CleanAir Workshops series 023

Dust Monitoring Compliance

Thursday, September 14, 2023

Morning Program

9:00 Welcome

9:05 Overview and Updates of CDPH Regulatory and Community Air Monitoring Approaches
Michael Enos, CDPH

9:40 Regional and National Regulatory Overview
Brian Newgent and Claire Amin, Aeroqual

10:05 Monitoring Program Design and Data Analysis Considerations
Volker Schmid, CleanAir

10:30 **BREAK**

10:45 Intro to Site Contribution Analysis and Aeroqual's Site Contribution Tool
Connor Porter, Aeroqual

11:10 New Developments for Special Applications
Don Allen and Volker Schmid, CleanAir

11:35 Top 10 Support Questions
Don Allen, CleanAir, and Connor Porter, Aeroqual

12:00 **LUNCH**

aeroqual

CleanAir

CleanAir Workshops

Dust Monitoring Compliance

cleanair.com/workshops/dust

Regional and National Regulatory Overview

Air & Dust Monitoring Solutions for Environmental Professionals – ***"Air Monitoring Made Easy!"***

aeroqual

Protecting people and planet from the harmful effects of air pollution starts with reliable and actionable air quality data.

- Founded in 2001, we pioneered the use of sensors for monitoring the quality of ambient air
  - Coined the term “Near-Reference”
- Today we are the leading air quality monitoring platform
  - Integrated instrumentation and software
  - 6 sensor technology patents
  - 10M+ air monitoring measurements daily
  - 100+ regional partners globally
  - U.S. EPA R&D collaboration agreement

CleanAir®

CleanAir Workshops

Dust Monitoring Compliance

cleanair.com/workshops/dust

The U.S. EPA announced a 5-year Cooperative Research and Development Agreement (CRADA) with Aeroqual.

"EPA is looking forward to collaborating with Aeroqual to improve knowledge of air sensor technologies, explore applications, and better understand the challenges of these devices such as calibration and performance over long time periods."

— Dr. Rachelle Duvall of U.S. EPA's Office of Research and Development

EPA Combines Expertise with New Zealand Company to Advance Air Sensor Technologies | US EPA

Our Credentials

U.S. EPA Collaboration

Aeroqual has a five-year Cooperative Research and Development Agreement (CRADA) with the U.S. EPA to advance air sensor technologies

ASTM International

Member of ASTM International Air Quality Committee (D22) developing new standard WK64899 for air quality sensors installed in cities, communities, and industrial sites.

MET ONE inside

Met One proven particle sensing technology has been integrated inside our products since 2009. Met One technology is used by 85% of U.S. environmental agencies.

MCERTS certification

World's first nephelometer to meet the UK Environmental Agency's MCERTS indicative particle monitoring standard. This drives pre-approval for use in US and global regulations.

Rule 1466 pre-approved

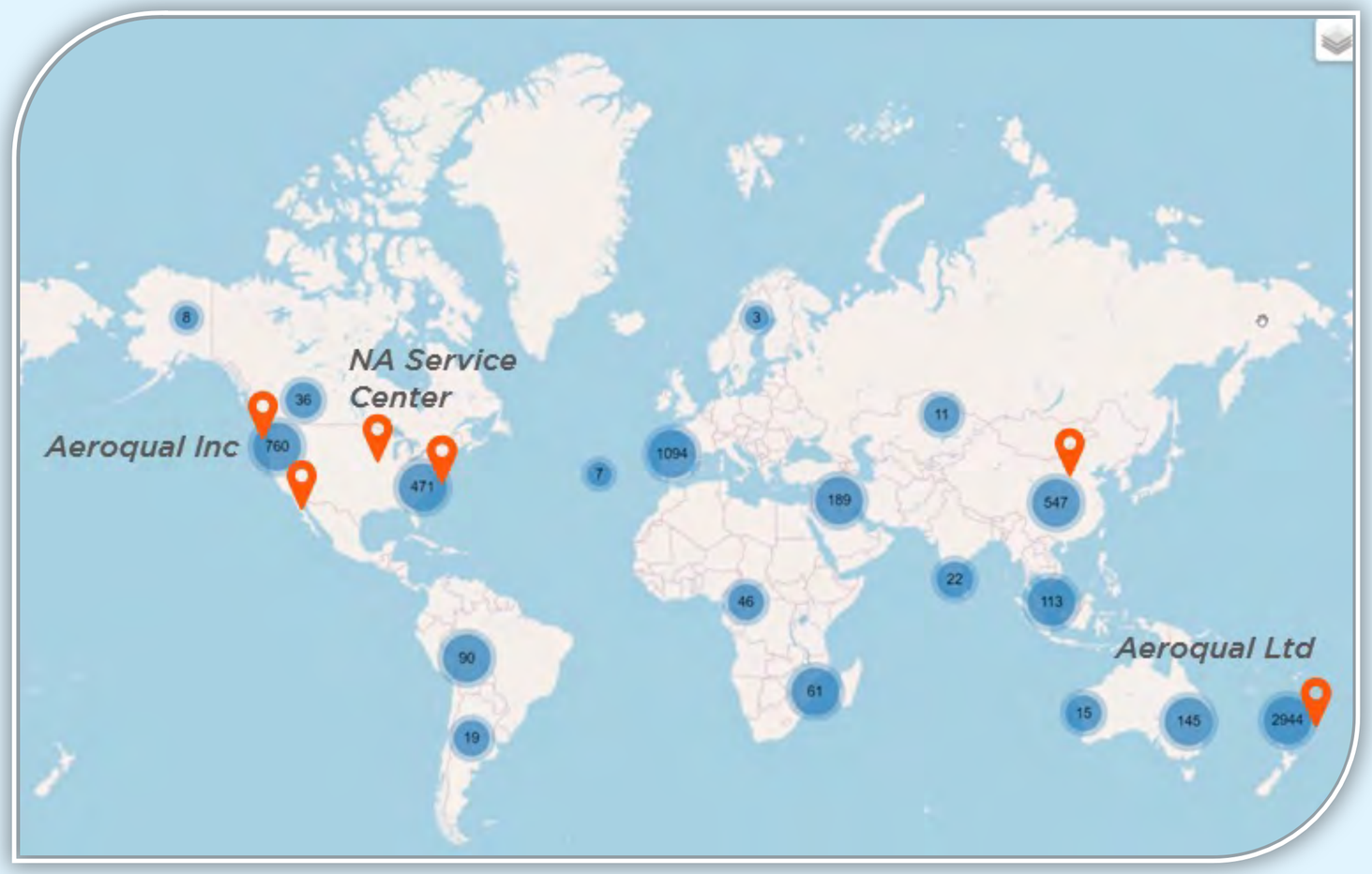
Aeroqual Dust Sentry is pre-approved by Executive Officer for SCAQMD for compliance monitoring under Rule 1466 and Rule 403 in California.

ISO 9001:2015 Certified

We operate a quality management system accredited to ISO 9001:2015 which requires stringent process adherence and speaks to the high level of QA/QC.

Aeroqual Connected Air Monitors

Two-way Integration | Cloud Storage | Real-Time Data and Alerts

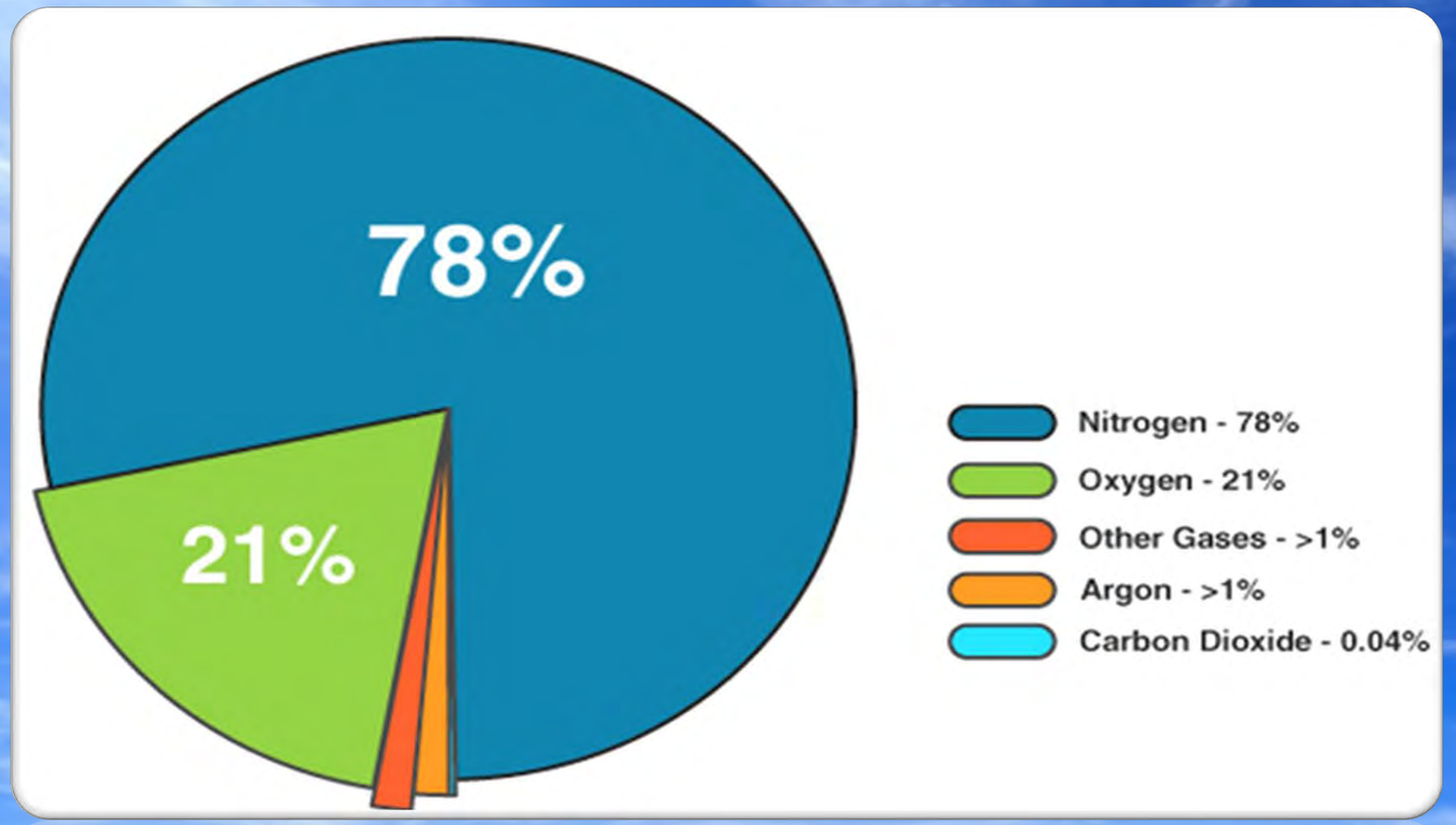


- 6,582 Global
- 100 Regional Partners

- 7M+ datapoints /day
- 99% Data Uptime

"We Make it Easier to Monitor Air Quality"

What is the basic composition of “Air”?



1963 Clean Air Act – Hazardous Air Pollutants

"Toxic pollutants that are known or suspected to cause cancer or other serious health effects"

There are about 187 hazardous air pollutants (HAPs) that EPA is required to control.

List of 30 Urban Air Toxics		
Acetaldehyde	Dioxin	Mercury compounds
Acrolein	Propylene dichloride	Methylene chloride (dichloromethane)
Acrylonitrile	1,3-dichloropropene	Nickel compounds
Arsenic compounds	Ethylene dichloride (1,2-dichloroethane)	Polychlorinated biphenyls (PCBs)
Benzene	Ethylene oxide	Polycyclic organic matter (POM)
Beryllium compounds	Formaldehyde	Quinoline
1,3-butadiene	Hexachlorobenzene	1,1,2,2-tetrachloroethane
Cadmium compounds	Hydrazine	Tetrachloroethylene (perchloroethylene)
Chloroform	Lead compounds	Trichloroethylene
Chromium compounds	Manganese compounds	Vinyl chloride

Urban Air Toxic Pollutants | US EPA

Pittsburgh at the junction of the Monongahela and Allegheny rivers in 1936 (left), and in 2014 (right) (Left photo © Margaret Bourke-White/The LIFE Picture Collection/Getty Images. Right photo © Clarence Holmes Photography/Alamy)

Pittsburgh 1936 vs. 2014

1970 EPA Establishes Criteria Pollutants

Criteria Air Pollutants can be harmful to public health and the environment

The Clean Air Act requires EPA to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants (also known as "criteria air pollutants")

National Ambient Air Quality Standards

Criteria Air Pollutants can be harmful to public health and the environment

Pollutant [links to historical tables of NAAQS reviews]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)		primary	8 hours	9 ppm	Not to be exceeded more than once per year
			1 hour	35 ppm	
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 µg/m^3 (1)	Not to be exceeded
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		primary and secondary	1 year	53 ppb (2)	Annual Mean
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 µg/m^3	annual mean, averaged over 3 years
		secondary	1 year	15.0 µg/m^3	annual mean, averaged over 3 years
		primary and secondary	24 hours	35 µg/m^3	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24 hours	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

- Primary Standards provide health protection, including sensitive populations – asthmatics, children, and the elderly
- Secondary Standards provide public welfare protection (decreased visibility and damage to animals, crops, vegetation, and buildings

- EPA must designate areas as meeting (attainment) or not meeting (nonattainment) the standard.
- The Clean Air Act requires states to develop a general plan to attain and maintain the standards in all areas of the country and a specific plan to attain the standards for each area designated nonattainment.
  - These plans, known as State Implementation Plans or SIPs, are developed by state and local air quality management agencies and submitted to EPA for approval.

Recent or Proposed Changes (EPA)

Community Air Monitoring
June 25, 2021

Methane
November 11, 2022

PM2.5 Standard
January 6, 2023

Ethylene Oxide
April 11, 2023

Ozone
August 21, 2023

ARP American Rescue Plan - Enhanced Air Quality Monitoring for Communities

- ❑ June 25, 2021 -ARP American Rescue Plan - Enhanced Air Quality Monitoring for Communities
- ❑ Replace existing filter-based PM2.5 monitors or enhance existing to provide 24/7, real-time reporting
- ❑ Automation of PM2.5 Monitors
- ❑ Enhanced monitoring of PM2.5 and five other air pollutants regulated by the National Ambient Air Quality Standards under the Clean Air Act
- ❑ Conduct monitoring of pollutants of greatest concern
- ❑ For Agency mobile monitoring labs or Air Sensor Loan Programs. (Short-term monitoring and air quality information)

Biden-Harris Administration Strengthens Proposal to Cut Methane Pollution to Protect Communities, Combat Climate Change, and Bolster American Innovation | US EPA

EPA Proposal to Reduce Methane

- November 11, 2022 - The U.S. Environmental Protection Agency (EPA) announced it is strengthening its proposed standards to cut **Methane** and other harmful air pollution.
- The agency estimates that in 2030, the proposal would reduce methane from “Super Emitter” sources by 87 percent below 2005 levels.
- EPA projects that the proposed standards would reduce an estimated 36 million tons of methane emissions from 2023 to 2035, the equivalent of 810 million metric tons of carbon dioxide.

Biden-Harris Administration Strengthens Proposal to Cut Methane Pollution to Protect Communities, Combat Climate Change, and Bolster American Innovation | US EPA

EPA Proposed Changes to PM2.5 Standard

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January 6, 2023 - EPA announced its proposed decision to revise the primary (health-based) annual **PM2.5 standard** from its current level of 12.0 µg/m3 to within the range of 9.0 to 10.0 µg/m3

EPA Proposes to Strengthen Air Quality Standards to Protect the Public from Harmful Effects of Soot | US EPA

EPA Proposal to Reduce Ethylene Oxide

- April 11, 2023, EPA proposed new requirements for 86 commercial sterilizers across the country.
- These requirements, if implemented, will reduce the amount of **Ethylene Oxide** Emissions EtO that comes out of commercial sterilizers by 80 percent

Proposal to Reduce Ethylene Oxide Emissions from Commercial Sterilization Facilities | US EPA

EPA announced a new review of the Ozone National Ambient Air Quality Standards (NAAQS)

- August 21, 2023 EPA announced a new review of the Ozone National Ambient Air Quality Standards (NAAQS) to ensure the standards reflect the most current, relevant science and protect people's health from these harmful pollutants

EPA Initiates New Review of the Ozone National Ambient Air Quality Standards to Reflect the Latest Science | US EPA

Regional Regulations

- **May 3, 2010 - New York State Department of Environmental Conservation (DEC) remedial programs Issues**
  - DER-10, Technical Guidance for Site Investigation and Remediation - administered by the Division of Environmental Remediation (DER) – (New Rules coming soon)
  - VOC action levels > 5ppm and >25 ppm above background
  - PM10 action levels >100 Ug/M3 above Upwind (15min Avg), >150 Ug/M3 above Upwind (15min Avg)
- **April 19, 2021 - Chicago Department of Public Health – Demolition by Implosion**
  - The Comprehensive Plan must include a comprehensive air monitoring plan that investigates air quality impacts from Fugitive Dust prior to Implosion and a plan for the monitoring of PM 10 in the air before, during, and after Implosion activities using instruments designated as Federal Equivalent Method (FEM) by EPA or meet the requirements for a Near Reference PM 10 Monitor
- **January 1, 2023 - SCAQMD Rule 1466 Amendment**
  - PM10 calculation methodology require calculation of the two-hour PM10 average concentration as a rolling average every minute
  - Clarify that PM10 average calculation restarts when resuming earth-moving activities after addressing a PM10 concentration exceedance
  - Revise wind monitoring requirements
  - Action Levels If the PM10 site activity contribution (downwind minus upwind concentration) exceeds 25 micrograms per cubic meter (µg/m3) averaged over one hour…earth-moving operations cannot recommence until the particulate contribution drops below 25 µg/m3 averaged over 30 minutes.
- **March 7, 2023 – Chicago Department of Public Health - Revises Rules for Reprocessable Construction/Demolition Material Facilities**
  - Chicago’s new rule for waste reprocessing facilities allows the use of near-reference PM10 monitors that are SCAQMD 1466 approved.
  - Reportable Action Level is the PM10 concentrations above 150 micrograms per cubic meter averaged over a 15-minute period.
  - Facilities using FEM monitors may subtract the upwind PM10 concentration from the downwind PM10 concentration in determining a PM10 RAL exceedance.

