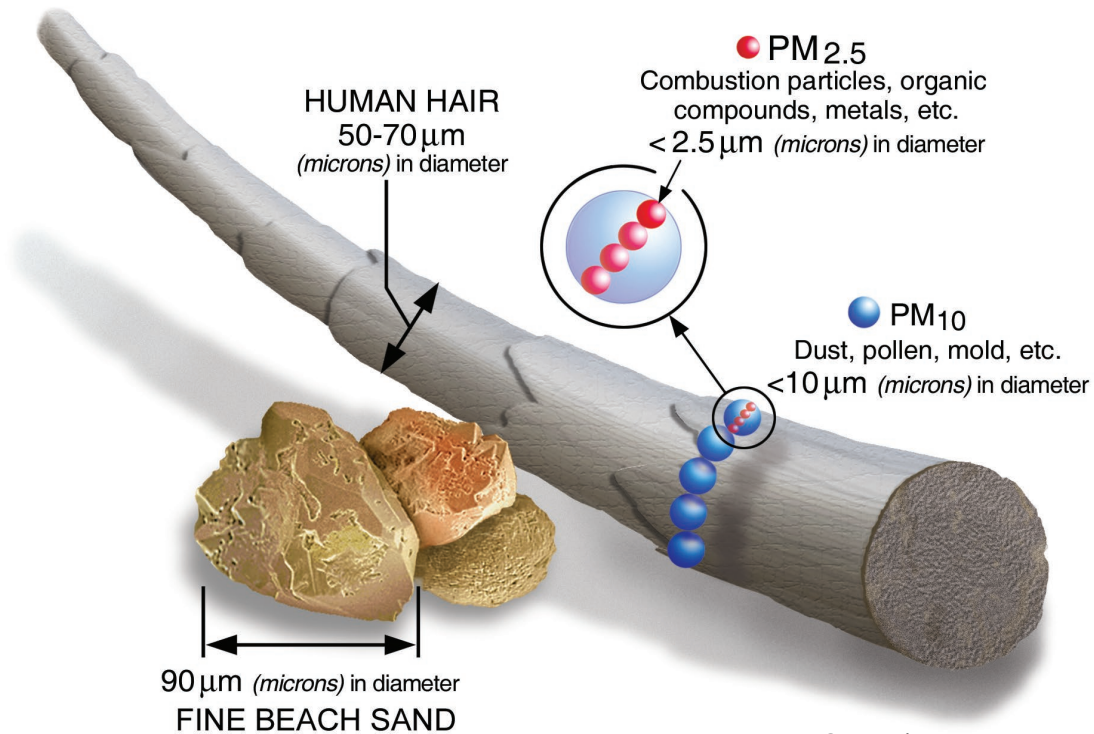
- Network operations and analysis of PM samples collected on Teflon filters (XRF, gravimetric weighing, HIPS)- **UC Davis.**
- Carbon contract: analysis of samples collected on quartz fiber filters for carbonaceous content- **DRI.**
- Ion contract: analysis of the samples collected on nylon filters for ionic composition- **RTI.**



Great Sand Dunes, CO

Routine Monitoring

Atmospheric Aerosols



There are many different types of particles in the atmosphere.

PM_{2.5} and PM₁₀ are the tiny particles collected by the IMPROVE filters.



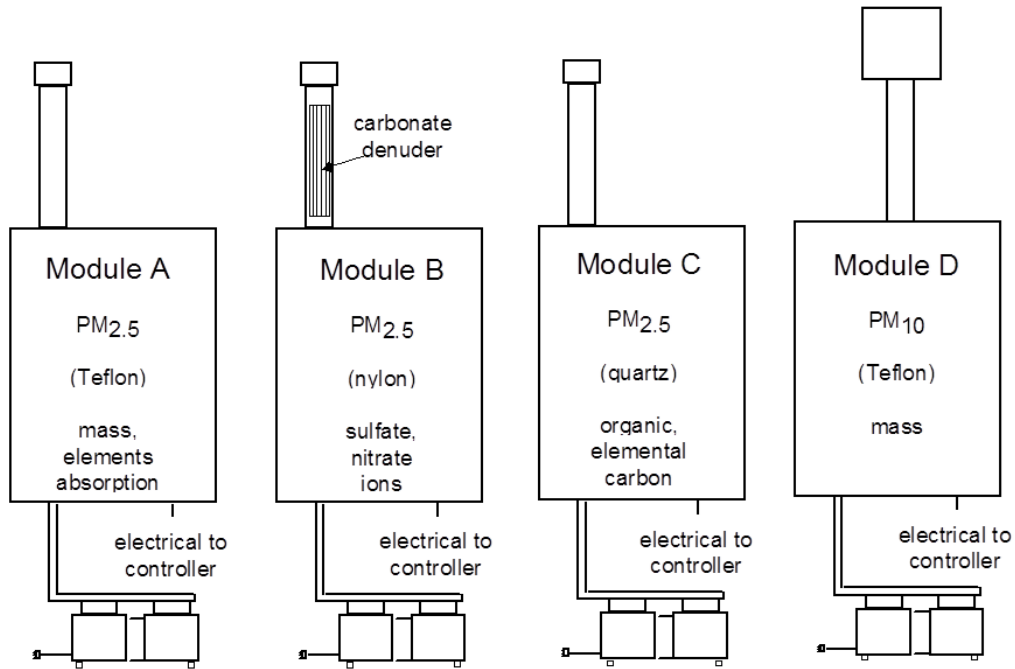
Routine Monitoring

- 24-hr samples collected every 3rd day
- Midnight-midnight local standard time





IMPROVE Samplers



Dome Lands, CA

A: PM_{2.5} Gravimetric mass, elements, filter absorption

B: PM_{2.5} Ions (SO₄²⁻, NO₃⁻, Cl⁻, NO₂⁻)

C: PM_{2.5} Organic Carbon, Elemental Carbon

D: PM₁₀ Gravimetric mass



IMPROVE Module A

Gravimetric Mass: Filter is weighed in a temperature and relative humidity-controlled chamber ($T = 21.5\text{ }^{\circ}\text{C}$ and $\text{RH} = 39\%$).

[PM_{2.5} gravimetric mass]

Teflon filter



Photo: UC Davis



IMPROVE Module A

XRF Elemental Analysis: Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Se, Br, Rb, Sr, Zr, Pb

Calculate:

(old*) $[Fine\ Dust] = 2.20 \times [Al] + 2.49 \times [Si] + 1.63 \times [Ca] + 2.42 \times [Fe] + 1.94 \times [Ti]$

(new) $[Fine\ Dust] = 2.53 \times [Al] + 2.86 \times [Si] + 1.87 \times [Ca] + 2.78 \times [Fe] + 2.23 \times [Ti]$

Assumes all measured dust is the same at all locations.

Teflon filter

(*Used in FED)





IMPROVE Module A

Hybrid Integrating Plate/Sphere (HIPS): Measures the reflected and transmitted laser light through the Teflon filter (633 nm)

Light Absorption Coefficient [f_{abs} , Mm^{-1}]

Teflon filter

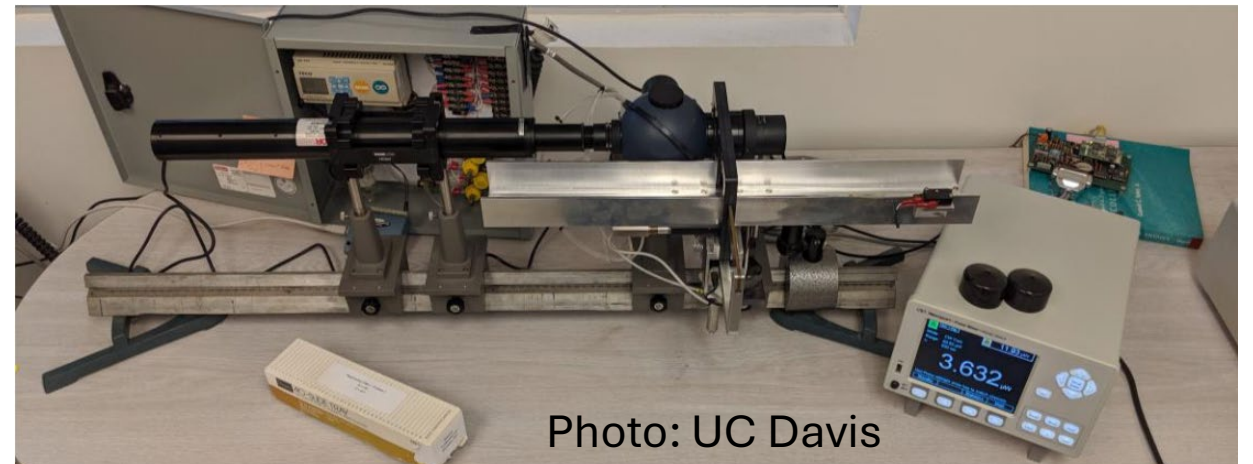


Photo: UC Davis



IMPROVE Module B

Ions: sulfate [SO_4^{2-}], nitrate [NO_3^-], chloride [Cl^-], nitrite [NO_2^-]

Calculate:

[Ammonium Sulfate] = 1.375 × [sulfate ion]

[Ammonium Nitrate] = 1.29 × [nitrate ion]

[Sea Salt] = 1.8 × [chloride ion]

Nylon filter



Photo: RTI



IMPROVE Module C

Carbon: [Organic Carbon], [Elemental Carbon]



Photo: DRI

For organics, we only measure organic carbon and estimate total particulate organic matter (organic mass by carbon, OMC).

