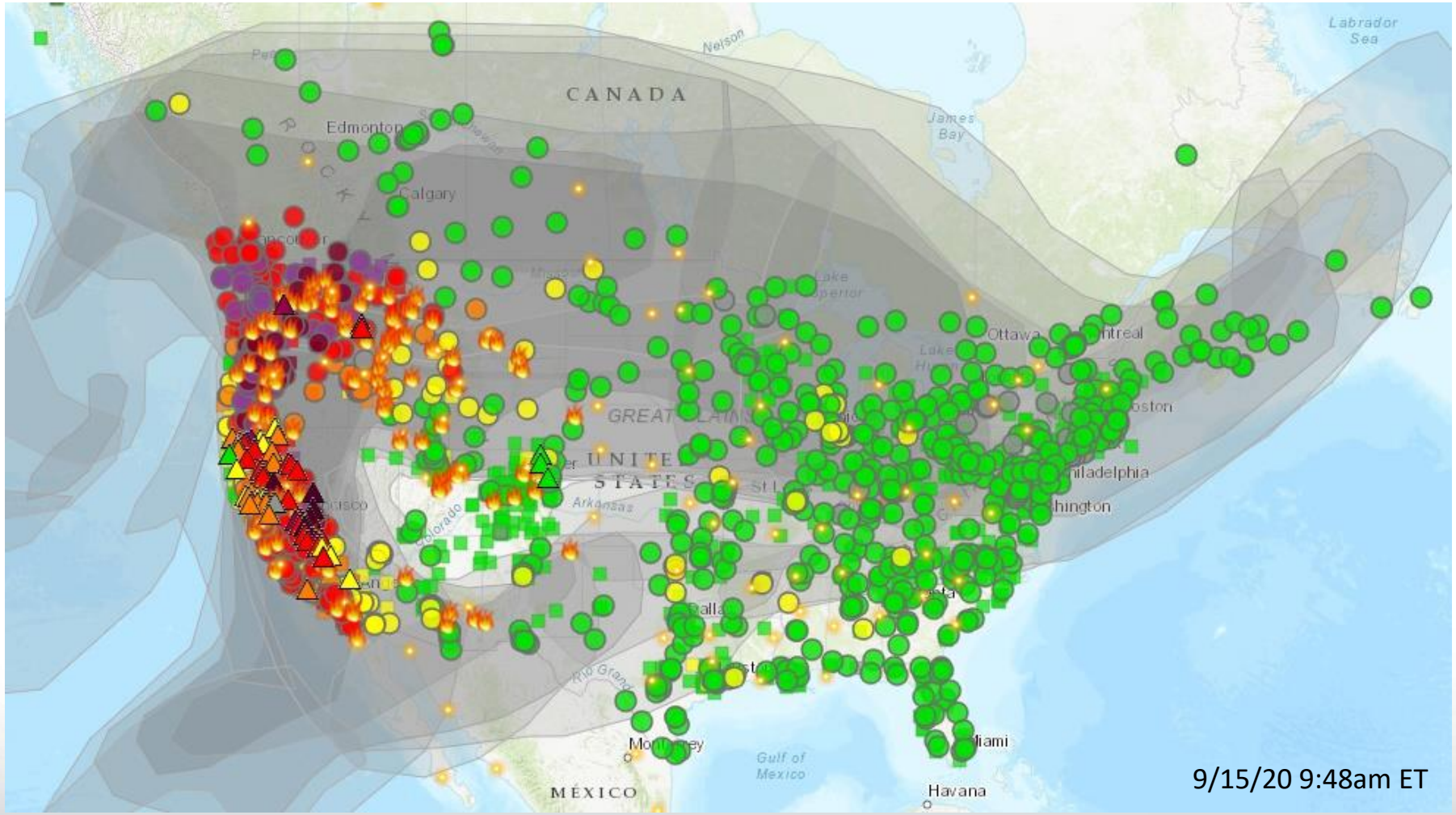
Wildfires and Air Quality – Part 1

AirNow Maps and Sensors for Community Smoke Monitoring



Introductions

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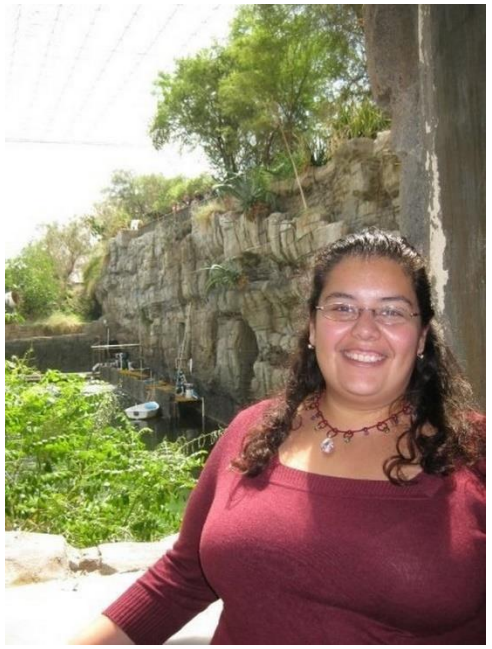

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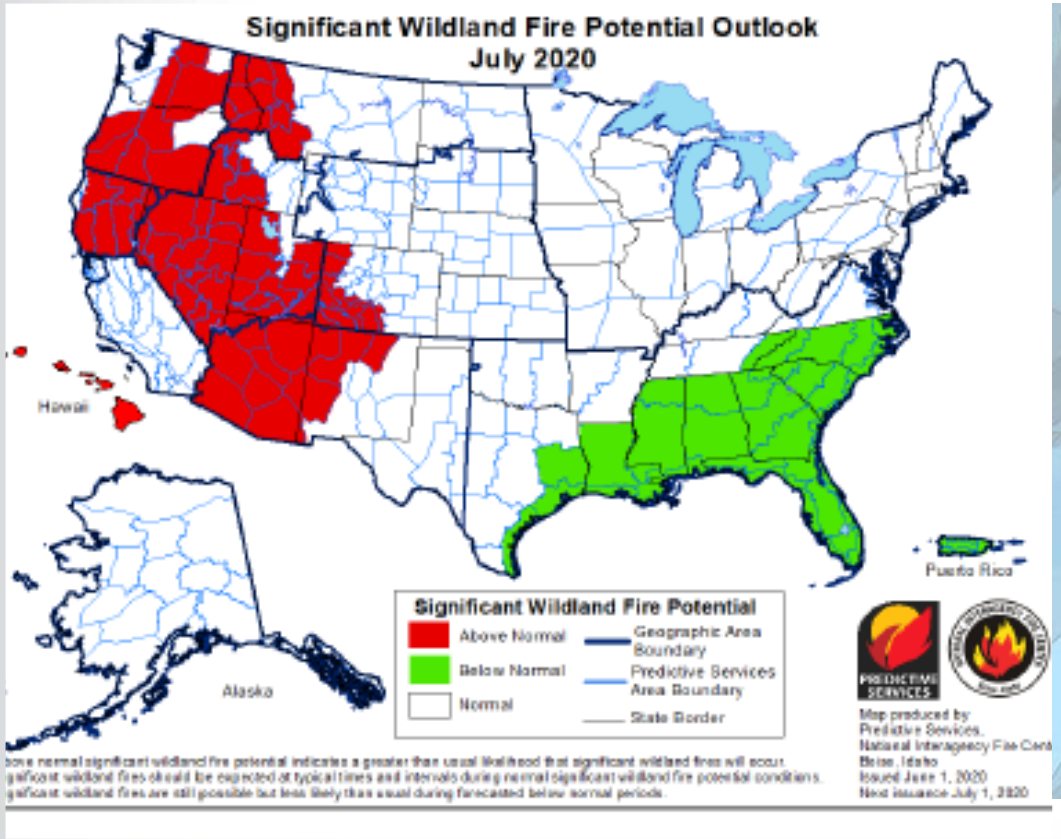
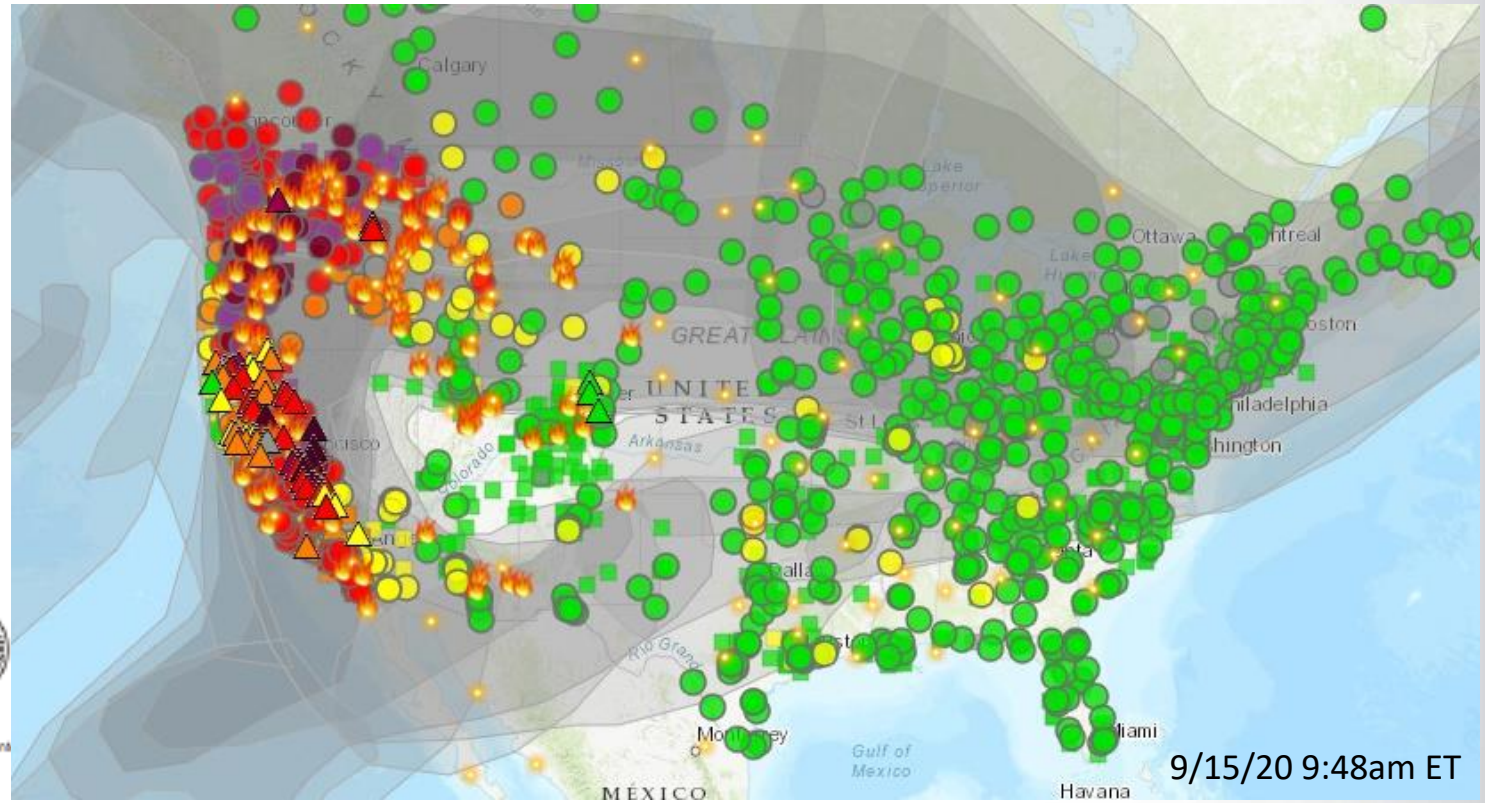
Overview of Today's Presentation

We'll discuss…

- **The motivation and background for this work**
  - Challenges of air quality monitoring in tribal areas
- **How PurpleAir sensors are increasingly being used for air monitoring**
  - PurpleAir primer
- **The integration of sensor data onto the AirNow Fire and Smoke Map**
  - Comparison with the PurpleAir Map
- **How PurpleAir sensors can facilitate community air monitoring**
  - Factors to consider
  - Hoopa Valley Tribal PurpleAir Monitoring Network
- **ORD's research on improving indoor air quality during smoke episodes**
- **Where to find helpful resources**

Many parts of the U.S. have significant air quality impacts from wildfire smoke





The Hoopa Valley Tribe in CA

The Hoopa Valley Tribe in CA has experienced severe smoke episodes

Red Salmon Complex Fire
August 2021
AQI: Unhealthy of Sensitive Groups

The Hoopa Valley Tribe in CA has experienced severe smoke episodes

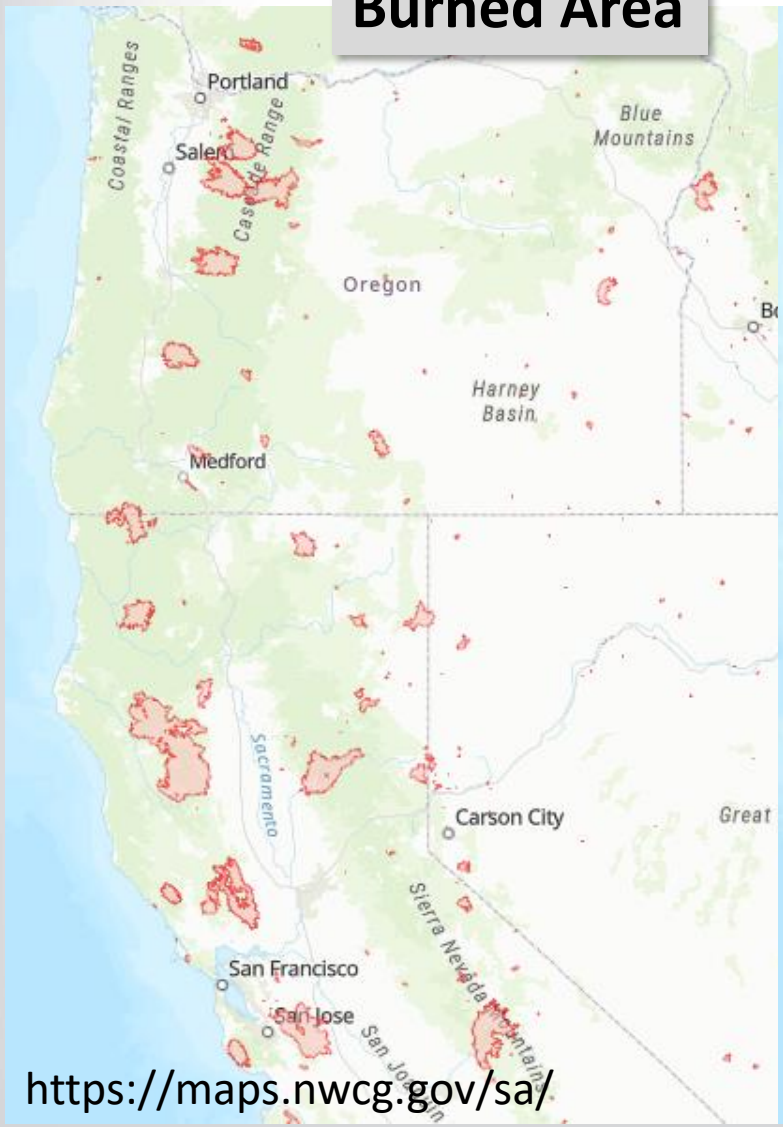
Red Salmon Complex Fire
September 2021
AQI: Unhealthy