Methods for Measuring Pollutants

CRITERIA POLLUTANTS

OTHER POLLUTANTS OF CONCERN

Pollutant	EPA Reference Method	EPA Equivalent Method (or Measurement Technology for Non-Criteria Pollutants)	Near Reference (* w/ ABC – Automatic Baseline Correction)
Ozone	UV Photometric Ozone Analyzer	• UV Absorption O3 Analyzer • Chemiluminescence Ozone Analyzers	*AQM LZ (0-500 ppb) GSS (Gas Sensitive Semiconductor)
Sulphur Dioxide	Pararosaniline Method (Manual)	UV Fluorescence SO2 Analyzer	*AQM SOL (0-10000 ppb) GSE (Gas Sensitive Electrochemical)
Carbon Monoxide		Gas Filter Correlation CO Analyzer	*AQM CO (0-25 ppm) GSE (Gas Sensitive Electrochemical)
Nitrogen Dioxide		• Chemiluminescence NO/NO2/NOx Analyzer • CAPS True NO2-NOX-NO Analyzer (Cavity Attenuated Phase Shift Spectroscopy)	*AQM NO2 (0-500 ppb) GSE (Gas Sensitive Electrochemical)
Lead	Physical Sample Collection with Lab Analysis		NA
Particulate Matter	Gravimetric High-Volume	• Broadband spectroscopy ,LED technology w/ well-understood light scattering theory • BAM • TEOM	Dust Sentry, PMX (Nephelometer/Particle Counter)
Carbon Dioxide	Performance Based	Gas Filter Correlation CO2 Analyzer	*AQM CD (0-2000 ppm) NDIR (Non-Dispersive Infra-Red)
Nitrogen Oxides	Performance Based	• Chemiluminescence NO/NO2/NOx Analyzer • CAPS True NO2-NOX-NO Analyzer (Cavity Attenuated Phase Shift Spectroscopy)	*AQM NX (0-0.5 ppm) GSS (Gas Sensitive Semiconductor)
Hydrogen Sulfide	Performance Based	UV Fluorescence H2S Analyzer	*AQM HSL (0-10000 ppb) GSE (Gas Sensitive Electrochemical)
Volatile Organic Compounds (VOC)	Performance Based	Performance Based	*AQM VOC (L/H) (0-500 ppb or 0-30 ppm) PID (Photoionization Detector) GC-PID, GC–FID, GC-MS
Methane	Performance Based	Performance Based	*AQM MT (0-100 ppm) GSS (Gas Sensitive Semiconductor) FID
BTEX (Benzene, Toluene, Ethylbenzene, and Xylene)	Performance Based	Performance Based	AQM BTEX (0.1 – 50 ppb) GC (Carrier Gas Free Miniature Gas Chromatograph) GC PID
Ethylene Oxide	Performance Based	Cavity Ring-Down Spectroscopy	NA

Our Product

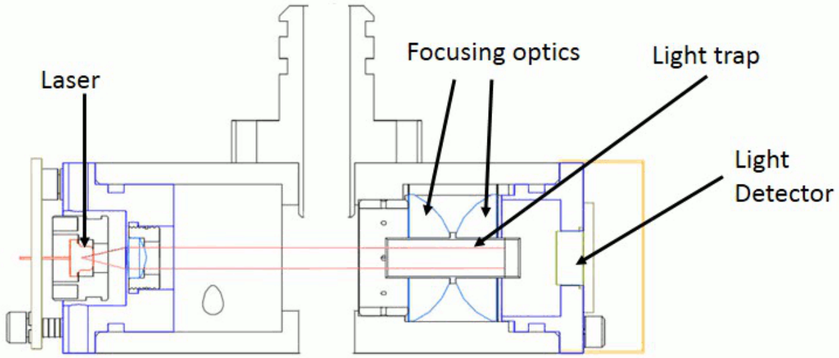
Fully-Integrated Solution

Real-Time, Actionable and Defensible Data

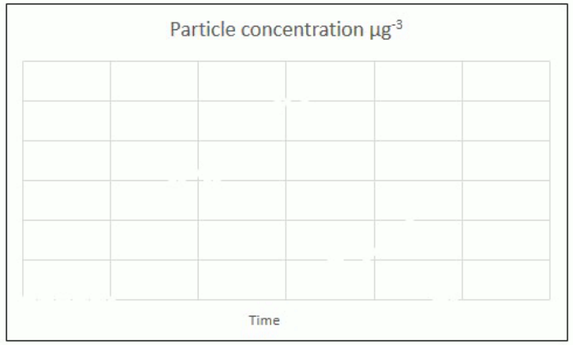
Available sensors: PM10, PM2.5, PM1, TSP, NO2, CO, CO2, O3, SO2, NOx, VOC, H2S, Meteorological, noise + 3rd party

Dust Sentry (Nephelometer)

Under conditions of zero particle load, all of the laser light is caught by the light trap, no light reaches the detector.



When particles fall through the laser beam, light is scattered, the light is focused on to a detector which produces a signal proportional to the amount of particles in the light beam.



- **Replace existing filter-based PM2.5 monitors** or enhance existing **to provide 24/7, real-time reporting of air quality concentrations**

Dust Sentry PCX and Pro

(Particle Counter)

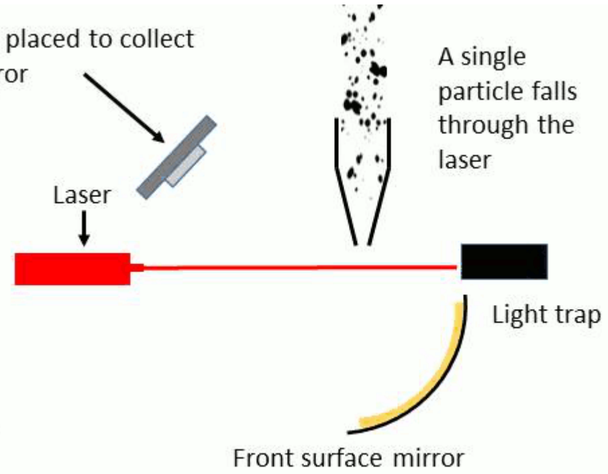
Under conditions of zero particle load, all of the laser light is caught by the light trap, no light reaches the detector.

When a single particle falls through the laser beam, light is scattered, some light is captured by the mirror and then focused upon the detector. The amount of light scattered depends on the particle size.

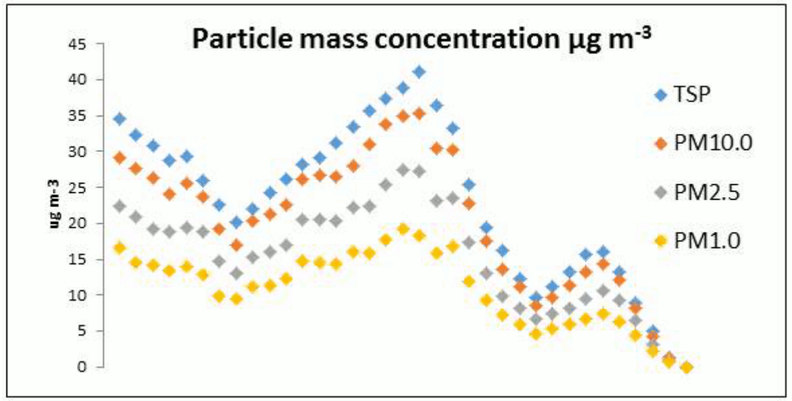
Each particle results in a single pulse which is counted, the height of the pulse is proportional to the size of the particle. The counts accumulate over a fixed sampling time.

After the fixed sampling time, particle counts are mathematically converted in to mass to provide particle concentrations in four sizes: TSP, PM10.0, PM2.5 and PM1.0. The mass measurement is recorded. Then the counts are set to zero and the process is repeated for another measurement cycle.

This results in a time series of four particle size fractions TSP, PM10.0, PM2.5 and PM1.0.



Particle size	Counts
0.3	0
0.5	0
0.7	0
1.0	0
2.0	0
3.0	0
5.0	0
10.0	0
$\int f(x)$	
	↓↓
TSP	0
PM10.0	0
PM2.5	0
PM1.0	0



- **Replace existing filter-based PM2.5 monitors** or enhance existing **to provide 24/7, real-time reporting of air quality concentrations**

Aeroqual Analyzer Modules

Delivering Near-Reference Levels of Performance for AQM/AQS

GSS Our Gas Sensitive Semiconductor sensors use proprietary sensing material, built-in **ABC** (Automatic Baseline Correction) and interference rejection. This combination results in ppb resolution and a highly linear response.

GSE Our Gas Sensitive Electrochemical sensors generate nano-amp currents proportional to the gas concentration. Aeroqual uses low noise electronics to capture these signals resulting in low detection levels.

NDIR Our Non-Dispersive Infra-Red sensors use infra-red light, a narrow band-pass filter and photodiode to measure the intensity of light at the gas absorption band. The light intensity is proportional to the gas concentration.

PID Our Photo Ionization Detector sensors use a krypton filled UV lamp to ionize VOC gas molecules and generate a current that's proportional to the VOC concentration. The PID sensor responds to a wide range of VOCs and is industry recognized.

- Conduct monitoring of pollutants of greatest concern
- Strengthening its proposed standards to cut **Methane** and other harmful air pollution

Aeroqual Ranger

Cloud Connected | Zero Calibration Downtime

28 Sensor Heads Spanning 14 Gases plus PM

PM 1, PM2.5, RES, PM10, TSP

CO | CO_2 | Perc | VOC | CH_4 | O_3 | Cl_2

CH_2O | H_2S | H_2 | NH_3 | NO_2 | SO_2 | NMHC

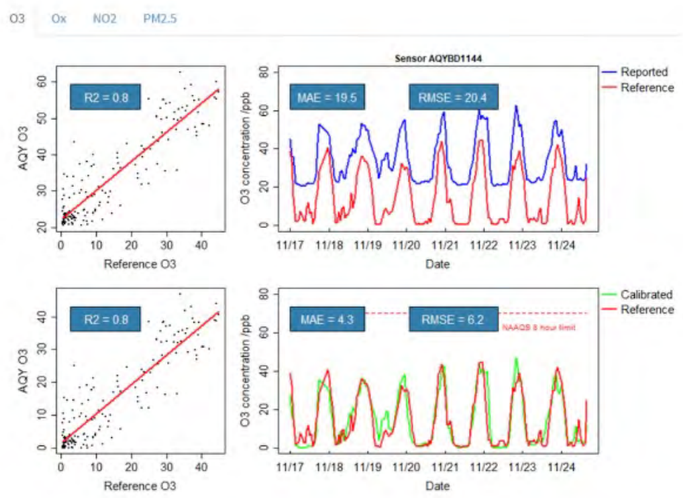
For Agency mobile monitoring labs or Air Sensor Loan Programs.
(Short-term monitoring and air quality information)

Aeroqual MOMA

A complete pollution monitoring software solution for air quality sensor networks

Aeroqual smart monitors or BYOD*

Unify's complete air quality network solution is compatible with one of Aeroqual's connected instruments and a range of third party devices.



Virtual calibration service (MOMA)

Calibrations are run by Aeroqual's air quality systems and data experts using our proprietary MOMA tool.

Reduced travel costs

Cut down on on-site visits, saving time and money.

Reduced labor cost

Remote calibration makes air quality network monitoring easy.

Less data processing

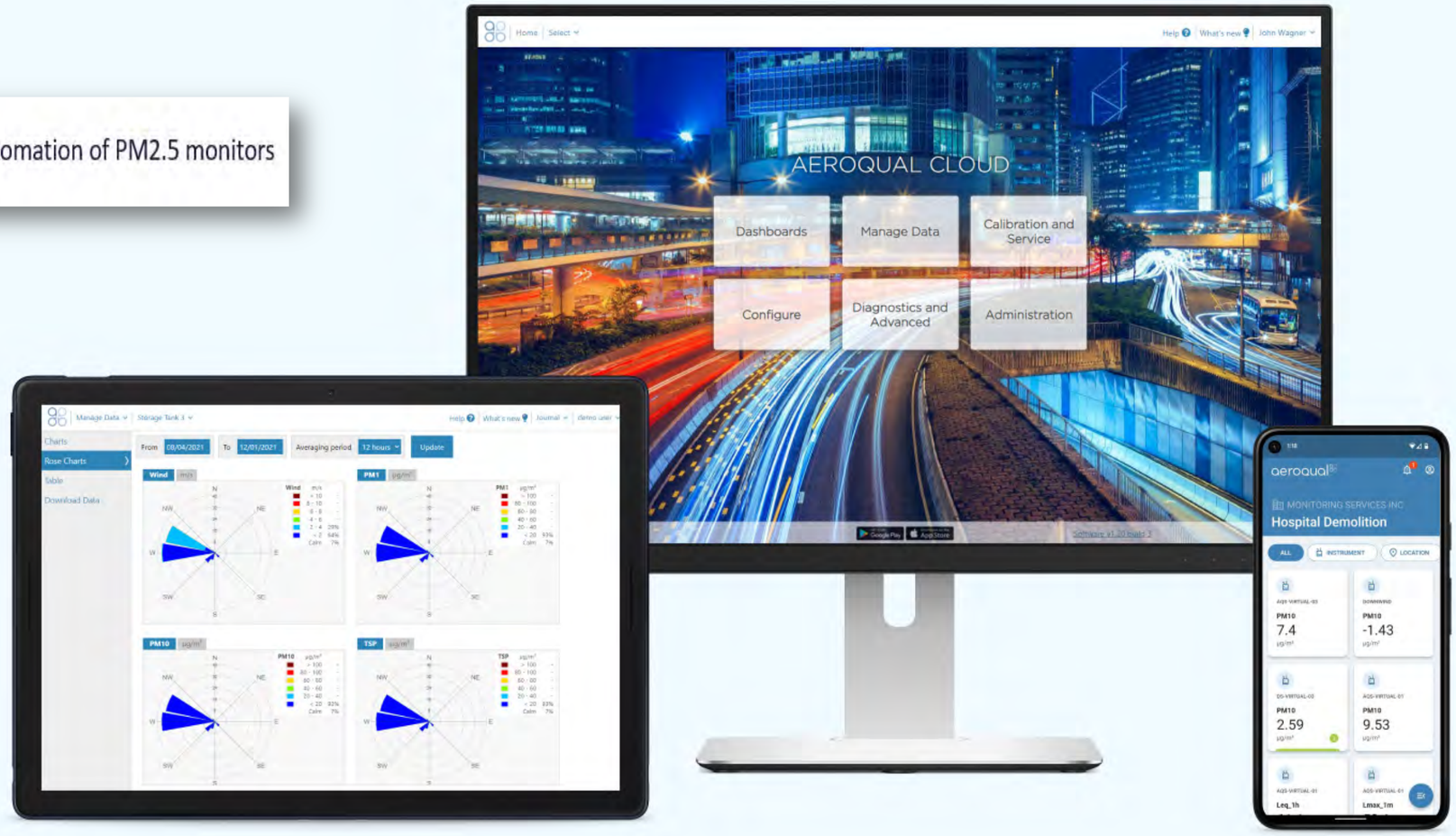
Improve data quality without increasing labor.

- ARP Enhanced Air Quality Monitoring for Communities
- Proposed decision to revise the primary (health-based) annual PM2.5 standard from its current level of 12.0 µg/m3 to within the range of 9.0 to 10.0 µg/m3
- Automation of PM2.5 monitors
- Replace existing filter-based PM2.5 monitors or enhance existing to provide 24/7, real-time reporting of air quality concentrations

Aeroqual Cloud

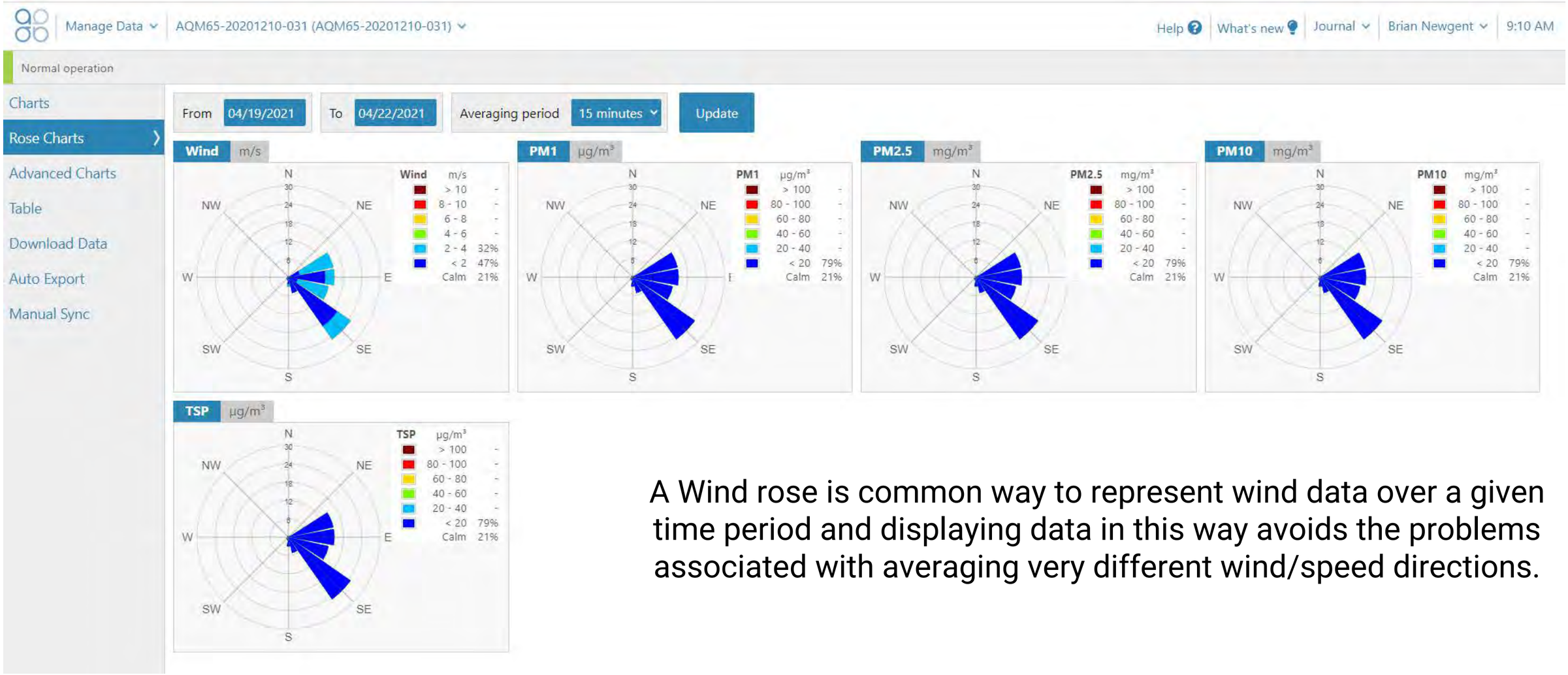
Data Visualization and Software Tools to Maximize Performance and Sharpen Accuracy

Automation of PM2.5 monitors



Data Visualization Tools

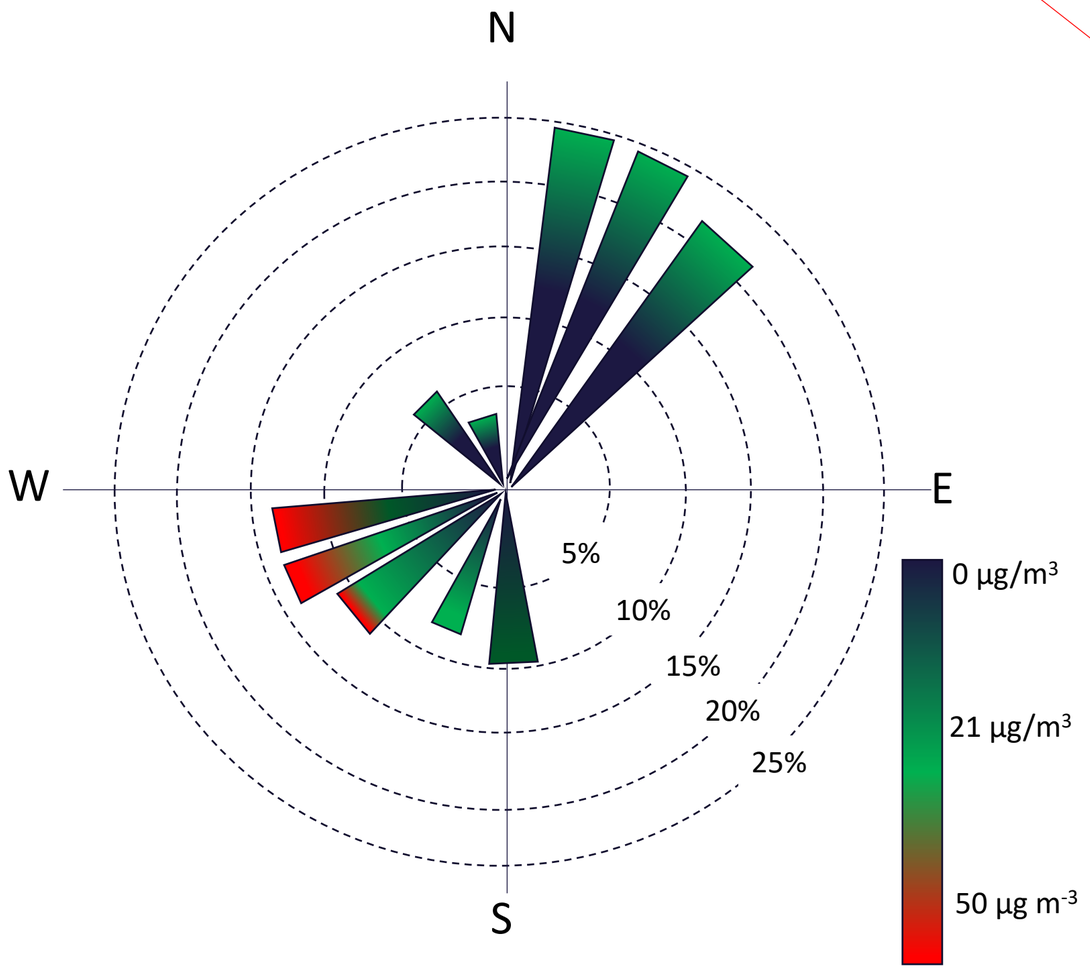
Aeroqual Cloud Pollution Charts



A Wind rose is common way to represent wind data over a given time period and displaying data in this way avoids the problems associated with averaging very different wind/speed directions.