Calculate:

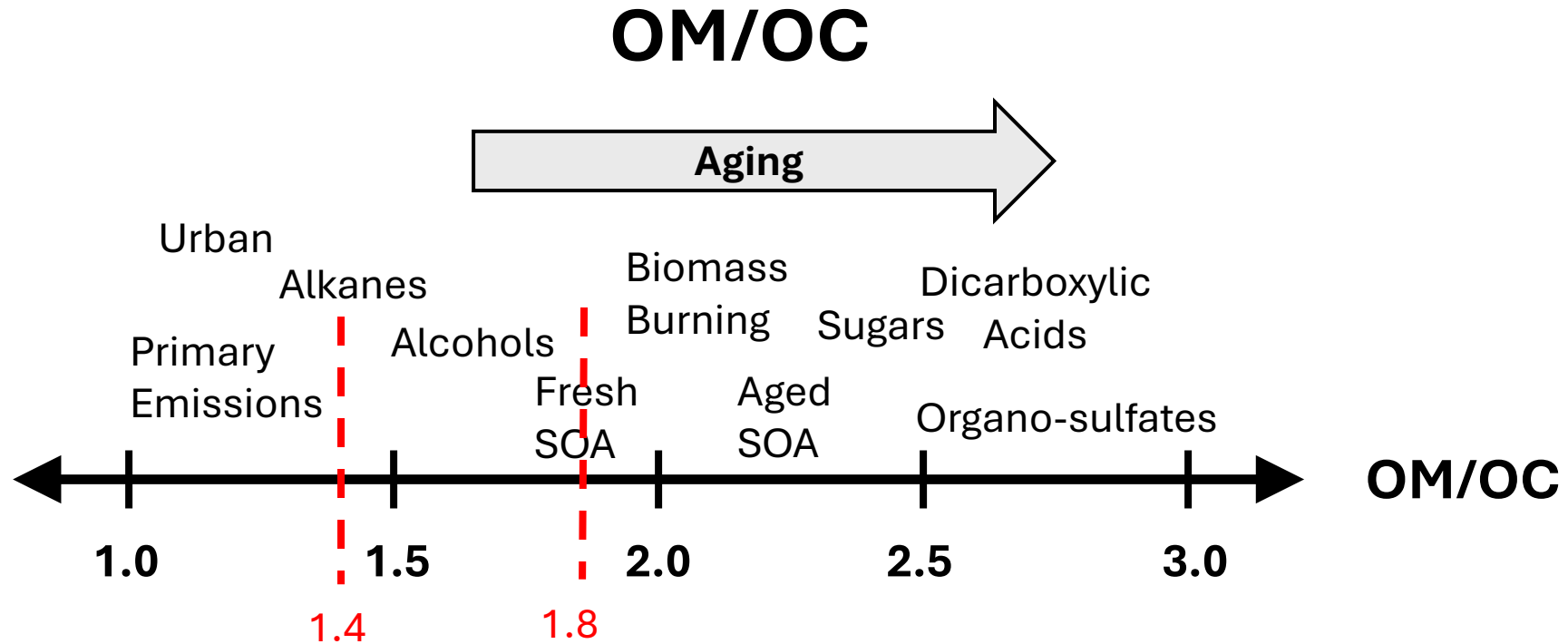
$$\text{[Particulate Organic Matter]} = (\text{OM/OC}) \times \text{[organic carbon]}$$

Quartz filter



IMPROVE Module C

Carbon: [Organic Carbon], [Elemental Carbon]



Previously, $OM/OC = 1.4$, and then 1.8^* , but now we vary it monthly.

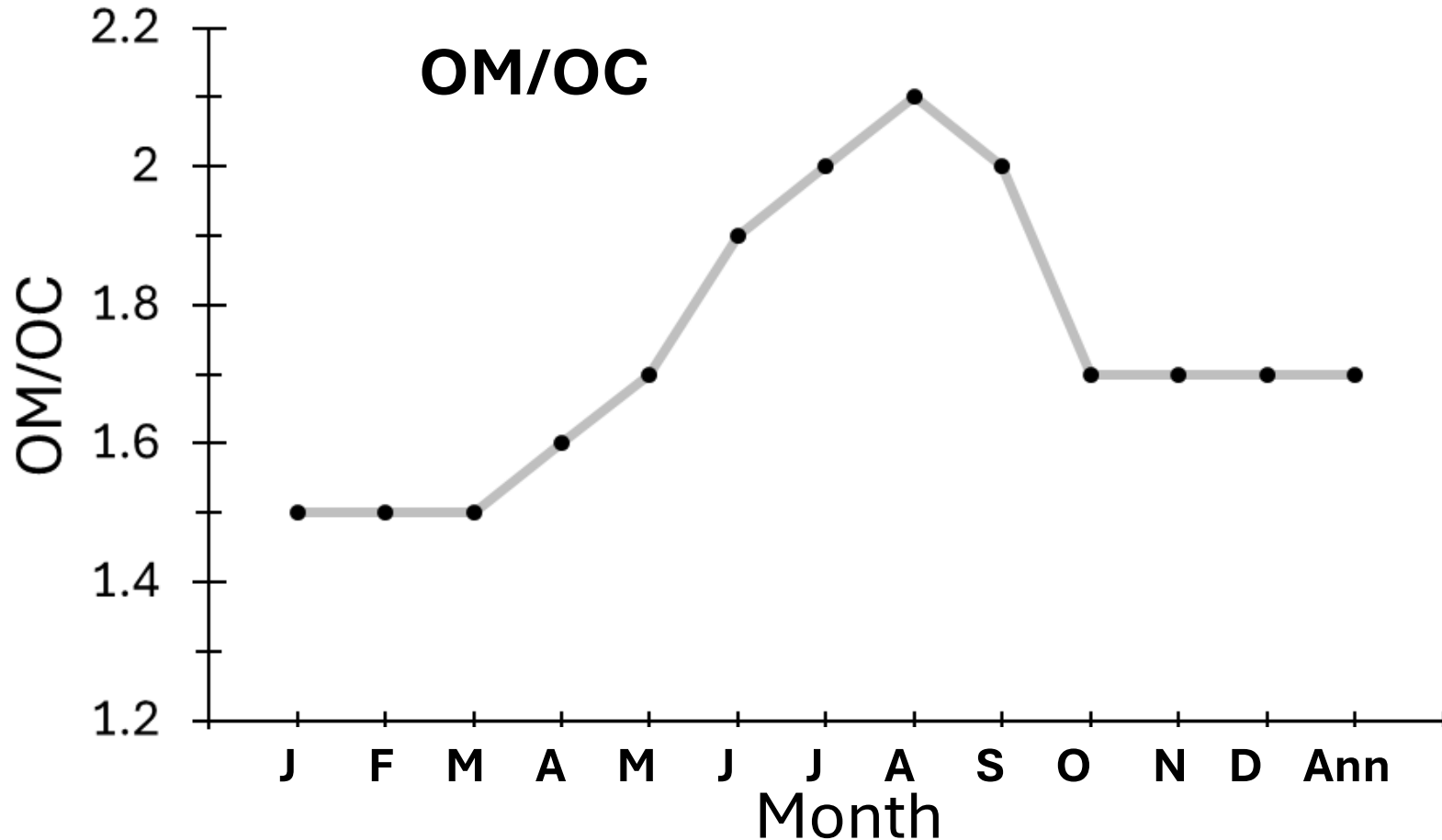
(*Used in FED)



IMPROVE Module C

Carbon: [Organic Carbon], [Elemental Carbon]

Monthly
varying
OM/OC
(regionally
constant)



Annual
mean: 1.7



IMPROVE Module D

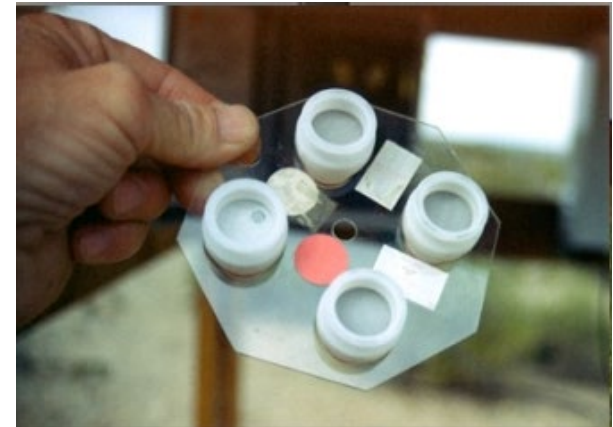
Gravimetric Mass: Filter is weighed in a temperature and relative humidity-controlled chamber (T=21.5 °C and RH=39%)

[PM₁₀ gravimetric mass]

Calculate:

$$\text{[Coarse Mass]} = \text{[PM}_{10}\text{]} - \text{[PM}_{2.5}\text{]}$$

Teflon filter





Reconstructed Mass Algorithm

Ammonium sulfate (AS) = $1.375 \times [\text{sulfate ion}]$

Ammonium nitrate (AN) = $1.29 \times [\text{nitrate ion}]$

Particulate Organic Matter (POM) = $(\text{OM/OC}) \times [\text{Organic Carbon}]$

Elemental Carbon (EC)

Fine Dust (FD) = $2.53 \times [\text{Al}] + 2.86 \times [\text{Si}] + 1.87 \times [\text{Ca}] + 2.78 \times [\text{Fe}] + 2.23 \times [\text{Ti}]$

Sea Salt (SS) = $1.8 \times [\text{chloride ion}]$

Reconstructed Fine Mass (RCFM) = AS+AN+POM+EC+FD+SS

Coarse Mass (CM) = $\text{PM}_{10} - \text{PM}_{2.5}$



Logistics

Each IMPROVE site has a sponsoring agency

Sponsoring Agency:

- 110 RHR sites funded by the FLM whose CIA the site represents.
- Protocol sites are sponsored by the agency that funds them.
- Provides support (location, shelter, power, and a site operator).

Network contractor (UC Davis) supports the sites by providing samplers, internet connections, communications with site operators, sending filters to the sites, shipping costs, and routine maintenance once every two years.



North Absaroka, WY



Logistics

Site Operators

- Change filters once/week.
- Send filters to the network contractor (UC Davis).
- Serve as a point of contact for network contractor and auditors.
- Provide basic troubleshooting, with support from the network contractor.