The Hoopa Valley Tribe in CA has experienced severe smoke episodes

Red Salmon Complex Fire
October 2021
AQI: Hazardous

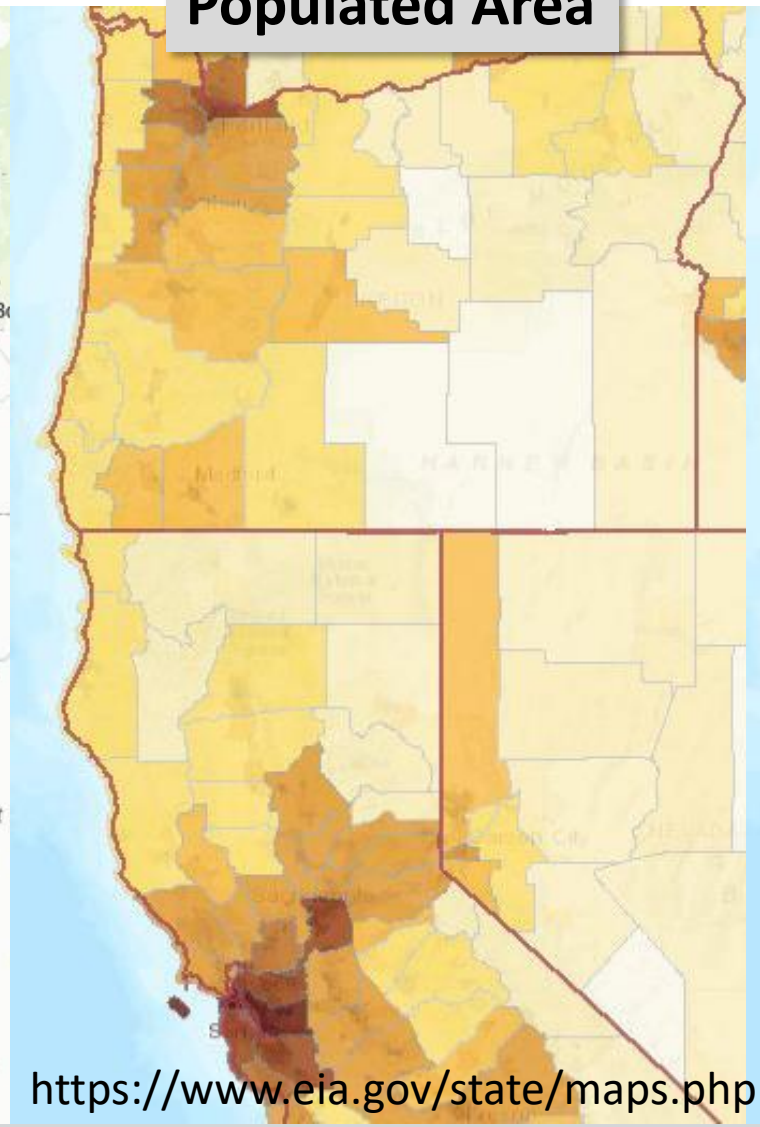
Many areas impacted by wildfires have few or no air quality monitors

Burned Area



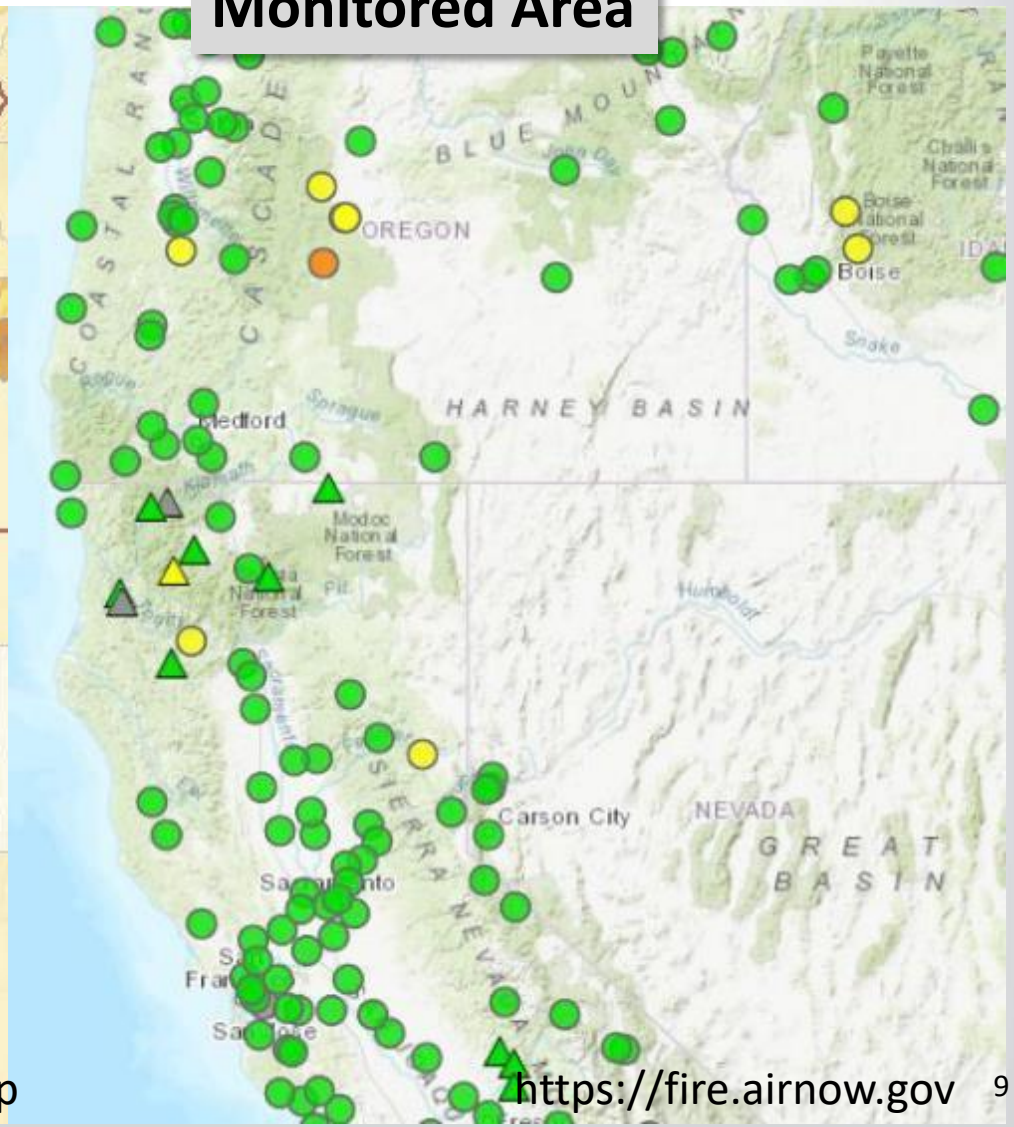
https://maps.nwcg.gov/sa/

Populated Area



https://www.eia.gov/state/maps.php

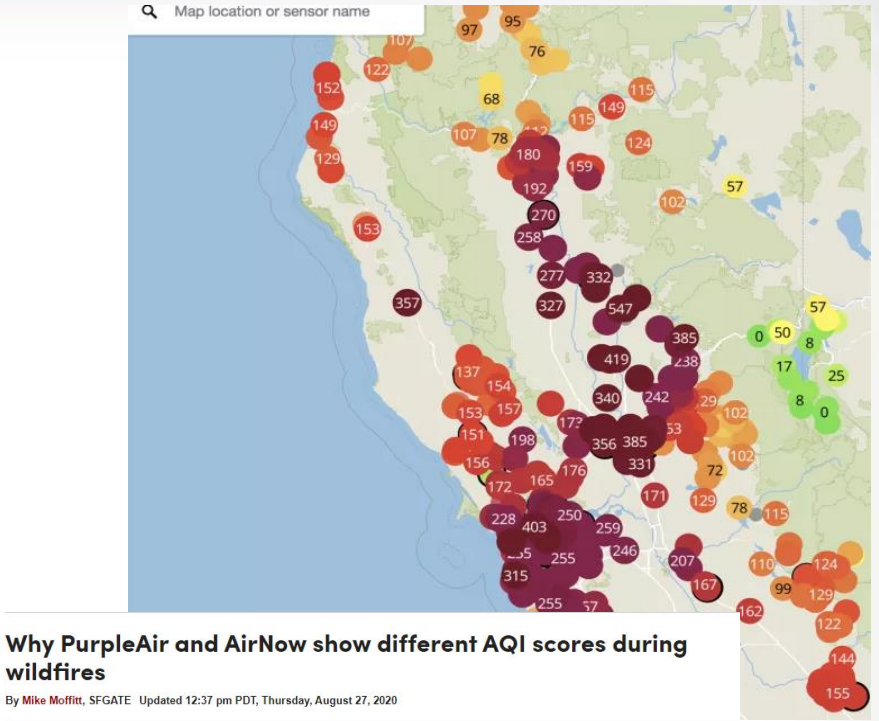
Monitored Area

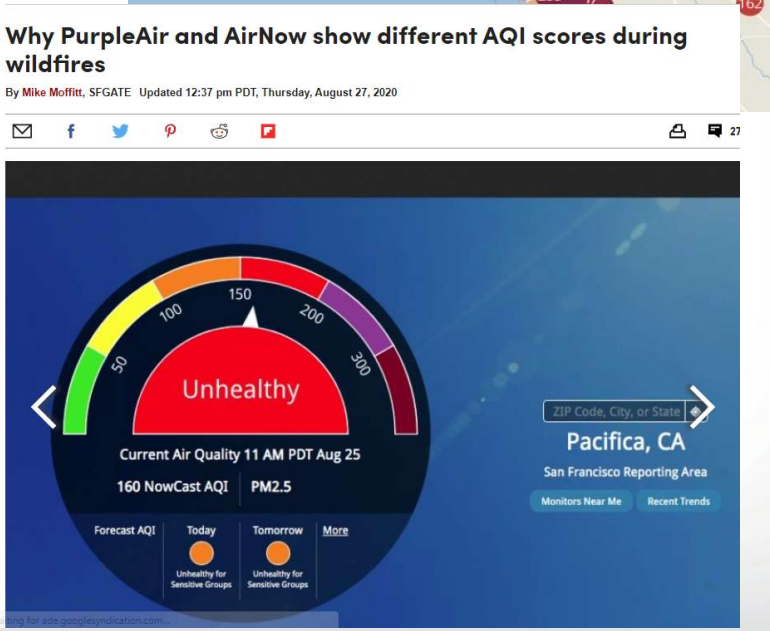


https://fire.airnow.gov

Challenges to using sensors to inform public health guidance

- **Air sensors can fill in the gaps**
  - Less expensive and more portable than traditional monitoring technologies
  - Especially important in rural areas and during smoke impacts
- **PurpleAir sensors are widely used**
  - PurpleAir data is reported on by media outlets
  - PurpleAir data does not agree with regulatory monitoring network
  - Contradicting data leads to confusion by the public
- **Indoor air is also impacted by wildfire smoke**
  - Can sensors be used to evaluate indoor air quality?
  - What approaches are needed to make clean air spaces during wildfires?





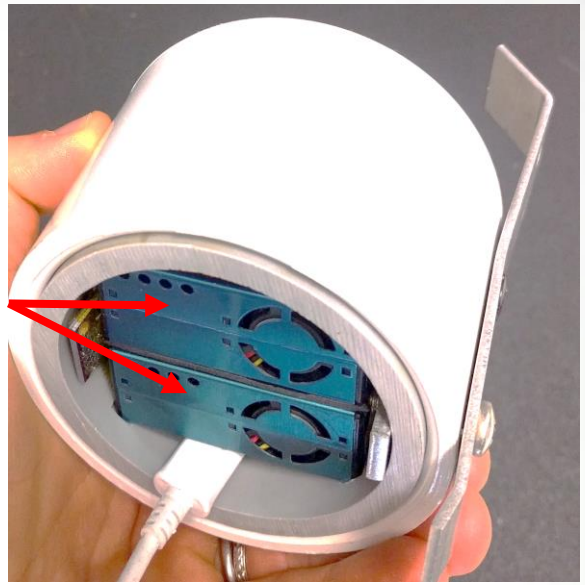
PurpleAir Primer

Primer on PurpleAir Sensors: Hardware and Outputs

PurpleAir Data Hardware

- ***2 Plantower PMS5003 PM sensor (channels A & B)***
- BME280 pressure, temperature, humidity sensor
- Sample for alternating 10-second intervals
- ***Generate 2-minute averages***
  - Previously 80-second averages

A & B channels



PurpleAir underside view

PurpleAir Data Outputs

- Reports PM_1, $PM_{2.5}$, PM_{10}, particle count
- Reports ***internal*** temperature and relative humidity (RH)

PurpleAir Data Storage

- Streamed to the PurpleAir cloud via WiFi
  - Public – displays on the public PurpleAir map
  - Private – displays only when the owner is logged in; data can be download/viewed only with owner permission
- Stored locally on a microSD card (PA-II-SD model only)

User supplies information at registration

- Name
- Location
- Indoor/Outdoor
- Public/Private

Primer on PurpleAir Sensors: Correction Factors

PurpleAir provides PM data directly from the Plantower sensors with two correction factors (cfs)

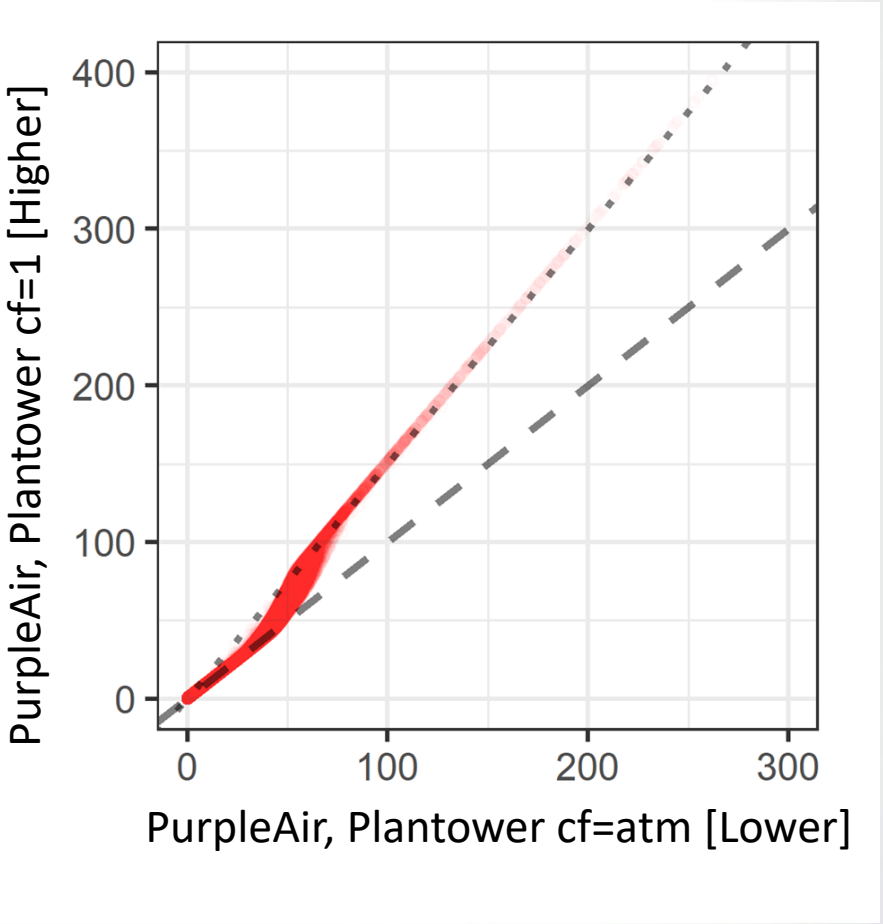
- **cf=atm described on the PurpleAir website as "outdoor"**
  - lower concentrations
  - Currently displayed on PurpleAir map for **outdoor** sensors
- **cf=1 described on the PurpleAir website as "indoor"**
  - higher concentrations
  - Currently displayed on PurpleAir map for **indoor** sensors

Two important take-aways

- Both cfs typically report concentrations that are higher than collocated regulatory monitors
- Comparing indoor/outdoor sensors on the PurpleAir map may be confusing at concentrations above 25μg/m^3

Previously, PurpleAir had these labels switched

- Easy check: cf=1 is higher
- Helps create confusion in the literature about which cf was used