Rose Chart | PM Contribution

Dust Monitor location with additional wind speed/direction sensor, located on the boundary between residential area and power station.



Coal fired power station.

Residential area

The pollution rose says that most of wind comes from the **NorthEast** and when it does **PM values are low**. But when wind blows from the **SouthWest PM values are high.**

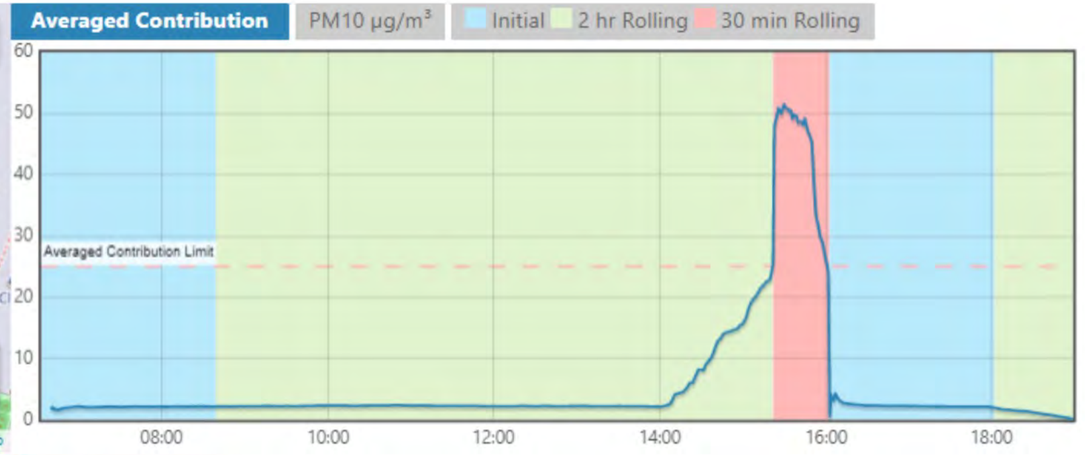
Site Contribution

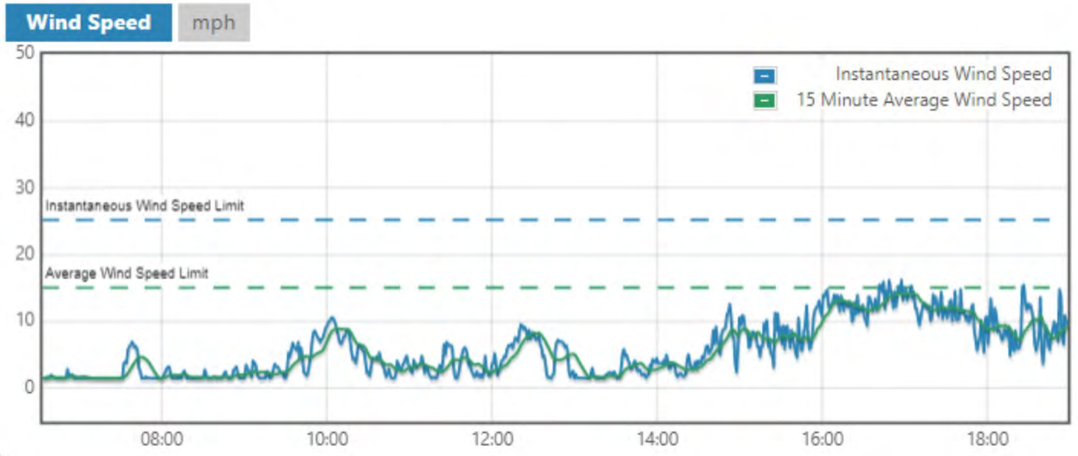
The software automatically tracks pollutant levels, wind direction and speed to calculate the total site contribution. Real-time alerts notify you within a minute if you are approaching regulatory limits. **It seamlessly reports data in the required format.**

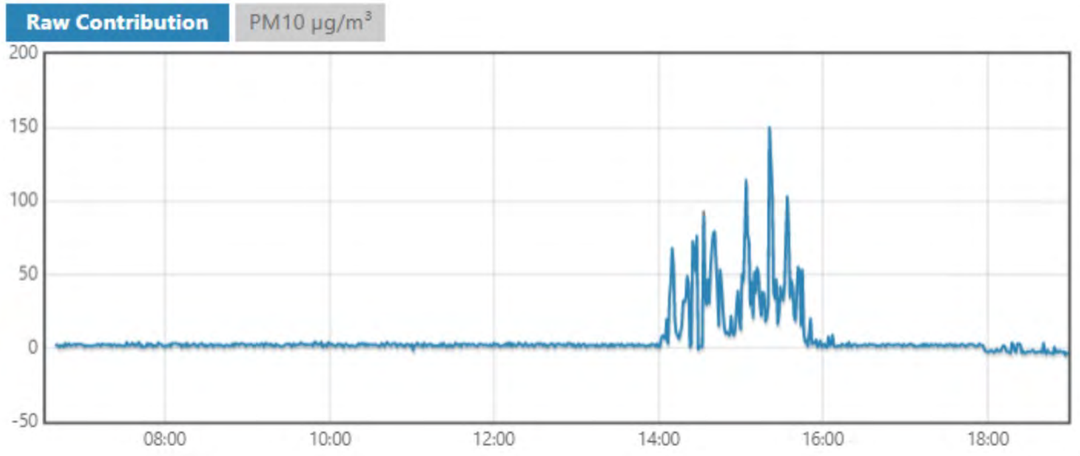
Site Contribution - Dusty Remediation - Historical View

From Date 04/02/2022 06:00 To Date 04/02/2022 19:00 Update

Export as JSON Export as CSV Live View







Data Outcome...

Questions...

CleanAir Workshops series 023

Dust Monitoring Compliance

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Monitoring Program Design and Data Analysis Considerations

September 14, 2023

- Equipment Selection
- Siting Considerations
- Documentation
- Quality Assurance & Performance Criteria
- Data Management and Analysis

Equipment Selection

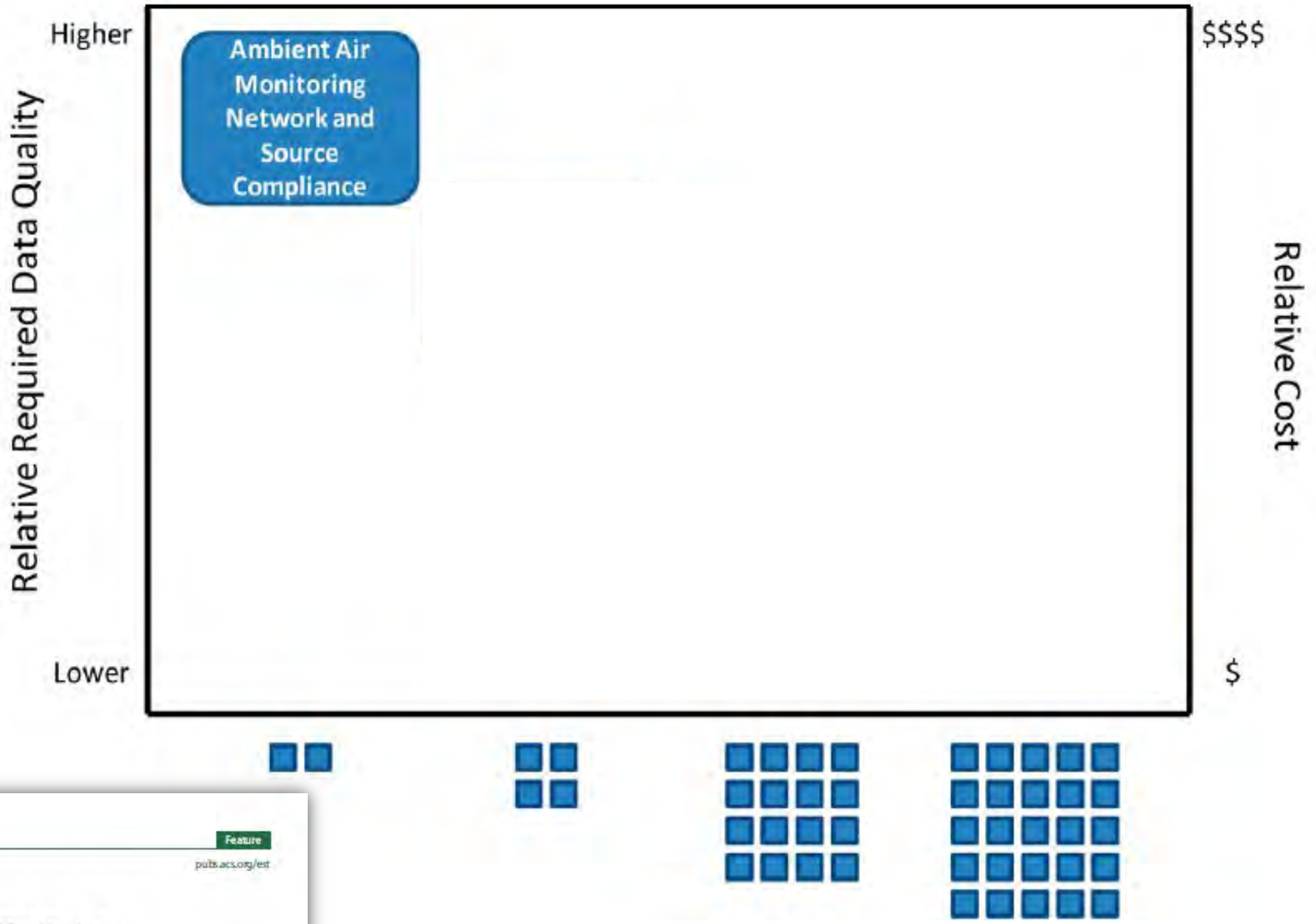
Siting Considerations

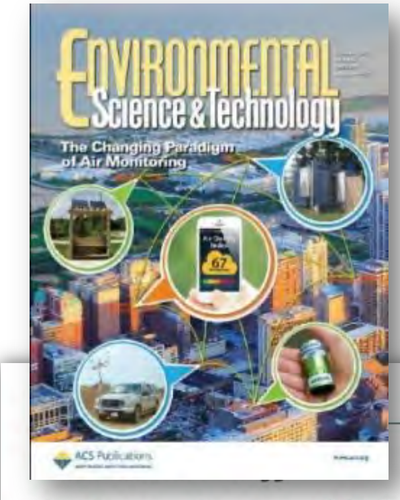
Documentation

Quality Assurance & Performance Criteria

Data Management and Analysis

PROJECT AND DATA QUALITY OBJECTIVES





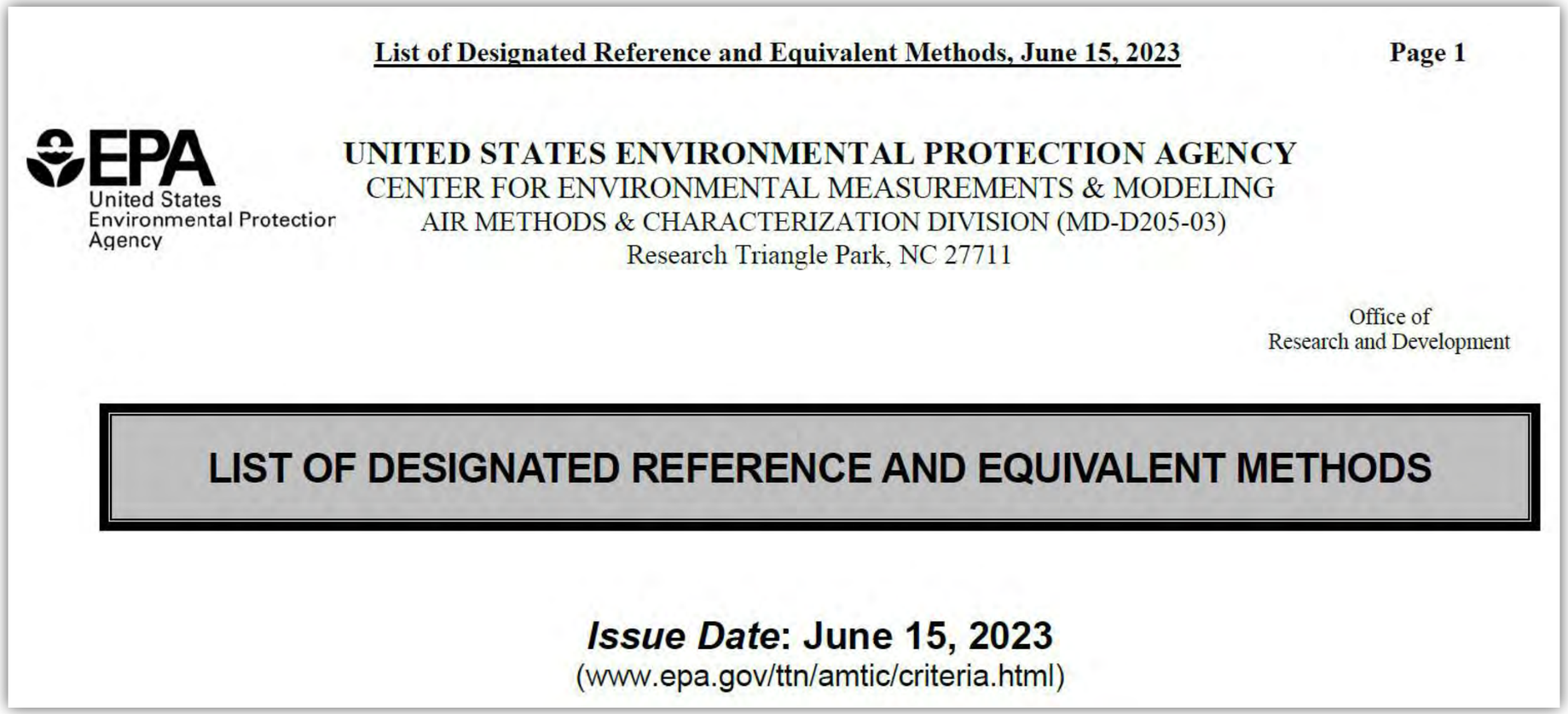
Feature

pubs.acs.org/est

The Changing Paradigm of Air Pollution Monitoring

Emily G. Snyder,*[†] Timothy H. Watkins,[†] Paul A. Solomon,[‡] Eben D. Thoma,[†] Ronald W. Williams,[†] Gayle S. W. Hagler,[†] David Shelow,[§] David A. Hindin,[∥] Vasu J. Kilaru,[†] and Peter W. Preuss[⊥]

Criteria Pollutants



List of Designated Reference and Equivalent Methods, June 15, 2023 Page 1

EPA United States Environmental Protection Agency

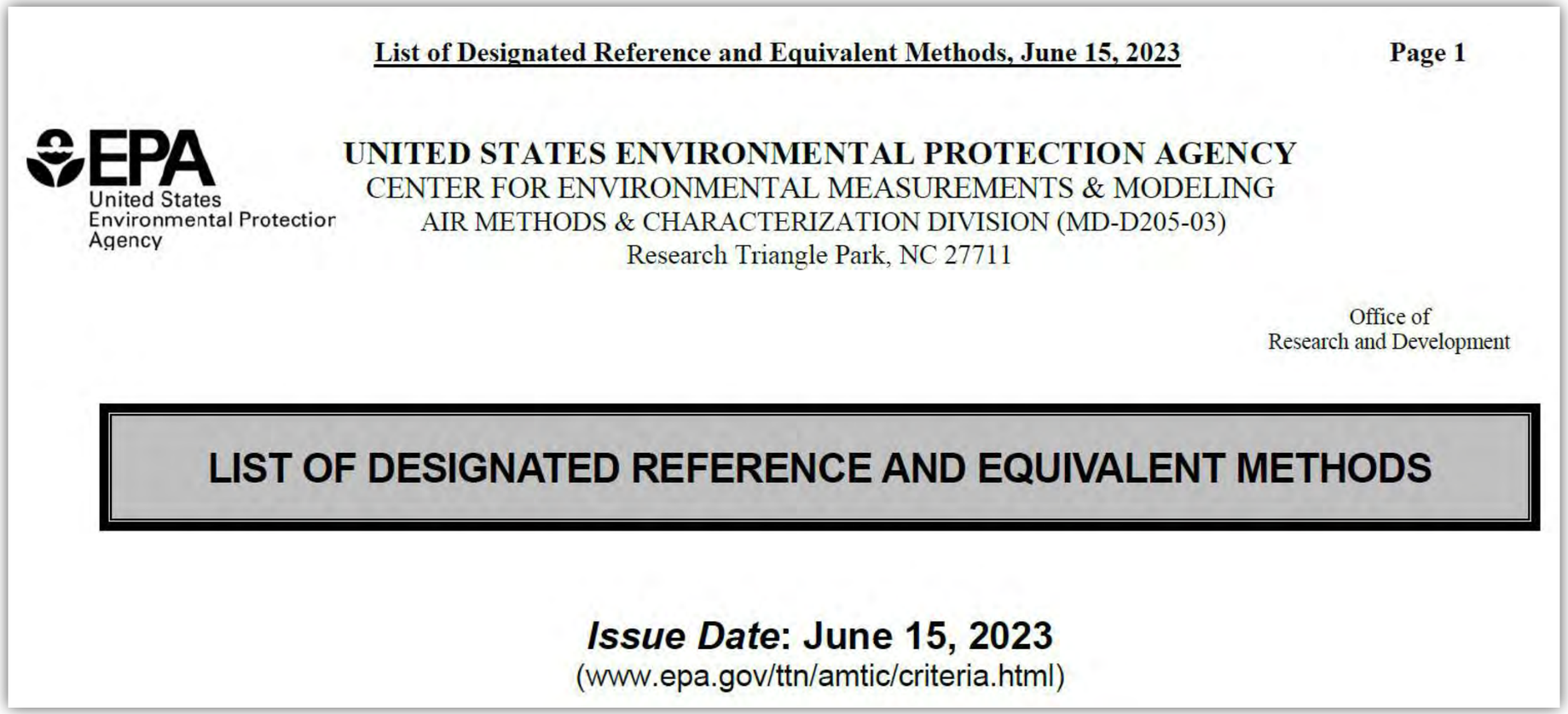
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CENTER FOR ENVIRONMENTAL MEASUREMENTS & MODELING
AIR METHODS & CHARACTERIZATION DIVISION (MD-D205-03)
Research Triangle Park, NC 27711