Wheeler Peak, NM



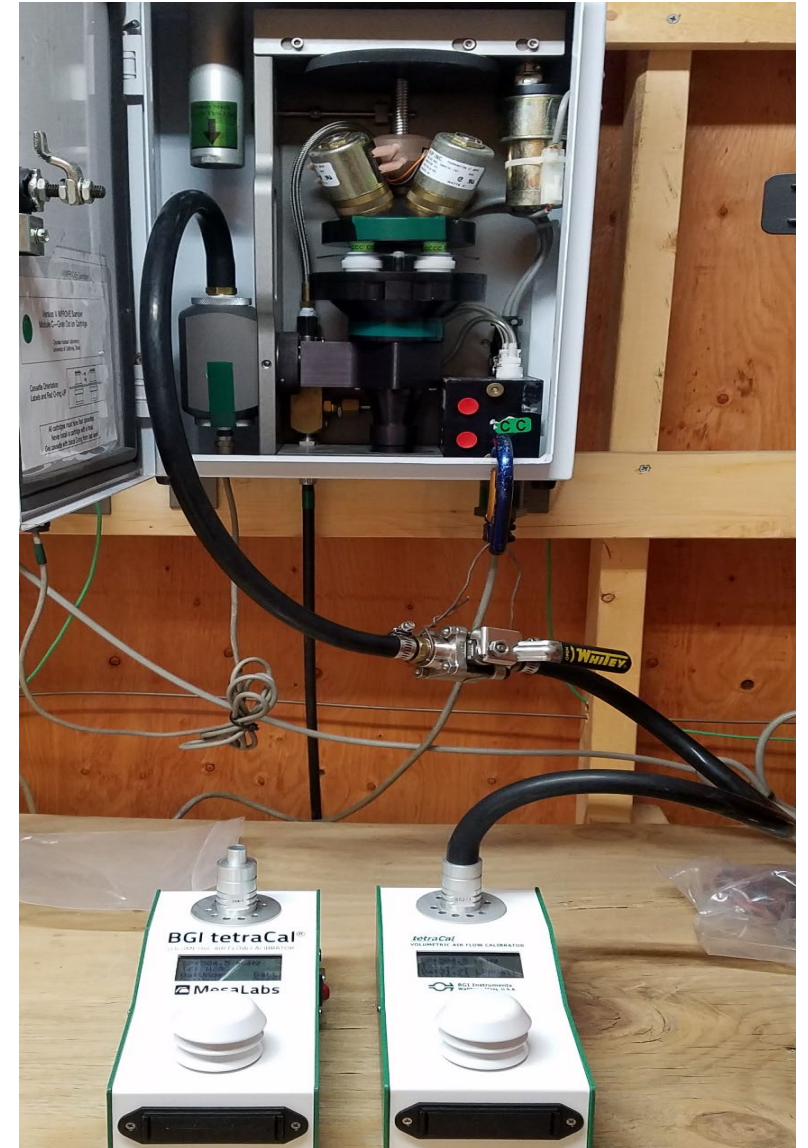
Technical System Audits (TSAs)

Assess whether a sampling site complies with IMPROVE QAPP.

1. Site meets sampling criteria – collecting regionally representative aerosol sample.
2. Integrity/condition of sampling structure.
3. Measure flow rates, temperature, pressure using NIST certified audit device.
4. Observe operator technique (when possible) to assess issues of sample contamination.

Required: One audit every ten years

All but five sites have been audited in the last seven years, three of which will be audited this winter.





Quality Assurance/Quality Control

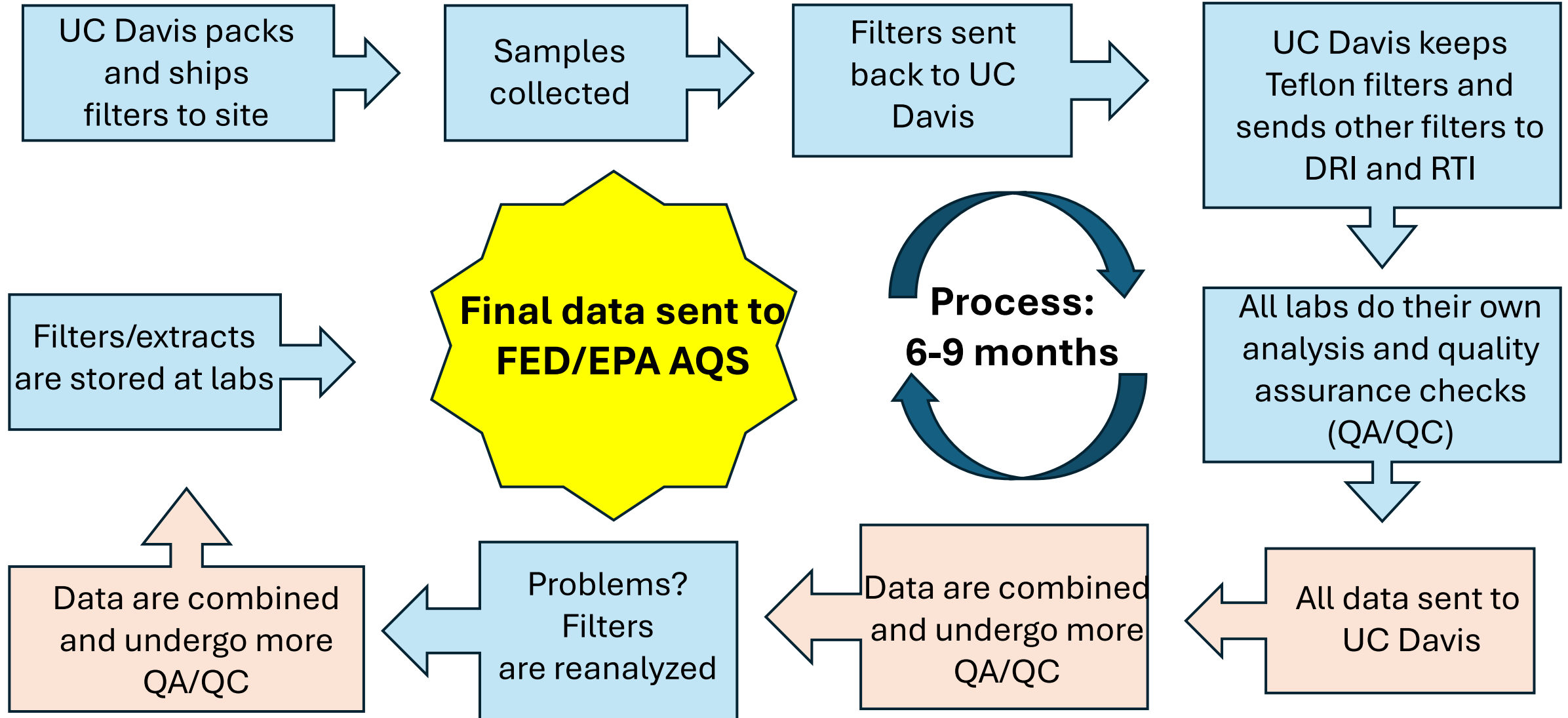
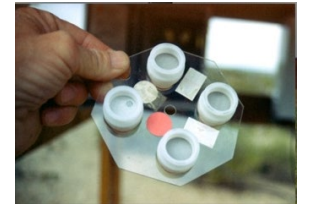
- Mass concentrations are blank corrected using field and laboratory blanks.
- All data undergo quality assurance evaluations.
 - QA reports
 - Standard Operating Procedures
 - Quality Management Plan (QMP) & Quality Assurance Project Plan (QAPP)



Hells Canyon, OR



Life Cycle of an IMPROVE Filter





Documentation

IMPROVE Website

Quality Assurance/Quality Control
Quality Management Plan (QMP)
Quality Assurance Project Plan (QAPP)
QA Reports by Labs
Standard Operating Procedures
Technical System Audits
Data Advisories
IMPROVE Reports
Data User Guide
Visibility Documents



Kalmiopsis, OR



IMPROVE Website

IMPROVE

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Grand Teton National Park
photo: Scott Copeland

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News & Updates

A [new paper has been published](#) characterizing trends in seasonal mean speciated aerosol composition from IMPROVE data.

[Photos](#) and [Presentations](#) from the 2023 IMPROVE Steering Committee Meeting have been posted.

The [2022 RHR files](#) have been posted.

A revised [IMPROVE Data User Guide](#) has been posted


A draft of the [6th IMPROVE Report](#) has been posted.

A new video featuring Bill Malm has been released by the NPS: [National Parks in the History of Science: Visibility](#)

<https://vista.cira.colostate.edu/Improve/>



Quality Assurance/Quality Control

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Search

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- Data User Guide
- Data Acknowledgment
- Data Advisories
- Optical Data
- Photos
- Quality Assurance**

Quality Assurance

The IMPROVE monitoring network has a rigorous quality assurance program and extensive quality control and assessment procedures. Included here are the primary documents governing the QA program, as well as some recent presentations aimed at QA/QC measures.

UC Davis Quality Assurance Reports

[QA Report for 2021](#)

[September 2021 Report](#)

[November 2019 Report](#)

Plots of additional species are available upon request.

[April 2019 Report](#)

[October 2018 Report](#)

[March 2018 Report](#)

[August 2017 Report](#)

UC Davis Field Maintenance Schedule

[2020 Schedule Revised](#)

[2019 Schedule](#)

[2018 Schedule](#)

UC Davis Quarterly Field Status Reports

[2024 Second Quarter](#)

[2024 First Quarter](#)



Data Advisories

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IMPROVE Data

Data User Guide

Data
Acknowledgment

Data Advisories

Optical Data

Photos

Quality
Assurance

Data Advisories

This is an IMPROVE data user community supported page meant to document interesting findings from the IMPROVE database including data anomalies, potential problems, and new uses for the IMPROVE data. These advisories are not meant to be comprehensive or complete. In addition, unless explicitly stated the data advisories are not necessarily endorsed by the IMPROVE steering committee, National Park Service, CIRA or others.

Universal calibration constants for flow rate calculation	Submitted by: C. Wallis	On: 09/2019	Doc #: da0044
Sites: All, following installation of Version 4 controllers	Time Period: 2018-present	Module/Species: All	
Change in analytical protocol for XRF analysis	Submitted by: K. Trzepla	On: 06/2019	Doc #: da0043
Sites: All	Time Period: 10/2018-present	Module/Species: A/All elements	
Method change for calibrating flow rate transfer standards	Submitted by: C. Wallis	On: 05/2019	Doc #: da0042
Sites: All	Time Period: 1/2015-present	Module/Species: All	
Changes to HIPS System	Submitted by: K.Trzepla & J. Giacomo	On: 04/2019	Doc #: da0041
Sites: All	Time Period: 1/2017-present	Module/Species: A/Fabs	
Updated data for Carbon	Submitted by: B Schichtel	On: 04/2019	Doc #: da0040



Data User Guide

IMPROVE DATA USER GUIDE 2023 (VERSION 2)

J.L. Hand (24 October 2023)

Version 1.0 1995 User Guide can be found [here](#).