Primer on PurpleAir Map: Data Display

PurpleAir's Map allows users to view sensor data in multiple ways

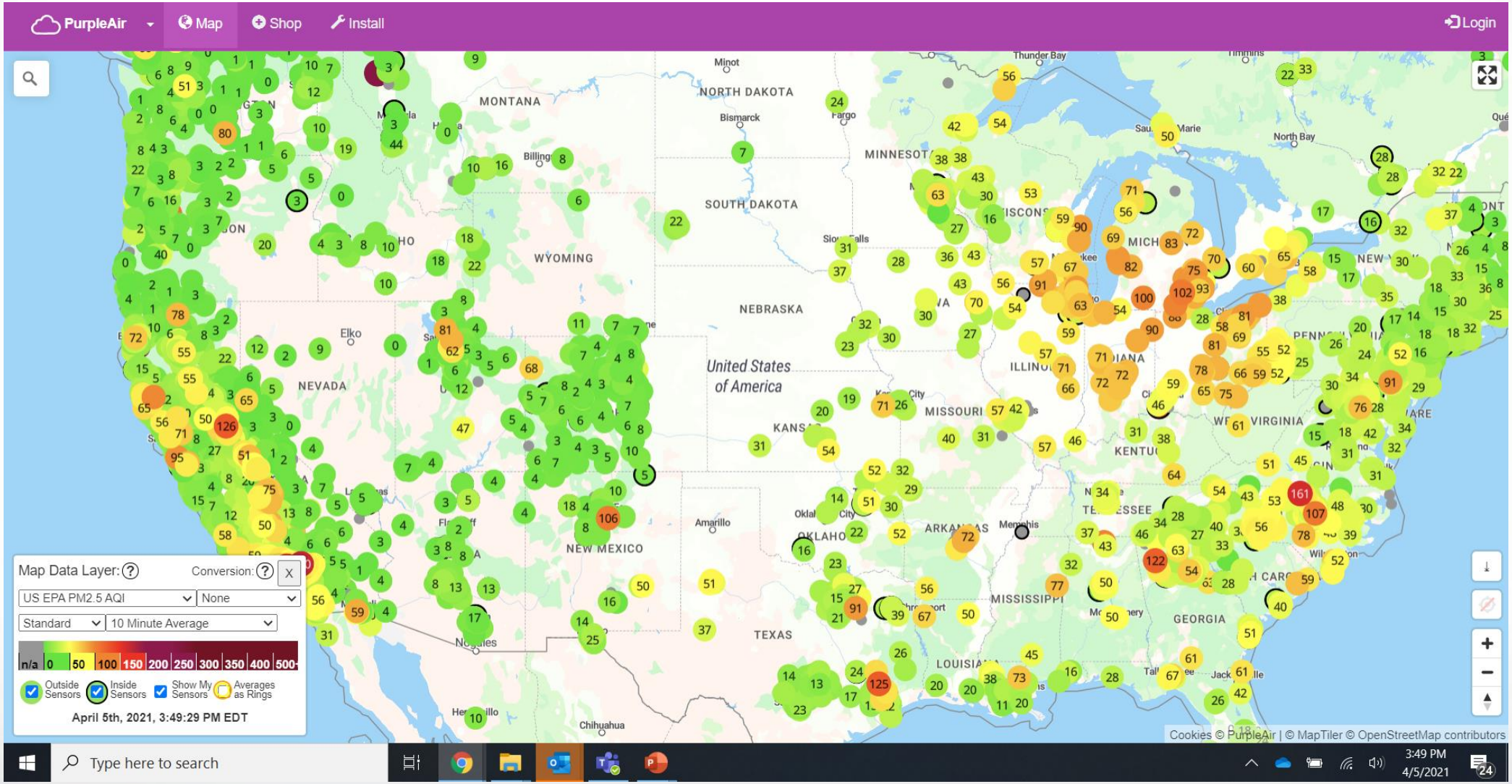


Image source: PurpleAir.com/map

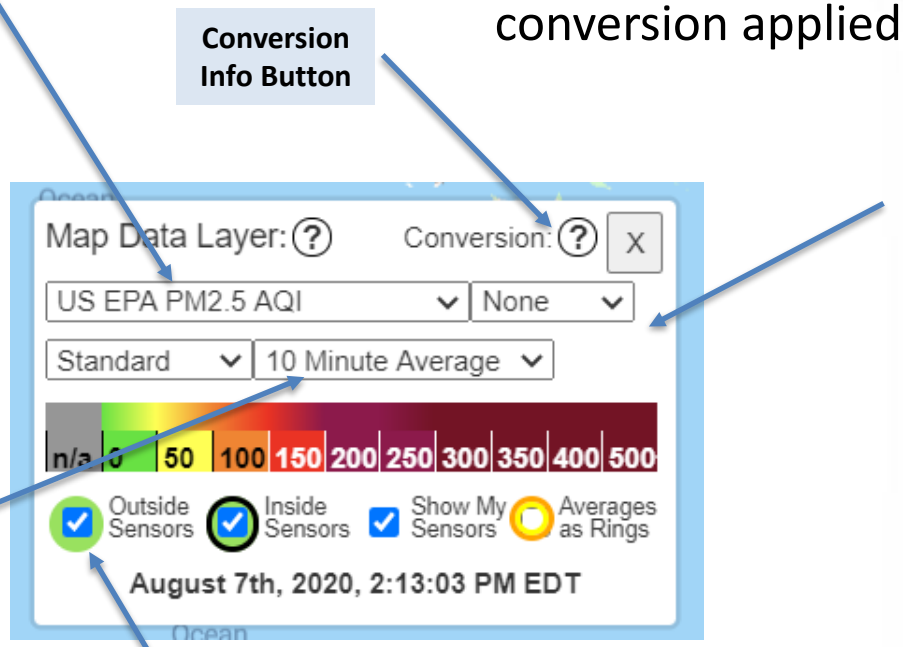
Primer on PurpleAir Map: Data Display

This first drop-down menu can be used to select what data is displayed

- The default is the "US EPA PM2.5 AQI" which directly relates the sensor data to the Air Quality Index (AQI)
- Can use the menu to look at "Raw PM2.5 in μg/m^3"
- Other options exist including T and RH

Conversions can be applied to the data with this drop-down menu

- The default is "none" or no conversion applied



This drop-down menu can be used to select how the data is averaged

- The default is to look at 10-minute averages
- Users can choose to view real-time data
- Other averaging options are also available (30-minute, 1-hour, 1-day)

These radio buttons can be used to select which sensors are displayed on the map

- The styles used show how the sensors can be distinguished on the map

Image source: PurpleAir.com/map

Primer on PurpleAir Map: Online Conversions

PurpleAir's Map allows users to apply a conversion (or correction equation) to the data too

- Currently, 4 different conversion factors can be applied to data on the map
  - The conversion information page provides more information about the available options
  - Each conversion is based on a body of research with links and equations provided
    - **"US EPA"** was developed using data from across the US for both everyday and smoke impacted times
    - **"AQ and U"** was developed by U. Utah during wintertime in Salt Lake City
    - **"LRAPA"** was developed by Lane Regional Air Protection Agency for woodsmoke dominated times
    - **"Woodsmoke"** was developed by UNE during smoke from domestic wood heating in Australia
- Currently, converted data cannot be downloaded

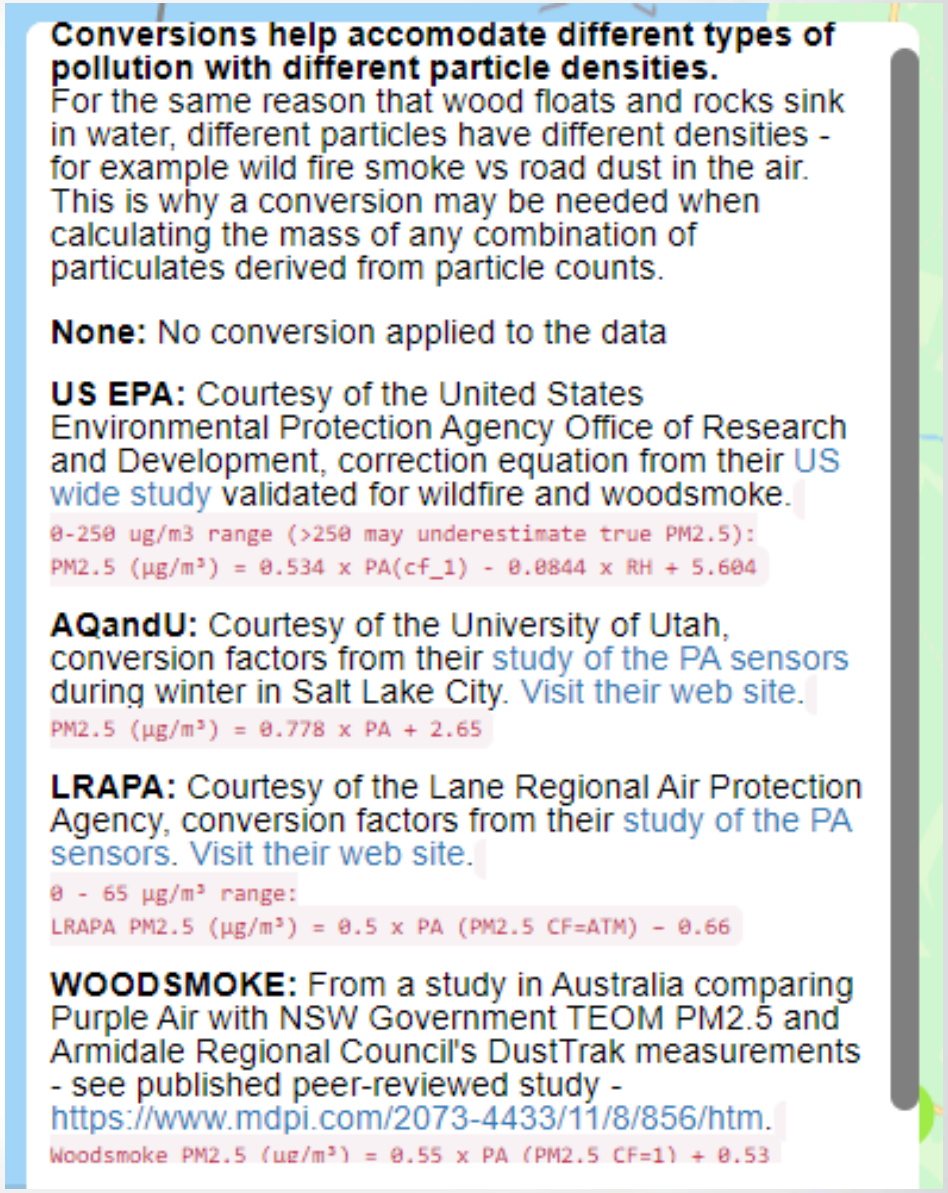
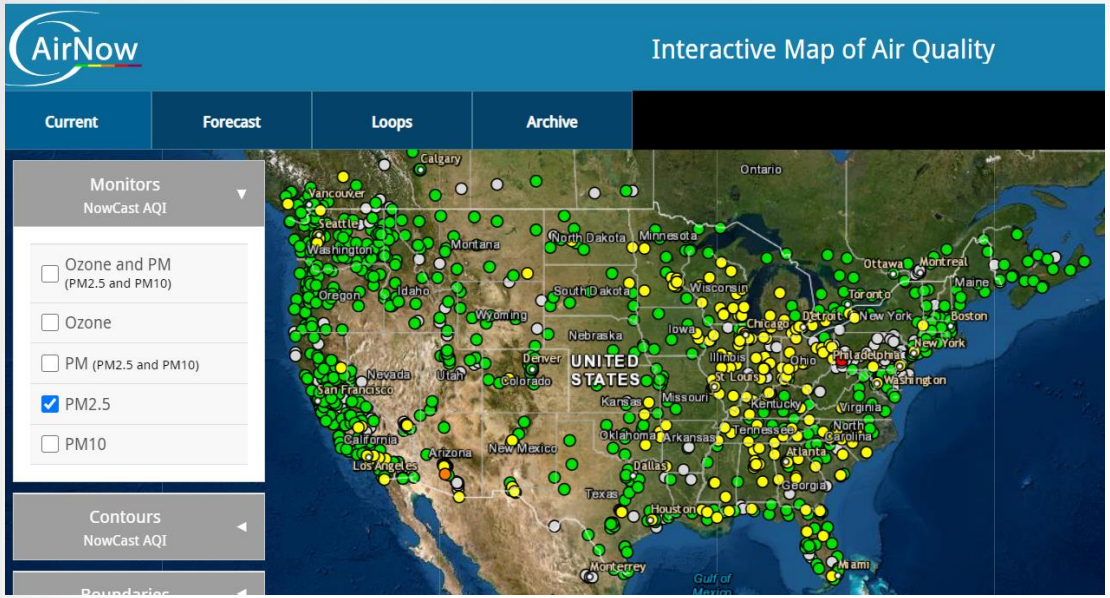


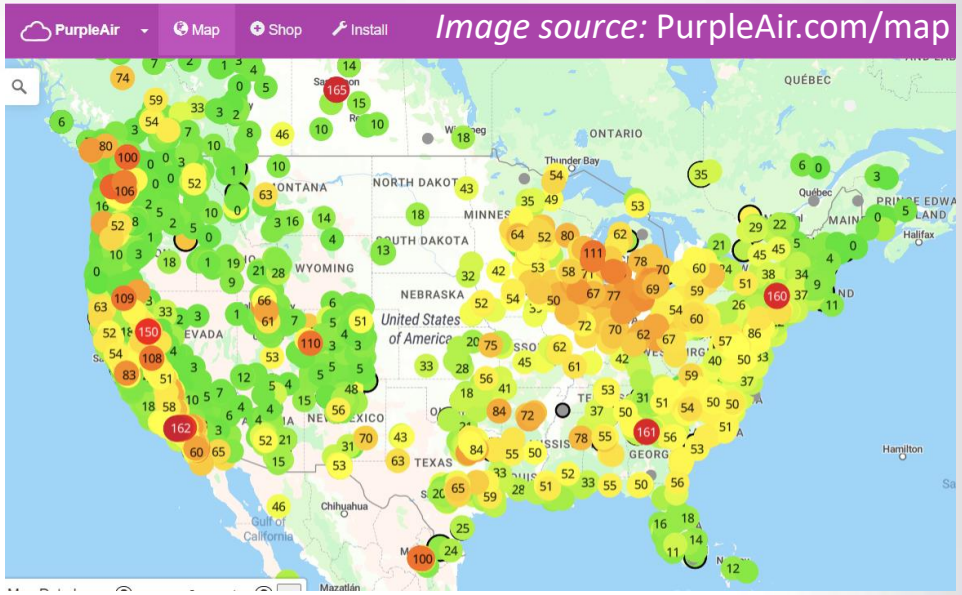
Image source: PurpleAir.com/map

Integration of Sensor Data onto the AirNow Fire and Smoke Map and PurpleAir Map

Information about the data sources



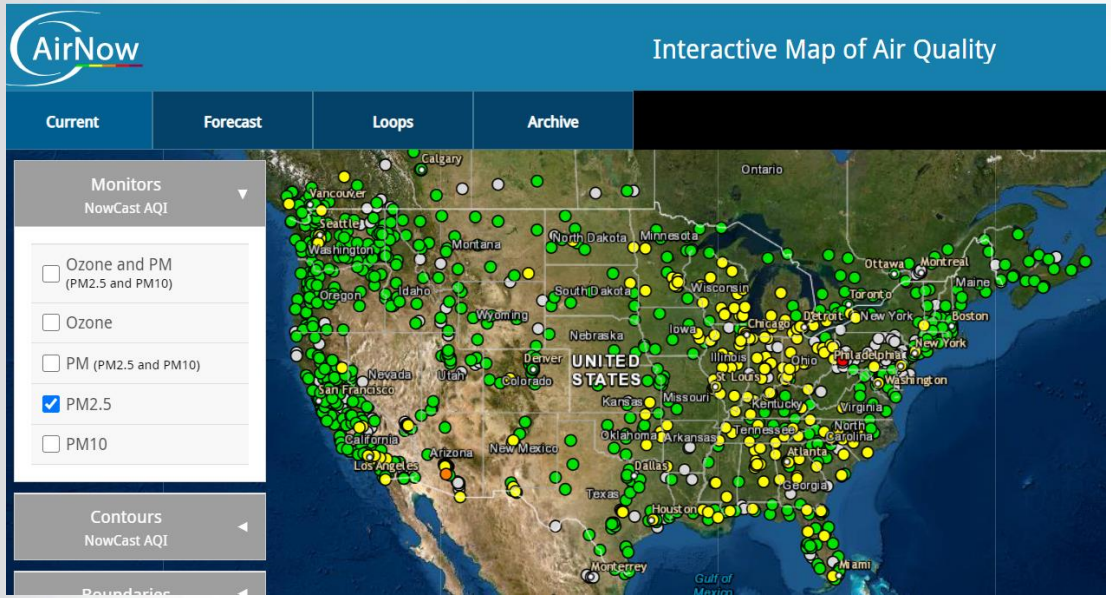
- Trusted source of high-quality air quality information collected by certified instruments and trained staff
- Multiple pollutants are measured
- Citing protocols to avoid hyper-local sources
- Data is quality checked by trained professionals
- Website reports air quality hourly, using the NowCast AQI, and provides health-based messaging

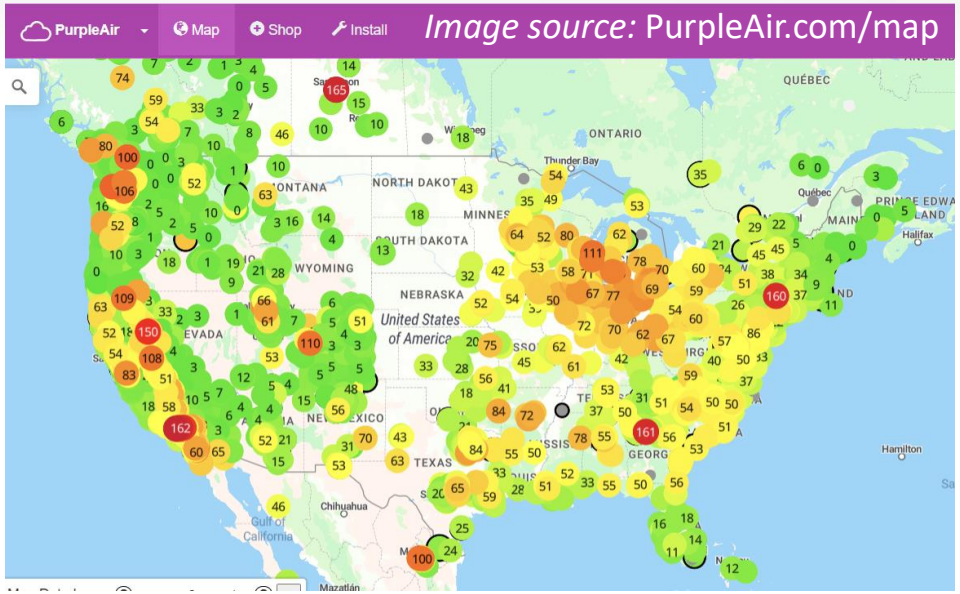


- Extensive collection of crowdsourced participatory air quality measurements
- High-time resolution – 2-minute data
- Measurements may be more local to the consumer
- Uncertain sensor citing and maintenance
- Uncertain data quality