Office of
Research and Development

LIST OF DESIGNATED REFERENCE AND EQUIVALENT METHODS

***Issue Date*: June 15, 2023**
(www.epa.gov/ttn/amtic/criteria.html)

PM10 – FRM & FEM



List of Designated Reference and Equivalent Methods, June 15, 2023 Page 1

EPA United States Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
CENTER FOR ENVIRONMENTAL MEASUREMENTS & MODELING
AIR METHODS & CHARACTERIZATION DIVISION (MD-D205-03)
Research Triangle Park, NC 27711

Office of
Research and Development

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PM10 – FEM

Teledyne API T640X

Met One Instruments E-BAM Plus

ThermoScientific TEOM 1405

Higher

Relative Required Data Quality

Lower

$$$$

Relative

$

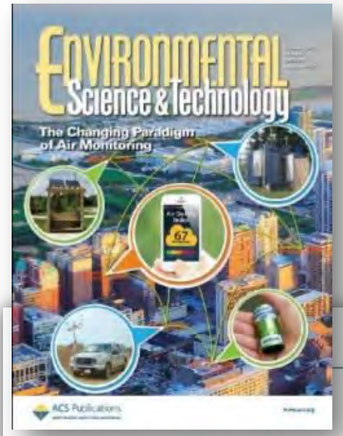
Ambient Air Monitoring Network and Source Compliance

Supplement Air Monitoring Network

VSCC

Inlet Heater

Zero Air Purge and Drift Adjust

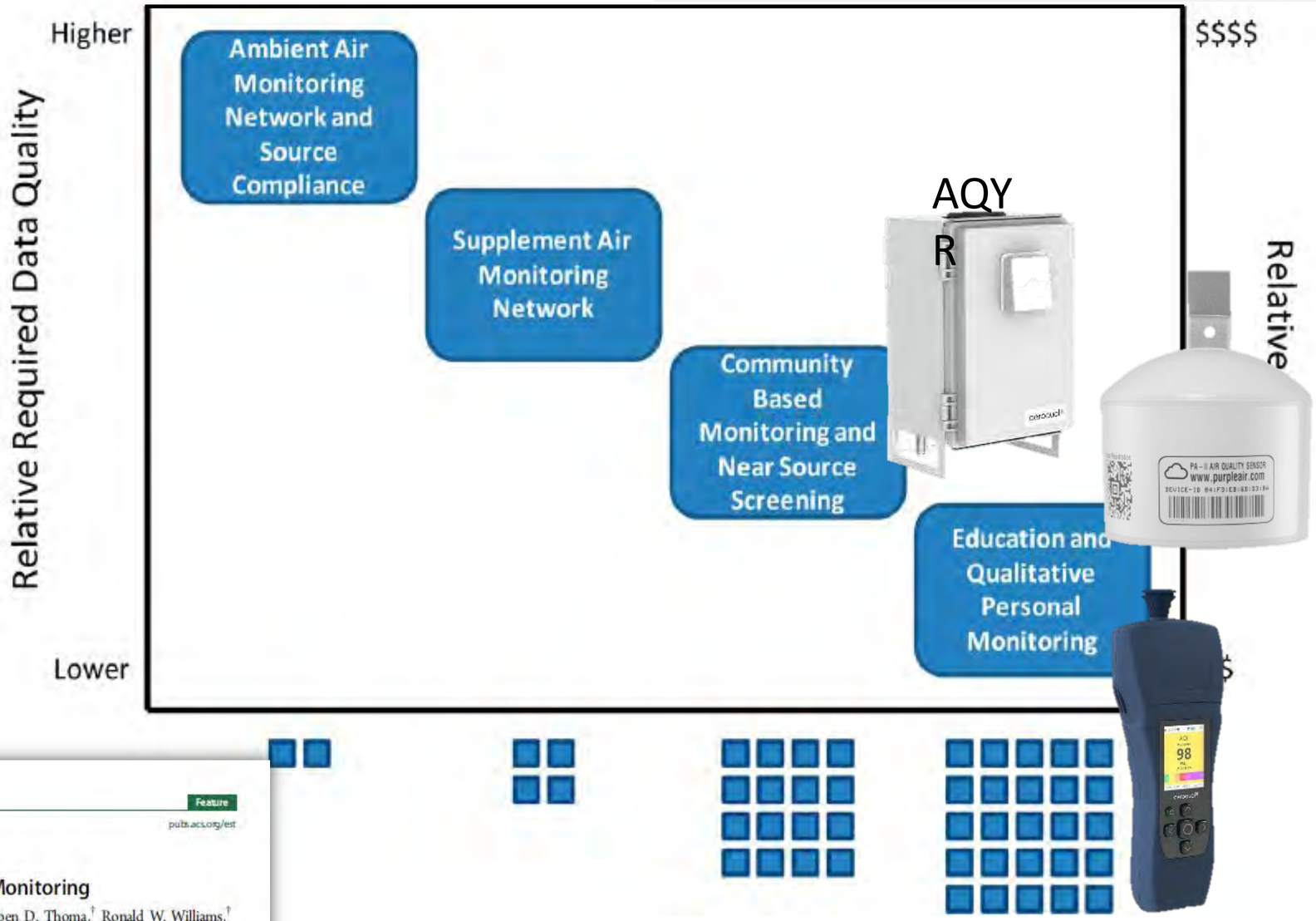


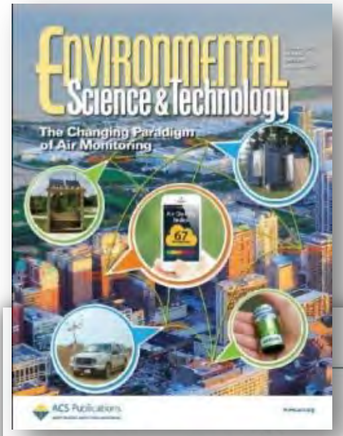
Feature

pubs.acs.org/est

The Changing Paradigm of Air Pollution Monitoring

Emily G. Snyder,*[†] Timothy H. Watkins,[†] Paul A. Solomon,[‡] Eben D. Thoma,[†] Ronald W. Williams,[†] Gayle S. W. Hagler,[†] David Shelow,[§] David A. Hindin,[∥] Vasu J. Kilaru,[†] and Peter W. Preuss[⊥]





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CleanAir®

FEM

CITY OF CHICAGO
RULES

Control of Emissions from Handling and Storing Bulk Materials

Effective January 25, 2019

Near-Reference

CITY OF CHICAGO
RULES

Rules for Large Recycling Facilities

Effective June 5, 2020

Near-Reference

CITY OF CHICAGO
RULES

DEMOLITION BY IMPLOSION

Near-Reference

CITY OF CHICAGO
RULES

Rules for Reprocessable Construction/Demolition Material Facilities

Revised March 7, 2023

Equipment Selection

Siting Considerations

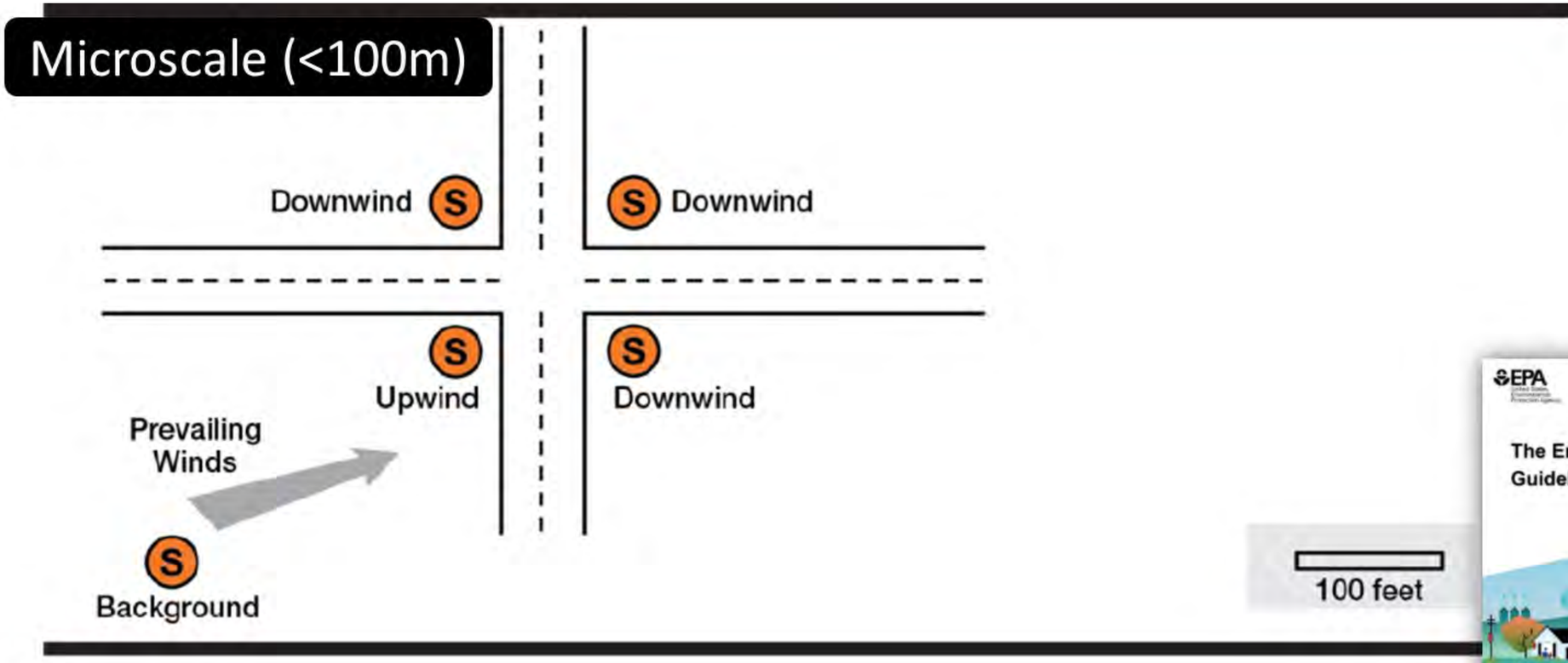
Documentation

Quality Assurance & Performance Criteria

Data Management and Analysis

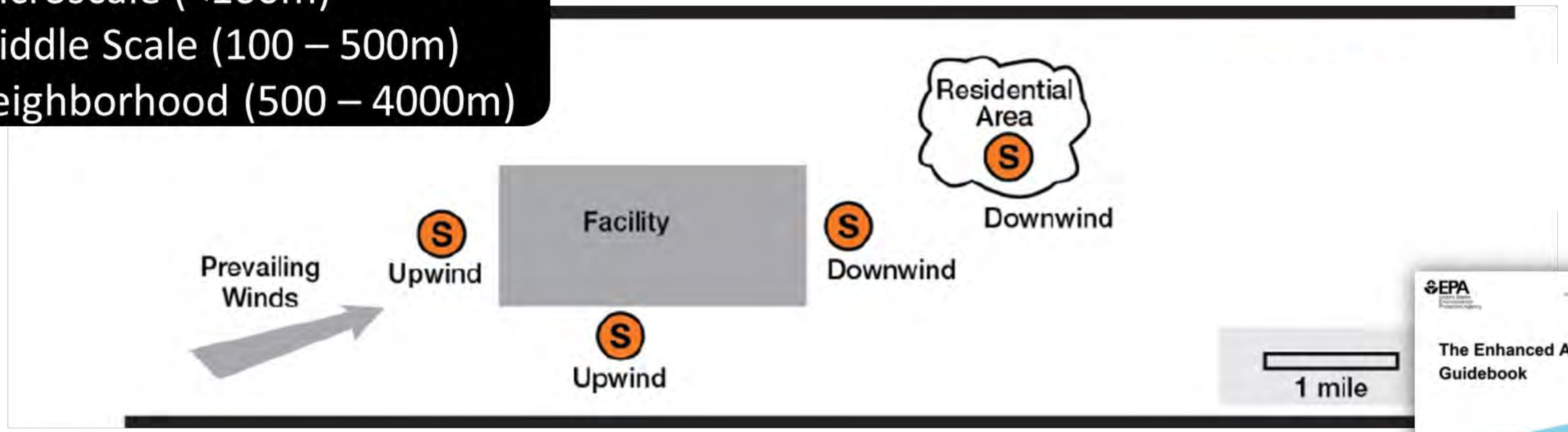
REPRESENTATIVENESS!!!

MAKE SURE THAT THE SPATIAL SCALE OF THE AIR PARCEL THAT IS MEASURED BY THE EQUIPMENT MATCHES YOUR MONITORING OBJECTIVE

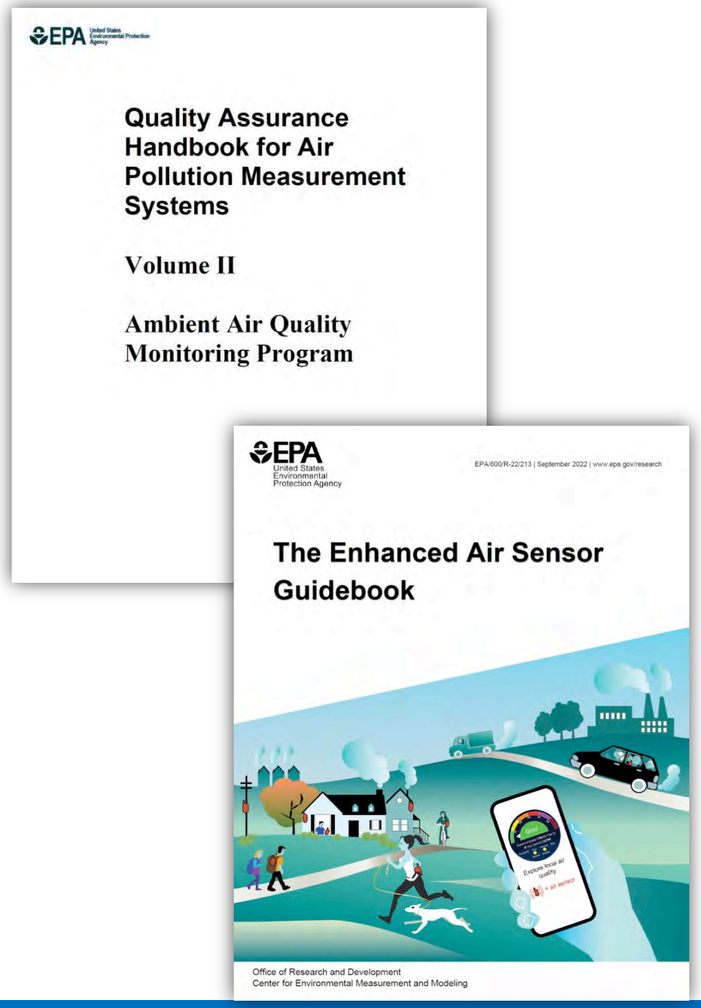


MEASUREMENT SCALES OF GREATEST INTEREST FOR SOURCE IMPACT ASSESSMENT AND CONTRIBUTION ANALYSIS

Microscale (<100m)
Middle Scale (100 – 500m)
Neighborhood (500 – 4000m)



Siting Recommendations

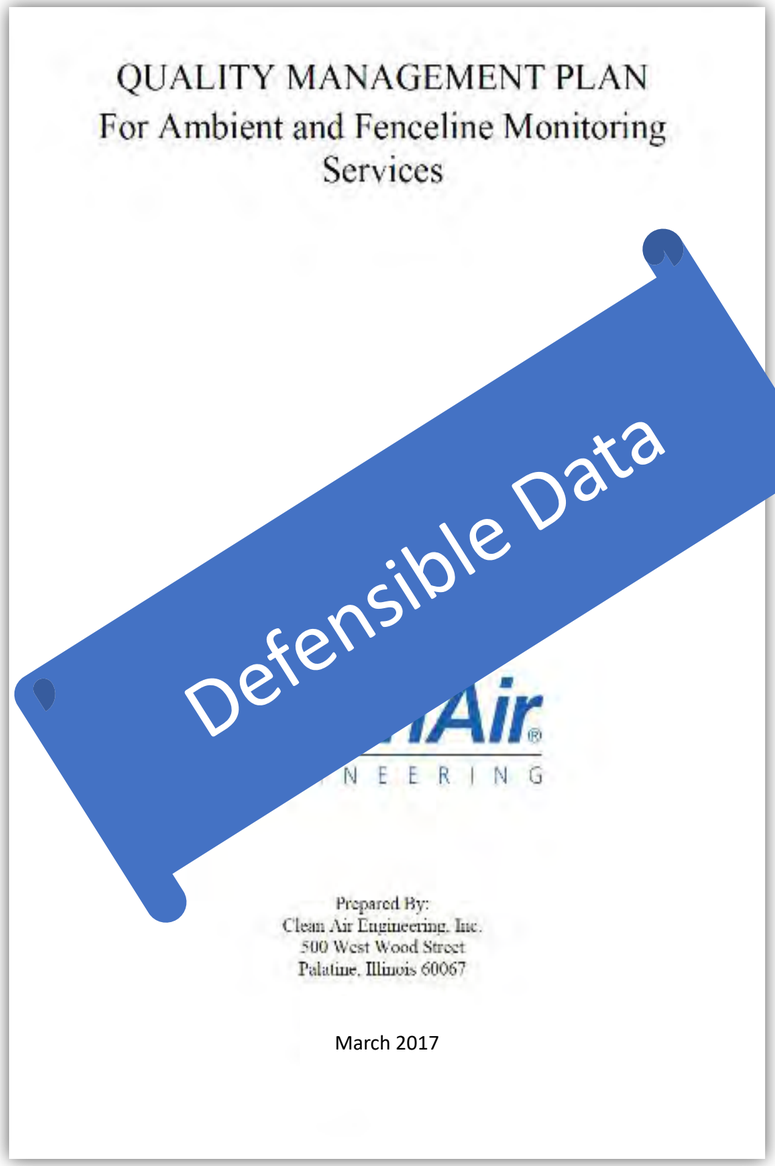


- Follow EPA siting guidance as much as you can (distance from obstructions, roadways, probe inlet height, etc.)
- Final siting is almost always a compromise
- Evaluate the impact and whether the measurement still meets the monitoring objective.
- Document the final locations and deviations from guidelines.