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1.0 INTRODUCTION

The IMPROVE Data User Guide provides information for the general user on routine monitoring, aerosol sampling and analysis, accessing and downloading data, descriptions of methods for determining concentrations, minimum detection limits, uncertainties, calculated variables, mass and aerosol extinction reconstruction algorithms, and other applicable information for obtaining, analyzing and interpreting IMPROVE data. The guide will periodically be updated as new information is available or changes occur.

Information in this Guide is reproduced or summarized from several documents that provide additional details regarding the operation of the IMPROVE network and reporting of



Yosemite, CA



Standard Operating Procedures

Intro to
Visibility

IMPROVE
Reports

Gray Literature

Standard
Operating
Procedures

IMPROVE
Calendars

Principal
Visibility
Documents

Newsletters
(discontinued)

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Standard Operating Procedures

The IMPROVE network follows strict protocols that have been peer reviewed. In depth documentation of these protocols are provided in the Following SOPs.

[Particulate Monitoring Network](#)

The University of California, Davis is responsible for the installation and operation of the IMPROVE samplers. In addition UC Davis analyzes the Teflon filters from module A for fine mass and its elemental constituents. The PM10 mass is also obtained from the Teflon filter in module D. The following SOP's describe the site selection, installation and operating procedures of the IMPROVE samplers. The analysis of the filters for mass and elemental composition and QA/QC procedures are also described.

[Carbon Analysis](#)

The Desert Research Institute analyses the quartz filters from module C of the IMPROVE sampler for organic and elemental carbon using the DRI thermal/optical reflectance carbon analyzer. The following operating protocols provide the basic understand of the principle of the carbon analysis and carbon analyzer and detailed descriptions of the procedures for conducting the carbon analysis.

[Ion Chromatography Analysis](#)

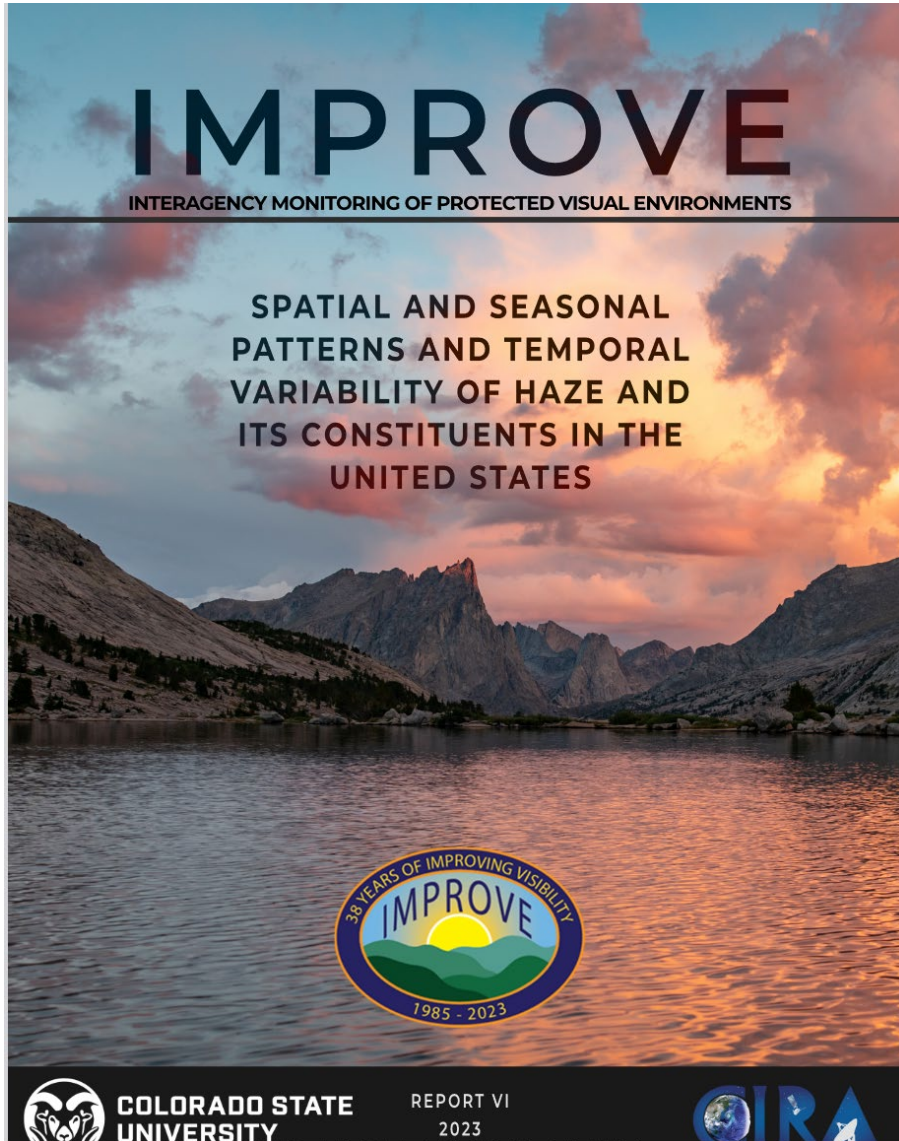
The Research Triangle Institute analyzes the nylon filters from module B of the IMPROVE sampler for ions using ion chromatography (IC). The following SOP describes the procedures for analyzing the filters and QA/QC analyses conducted on the data.


[Optical Monitoring](#)

Air Resource Specialist operate the optical monitors, transmissometer, nephelometer and camera, at the IMPROVE and IMPROVE protocol monitoring sites. This SOP describes the operating procedures for all three instrument from site selection to data archiving.



IMPROVE Report



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Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States Report VI: June 2023

IMPROVE Report

[Entire Document \(PDF\) Chapters only \(no appendices\)](#)

[Cover-dedication-title-TOC](#)

[Executive Summary](#)

[Chapter 1 – Interagency Monitoring of Protected Visual Environments \(IMPROVE\) Network: Configuration and Measurements](#)

[Chapter 2 – Spatial Patterns of Speciated PM_{2.5} Aerosol Mass Concentrations](#)

[Chapter 3 – Seasonal Distributions of PM_{2.5} Aerosol Mass](#)

[Chapter 4 – Reconstructed Aerosol Light Extinction Coefficients](#)

[Chapter 5 – Seasonal Distribution of Reconstructed Aerosol Light Extinction Coefficients](#)

[Chapter 6 – Trends in IMPROVE Speciated Aerosol Concentrations](#)

[Chapter 7 – Trends in IMPROVE Reconstructed Light Extinction Coefficients](#)

[Chapter 8 – IMPROVE Bibliography 2010 to Present](#)

[Appendix 1.1 – A New Cost-Effective Analytical Method for IMPROVE: Nondestructive Infrared Analysis of PTFE Filters to Measure Organic, Elemental, and Total Carbon, Inorganic Ions, Soil Elements, Organic Matter \(OM\), and Organic Functional Groups](#)

[Appendix 1.2 – Documentation of Changes in Analytical Methods and Data Processing Due to the Chemical Speciation Network \(CSN\) Contractor Changes in 2015](#)

[Appendix 2.1 – Monthly Varying Organic Carbon to Mass Ratio](#)

[Appendix 2.2-2.3 – 2016–2019 IMPROVE and CSN Annual Mean Mass Concentrations and Mass Fractions](#)

<https://vista.cira.colostate.edu/Improve/>



Regional Haze Rule

- RHR
Summary
Data
- Impairment
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Interagency Monitoring of Protected Visual Environments



Data Download and Analysis Tools

“FED”

Federal Land Manager Environmental Database

Tools Search Logout Profile

AQRV SUMMARIES DATA EXPLORATION DATA ACCESS RESOURCES HELP

Shenandoah National Park

All AQRV Data Metadata Visualization Click a button to filter the grid

Visibility Tools
A set of charting tools for analyzing haze trends and composition from the IMPROVE aerosol

Query Wizard
An advanced query and selection tool for filtering and downloading raw data from the database

AQRV Tools
A set of charting tools for analyzing haze, ozone, and deposition impacts in Federal Class 1 Areas

Database Query Wizard

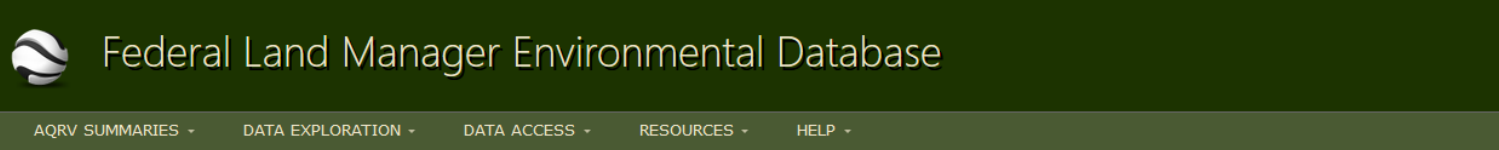
UPDATES

- 11/06/24: The May 2024 EPA Chemical Speciation Network (CSN) data from AQS were imported into the database.
- 11/05/24: The March 2024 - September 2024 IMPROVE Aerosol Preliminary (unvalidated) data from UCD were imported into the FED database.
- 10/28/24: The February 2024 IMPROVE Aerosol data from UCD were imported into the database.
- 10/28/24: The February 2024 - August 2024 IMPROVE Aerosol Preliminary (unvalidated) data from UCD were imported into the FED database.
- 09/25/24: The January 2024 IMPROVE Aerosol data from UCD were imported into the database.
- 09/19/24: The NADP National Trends Network (NTN) Total Wet Deposition (kg/ha) dataset was updated for 2023-2024.