Although both sources of information are valuable, this is not an apples-to-apples comparison

Integration on the Fire and Smoke Map





Fire Information

- Incident Reports
- Fire detects
- Smoke plume extents

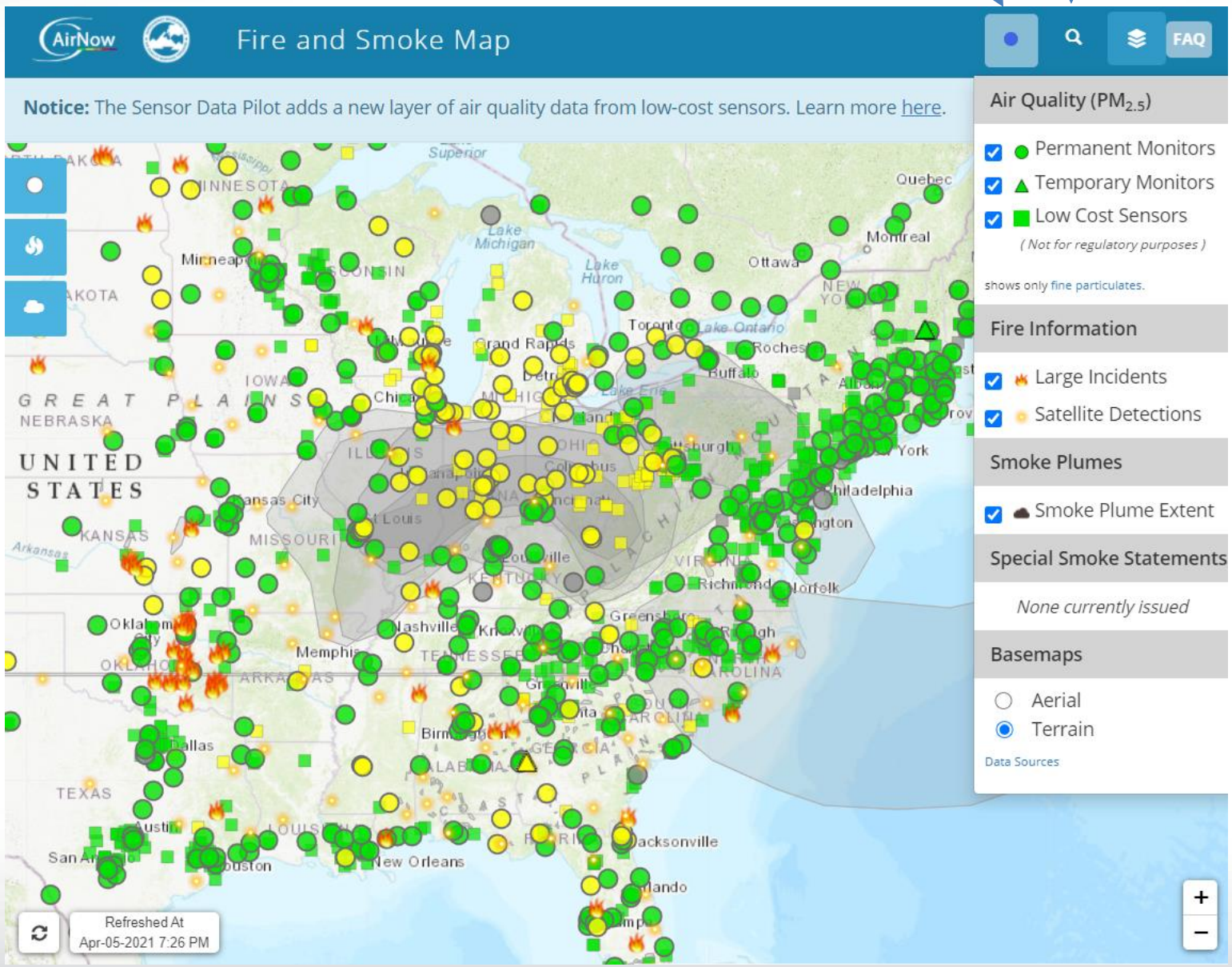
- Select only $PM_{2.5}$ measurements
  - Include permanent monitors
  - Include temporary monitors

- Select only outdoor sensors
- Average data to 1-hour
- Use the A&B channels to remove questionable data
- Apply a correction equation to address over-estimation of concentration
- Apply the NowCast AQI

- Includes ground and satellite observations
- Includes reports from specialists

A lot of work goes into making these data sources comparable and it will all be done behind the scenes on the map

Fire and Smoke Map



The pilot version map was launched before the 2020 fire season.

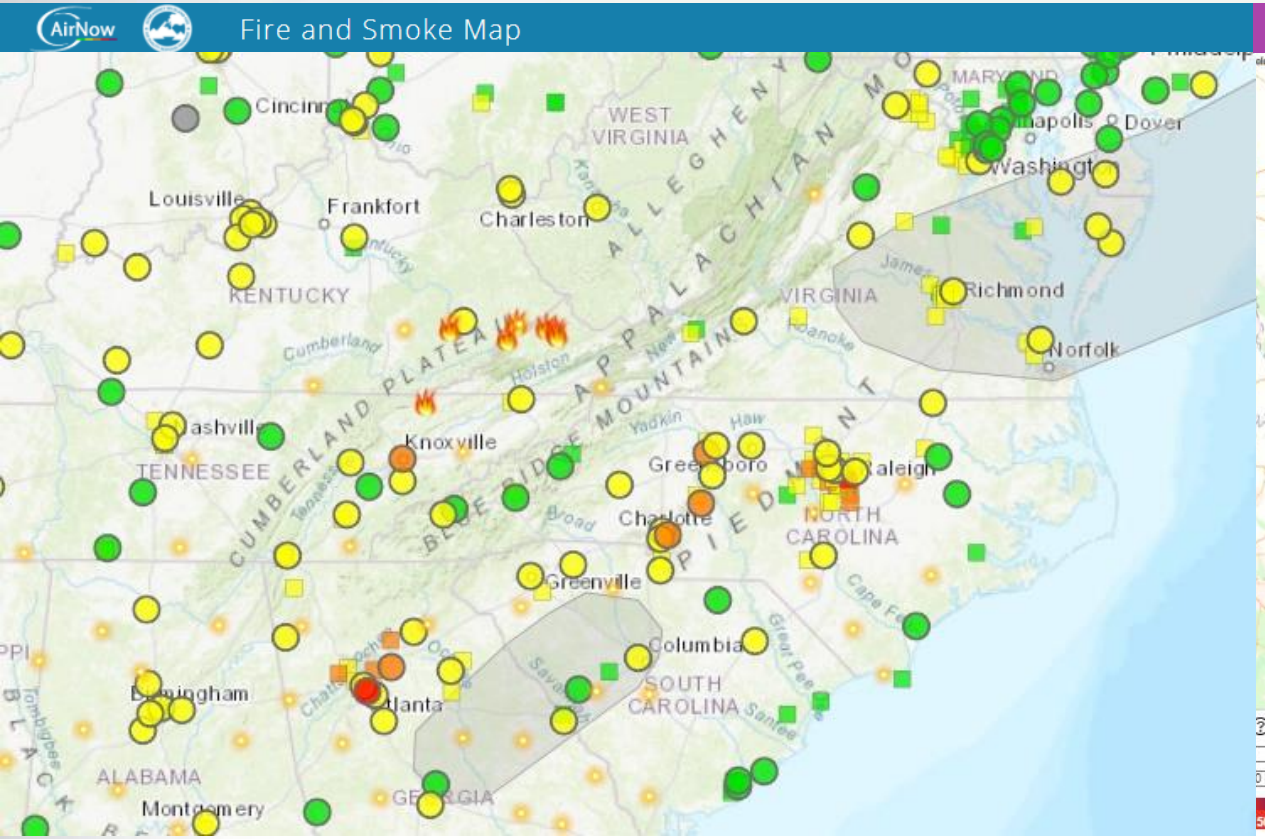
An update is expected in July 2021.

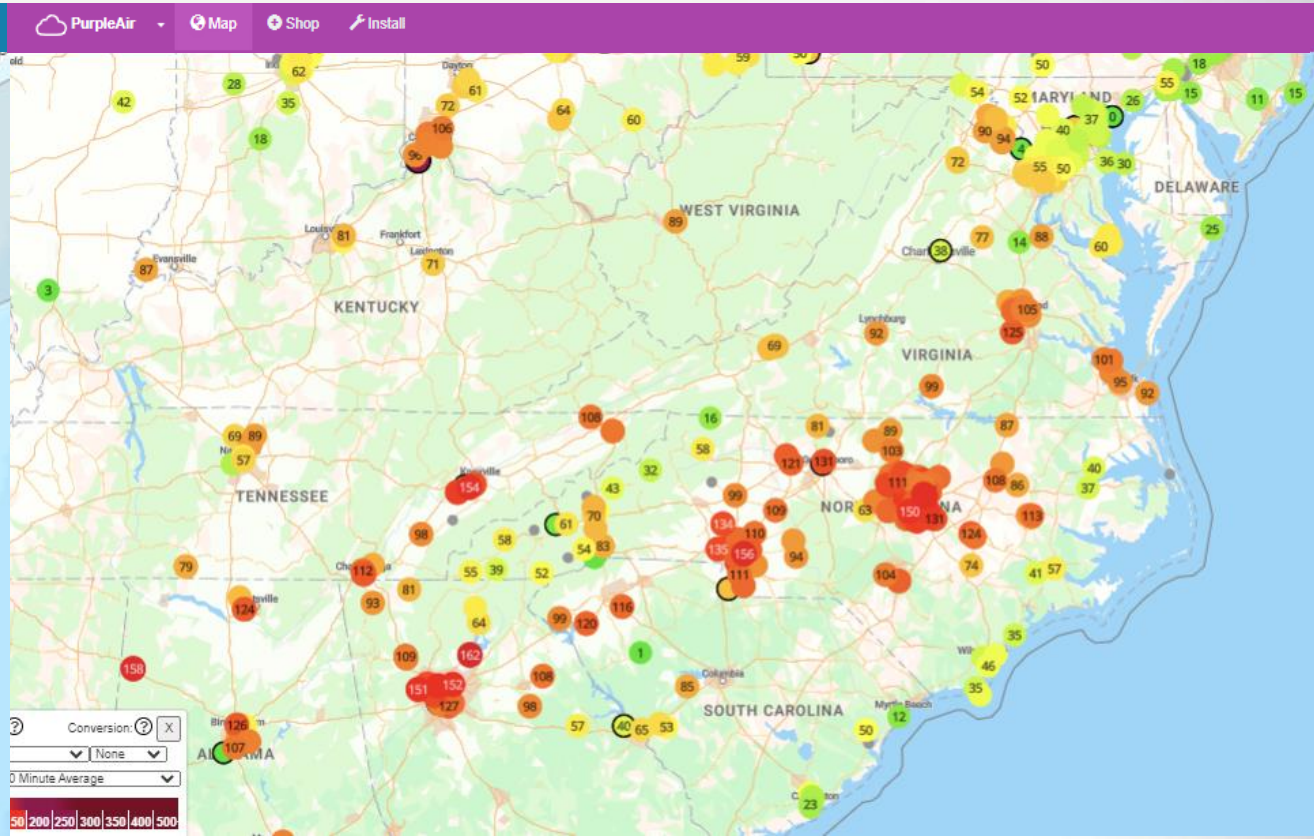
Comparison between AirNow Fire and Smoke Map and PurpleAir Map

Differences between PurpleAir AQI Map and the AirNow AQI Map

Map		Averaging Time	Sensors	Temporary Smoke Monitors	Regulatory Monitors	Pollutant(s)	QA Procedures
AirNow		NowCast (~3 hr)			✓	$PM_{2.5}$ and/or O_3	Preliminary data quality assessment only
AirNow Fire and Smoke Map		NowCast (~3 hr)	✓	✓	✓	$PM_{2.5}$	Cleaning steps (slide 20) Manually flagged sensors removed
PurpleAir Default	outdoor (CF=atm) Indoor (CF = 1)	10 – min Modifiable	✓			$PM_{2.5}$	A-B disagreement downgraded and hidden behind other data points
PurpleAir correction options	LRAPA AQ&U Woodsmoke	10 – min Modifiable	✓				
	U.S. EPA correction	2-min, NOT modifiable	✓				