Meteorological Station Siting Is Important

- Source identification and contribution analysis relies on accurate and representative meteorological data
- Tower height requirements
- Distance from obstructions
- Surface properties
- Follow siting guidelines as much as possible and document any deviations and their potential impact

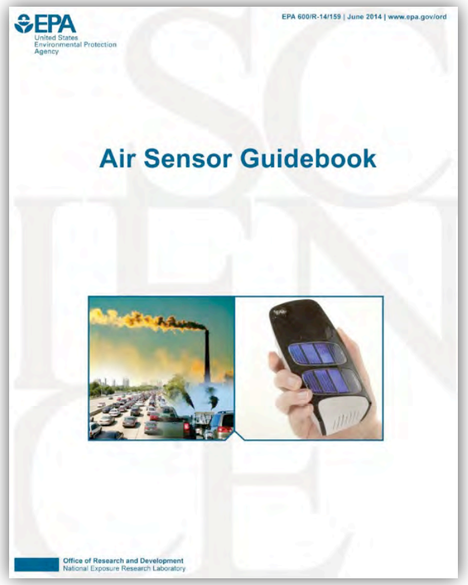
- Equipment Selection
- Siting Considerations
- Documentation
- Quality Assurance & Performance Criteria
- Data Management and Analysis



- Quality Assurance Project Plan / Monitoring Plan
- Develop Standard Operating Procedures / Designated Forms
- Document everything: if things are not documented, they never happened.

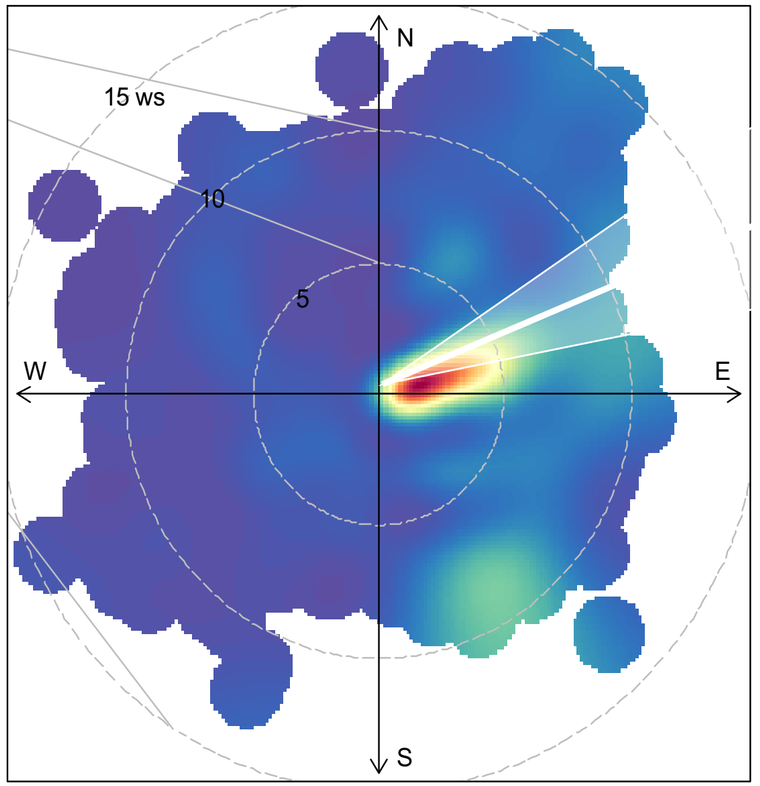
- Equipment Selection
- Siting Considerations
- Documentation
- Quality Assurance & Performance Criteria
- Data Management and Analysis

Tier	Application Area	Pollutants	Precision and Bias Error	Data Completeness
I	Education and Information	All	<50%	≥50%
II	Hotspot Identification and Characterization	All	<30%	≥75%
III	Supplemental Monitoring	Criteria pollutants, Air Toxics (incl. VOCs)	<20%	≥80%
IV	Personal Exposure	All	<30%	≥80%
V	Regulatory Monitoring	O3, CO, SO2 NO2, PM2.5/10	<7% <10% <15% <10%	≥75%



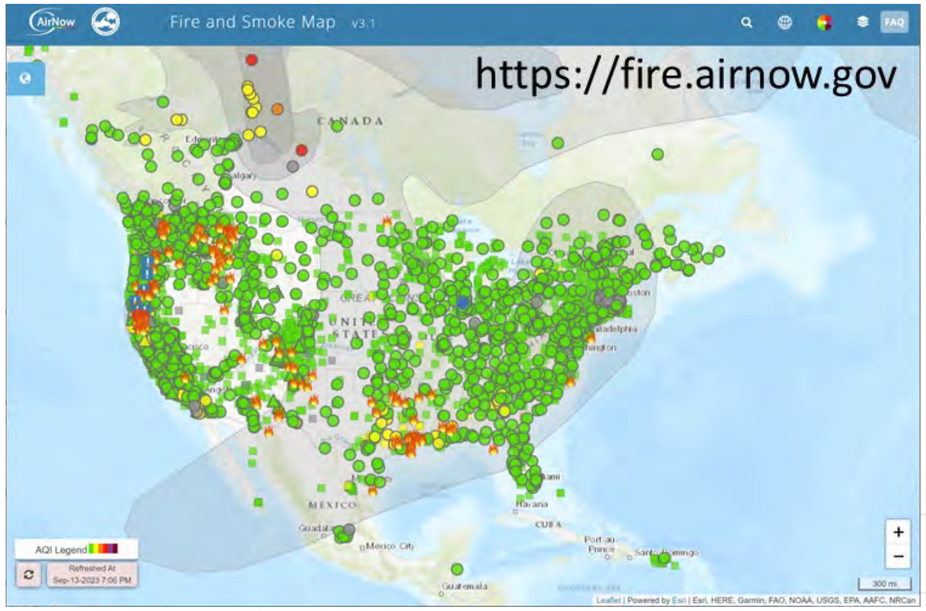
- Equipment Selection
- Siting Considerations
- Documentation
- Quality Assurance & Performance Criteria
- Data Management and Analysis

Source Direction Indicator Plots



http://davidcarslaw.github.io/openair/

Include Other Data Sources in Your Analysis



Equipment Selection

Siting Considerations

Documentation

Quality Assurance &
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Data Management and Analysis

CleanAir Workshops series 023

Dust Monitoring Compliance

Thursday, September 14, 2023

Morning Program

9:00 Welcome

9:05 Overview and Updates of CDPH Regulatory and Community Air Monitoring Approaches
Michael Enos, CDPH

9:40 Regional and National Regulatory Overview
Brian Newgent and Claire Amin, Aeroqual

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Connor Porter, Aeroqual

11:10 New Developments for Special Applications
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11:35 Top 10 Support Questions
Don Allen, CleanAir, and Connor Porter, Aeroqual

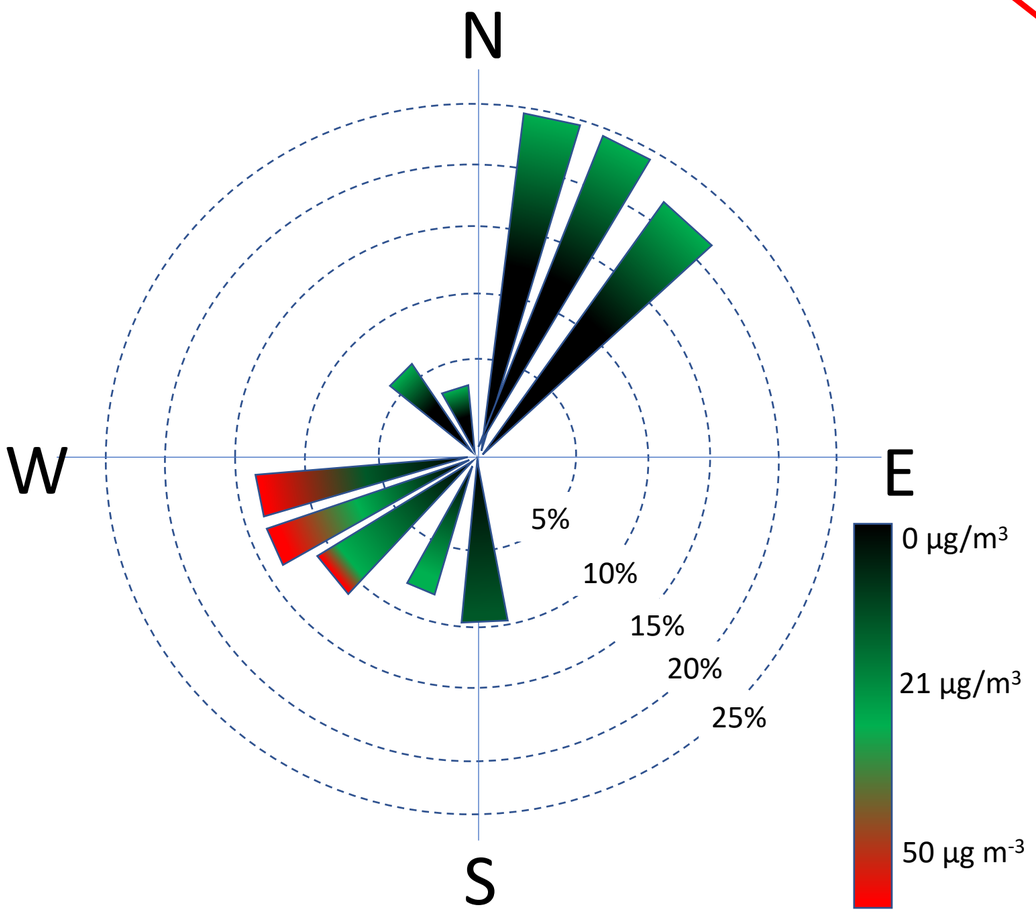
12:00 **LUNCH**

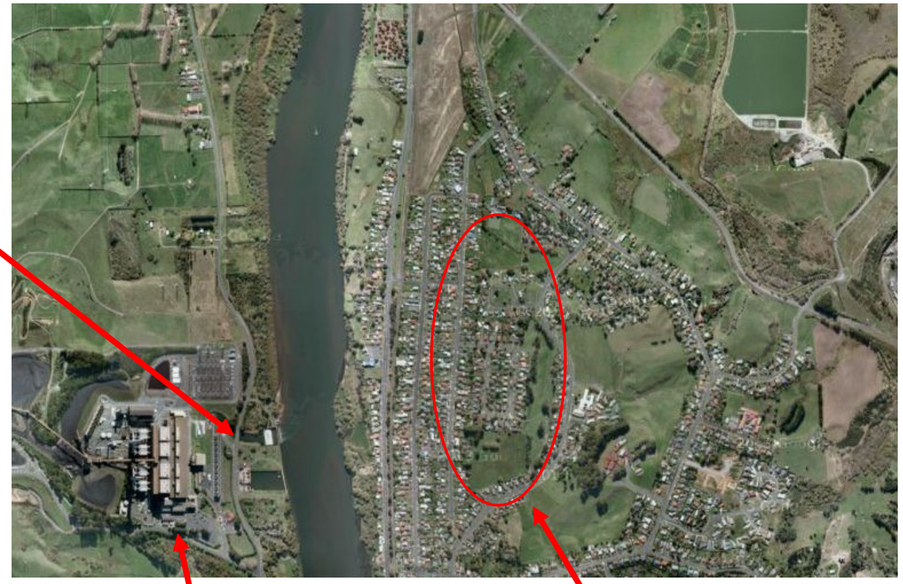
Site Contribution

What is it, What does it Solve; An Introduction and Analysis

Rose Chart |PM Contribution

Dust Monitor location with additional wind speed/direction sensor, located on the boundary between residential area and power station.





Coal-fired power station.

Residential area

The pollution rose says that most of wind comes from the **NorthEast** and when it does **PM values are low**. But when wind blows from the **Southwest PM values are high.**

Site Contribution

The software automatically tracks pollutant levels, wind direction and speed to calculate the total site contribution. Real-time alerts notify you within a minute if you are approaching regulatory limits. **It seamlessly reports data in the required format.**

2019 Catellus / Vista Environmental Consultants

Transforming the former site of the US Navy's Alameda Fleet Industrial Supply Center

Project
Alameda Point Redevelopment

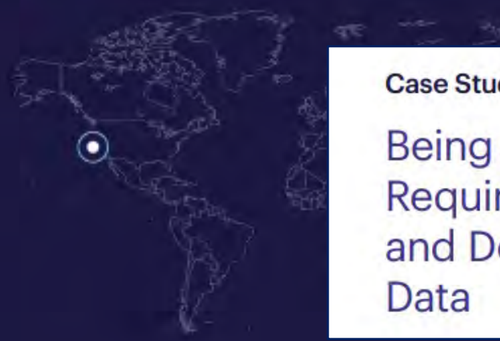
Location
Alameda, California, USA

Date
2019

Services
3x Dust Sentry, Aeroqual Cloud Plus

Measurements
PM_{10}, $PM_{2.5}$, wind and noise

Sector
Remediation



Case Study

Being a Good Neighbor Requires Real-Time Alerts and Defensible Air-Quality Data

A leading national developer used integrated weather, noise, and particulate matter monitoring to produce credible air quality data and achieve regulatory compliance.

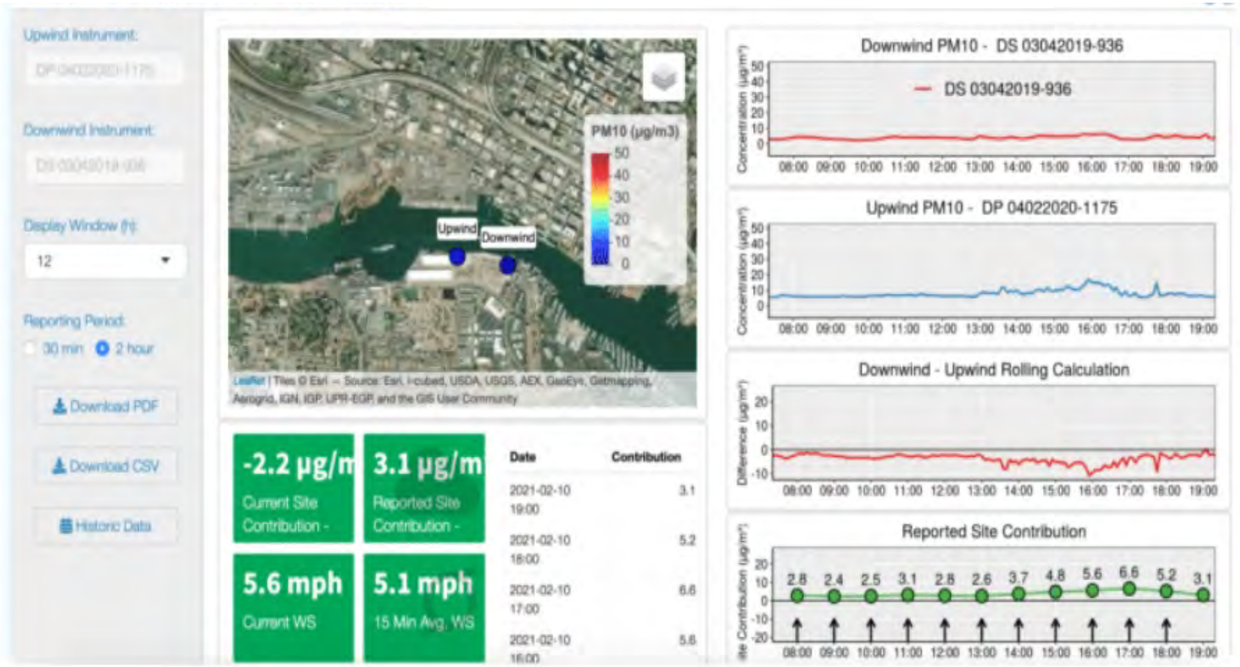
Understanding and Planning for Site Challenges

Challenges

1. The Catellus site shares an eastern boundary with the community and a busy marina housing multiple yacht clubs
2. Prevailing westerly winds blowing down the Oakland estuary picking up dust from other sources
3. Need to restrict and control the spread of dust and particulate matter
4. Catellus needed a solution that would provide accurate, defensible data to protect these community relationships

The Solution

Integration of Hardware and Software



"The solution works really well, and it was valuable to be able to upload and download data remotely and to have a permanent record of it."

Chuck Bove
Vista

- **Proactive Community Outreach**
  - Explaining the development vision, their activities, and their dust mitigation plan
- **Three Aeroqual Dust Sentry PM10 w/MET**
  - One Fully Integrated Meteorological Station
  - One Upwind Boundary, one on the Downwind Boundary, and one fixed monitoring station adjacent to the Sensitive marina area
- **Aeroqual Cloud**
  - Exceedance alerts were configured for PM and Wind Speeds
- **Aeroqual Site Contribution**
  - Calculated the amount of PM10 dust moving onto the site at the west boundary and how much was moving off the east boundary, showing the site's contribution
  - Data was combined with wind roses to prove the low impact the site had on dust creation in the community

The Outcome

Reliable, Accurate, Actionable and Defensible Information Builds Trust, and Reduces Claims

- **Achieved Regulatory Compliance**
  - 100% compliance with air ordinance of PM10 < 75µg/m3
  - Nuisance dust below 20 µg/m3
- **Built Community Trust**
  - Community meetings previously disrupted by accusations of, “the dust was terrible yesterday,” were quickly calmed by sharing reports
- **Proved Responsibility**
  - Catellus was able to prove to a local business owner that the metal recycler and railways to the northwest were responsible for metal dust in their paint
  - Over $60,000 saved in 2 months

“Everything that the equipment promised was delivered,” says Bove. “We have not had any issues or problems with the monitors, they have been reliable and really haven’t missed a step.”

- Chuck Bove
- Principal and CEO at Vista

What is Site Contribution?

Understanding how it came about, what it solves

- How’d it come about?