Data Download Tool



FED



Database Query Wizard

Choose a data product:
Raw Data

- Datasets**
- Sites
- Parameters
- Dates
- Fields
- Options

Select a Dataset 1 of 36 selected Metadata

<input checked="" type="radio"/>	IMPROVE Aerosol	1-in-3 day	1988	2024
<input type="radio"/>	IMPROVE Aerosol Preliminary	1-in-3 day	2024	2024
<input type="radio"/>	IMPROVE Natural Conditions (2064)	Once	2064	2064
<input type="radio"/>	IMPROVE Nephelometer	Hourly	1993	2023
<input type="radio"/>	IMPROVE RHR2 5yr Avg	Annual	1993	2023
<input type="radio"/>	IMPROVE RHR2 Group Means	Annual	1989	2023
<input type="radio"/>	IMPROVE RHR2 Metrics	1-in-3 day	1988	2023
<input type="radio"/>	IMPROVE RHR3 5yr Avg	Annual	1993	2023
<input type="radio"/>	IMPROVE RHR3 Endpoints (2064)	Once	2064	2064
<input type="radio"/>	IMPROVE RHR3 Group Means	Annual	1989	2023
<input type="radio"/>	IMPROVE RHR3 Metrics	1-in-3 day	1988	2023
<input type="radio"/>	NADP AIRMoN	Episodic	1992	2019
<input type="radio"/>	NADP AMoN	Biweekly	2007	2024
<input type="radio"/>	NADP MDN	Weekly	1996	2024
<input type="radio"/>	NADP NTN - Annual PWM (mg/L)	Annual	1978	2022

Submit... Show results in separate window

Choose from a variety of datasets:
IMPROVE aerosol
IMPROVE b_{ext}
EPA $PM_{2.5}$ and PM_{10} FRM
EPA CSN
NADP
Ozone
CASTNET





FED



Database Query Wizard

Choose a data product:
Raw Data

Parameters | Datasets | Sites | Dates | Fields | Options

Select one or more Parameters | 1 of 107 selected | Select all | De-select all | Metadata

Parameter	Code	Type	Units	EPACode
Aluminum (Fine)	ALf	PM2.5	µg/m ³	88104
Ammonium Nitrate (Fine)	ammNO3f	PM2.5	µg/m ³	88344
Ammonium Sulfate (Fine)	ammSO4f	PM2.5	µg/m ³	88339
Arsenic (Fine)	ASf	PM2.5	µg/m ³	88103
Bromine (Fine)	BRf	PM2.5	µg/m ³	88109
Calcium (Fine)	CAf	PM2.5	µg/m ³	88111
Carbon, Elemental Fraction 1 (Fine)	EC1f	PM2.5	µg/m ³	88329
Carbon, Elemental Fraction 2 (Fine)	EC2f	PM2.5	µg/m ³	88330
Carbon, Elemental Fraction 3 (Fine)	EC3f	PM2.5	µg/m ³	88331
Carbon, Elemental Total (Fine)	ECf	PM2.5	µg/m ³	88321
Carbon, Organic Fraction 1 (Fine)	OC1f	PM2.5	µg/m ³	88324
Carbon, Organic Fraction 2 (Fine)	OC2f	PM2.5	µg/m ³	88325
Carbon, Organic Fraction 3 (Fine)	OC3f	PM2.5	µg/m ³	88326
Carbon, Organic Fraction 4 (Fine)	OC4f	PM2.5	µg/m ³	88327
Carbon, Organic Mass (Fine) (1.8*OC)	OMCf	PM2.5	µg/m ³	88350
Carbon, Organic Pyrolyzed (Fine), by Reflectance	OPf	PM2.5	µg/m ³	88328
Carbon, Organic Pyrolyzed (Fine), by Transmittance	OPTf	PM2.5	µg/m ³	88336
Carbon, Organic Total (Fine)	OCf	PM2.5	µg/m ³	88320

Show results in separate window

IMPROVE aerosol data:

Measured and calculated parameters



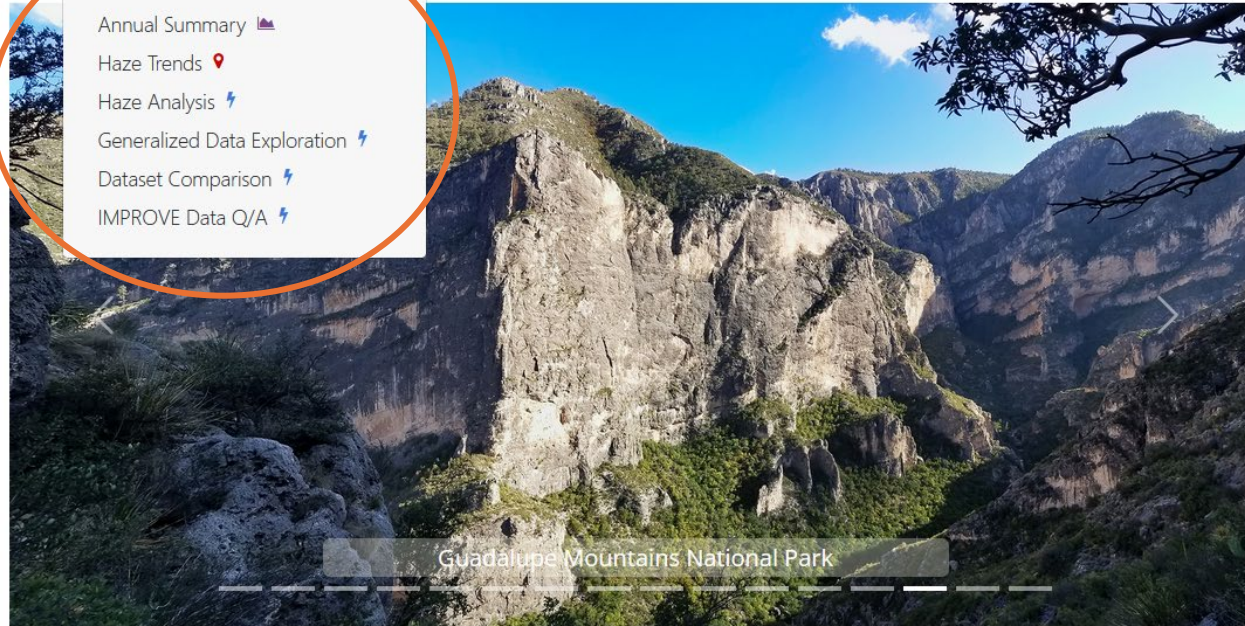
FED

Federal Land Manager Environmental Database

AQRV SUMMARIES ▾ DATA EXPLORATION ▾ DATA ACCESS ▾ RESOURCES ▾ HELP ▾

- Annual Summary 📄
- Haze Trends 📍
- Haze Analysis ⚡
- Generalized Data Exploration ⚡
- Dataset Comparison ⚡
- IMPROVE Data Q/A ⚡

Data exploration tools



All AQRV Data Metadata Visualization ← Click a button to filter the grid

Visibility Tools

Query Wizard

AQRV Tools



FED Analysis Tools

Federal Land Manager Environmental Database

AQRV SUMMARIES | DATA EXPLORATION | DATA ACCESS | RESOURCES | HELP

Annual Summary 📄

Haze Trends 📍

Haze Analysis ⚡

Generalized Data Exploration ⚡

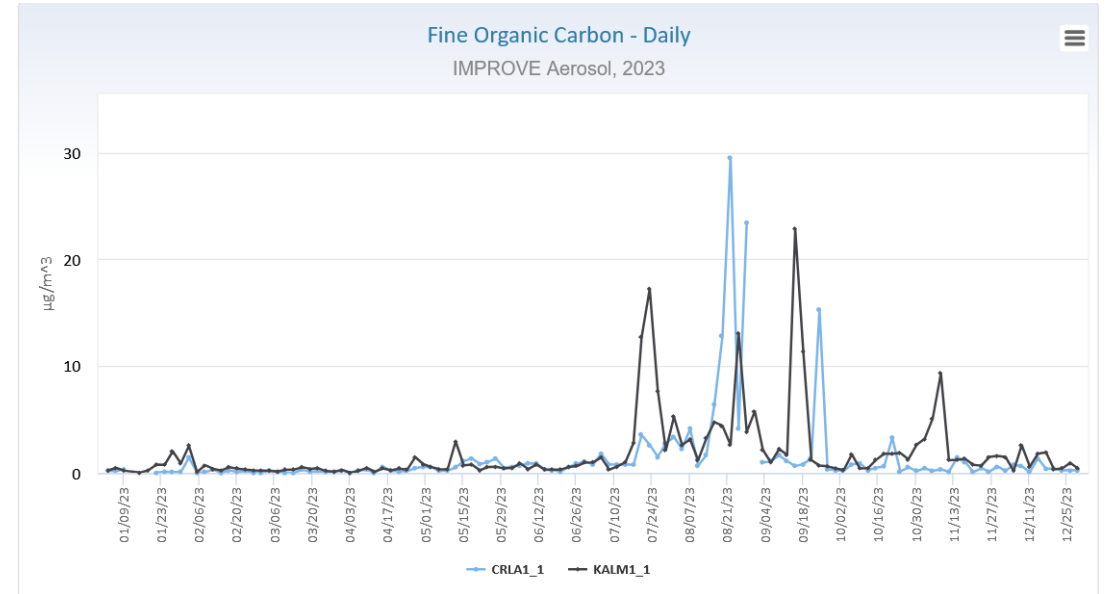
Dataset Comparison ⚡

IMPROVE Data Q/A ⚡

Rule II (2033 Guidance) ▾

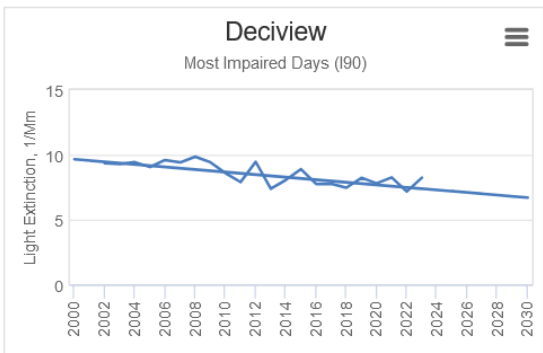
Winnipeg

NORTH

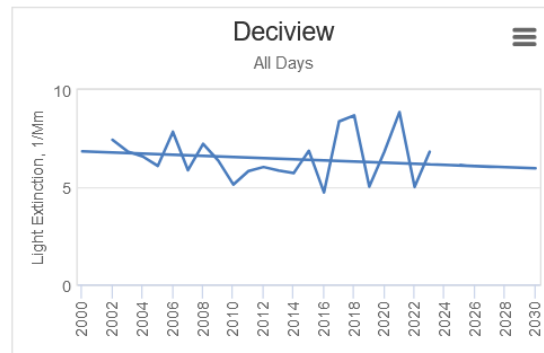


Species Trends: Most Impaired Days, All Days, and Crater Lake NP (CRLA1), 2000 - 2030