AirNow Fire and Smoke Map vs. PurpleAir Map



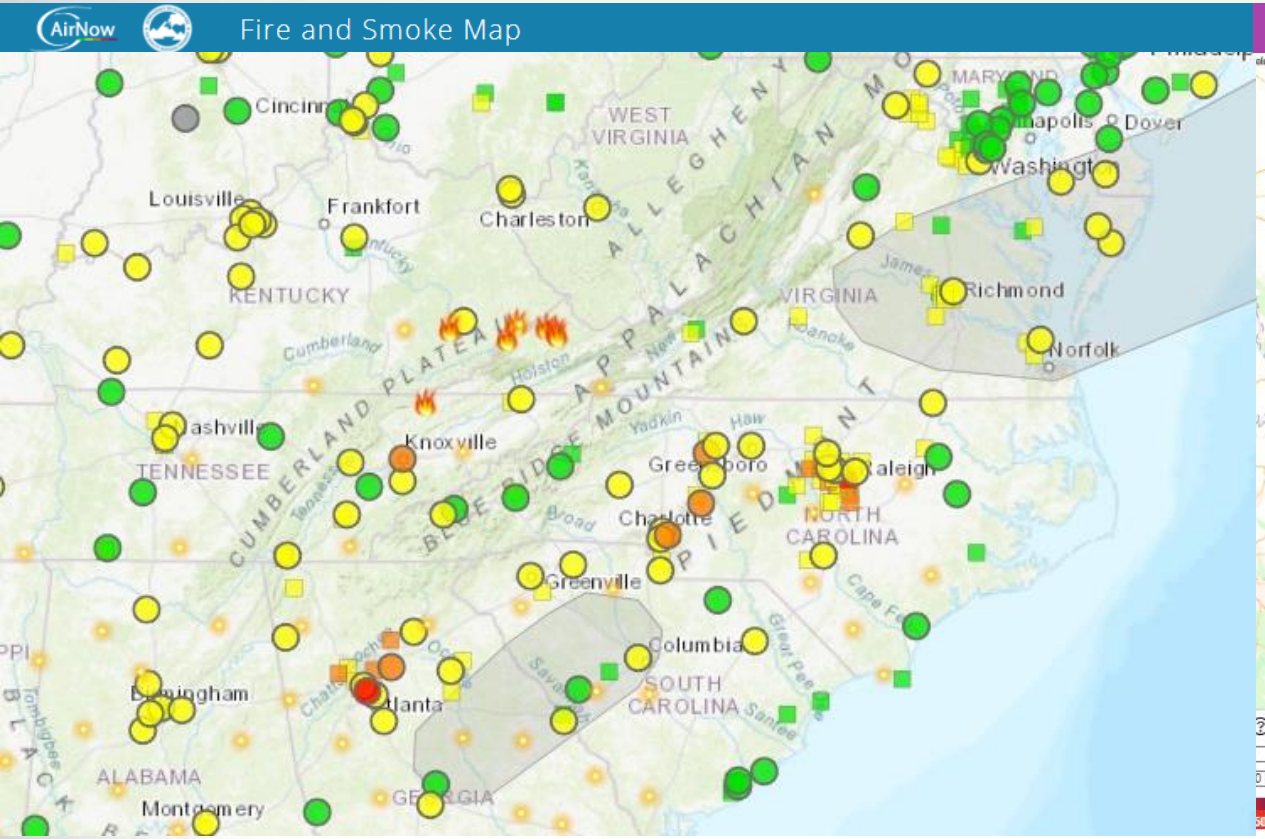


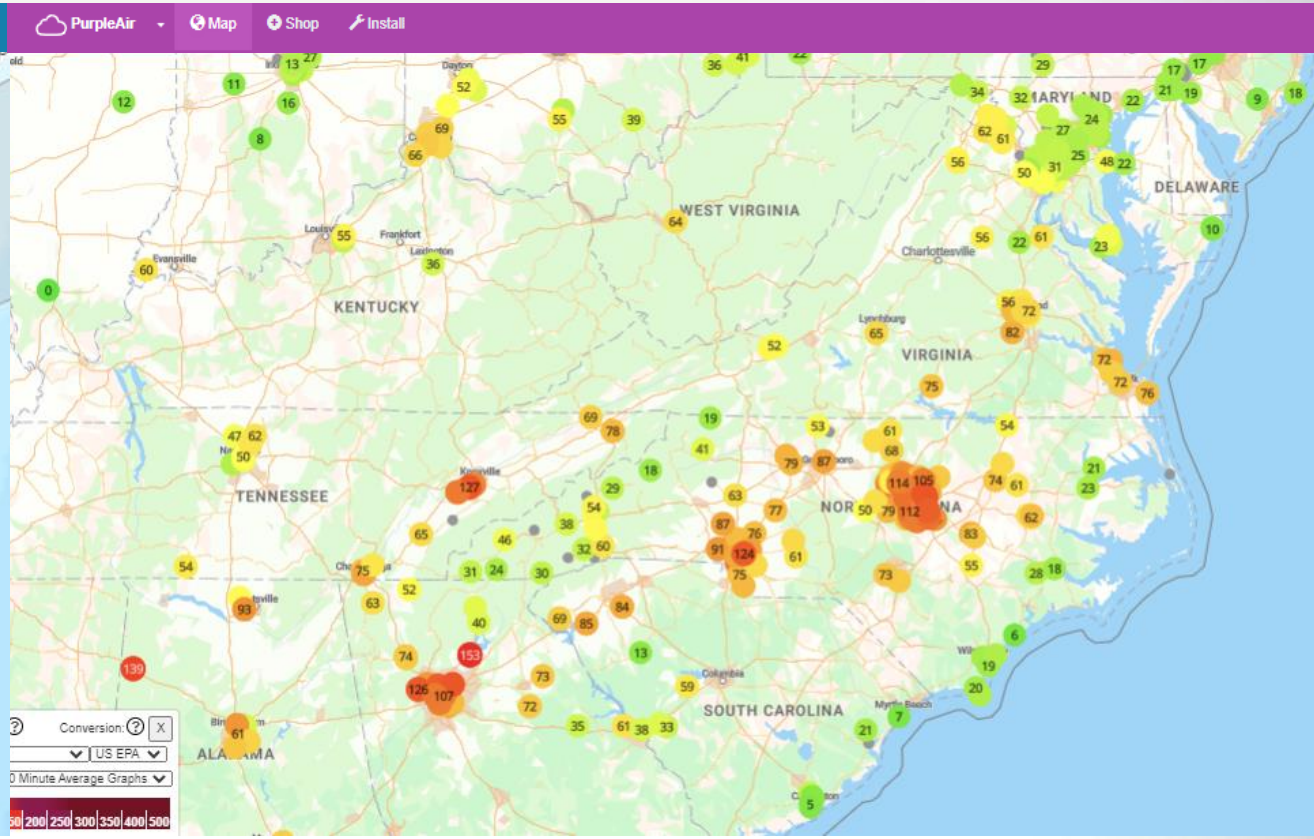
AirNow Fire and Smoke map displays PurpleAir outdoor data that has been cleaned, averaged, and corrected with the NowCast algorithm applied

- PurpleAir defaults to indoor (cf=1) and outdoor (cf=atm) sensors 10-minute averaged data
- Sensors with A & B disagreement are displayed behind other sensors

AirNow Fire and Smoke Map vs. PurpleAir Map

Dec 2020



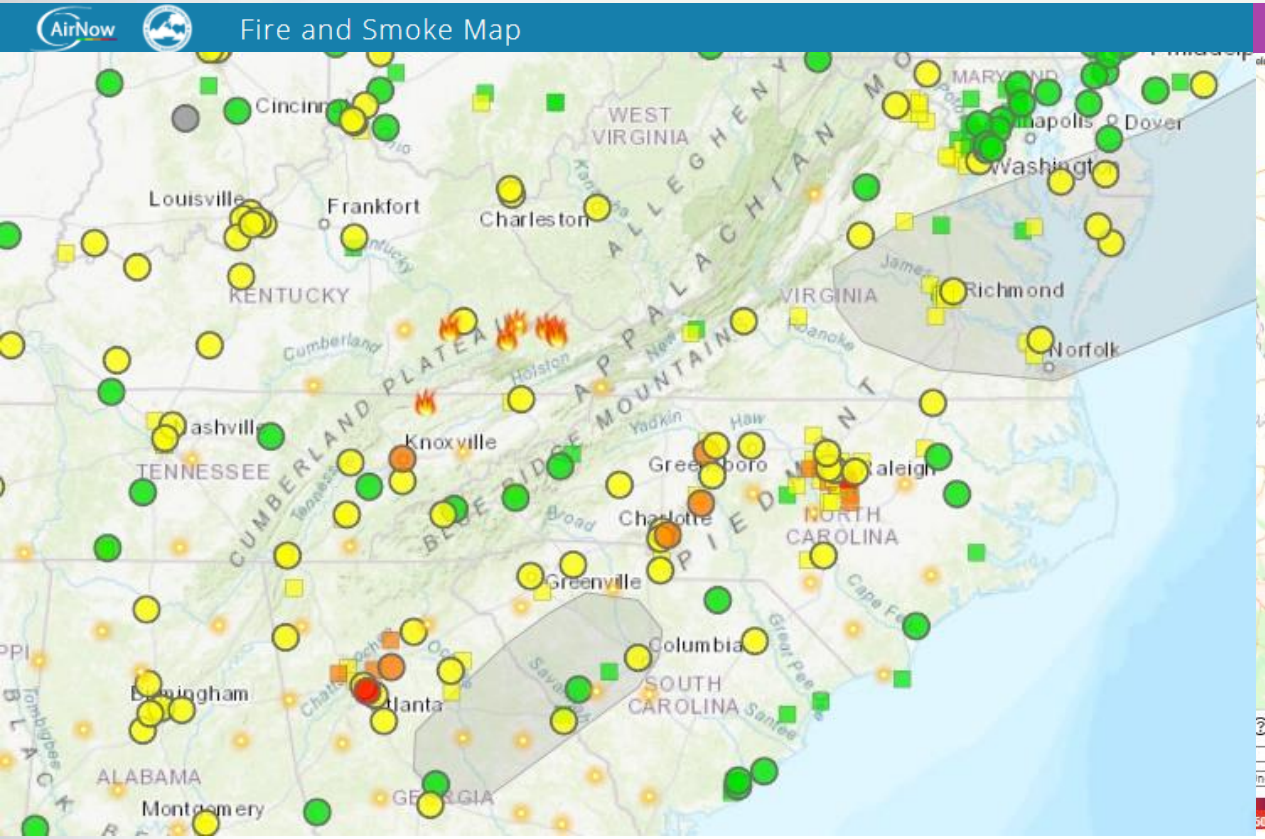


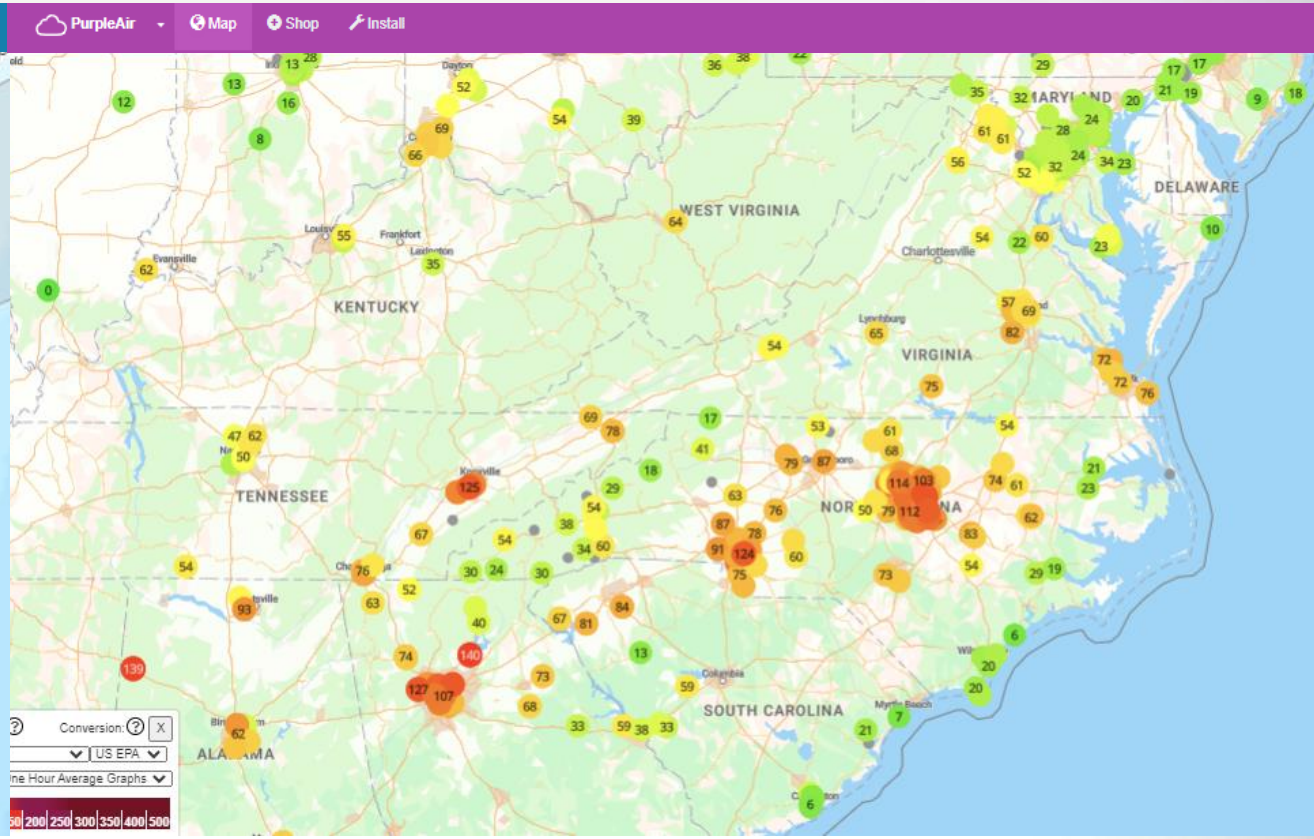
On PurpleAir Map you can select to:

- Remove the indoor sensors
- Use U.S. EPA correction, but it only applies to outdoor sensors and 2-minute data

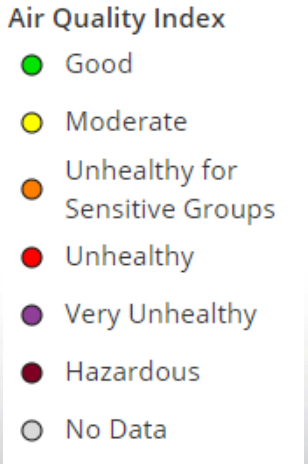
AirNow Fire and Smoke Map vs. PurpleAir Map

Dec 2020





AirNow shows discrete colors corresponding to the AQI categories



PurpleAir displays a continuous range of colors in between AQI categories

Key Considerations about PurpleAir Sensors and Crowdsourced Data

Issues with PurpleAir Sensors and Crowdsourced Data

1. Sensors can fail
    - Air sensors do not have status codes to indicate failures
    - Most failure captured by A & B channel cleaning steps
    - Lifespan unknown, drift hard to identify
2. Sensors can be mislabeled, mislocated, or poorly sited
3. Sensors can saturate at high concentration
    - ≥ 250 µg m^{-3} nonlinear correction under development
4. Sensors may not respond the same to all sources
    - Light scattering-based sensors are sensitive to PM optical properties and may not respond the same to all sources (e.g., dust)

Frequent sensor data review will be necessary until algorithms are developed to detect malfunctioning, improperly sited, or mislabeled sensors

Consideration 1: Sensors can fail

- **Most PurpleAir failures are captured by A & B channel cleaning steps.**

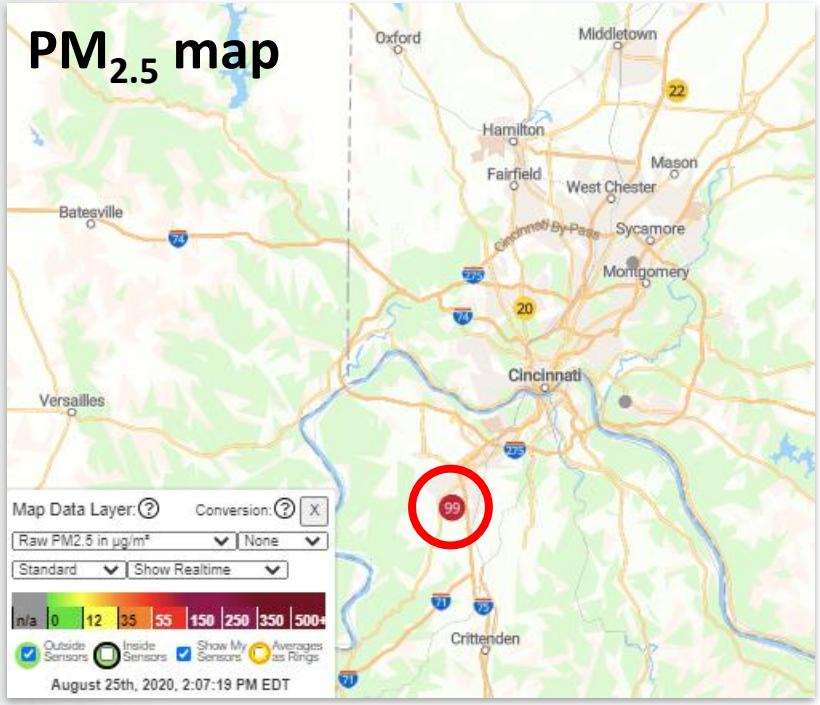
  Mazama Science developed a list of example failure modes that can be found here: https://mazamascience.github.io/AirSensor/articles/articles/purpleair_failure_modes.html

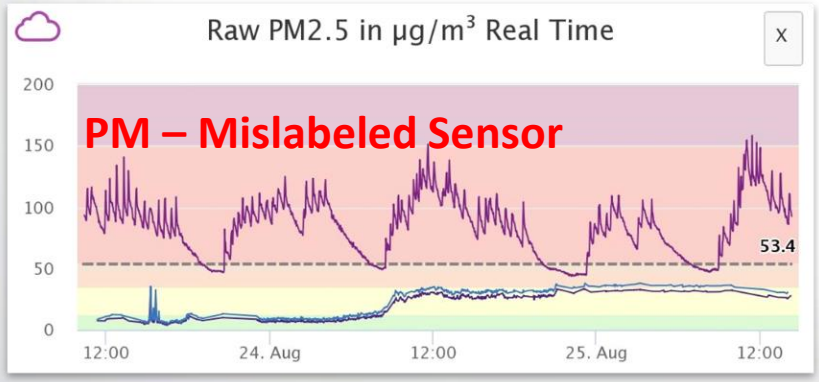
  Briefly:
  - Single channel noise
  - Large jump in single channel data
  - Single channel tracks RH or T
  - Single channel stuck at a number or zero

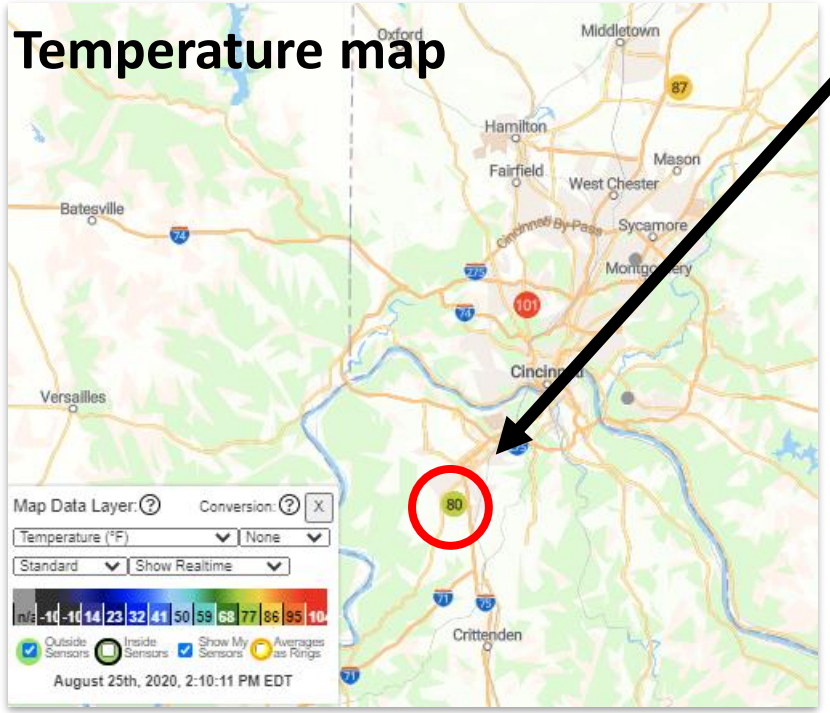
- **Sensor drift with age is not easy to identify.**