Rule 1466 (California)

- The purpose of Rule 1466 is **to minimize off-site fugitive dust emissions from earth-moving activities at sites containing specific toxic air contaminants by establishing dust control measures**.
  - https://www.aqmd.gov/home/rules-compliance/compliance/rule-1466

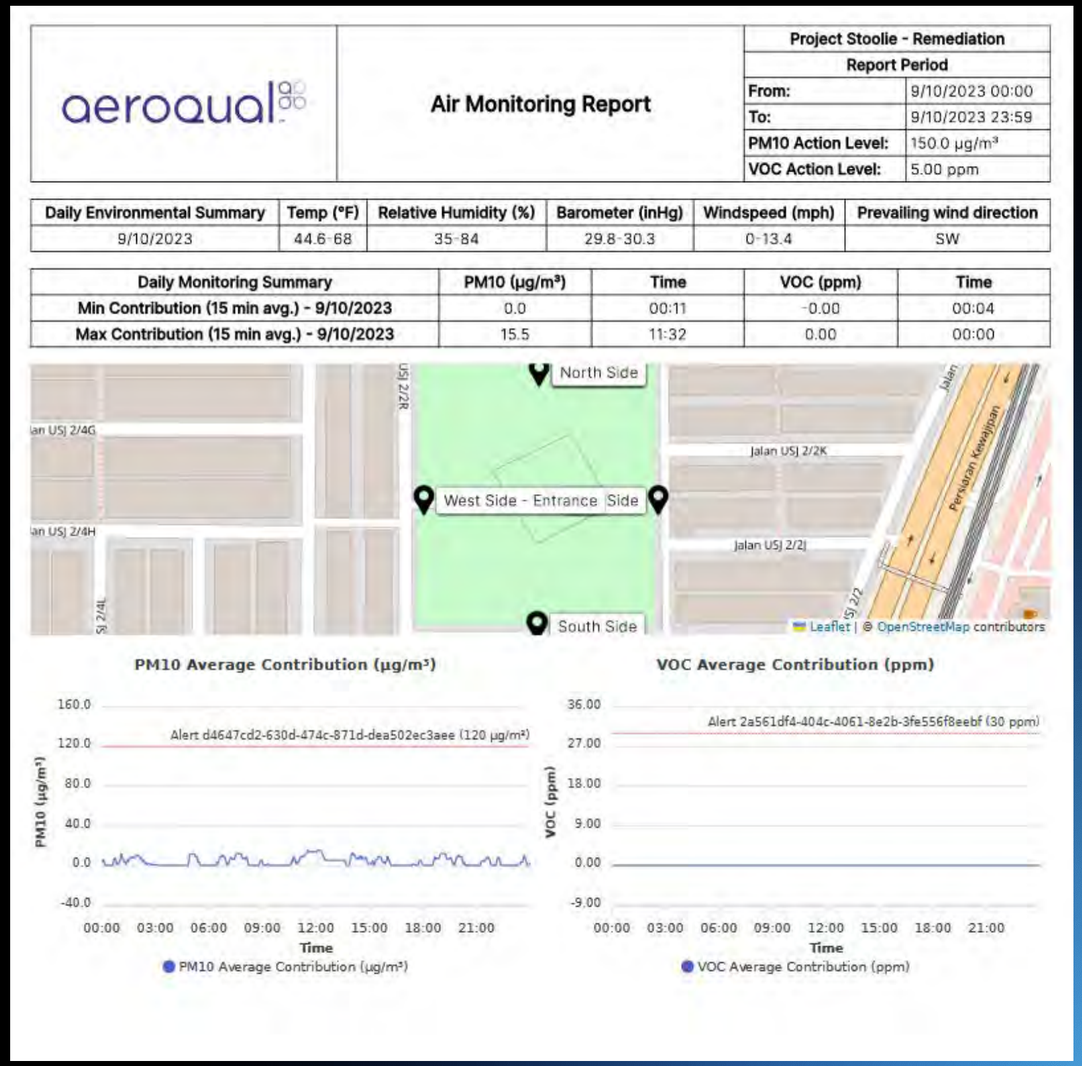
DER-10 (State of New York)

- DER-10 **provides an overview of the site investigation and remediation process for DEC's remedial programs administered by the Division of Environmental Remediation (DER)**.
  - https://www.dec.ny.gov/regulations/67386.html

What Does it Solve?

What's the value-add?

- Provides Defensible Data, and Resolves Accountability
- Saves you and your team countless hours of charting and data digestion.
- Provides automated alerts when calculated values reach certain thresholds.
- Collates data for you so you don't have to!



aeroqual

Air Monitoring Report

Project Stoolie - Remediation	
Report Period	
From:	9/10/2023 00:00
To:	9/10/2023 23:59
PM10 Action Level:	150.0 µg/m³
VOC Action Level:	5.00 ppm

Daily Environmental Summary	Temp (°F)	Relative Humidity (%)	Barometer (inHg)	Windspeed (mph)	Prevailing wind direction
9/10/2023	44.6-68	35-84	29.8-30.3	0-13.4	SW

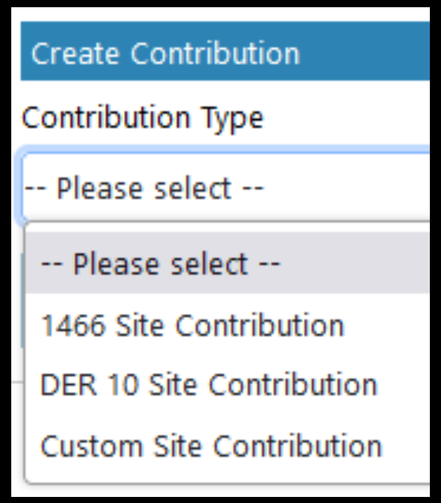
Daily Monitoring Summary	PM10 (µg/m³)	Time	VOC (ppm)	Time
Min Contribution (15 min avg.) - 9/10/2023	0.0	00:11	-0.00	00:04
Max Contribution (15 min avg.) - 9/10/2023	15.5	11:32	0.00	00:00

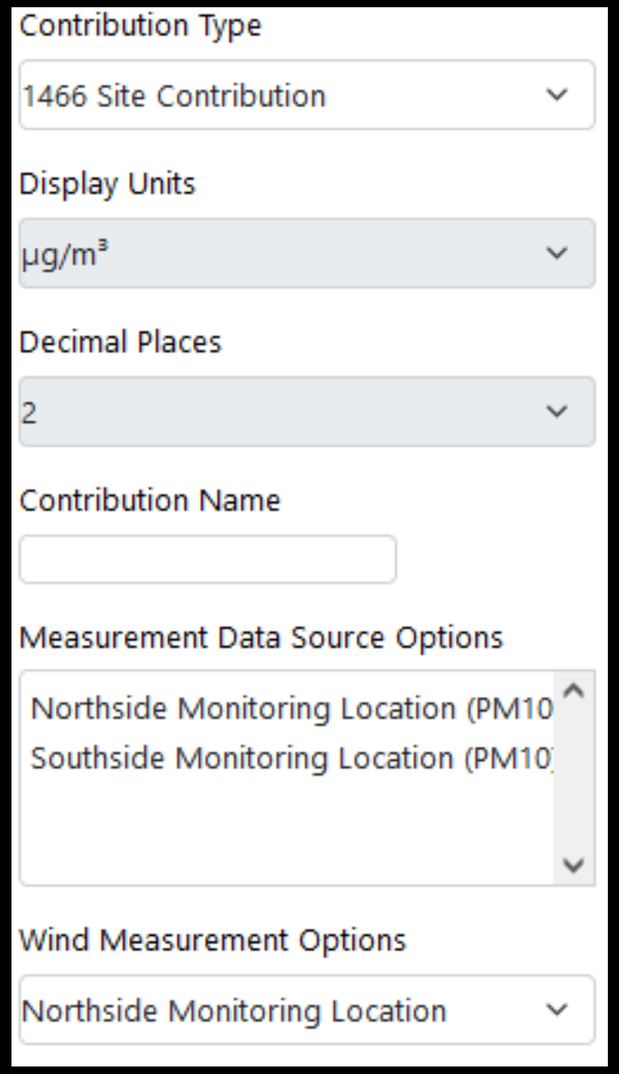
Getting Started

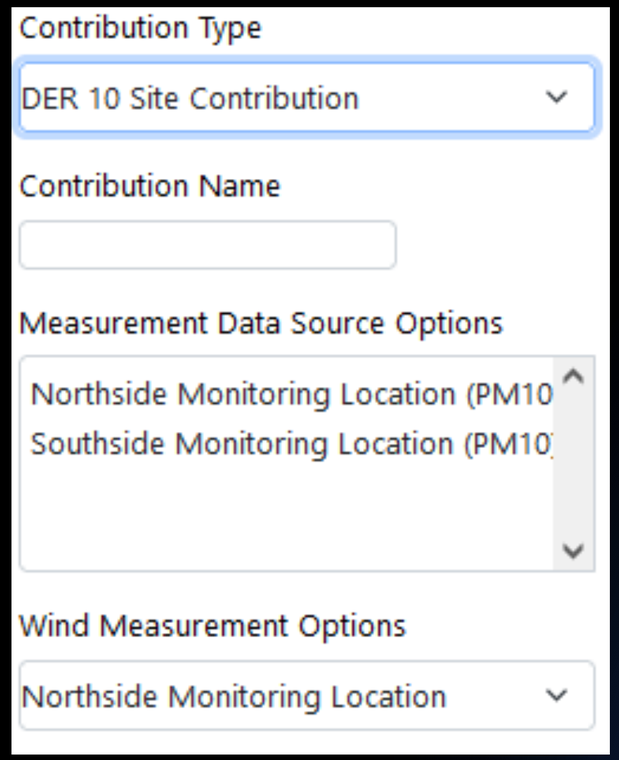
All the Prep Work

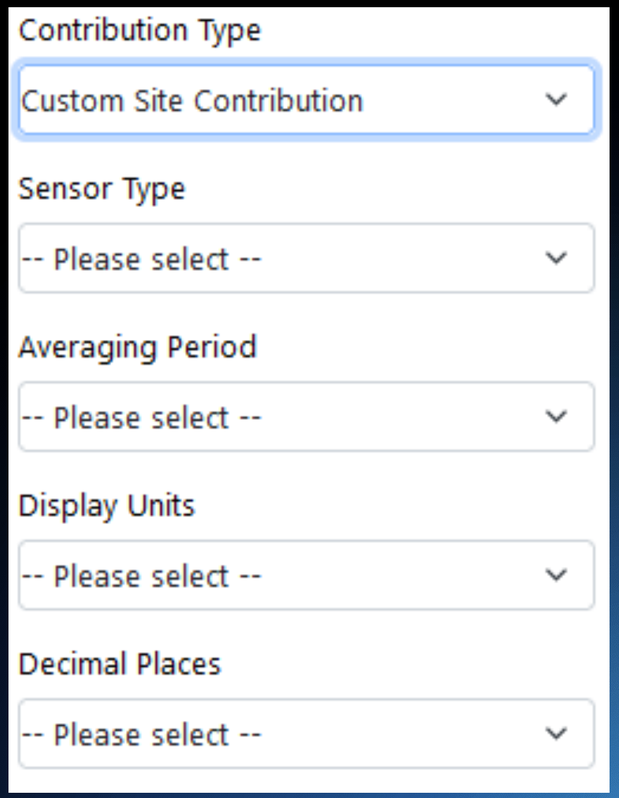
- Ensure There's a Unit That Has Wind Speed & Direction
- Plan it out
  - Where are the units going on site?
  - How many units?
  - Are there designated names for each location?
- Get Your Users Enabled
  - Send an e-mail with a list of e-mails of the users that will be using the Site Contribution tool
- What Contribution Type will you be using?
  - 1466, DER-10, Custom, Other?
  - Know the Averaging Period

Creating the Contribution

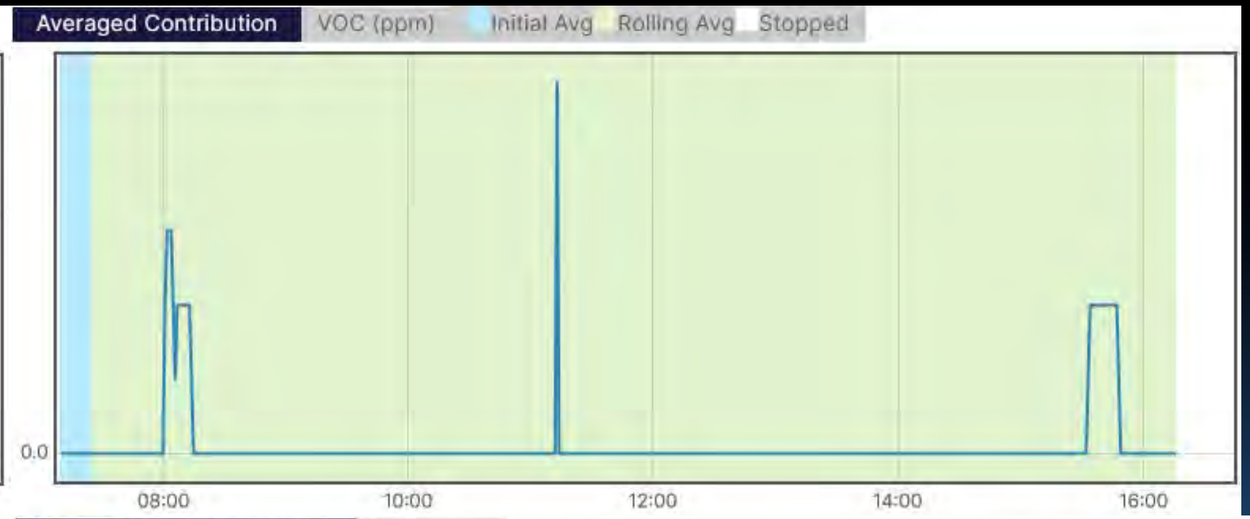


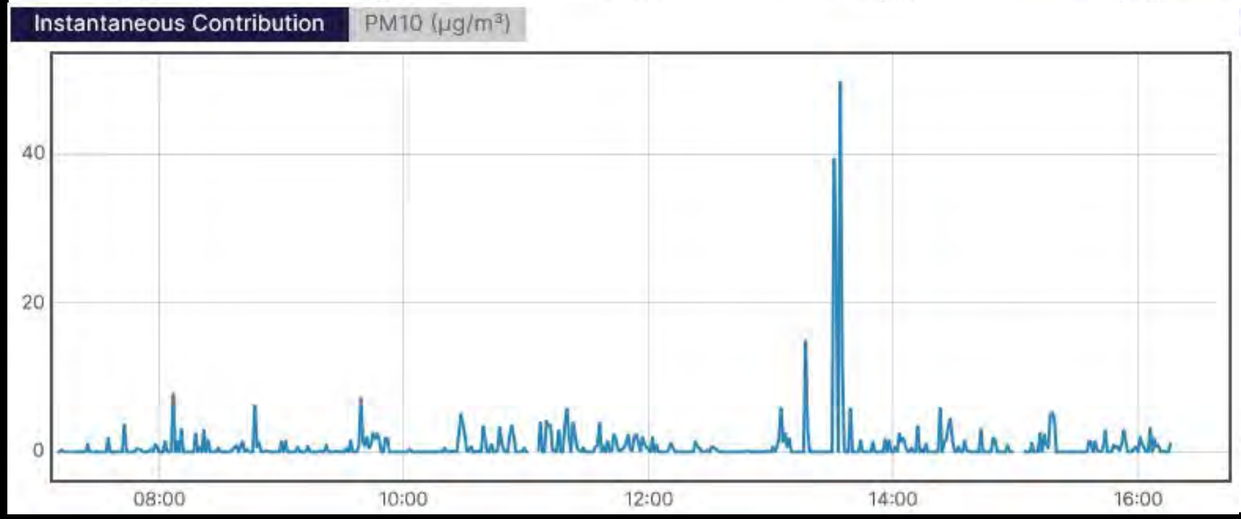


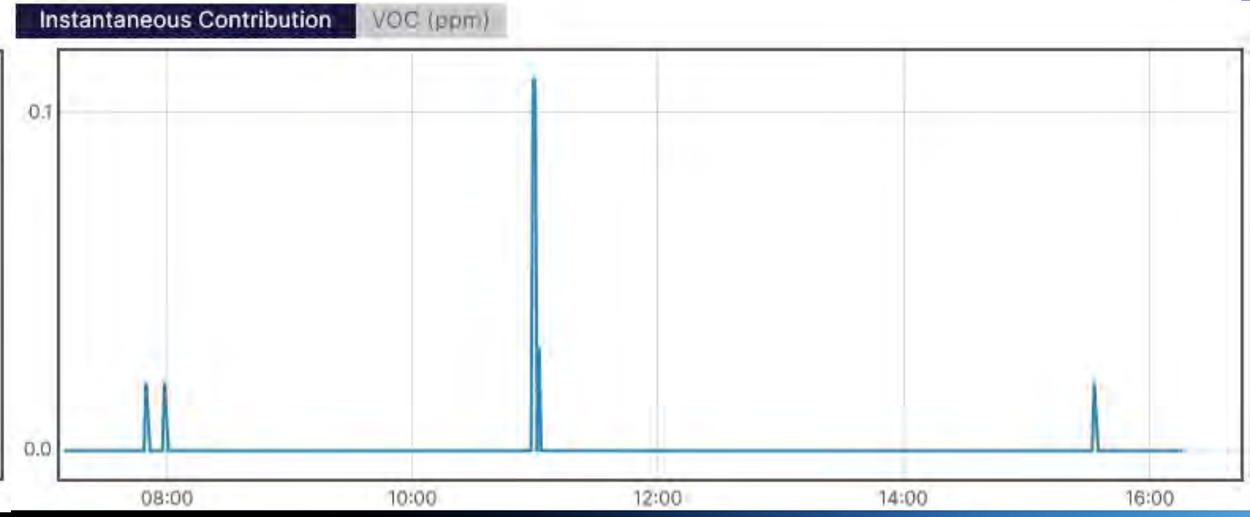




Now It’s Running







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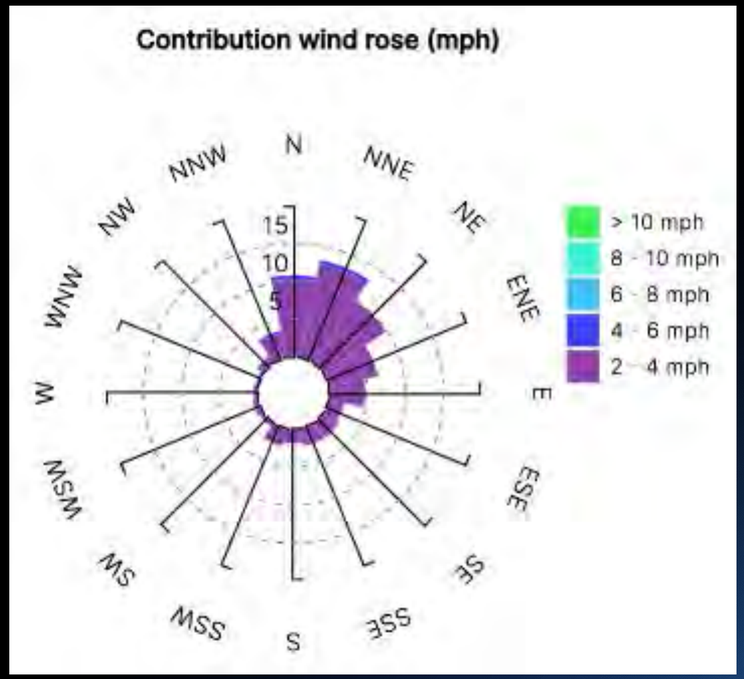