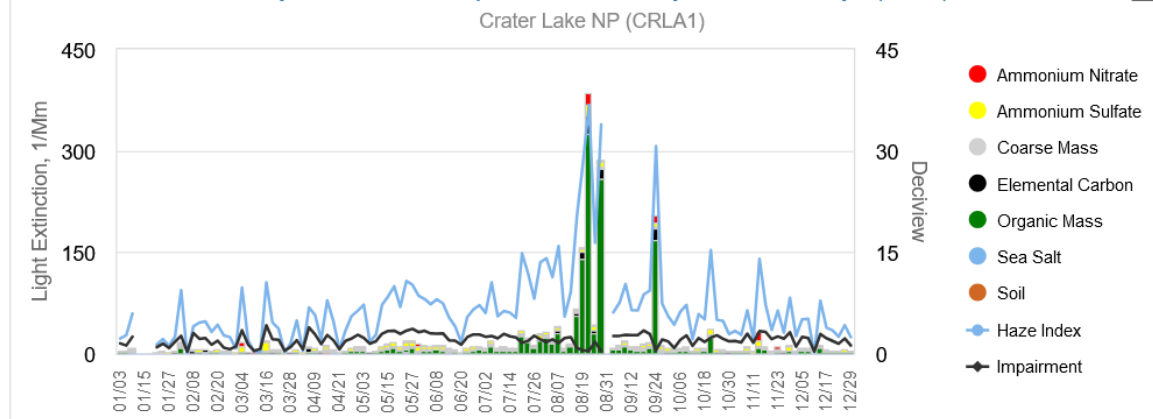
Most Impaired Days (I90)



All Days (G100)



Daily Extinction Composition Sorted by Date - All Days (2023)



IMPROVE Monitor: CRLA1; Class I Areas: Crater Lake National Park, Diamond Peak Wilderness, Mountain Lakes Wilderness, Gearhart Mountain Wilderness



WRAP Technical Support System v2

TSS: additional exploration tools, including emissions and modeling data

NOTICE

The TSS website is operational for Round 2 Regional Haze analysis results for the WESTAR-WRAP region. Minor changes and updates will need to continue to be made to tool formats and documentation links as needed. Those changes will be noted on the TSS so users can easily identify them.

UPDATES

- 04/22/21:** The suite of **Modeled Data Analysis - Express Tools** for quickly analyzing a variety of modeling data has been updated.
- 02/03/21:** The suite of **Emissions Data Analysis - Express Tools** for quickly analyzing annual emissions data has been updated.
- 01/20/21:** The suite of **Ambient Data Analysis - Express Tools** for quickly analyzing IMPROVE monitoring data has been updated.
- 04/13/20:** **COVID-19 Update:** Although development and operations are now being conducted according to the relevant social-distancing guidelines, work continues unabated on the TSS database and website with no significant impacts to progress.
- 03/20/20:** A prototype **Regional Haze Planning Steps** page was added to organize available resources and help guide users through the regional haze planning process.
- 02/14/20:** Emissions summary data and modeling results for the WRAP 2014v2 platform have been delivered by Ramboll and are being imported into the TSS database.
- 11/20/19:** **The Landscape of Forever: Visibility Protection in the West**, an educational storyboard that provides information about the unique challenges of protecting visibility in western states, is now available. You can most easily give feedback on the storyboard if you take this survey.
- 10/28/19:** A brief tour of the TSS Haze Analysis Tools was given via webinar for the 2019 National Regional Haze Meeting.
- 10/18/19:** The resubmitted Jan-Dec 2018 IMPROVE Aerosol data has been imported into the TSS database.
- 07/30/19:** A new collection of **Haze Trends** charts for analyzing visibility trends at IMPROVE sites on the most impaired, clearest, and all data has been published.

https://views.cira.colostate.edu/tssv2/SiteBrowser/Default.aspx?appkev=SRCF_VisSum&smmkeys=83



Technical Support System v3

TSS: additional exploration tools, including emissions and modeling data

Shawn McClure, CIRA

Regional Haze Technical Support System

MONITORING - EMISSIONS - MODELING - RESOURCES - HELP -

Search Login

Haleakala National Park

All Monitoring Emissions Modeling Documentation Click to filter

Haze Summaries
Tools for analyzing visibility trends and species composition from the IMPROVE network

Haze Trends
Annual time series charts that illustrate long term regional haze and visibility trends

Air Quality Analysis
Tools for analyzing haze, ozone, and deposition impacts in Federal Class 1 Areas

NOTICE

This preliminary launch of the TSS v3 website has been made available in preparation for Round 3 of Regional Haze planning. Only ambient data products are currently available since no Round 3 modeling/missions work is available yet.

UPDATES

- 09/10/24: The 2023 IMPROVE RHR3 (Impairment) 5-year averages were imported into the database.
- 09/10/24: The 2023 IMPROVE RHR2 (Haze) 5-year averages were imported into the database.
- 09/09/24: The 2023 IMPROVE RHR3 (Impairment) Group Means were updated/imported into the database.
- 09/09/24: The 2023 IMPROVE RHR3 (Impairment) Daily Budgets were updated/imported into the database.
- 09/09/24: The 2023 IMPROVE RHR2 Group Means were imported into the database.
- 09/09/24: The 2023 IMPROVE RHR2 Daily Budgets were imported into the database.
- 09/04/24: The 2023-2024 (partial) EPA Hourly Ozone data were imported into the database.
- 09/04/24: The Redelivered Full-Year 2023 IMPROVE Aerosol data from UCD were imported into the database.
- 11/14/23: The 1993-2022 IMPROVE RHR3 (Impairment) 5-year averages were updated (past years) and/or imported (2022) into the database.
- 11/14/23: The 1993-2022 IMPROVE RHR2 (Haze) 5-year averages were updated (past years) and/or imported (2022) into the database.
- 10/09/23: The 2016-2022 IMPROVE RHR3 (Impairment) Group Means were updated/imported into the database.
- 10/09/23: The 2016-2022 IMPROVE RHR3 (Impairment) Daily Budgets were updated/imported into the database.

(preliminary)



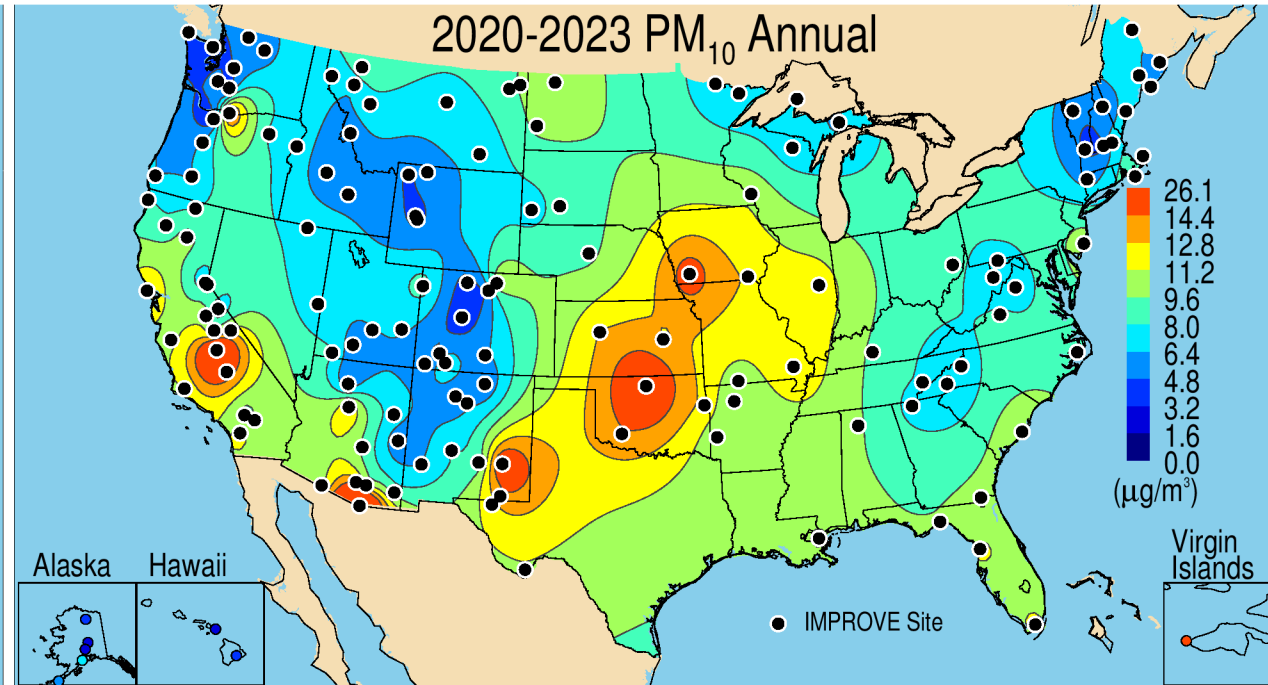
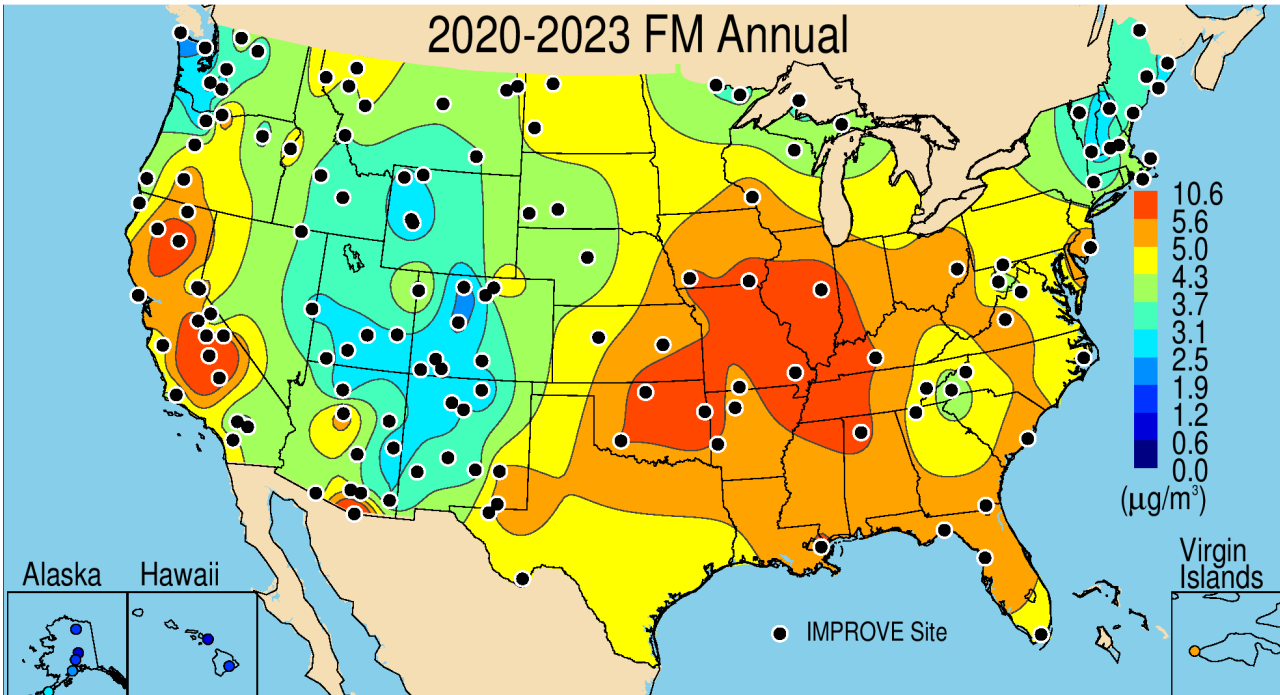
<https://views.cira.colostate.edu/tssv3/>