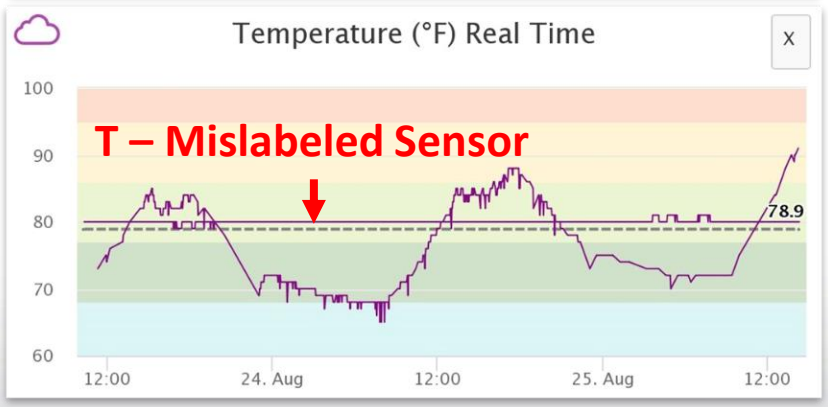
- **Sensor lifespan under different $PM_{2.5}$ concentrations or ambient conditions is still unknown.**

Consideration 2a: Sensors Can Be Mislabeled or Mislocated









Example of outdoor sensor that disagrees with neighbors

- Compare T and PM from surrounding sensors to identify sensors indoor
- Diurnal trends can be used to identify mislabeled sensors

Currently, sensor data review will be necessary to identify these issues

Consideration 2b: Sensors may be poorly sited

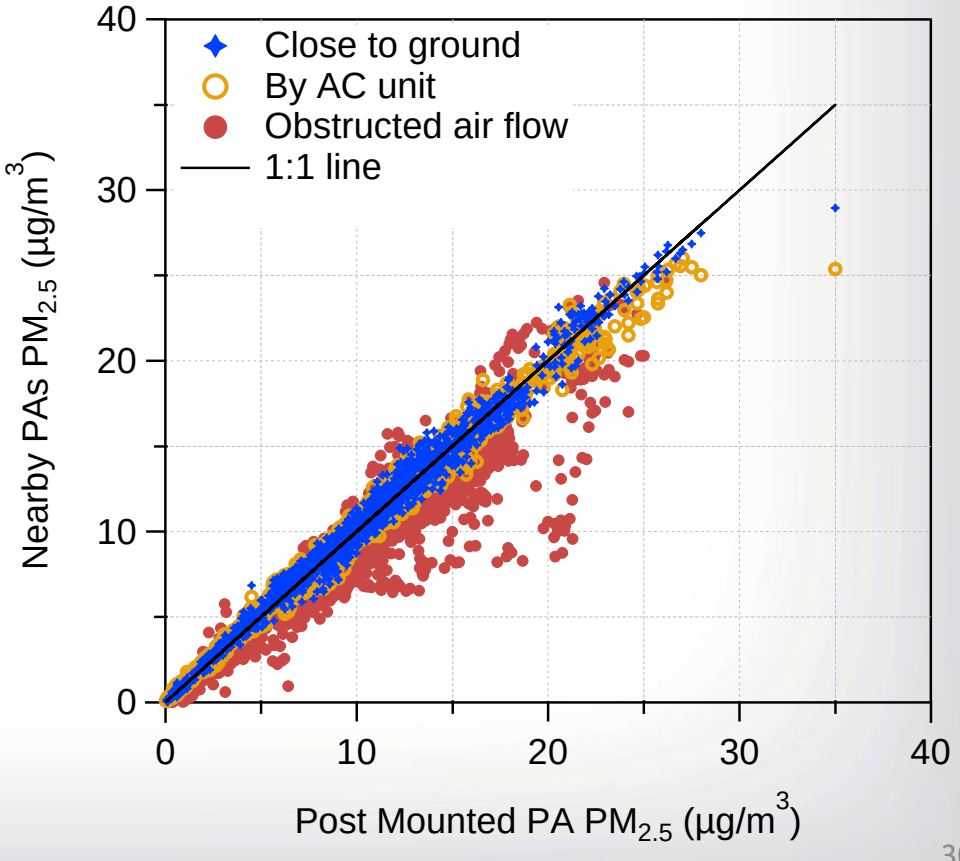
Sensors operated by the public may be poorly sited. We investigated a few suboptimal siting scenarios to identify the impact.

Next to strong air flow

Close to the ground

Obstructed air flow

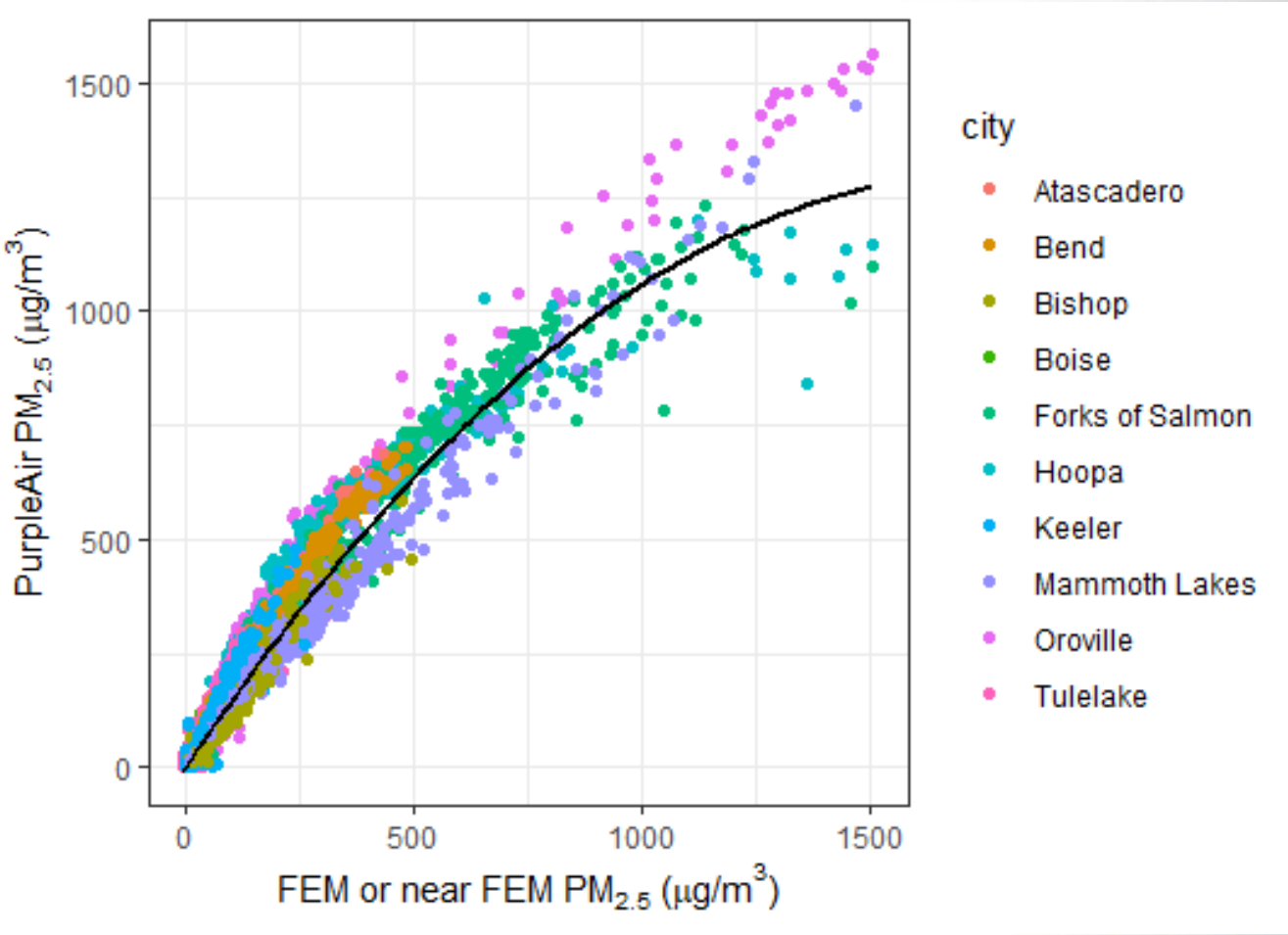
Siting	Regression	R^2	RMSE (µg m^{-3})	MBE (µg m^{-3})
Ground	Y = 0.98x +0.31	0.98	0.69	0.09
AC Unit	Y = 0.96x + 0.51	0.98	0.71	0.03
Obstructed	Y = 0.86x + 0.14	0.88	2.30	-1.32



Most siting scenarios provide acceptable data!

Consideration 3: Sensors Can Saturate at High Concentrations

- PurpleAir has a linear response up to ~200 μg m^{-3}
- Lab studies have shown:
  - Polynomial fit may be better at higher concentrations (Sayahi et al. 2019)
  - PurpleAir stops responding at about 11,000 – 13,000 μg m^{-3}, depends upon PM composition and size (Zou et al. 2019)
- New high concentration correction developed from crowdsourced CA and OR wildfire collocated data at ***very high*** concentrations
- **We are working to finalize and include an updated equation on the AirNow Fire and Smoke map**



Consideration 4: Sensors may not respond the same to all sources

- Sensors respond to PM light scattering
- Large dust particles scatter much less light than small particles per unit mass
- Sensor low bias compared to reference monitors
- **U.S.-wide correction is not applicable to some PM sources**

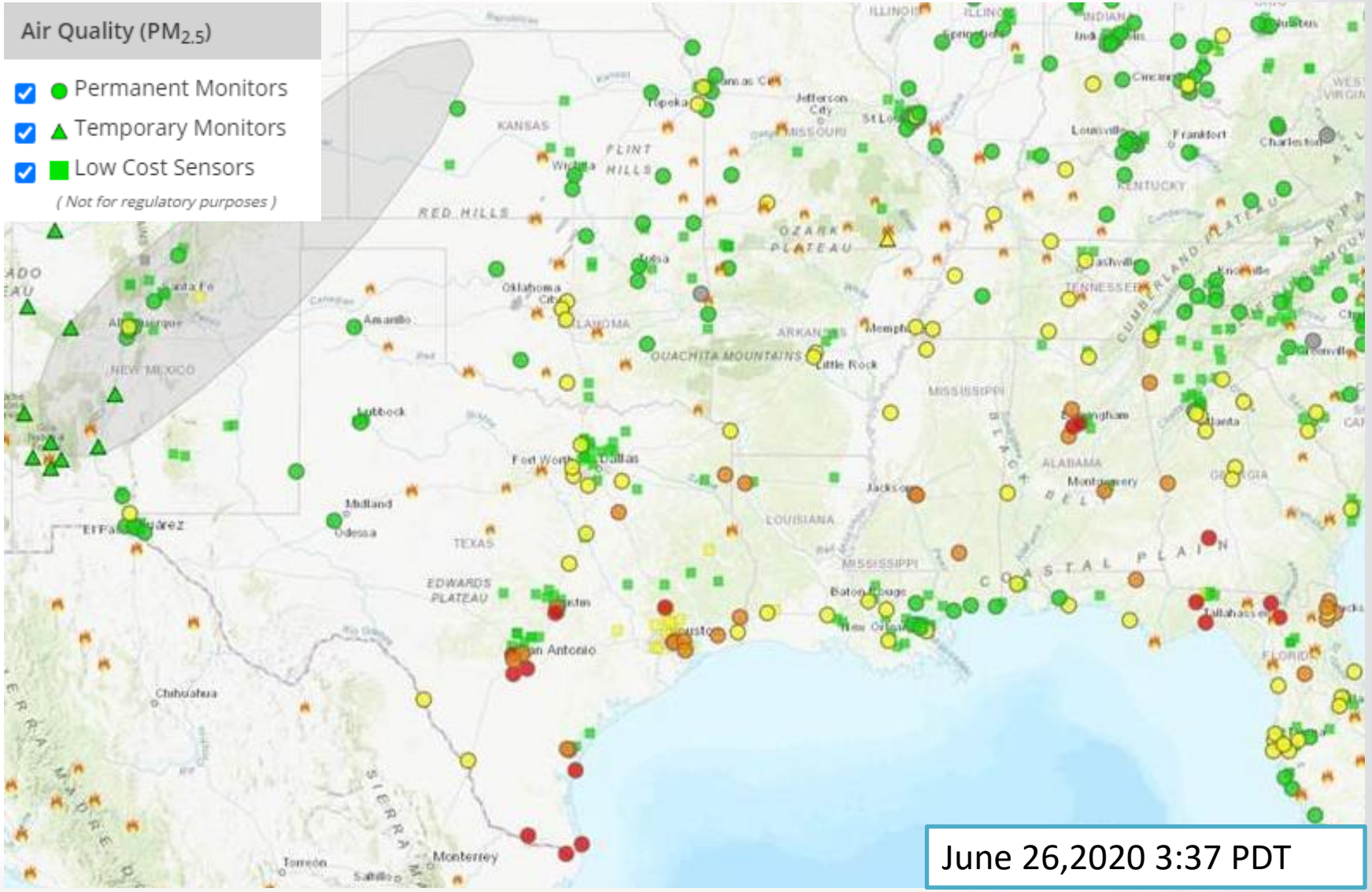


Image source: Duc Nguyen BAAQMD

Value of the Sensor Data Pilot and the AirNow Fire and Smoke Map for Communicating Air Quality Information to the Public

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AIR QUALITY

Making Sense of Purple Air vs. AirNow, and a New Map to Rule Them All

By Kevin Stark Sep 4

An Example of Community Monitoring in Hoopa, CA

What can communities do to reduce their exposure to wildfire smoke?

Wildfire ASPIRE study

Advancing Science Partnerships for Indoor Reductions of Smoke Exposures

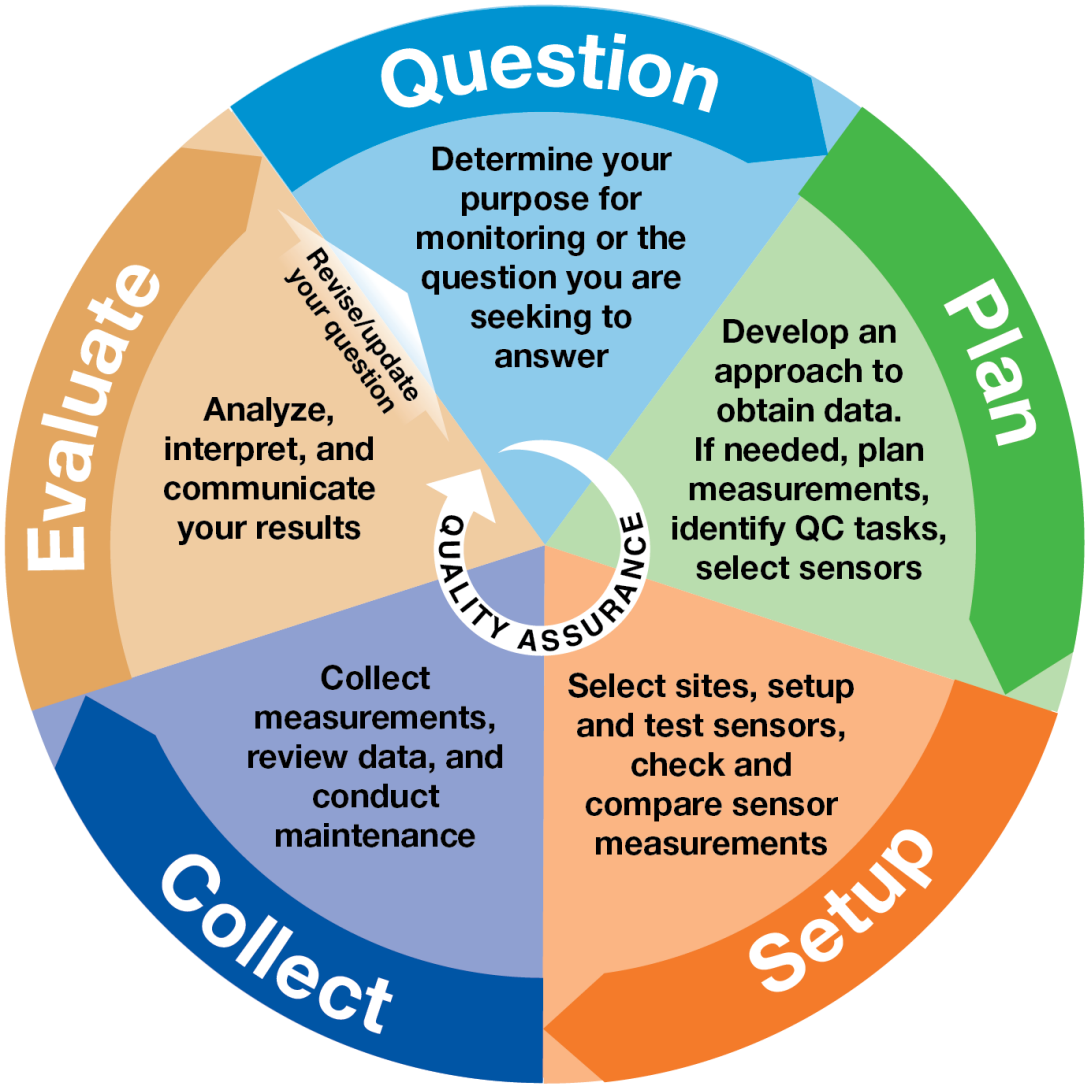
EPA partnered with Missoula, MT and the Hoopa Valley Tribe in CA to develop research to meet their needs to protect public health from wildfire smoke

Partner discussions led to these research questions:

- What interventions are effective for reducing wildland fire smoke exposures and risks?
- **What science is available to support recommendations for communities to develop clean air spaces in larger buildings (e.g., schools, community centers)?**
- How effective are portable air cleaners (PACs) during smoke events?