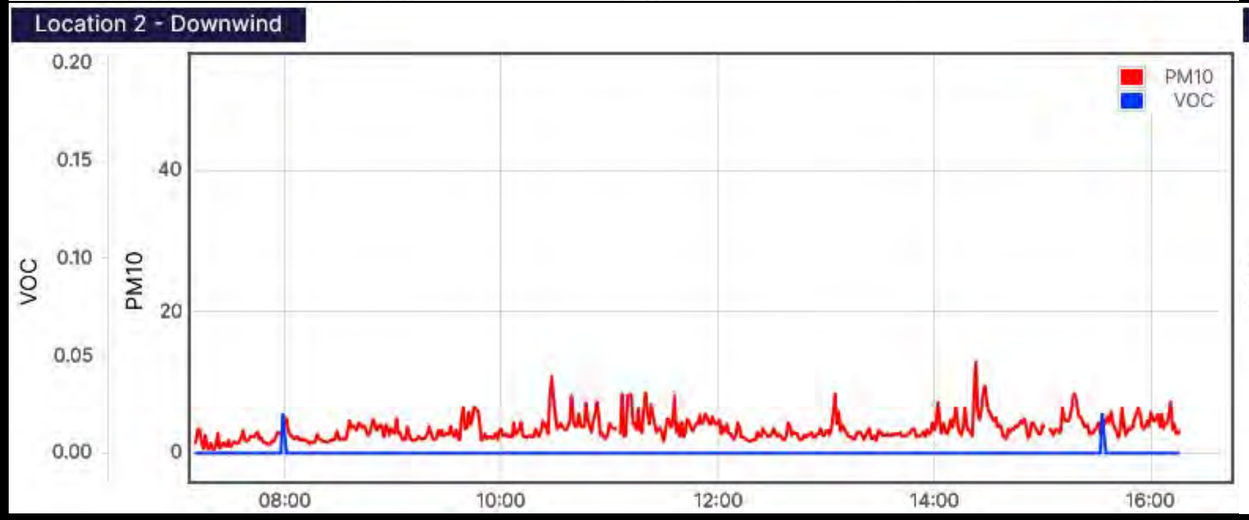

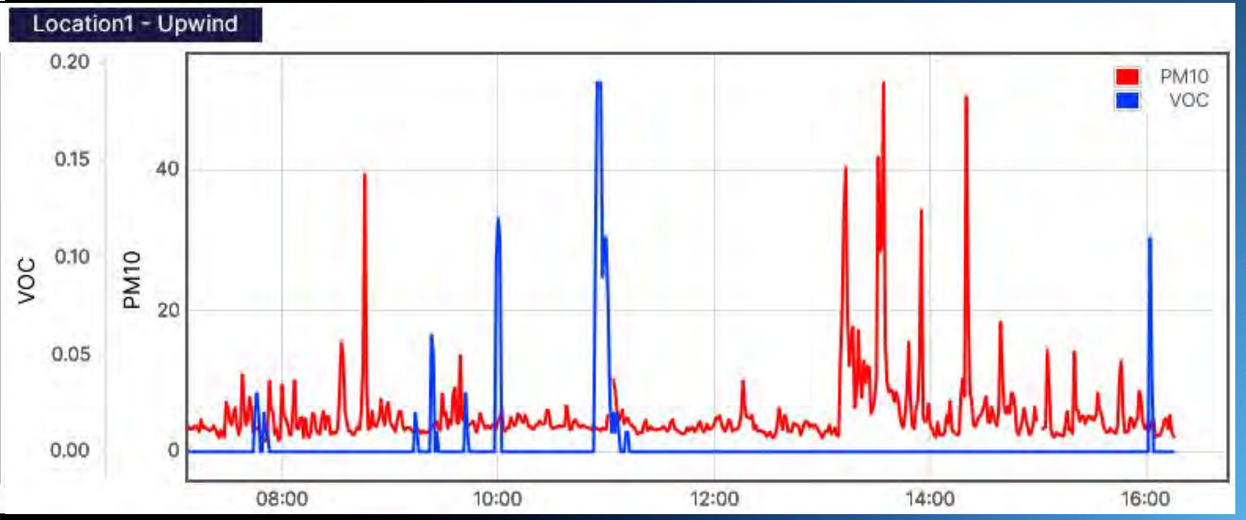

More Information About Site Contribution

- Blog Post - https://www.aeroqual.com/blog/introducing-aeroqual-site-remediation
- 40 Minute Webinar - https://www.aeroqual.com/events-webinars/introducing-aeroqual-site-contribution-webinar
- Support Docs - https://support.aeroqual.com/Guide/Site+Contribution+tool/288

CleanAir Workshops series 023

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12:00 **LUNCH**

The Met-SCS

September 14, 2023

AEROQUAL TOTAL VOC MONITOR

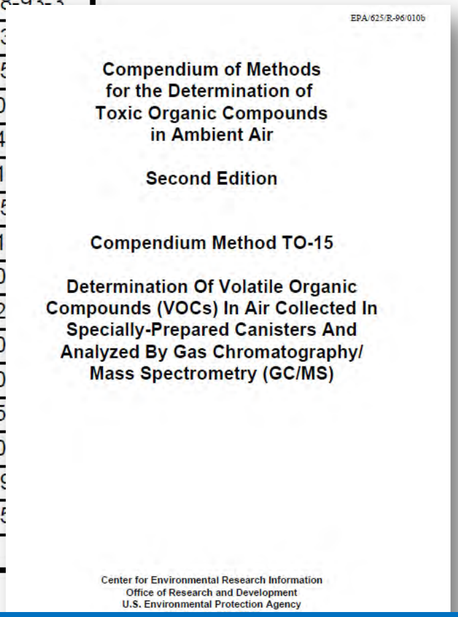
- Photoionization Detector (PID): sensitive, non-speciating detector.
- Does **NOT** respond to methane, ethane, or propane
- Responds to a large variety of inorganic and organic compounds including BTEX
- Lower Detection Limit: 1 ppb (Isobutylene)
- Automatic baseline correction to correct for cross interferences and minimize drift
- Actively pumped and supports conventional QA (bump test with zero and span gas)

VOC SPECIATION

Table

Toxics Monitoring Analyte List by Analysis Type			
TO-15 Analyte List (Toxic VOC)			
Analyte	CAS#	Analyte	CAS#
1,1,1-Trichloroethane	71-55-6	Chloroethane	75-00-3
1,1,2,2-Tetrachloroethane	79-34-5	Chloroethene (vinyl chloride)	75-01-4
1,1,2-Trichloroethane	79-00-5	Chloroform	67-66-3
1,1,2-Trichlorotrifluoroethane	76-13-1	Chloromethane	74-87-3
1,1-Dichloroethane	75-34-3	cis-1,2-Dichloroethene	156-59-2
1,1-Dichloroethene	75-35-4	cis-1,3-Dichloropropene	10061-01-5
1,2,4-Trichlorobenzene	120-82-1	Cyclohexane	110-82-7
1,2,4-Trimethylbenzene	95-63-6	Dibromochloromethane	124-48-1
1,2-Dibromoethane	106-93-4	Dichlorodifluoromethane	75-71-8
1,2-Dichlorobenzene	95-50-1	Ethylbenzene	100-41-4
1,2-Dichloroethane	107-06-2	Hexachlorobutadiene	87-68-3
1,2-Dichloropropane	78-87-5	m/p-Xylene	108-38-3
1,2-Dichlorotetrafluoroethane	76-14-2	MEK	78-93-3
1,3,5-Trimethylbenzene	108-67-8	Methyl Tert-Butyl Ether	163
1,3-Butadiene	106-99-0	Methylene Chloride	75
1,3-Dichlorobenzene	541-73-1	MIBK	10
1,4-Dichlorobenzene	106-46-7	n-Heptane	14
1-Bromopropane	106-94-5	n-Hexane	11
1-Ethyl-4-methylbenzene	622-96-8	o-Xylene	95
2-Hexanone	591-78-6	Propene	11
Acetone	67-64-1	Styrene	10
Acrolein	107-02-8	Tetrachloroethene	12
Benzene	71-43-2	Tetrahydrofuran	10
Bromodichloromethane	75-27-4	Toluene	10
Bromoform	75-25-2	trans-1,2-Dichloroethene	15
Bromomethane	74-83-9	trans-1,3-Dichloropropene	100
Carbon Disulfide	75-15-0	Trichloroethene	79
Carbon Tetrachloride	56-23-5	Trichlorofluoromethane	75
Chlorobenzene	108-90-7		

Benzene


EPA/625/R-96/010b

Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air

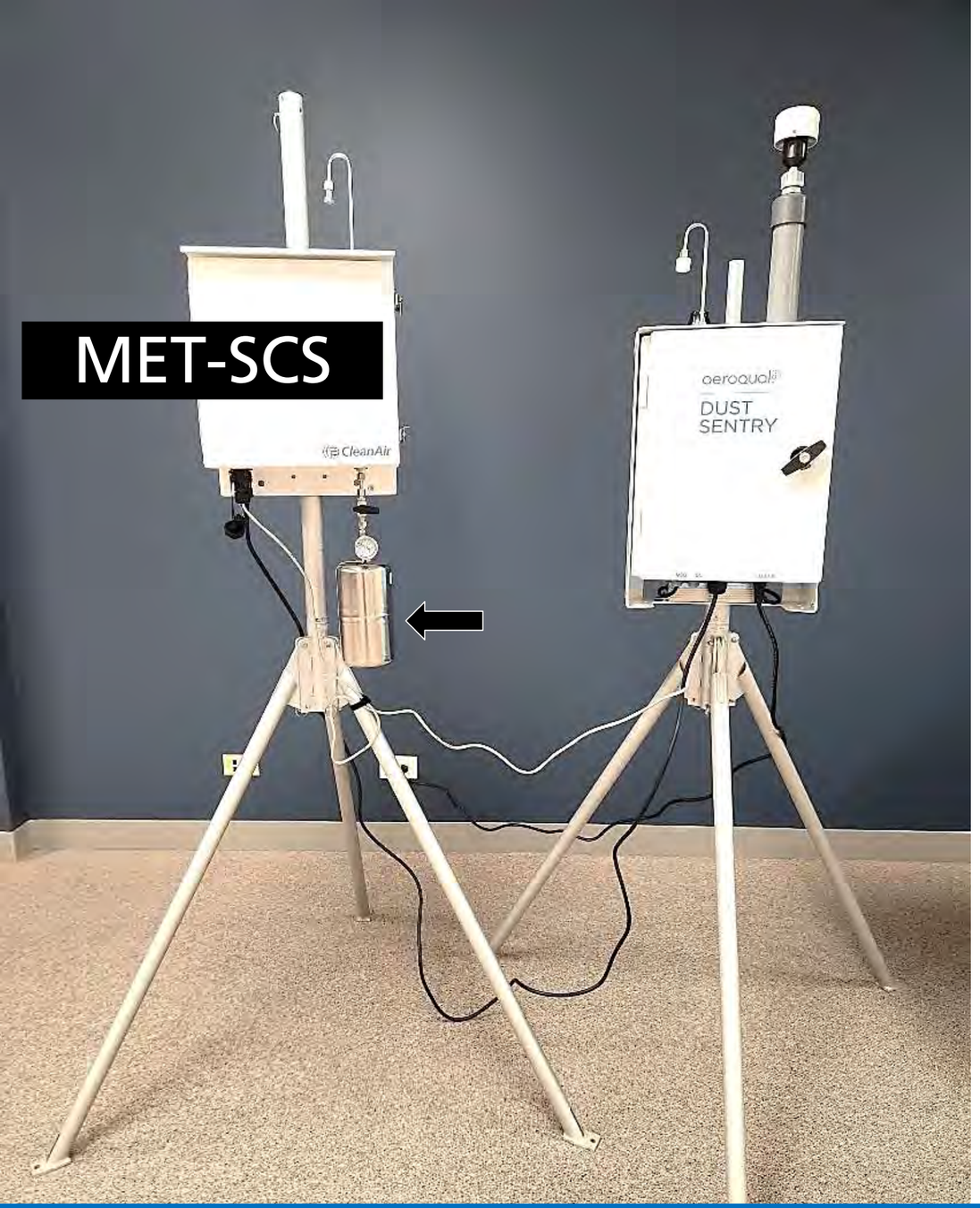
Second Edition

Compendium Method TO-15

Determination Of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/ Mass Spectrometry (GC/MS)

Center for Environmental Research Information
Office of Research and Development
U.S. Environmental Protection Agency


Background SUMMA-20
CleanAir



MET-SCS HIGHLIGHTS

- Powered via the Aeroqual host (12 VDC)
- Communication with host via connectAPI (Ethernet cable)
- Custom trigger level based on PID value
- Allows for selection of various sampling durations: 5, 15, 30, 60 min (grab sampling)
- Protects from oversampling by monitoring Summa can vacuum
- Vacuum reading is fed back into the Aeroqual host for remote cloud-based monitoring of sampling progress and alarming

MET-SCS HIGHLIGHTS CONTINUED…

- Silco-treated stainless steel for the entire flow path
- Silco-treated stainless steel filter
- Silco-treated stainless steel latching valve (low power operation)
- Vacuum sensor with 316SS diaphragm
- OLED display and keypad for user interaction, run configuration, and guided can replacement

MET-SCS HIGHLIGHTS CONTINUED…

- Accommodates various can sizes including 1.4 L and 6 L Summa cans
- Connection via ¼ inch Swagelock fitting

CLEANAIR BTU

CleanAir BTU

Span and Zero Gas Bump Test Unit

The CleanAir Engineering BTU performs automatic bump tests at user-defined time intervals and concentrations, using integrated span and zero gas disposable 6D or 8AL cylinders.

Housed in a durable, weather-proof enclosure, the BTU is engineered for use with various air monitors, in most applications requiring bump testing. After initial on-site set-up, track the BTU's performance remotely and set custom alerts using Aeroqual Cloud.

- ✓ **Available for Sale or Rent**
- ✓ **World-Class Technical Support from CleanAir**
- ✓ **Full Inspection on Every CleanAir Rental**
- ✓ **Equipment Repair and Calibration Services**

TECHNICAL SPECIFICATIONS	
TEST INTERVAL RANGE	15 min. - 72 hr. (User Defined)
SPAN GASES AVAILABLE	0.5, 1, and 25 ppm
GAS CYLINDER SIZE	6D or 8AL
MEASURING RANGE	0-30 ppm
RESOLUTION	0.01 ppm
FLOW RATE	100 cc
POWER	12VDC or Powered from Aeroqual Monitors
MOUNTING	Pole Mount or Free-Standing
TEMPERATURE RANGE	-10 °F to 105 °F
DIMENSIONS (DxWxH)	6" x 10" x 26"
WEIGHT	15 lb

SPAN ZERO

Bump Test Module | Aeroqual Cloud

KEY FEATURES

- User-Defined run times
- User-Defined run intervals
- Can be powered from Aeroqual monitors

APPLICATIONS

- Fenceline Monitoring
- Regulatory Compliance
- Remote locations
- Budget-Conscious studies
- Long-Term installations

Related Products Available from CleanAir


Thermo TVA 2020


Aeroqual AQS1


Disposable Gas Cylinders

Performance Beyond Measure, since 1972. Unparalleled technical support, equipment rental, sales and servicing in Chicago, Houston, Pittsburgh, and Marseille, France