Data Analysis

PM_{2.5}

PM₁₀

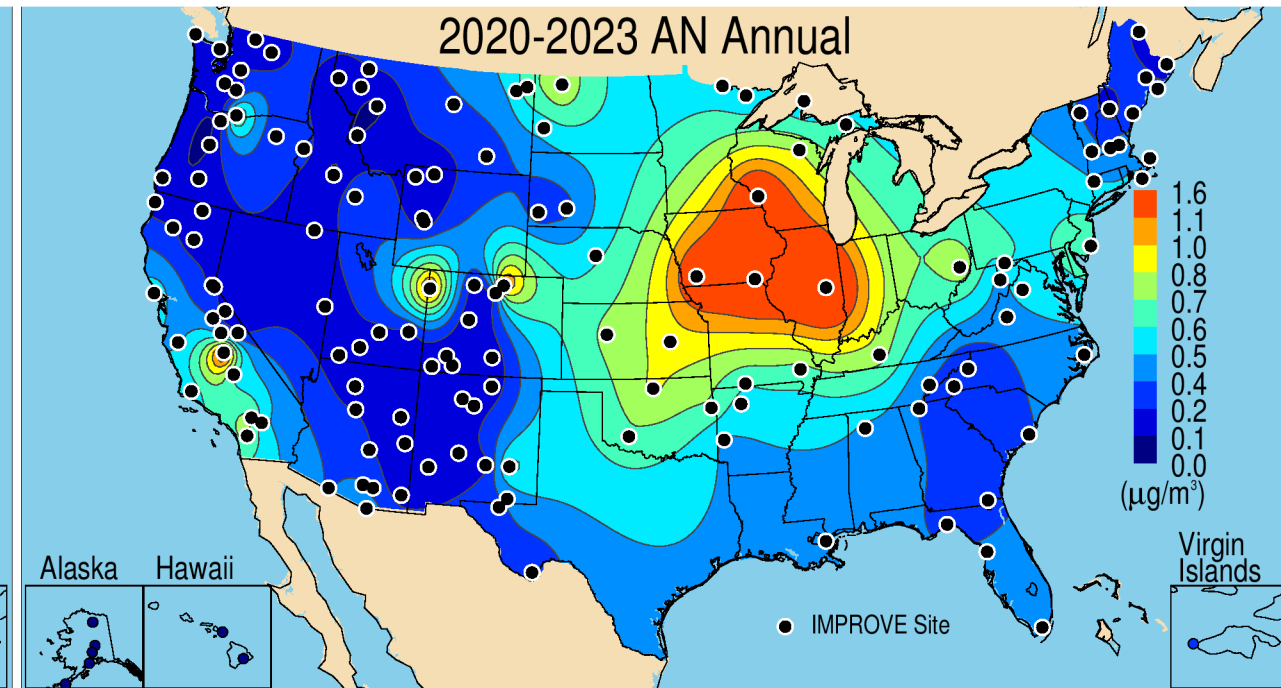
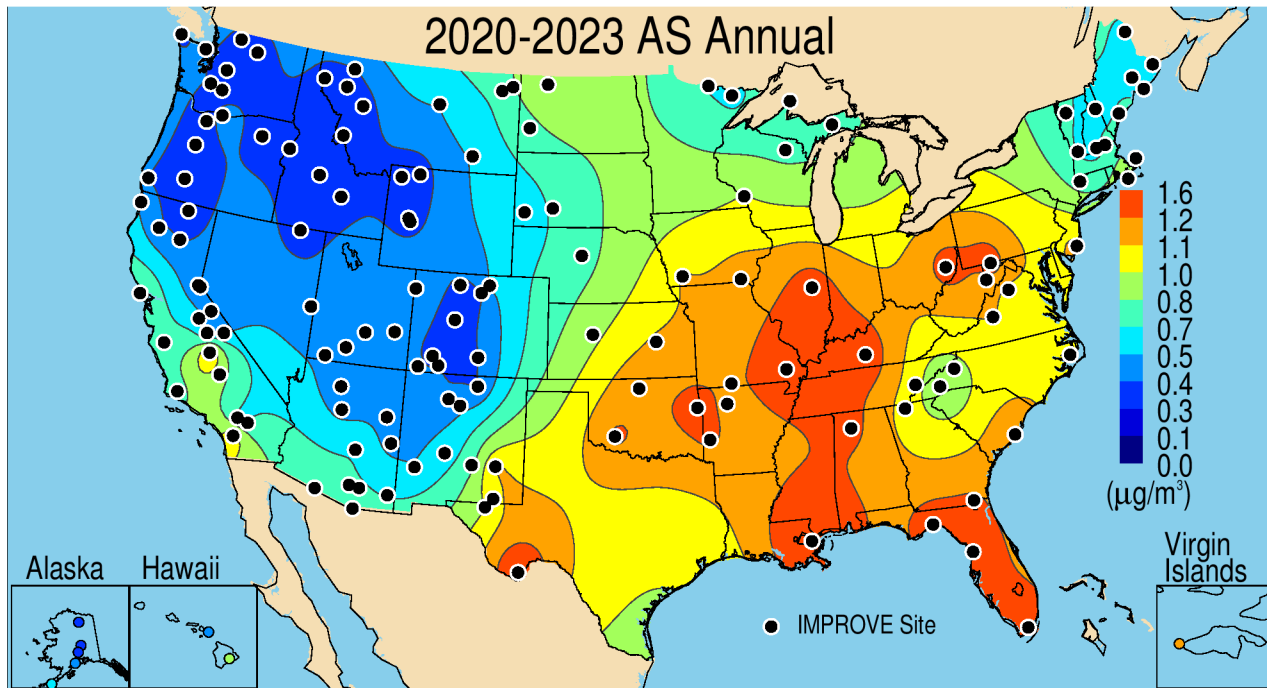