Used a general sensor monitoring development framework to design a monitoring plan for Hoopa

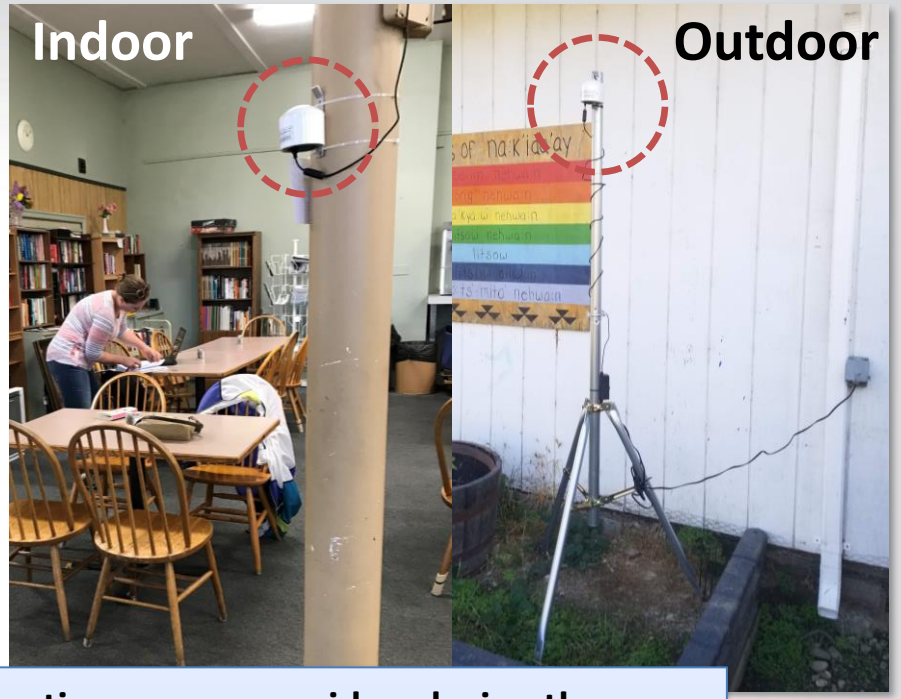
- ✓ Define your monitoring goals
  - ***Monitor across the community and indoors in public spaces***
- ✓ Select a sensor
  - ***Desired to smoke monitor in multiple locations, needed a precise, low-cost PM sensor, selected PurpleAir***
- ✓ Monitoring sites and setup
  - ***Ensured sites had power, WiFi, and secure location to install PurpleAir***
- ✓ Collect and maintain data
  - ***Data transmitted through WiFi and stored on SD card***
- ✓ Evaluate data
  - ***Data displayed privately on PurpleAir map to study partners only, used to diagnose sensor issues in remotely in real-time***



Basic steps of any monitoring plan

How to setup a sensor indoors and outdoors

- **Identify monitoring sites with air quality significance**
  - Places with sensitive or vulnerable populations
  - Places with community concerns
  - Places with outdoor workers
  - Places without monitors
  - Near roadways
- **Ensure site can support sensor deployment**
  - Meets infrastructure requirements
    - Onsite power or sun exposure for solar
    - WiFi/Cell/Satellite signal
  - Secure from tampering
  - Supportive host – e.g., schools, fire stations, libraries, community centers
  - Safe to access – e.g., no fall or shock hazards
- **Install sensor for optimal data quality**



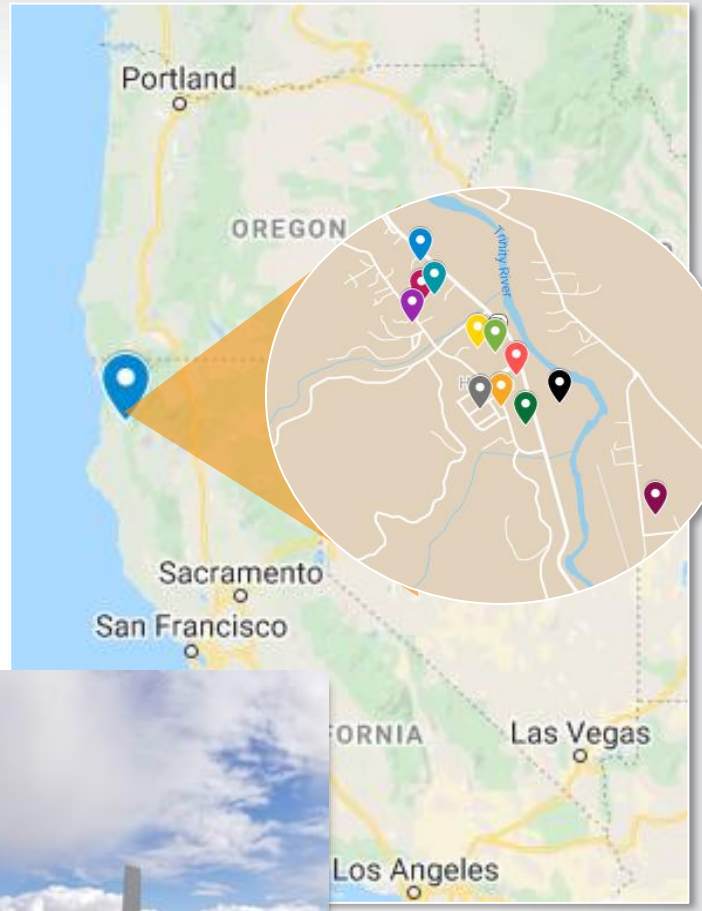
When mounting sensor consider placing the sensor:

- At least 180° free air flow
- Near breathing height indoors
- At least 1 meter above ground outdoors
- Upwind of any nearby structures
- Away from vegetation
- Away from PM sources or strong air flows:
  - Exhaust vents
  - AC units
  - Dusty roads
  - Cooking appliances (stoves/grills)
  - Fire pits/fireplaces

Adapted from Code of Federal Regulations Title 40 Part 58 Ambient Air Quality Surveillance Appendix E Probe and monitoring Path Siting Criteria for Ambient Air Quality Monitoring

Description of the Hoopa, CA monitoring network

- Initial collocation at central monitoring platform to quality control the sensors and develop site specific correction equation
- Deployed sensors at multiple outdoor locations and in multiple buildings
- Sampling started in November 2019 and is ongoing
- Mid-study collocation check planned for spring 2021
- Continue to sample year-round to observe impacts of woodsmoke during winter and spring and wildfire smoke during summer and fall



Photograph courtesy of Hoopa Valley Tribe

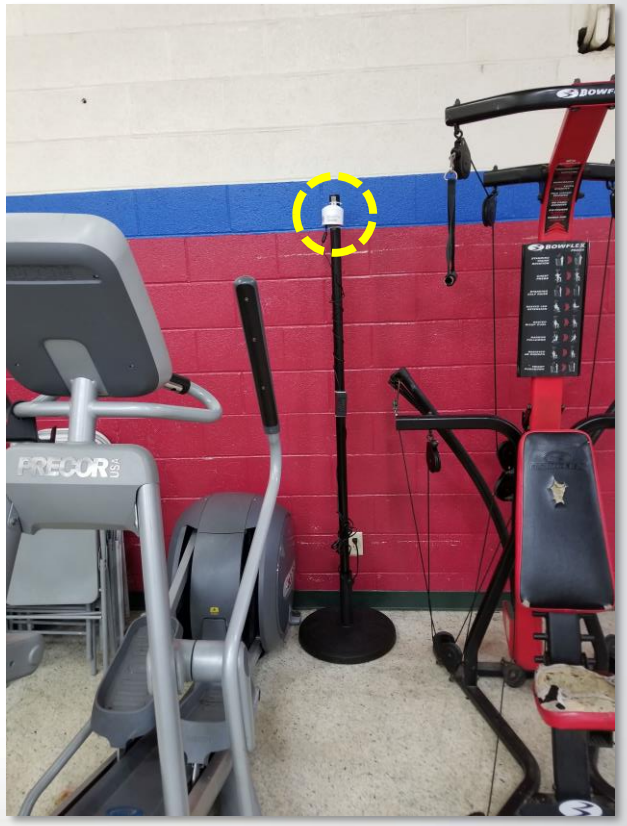
Sensor monitor site setup and building characteristics

- Measured at 10 outdoor locations across the valley and nearby
- Measured in 14 public buildings, targeted buildings where people may stay for extended durations and those that may be used as a clean air shelters:
  - **Workplaces**

    Land Management, Wildland Fire, Forestry, Radio Station
  - **Places with Sensitive/Vulnerable Populations**

    Hoopa Elementary & High Schools, After School Program, Early Childhood Development Center, Senior Nutrition Center
  - **Potential Clean Air Centers**

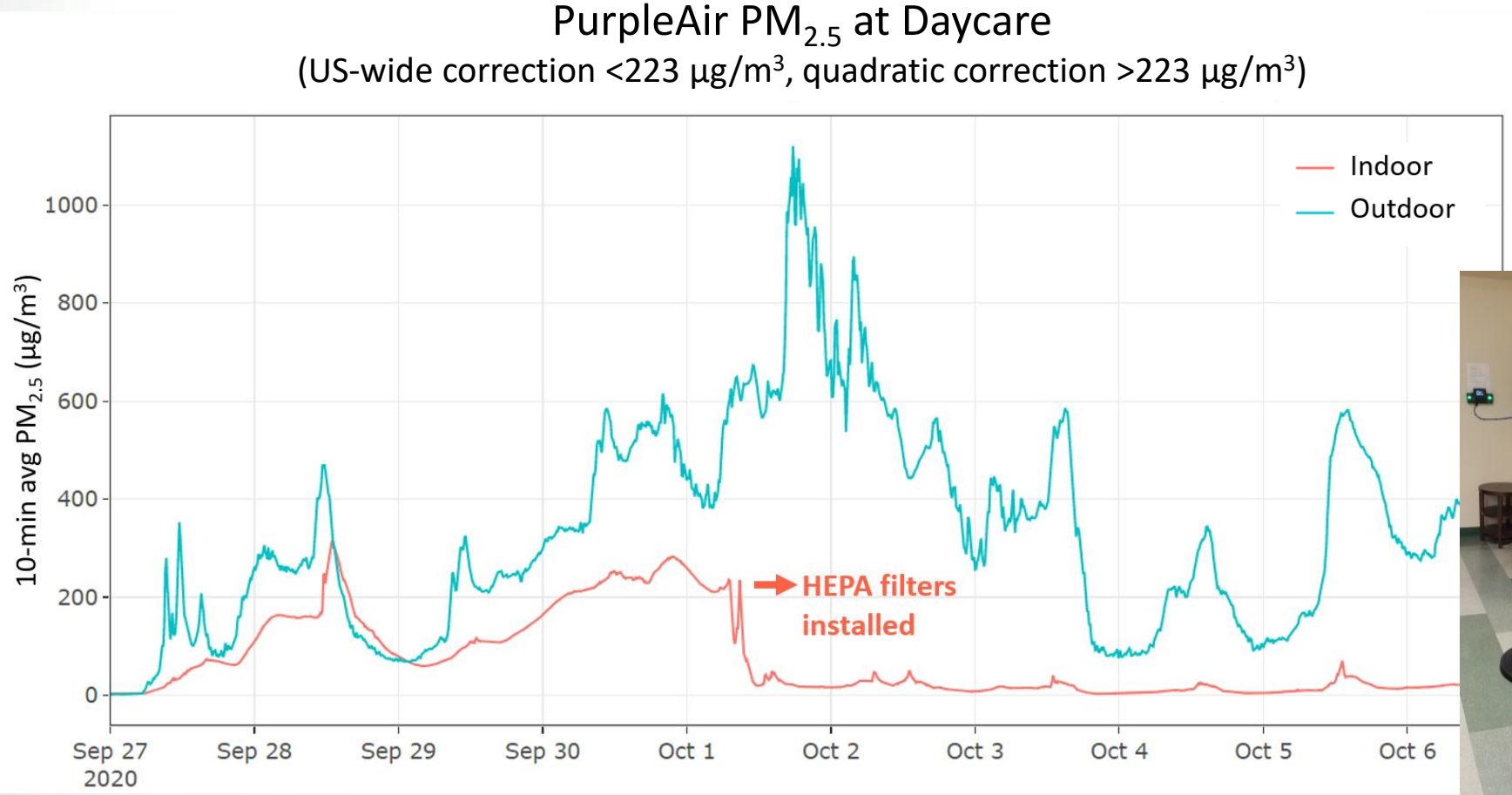
    Neighborhood Facility, K'ima:w Medical Center, Baptist Church
  - ***COVID adaptation Private Residence***
    Brian's house



Photographs courtesy of Hoopa Valley Tribe

Preliminary results from 2020 Wildfire Season

Indoor PurpleAir sensor measurements demonstrated the effectiveness of high-efficiency particulate air (HEPA) filter use during extreme smoke events.



- Building has central air conditioning (AC) system
- 1- 3 people occupy the building daily

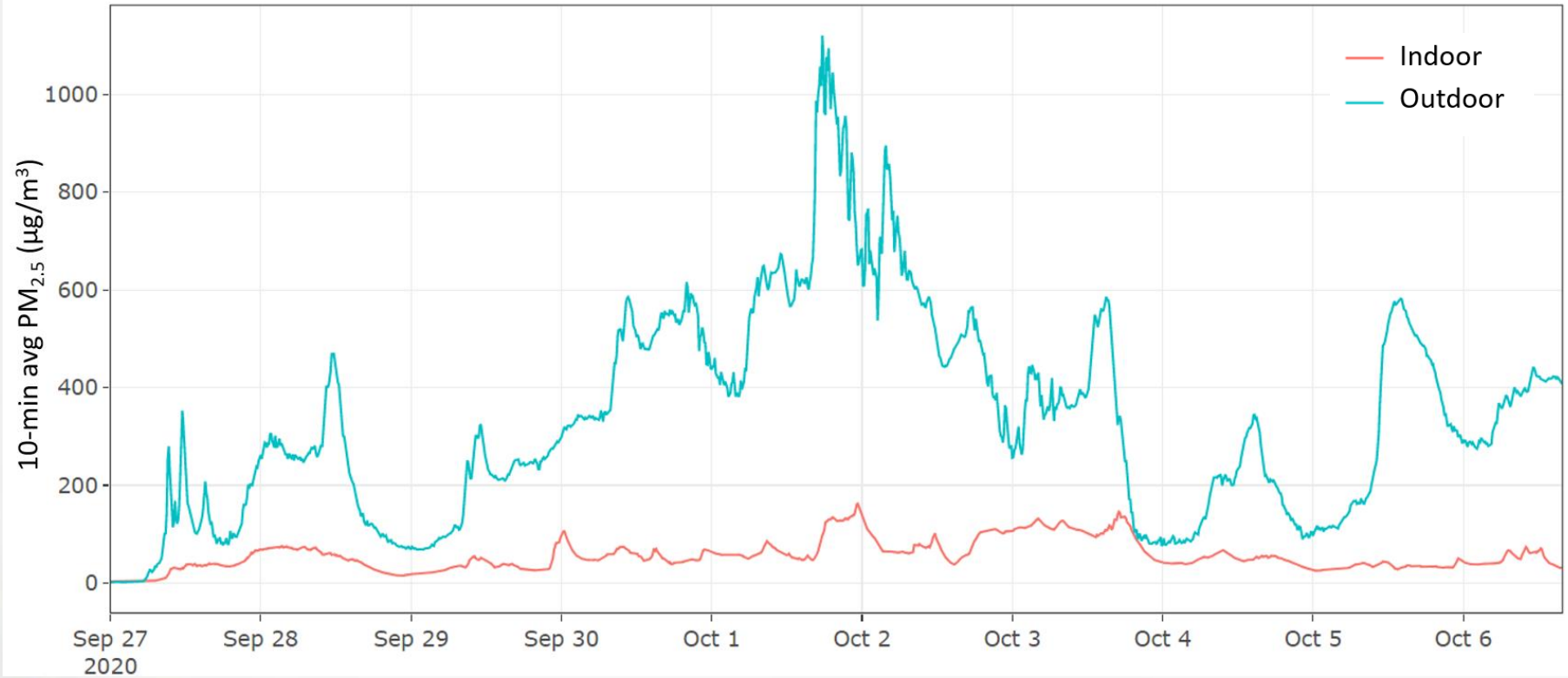
During this smoke episode, doors and windows were kept closed and an industrial rental air cleaner was used

Preliminary results from 2020 Wildfire Season

Some indoor sites were able to maintain consistent indoor concentrations, even when outdoor concentrations were extremely high.