www.cleanair.com | info@cleanair.com | 1-800-553-5511

METHANE MONITORING

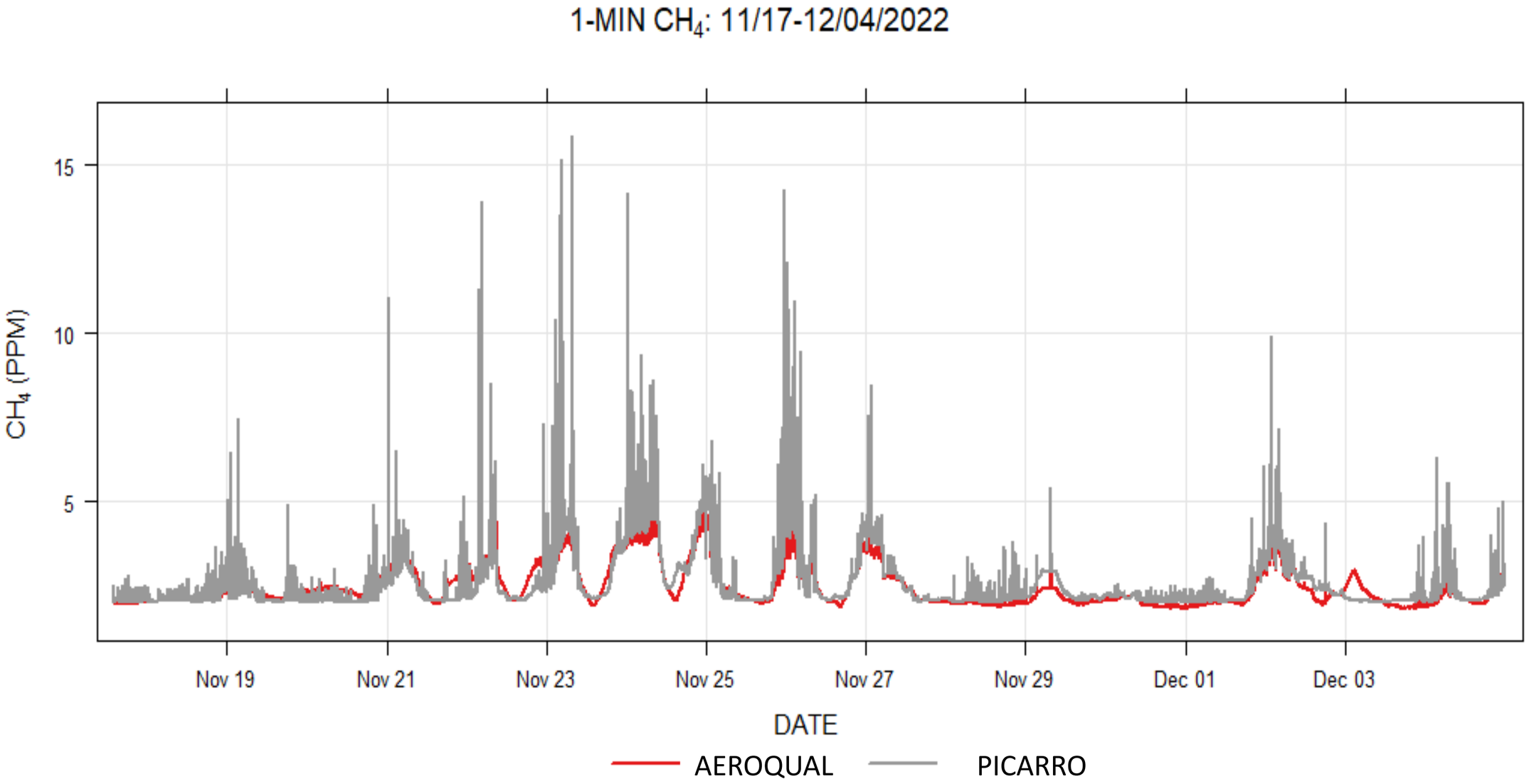
September 14, 2023

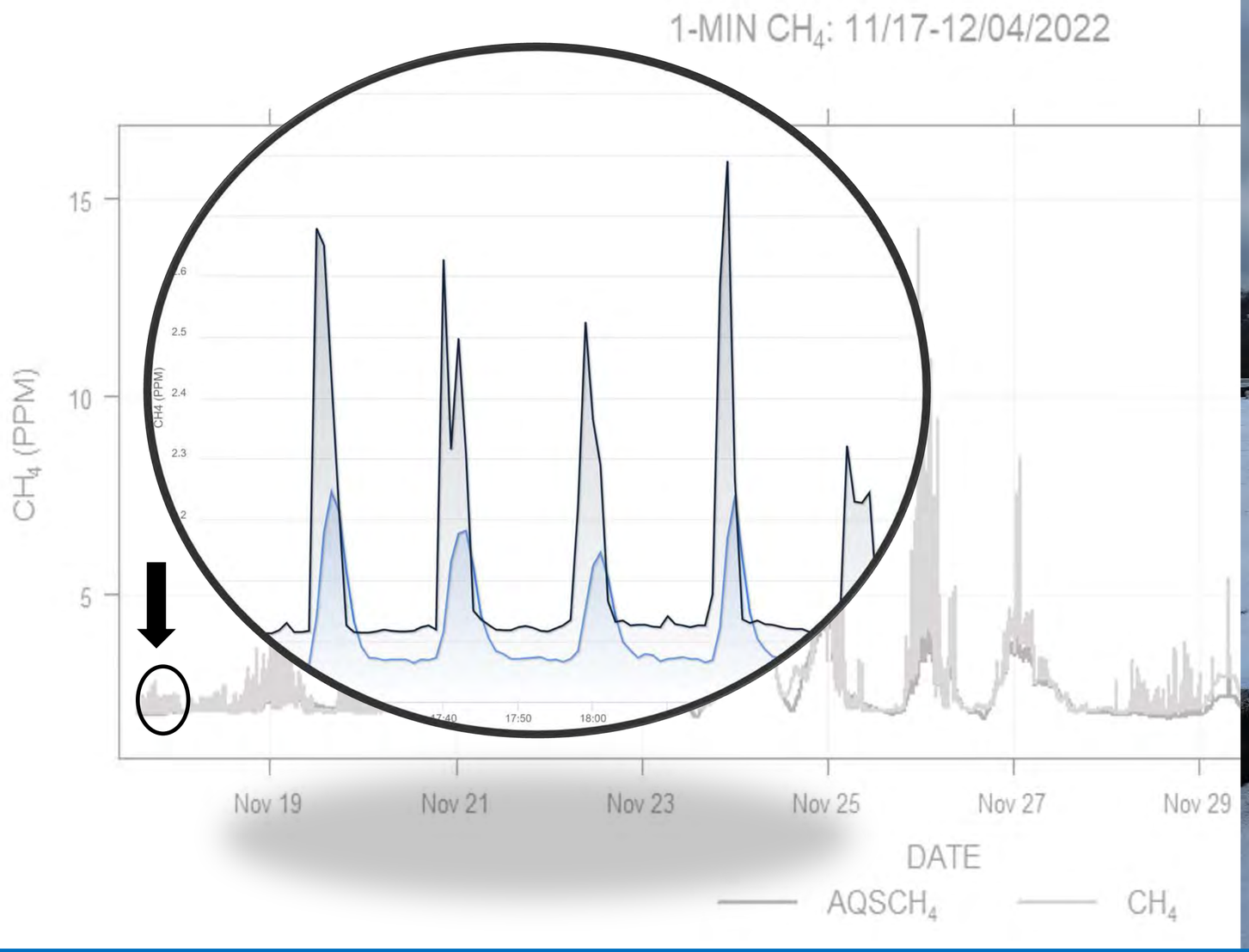
SMALL SENSOR SYSTEM

- Responds to CH4 and other gases
- CH4 Range: 0-50 ppm
- Precision (1 min): 0.5 ppm

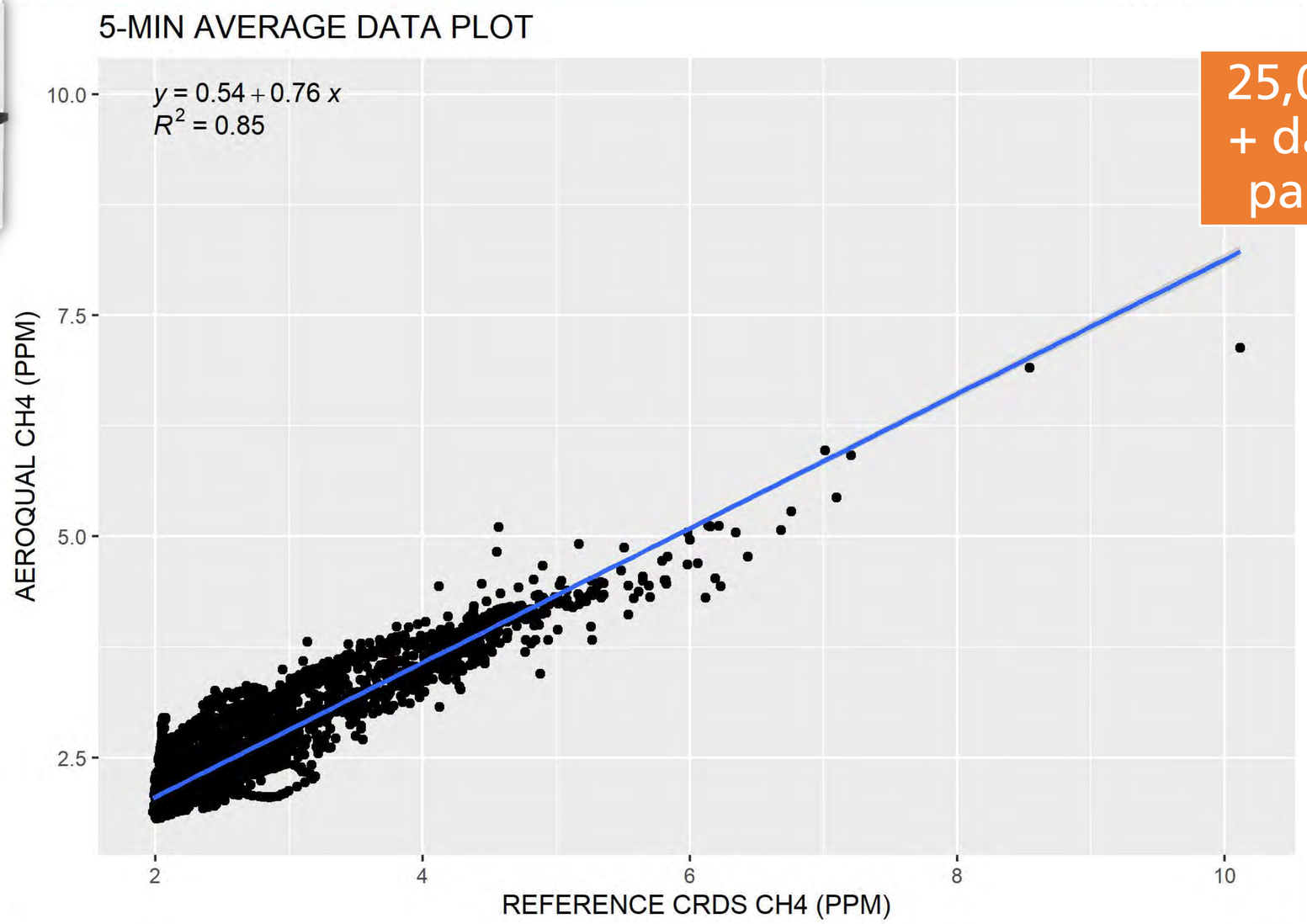
SIDE-BY-SIDE TESTING

- CH4 Range: 0-800 ppm
- Precision (1 sec): 3 ppb


1-MIN CH4: 11/17-12/04/2022
CH4 (PPM)
15
10
5
Nov 19
Nov 21
Nov 23
Nov 25
Nov 27
Nov 29
Dec 01
Dec 03
DATE
AEROQUAL
PICARRO


1-MIN CH4: 11/17-12/04/2022
CH4 (PPM)
15
10
5
Nov 19
Nov 21
Nov 23
Nov 25
Nov 27
Nov 29
DATE
AQSCH4
CH4
CH4 (PPM)
2.6
2.5
2.4
2.3
2
17:40
17:50
18:00


Boiler Vent



25,000 + data pairs

PICARRO

CleanAir Workshops series 023

Dust Monitoring Compliance

Thursday, September 14, 2023

Morning Program

9:00 Welcome

9:05 Overview and Updates of CDPH Regulatory and Community Air Monitoring Approaches
Michael Enos, CDPH

9:40 Regional and National Regulatory Overview
Brian Newgent and Claire Amin, Aeroqual

10:05 Monitoring Program Design and Data Analysis Considerations
Volker Schmid, CleanAir

10:30 **BREAK**

10:45 Intro to Site Contribution Analysis and Aeroqual's Site Contribution Tool
Connor Porter, Aeroqual

11:10 New Developments for Special Applications
Don Allen and Volker Schmid, CleanAir

11:35 Top 10 Support Questions
Don Allen, CleanAir, and Connor Porter, Aeroqual

12:00 **LUNCH**

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12:00 **LUNCH**

COMMON TECHNICAL QUESTIONS

Modules
What modules can be used in AQS1.

Calibration
Suggested Calibration gases
Equipment needed
AirCal 1000
O3 Generator
Calibration gases with regulators

What is a Hotswap?

Solar Setup
Unit wattage
Suggested solar array
Suggested battery size vs run time.

Duplicate users in Cloud

Autozero Nephelometer

VOC Module
Is the VOC module functioning?

AQS MODULES

Which modules can be used in AQS 1?

Carbon Monoxide	0-25ppm
Hydrogen Sulfide	0-10ppm
Methane	0-100ppm
Nitrogen Dioxide	0-500ppb
Ozone	0-500ppb
Sulfur Dioxide	0-10ppm
VOCL	0-500ppb
VOC	0-30ppm

VOC MODULE

Is the VOC Module Functioning?

VOC Modules have approximately 9 months of continual run time.

The most reliable method of verifying the functionality of any module is a challenge with a test gas. A bump test.
Isobutylene @ 10ppm for VOC

Aeroqual's Cloud software provides a Diagnostics screen where the SRB & SRG mV readings can be seen. If these fall under 50 the module is no longer functioning properly.

Time	VOC (ppm)	Raw (ppm)	SRB (mV)	SRG (mV)	Inlet
1:47 PM	0.70	0.452	418.142	382.733	Sample
1:46 PM	1.85	0.905	450.614	465.106	Sample
1:45 PM	3.34	2.961	365.905	424.612	Sample
1:44 PM	3.40	3.592	256.738	330.701	Sample
1:43 PM	1.24	3.339	119.069	187.879	Sample
1:42 PM	0.37	0.238	88.417	93.615	Sample
1:41 PM	0.10	0.315	76.603	83.465	Sample
1:40 PM	0.00	0.034	73.216	73.984	Sample
1:39 PM	0.00	0.014	72.633	72.942	Sample
1:38 PM	0.00	0.002	72.713	72.773	Sample

AUTOZERO NEPHELOMETER TIMING

The Nephelometer has a built-in autozero function—generally set to 1 day.

How to Change This?

On the right side the diagnostics screen you can select module settings. The TIMA field will contain a number relating to the minutes between autozeros. Runs approximately 5 minutes.

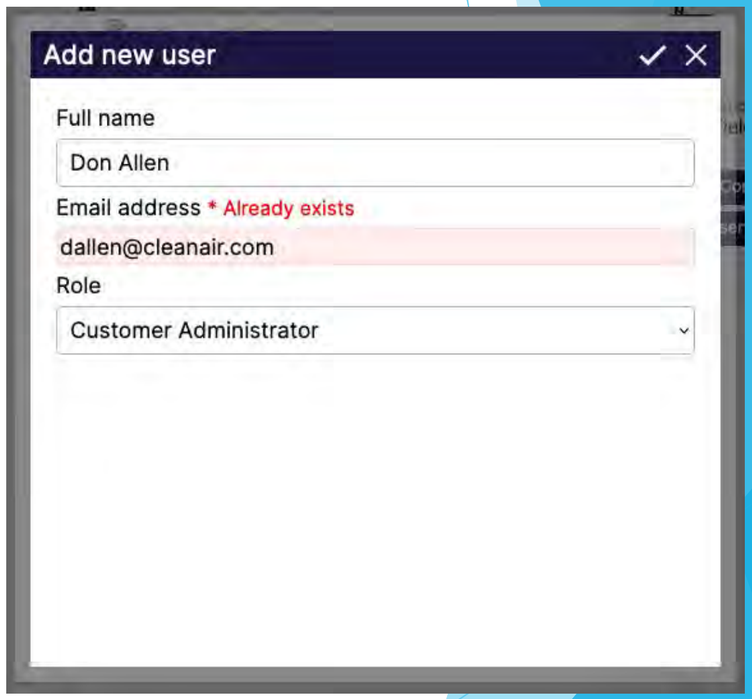
DUPLICATE USERS IN CLOUD

If your user is set up as a Company Admin, you will be able to create a new user. Sometimes you will encounter the Error:

Email address * Already exists

This error indicates that this Email address has been used to create an account. It could be under any account. Aeroqual only allows an email to have one instance in the cloud for security reasons.

The only way to add this user is to use a secondary Email.



CALIBRATION

Suggested Calibration Gases

AQM 65 gas module	O3	NO2	NOx	CO	SO2	VOC	H2S	CO2
Gas used for calibration	O3	NO2	NO2 or NO	CO	SO2	Isobutylene C_4H_8	H2S	CO2
Gas module measurement range	0 to 0.5 ppm	0 to 0.2 ppm	0 to 0.5 ppm	0 to 25 ppm	0 to 10.0 ppm	0 to 20 ppm	0 to 10 ppm	0 to 2000 ppm (0.2 %)
Span gas concentration for calibration Recommended Minimum, Maximum	0.1 ppm 0.08 – 0.150	0.1 ppm 0.05 - 0.150	0.1 ppm 0.05 - 0.2	10.0 ppm 5 - 15	0.5 ppm 0.2 – 1.5	10.0 ppm 5 - 15	0.5 ppm 0.2 – 1.5	1000 ppm
Recommended cylinder concentration when using AirCal 1000 or AirCal 8000 Recommended (ppm) Minimum, Maximum	Ozone is delivered by an Ozone generator	**20 ppm** 10 - 100	**20 ppm** 10 – 100	**1000 ppm** 500 - 5000	**20 ppm** 10 - 100	**1000 ppm** 500 - 5000	**20 ppm** 10 - 100	**1000 ppm** 500 – 1500
Recommended Gas cylinder from www.calgaz.com Part number:	N/A	20 ppm NO2 Balance AIR 8AL 58 liters C10 fitting A0446046	20 ppm NO2 Balance AIR 8AL 58 liters C10 fitting A0446046	1000 ppm CO Balance N2 6D 103 liters C10 fitting A0436734	20 ppm SO2 Balance N2 8AL 58 litres C10 fitting A0446071	Isobutylene 1000 ppm Balance Air 6D 103 litres A0436843	20 ppm H2S Balance N2 8AL 58 litres C10 fitting A0446004	1000 ppm CO2 Balance Air 6D 103 litres C10 fitting A0189932

Table 5-1 Recommended calibration cylinder concentrations. The recommended concentration is written in bold, the minimum and maximum recommend concentration are written in green in the table.

Note: The AQM 65 must be zero calibrated using zero air, N2 can not be used for zero calibration.

CALIBRATION

Equipment Needed

- Gases zero air and calibration
- Low-Level modules require a gas divider
- Ozone modules require an Ozone source

WHAT IS A HOTSWAP?

Aeroqual recommends factory calibration of Sensor Heads annually.

Old Model

- 30-45 business day turn around
- Poor customer experience

Aeroqual "Hot Swap"

- Sensor Heads within 10-14 months of initial purchase are eligible
- Cabinet Modules within 20-28 months of initial purchase are eligible.

Upon eligibility acceptance, a new Sensor will be drop-shipped to the supplied address. Arrival time depends on shipping. Sensors are newly-made and freshly-calibrated.

SOLAR SETUP

Calculating Wattage and Amp Hours

- The AQS1 uses maximum 30 watts.
- Batteries are generally in Amp hours.

Calculating Battery Amp Hours

Wh= Device W x Time
Wh = 30W x 1h
30Wh

Ah = Wh/V
Ah = 30Wh/12V
2.5Ah

One Day = 24h x 2.5Ah
One Day = 60 Ah

SOLAR SETUP

Sizing Arrays and Batteries

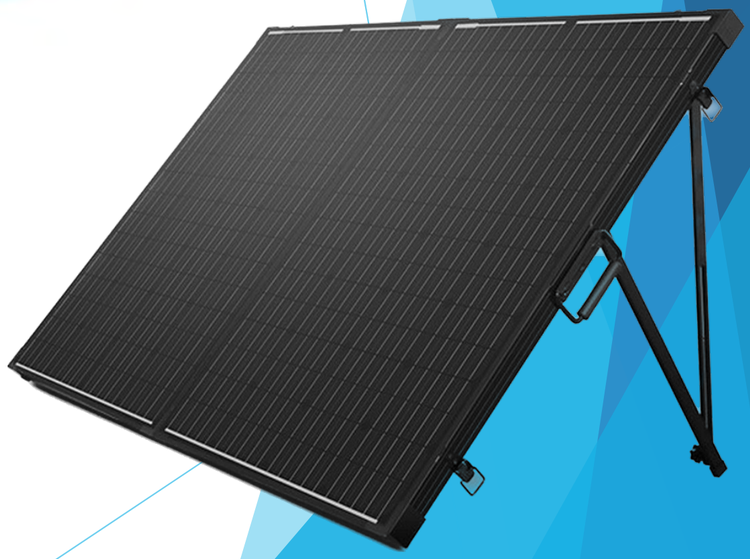
We set our solar systems to run four days with no sun.

Battery sized at 240Ah minimum.

One-Day Battery: 60Ah

We size our solar panel arrays at 400w.

Setup works in most of North America.



CleanAir aeroqual

CleanAir Workshops 023 series

Dust Monitoring Compliance

Thursday, September 14, 2023

Afternoon Program

1:00 Hands-On Sessions (20-min. Rotating Stations)
1:10-1:30 1:35-1:55 2:00-2:20
2:30 Closing Remarks
2:40 Adjourn

Hands-On Sessions

Session 1: System Setup, Software Configuration and Data Access
Session 2: Module Calibration, Module Exchange, and Hot-Swapping
Session 3: Troubleshooting Secrets and Best Practices
(Flow Rate and Leak Checks, Filter and Pump Exchanges)