Data Analysis

Ammonium Sulfate

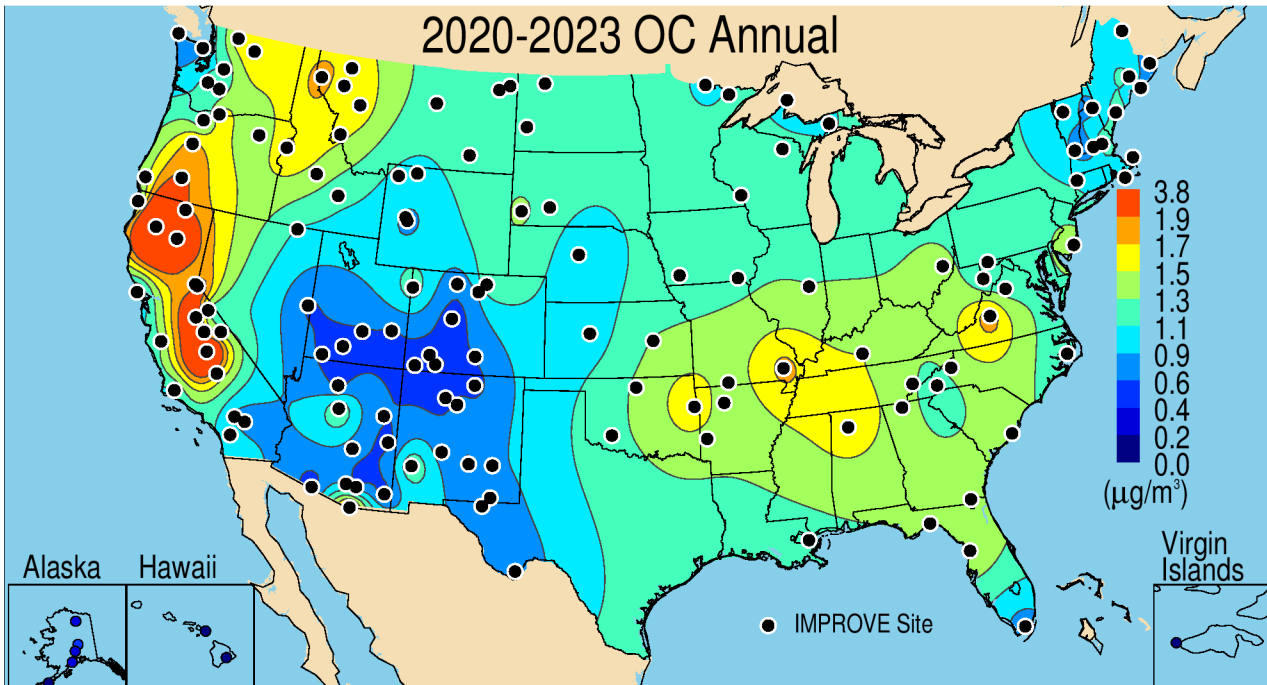
Ammonium Nitrate



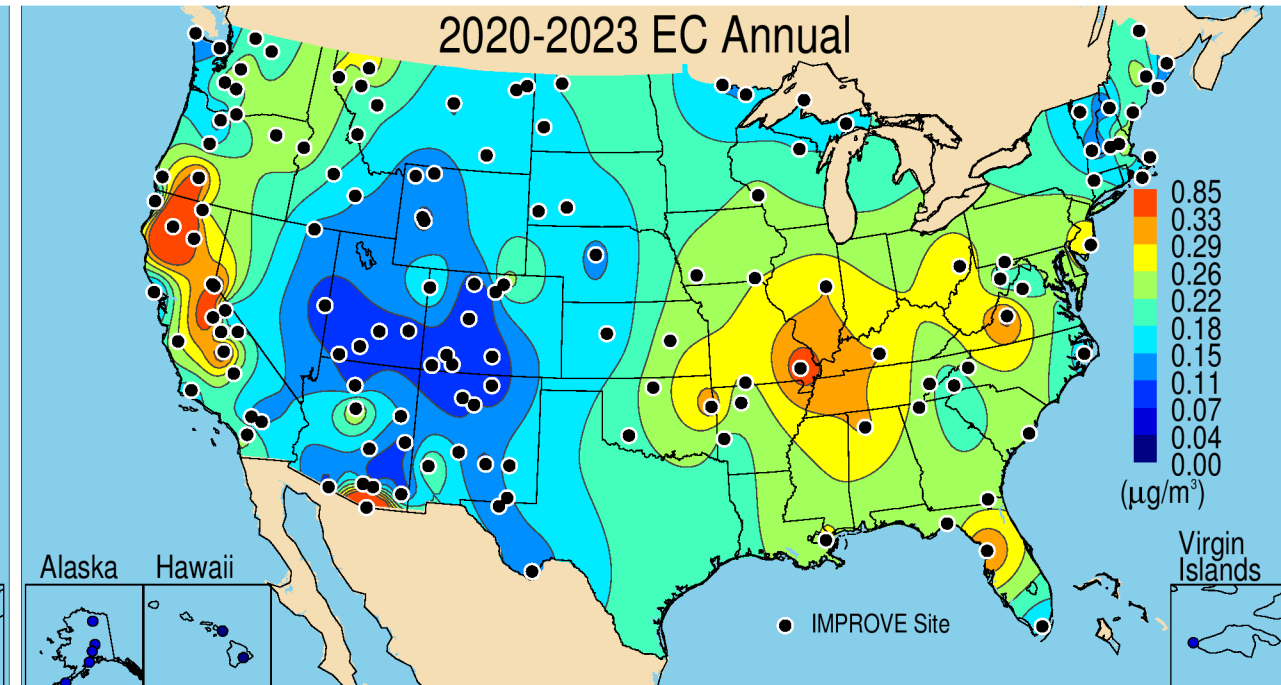


Data Analysis

Organic Carbon



Elemental Carbon

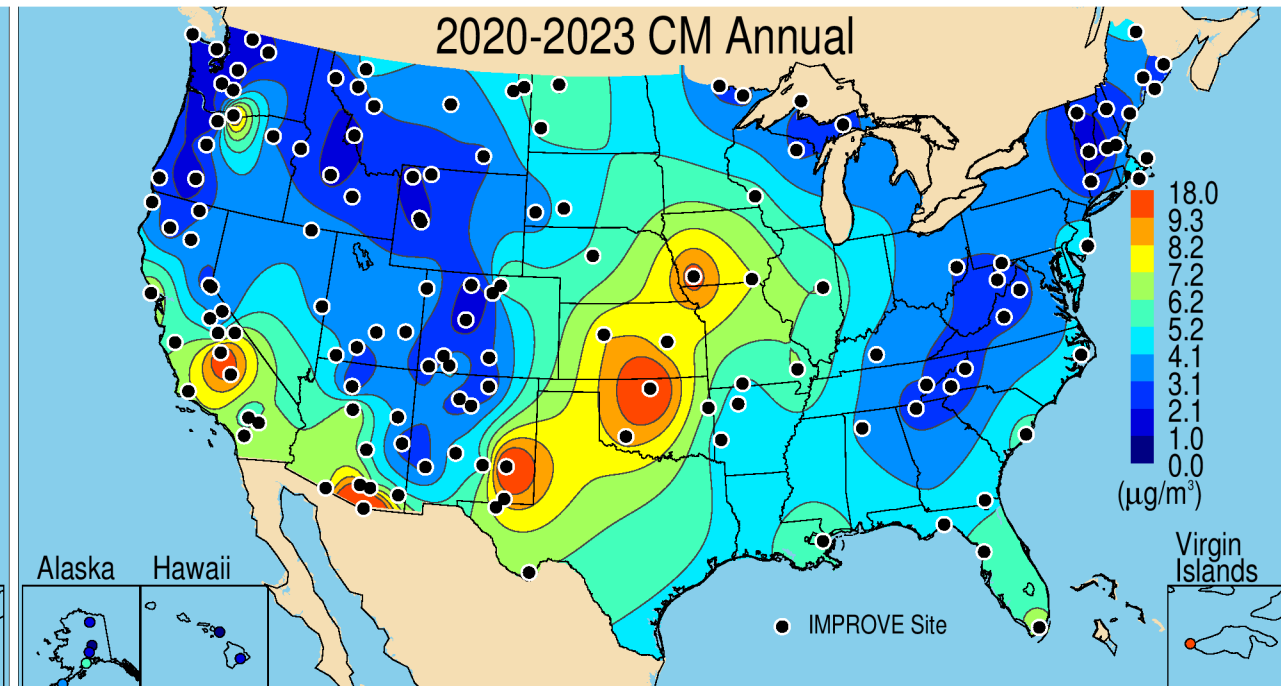
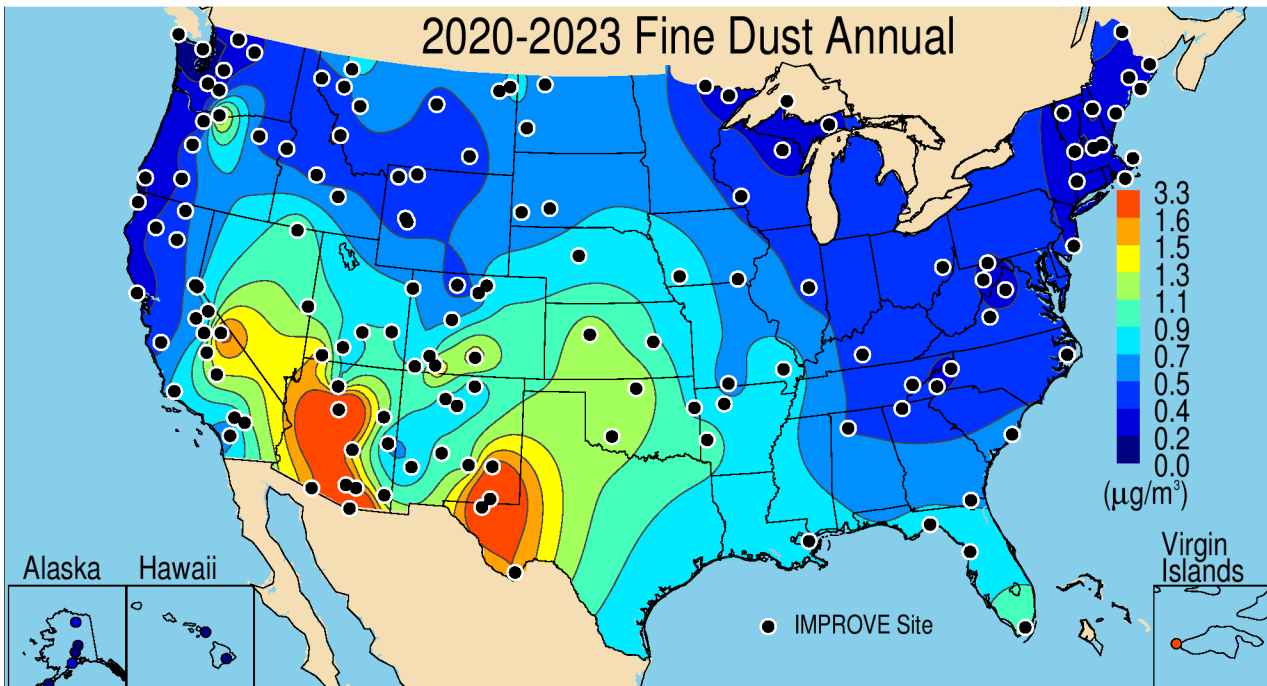




Data Analysis

Fine Dust

Coarse Mass





Thanks!



Bosque del Apache, NM

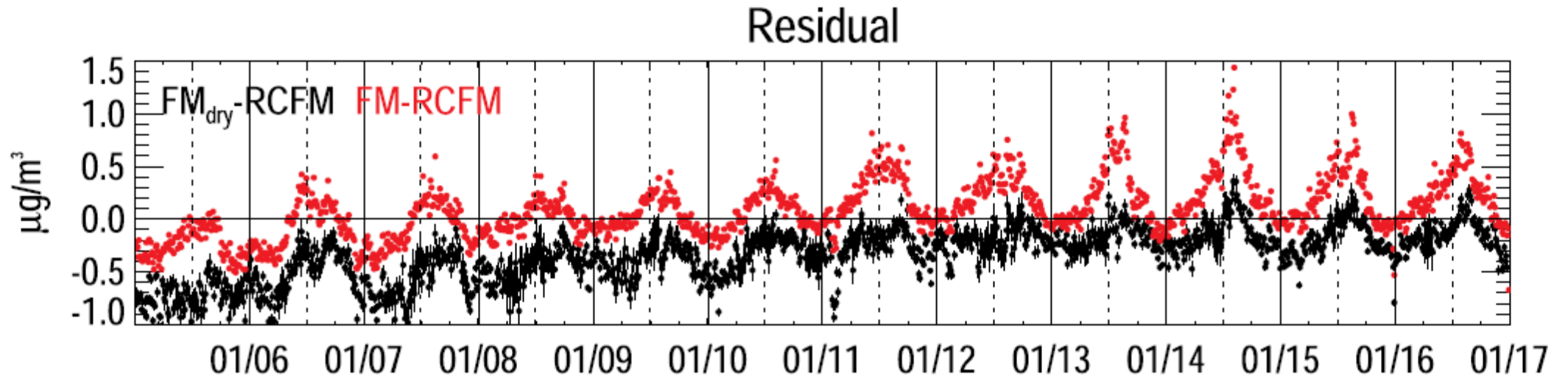


Fig. 4. IMPROVE daily network median dry residual ($\text{FM}_{\text{dry}} - \text{RCFM}$, $\mu\text{g m}^{-3}$) in black and original FM residual ($\text{FM} - \text{RCFM}$) in red. Measurement uncertainties are shown only for the dry residual.