PurpleAir $PM_{2.5}$ at Local Agency Building

(US-wide correction <223 µg/m^3, quadratic correction >223 µg/m^3)



- Building has no central air conditioning (AC) system
- Cooling is achieved with a window AC unit
- 30 – 40 people occupy the building daily
- During this smoke episode, doors and windows were kept closed and borrowed air filters were used (filter type not specified)

Preliminary results from 2020 Wildfire Season

Some indoor sites saw little-to-no reduction of $PM_{2.5}$ indoors

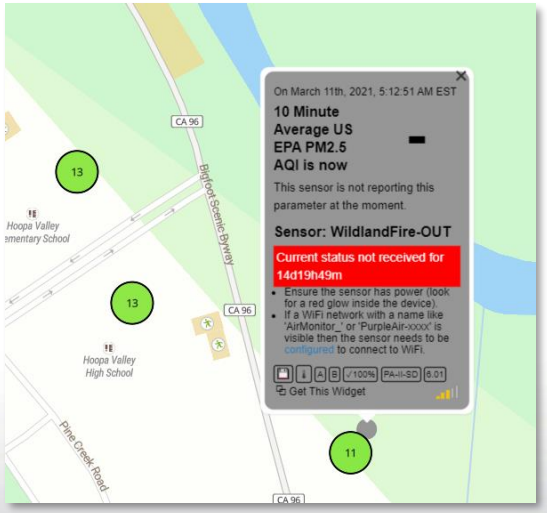
PurpleAir $PM_{2.5}$ at High School Classroom
(US-wide correction <223 µg/m³, quadratic correction >223 µg/m³)

- Building has a central air conditioning (AC) system with unknown MERV* rating
- 1 - 4 people occupy the building occasionally
- During this smoke episode, doors and windows were kept closed and no additional air filtration was used

*MERV = Minimum Efficiency Reporting Value

Lessons learned from a Community Sensor Network

1. Initial batch sensor collocation can identify defective sensors and improve sensor precision with individual sensor corrections
2. Long term sensor collocated with reference useful to ensure correction equation is accurate for your location
3. Power strips help prevent unplugging indoors and data loss
4. Sensor installation at an inaccessible, secure site is recommended to prevent tampering or theft
5. Online data reporting is useful to rapidly identify sensors that have gone offline or are failing

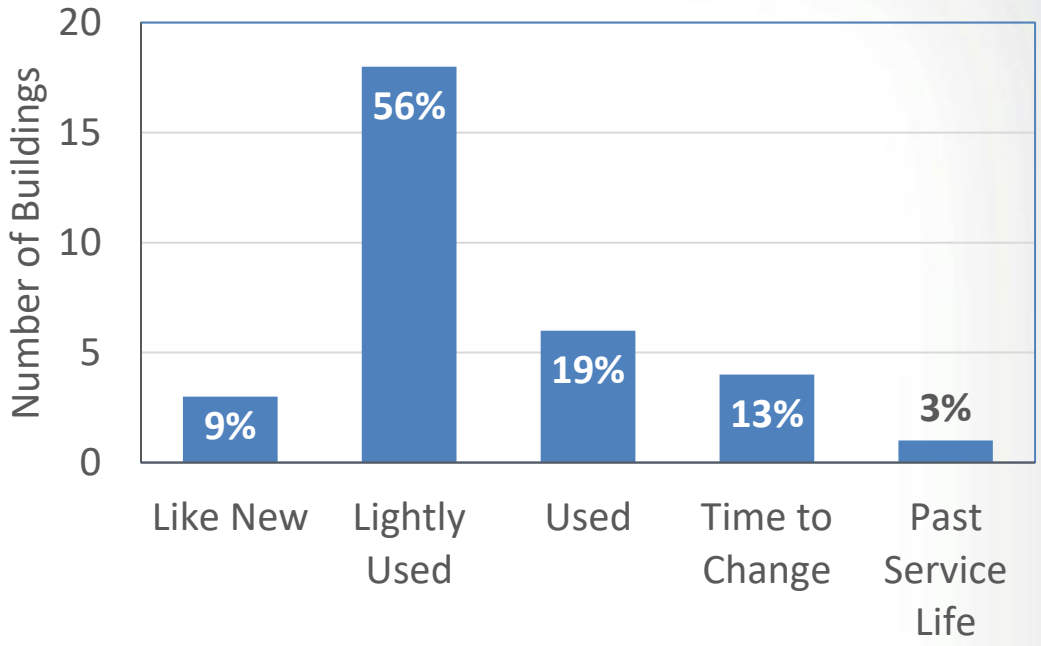


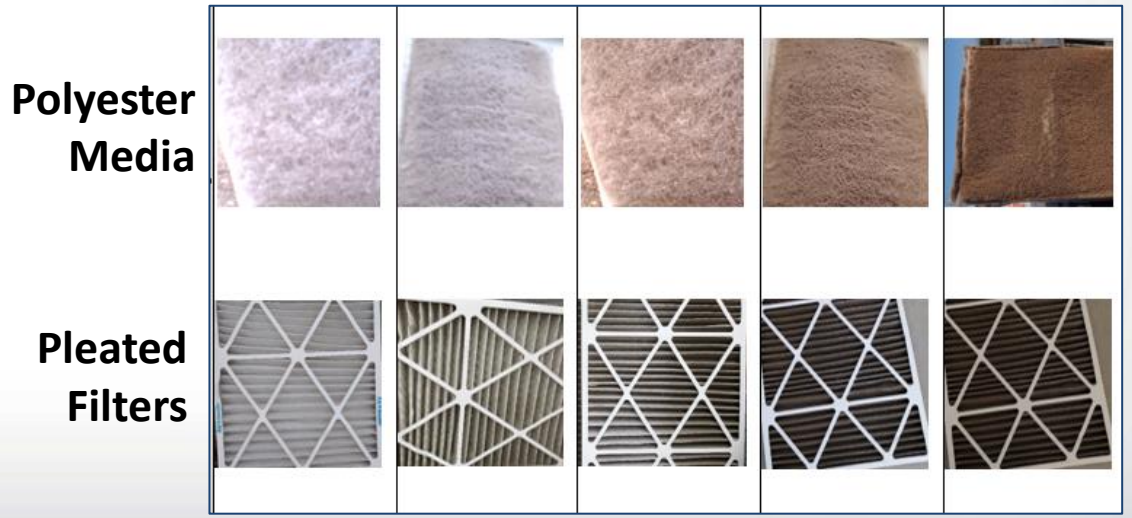
Indoor/Outdoor measurements are paired with HVAC evaluations

Onsite inspection of building HVAC condition:

- Air handling settings/schedules
- Use of portable air cleaners
- HVAC system and filter conditions
- Gaps and seals around filters, doors, and windows
- Door and window inspections
- Building age and construction type
- Room pressure
- Notes of potential indoor sources (*e.g.,* cooking, tobacco smoke, vacuuming/sweeping)
- Building open/close hours
- Door counters to estimate occupancy

Preliminary data from Missoula, MT study



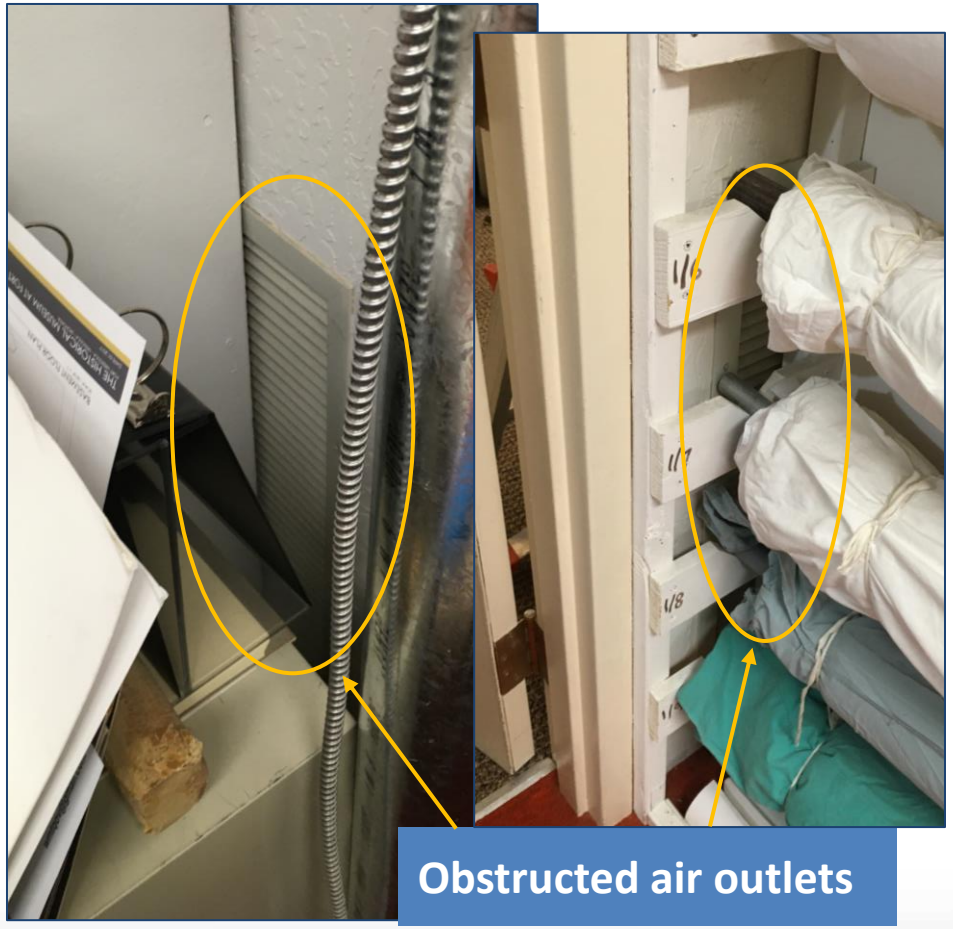


Work in Progress: Development of a building checklist to HVAC identify issues

✗ Right Sized Filters

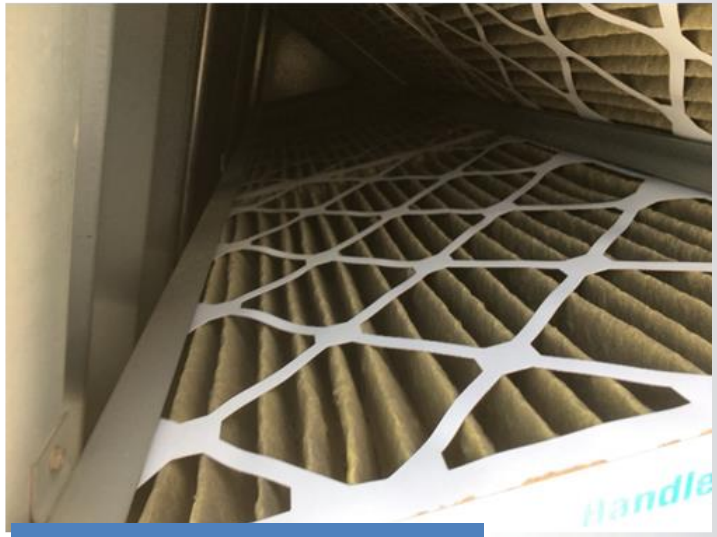
Crushed filter (too large for filter rack)

✗ Unobstructed Air Outlets



Obstructed air outlets

✗ Clean Filters

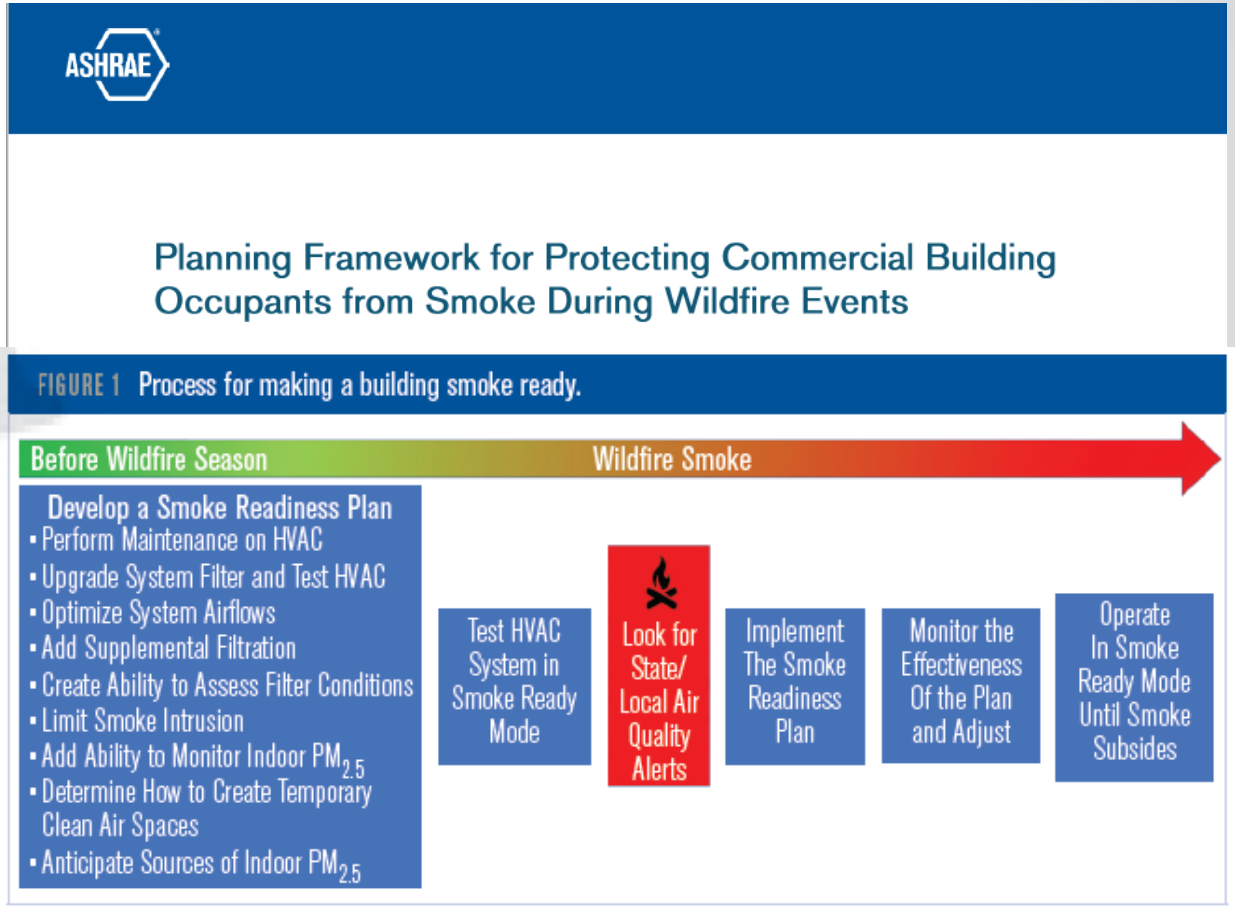


Dirty Filters

Credit: Tom Javins

Under Development: ASHRAE* Guideline 44 – Protecting Commercial Building Occupants During Wildfire Events

- **How to make buildings with air handling units for heating ventilation and air conditioning (HVAC) smoke ready**
  - Upgrade to MERV 13 filters and have extra filters on hand for frequent replacement
  - Maintain HVAC system, identify and repair broken dampers and controls
  - Test and optimize HVAC flows to ensure positive building pressure and sufficient ventilation
  - Limit smoke intrusion by weatherizing building, closing windows, limiting door openings
  - Monitor $PM_{2.5}$ levels indoors
  - Identify indoor sources of $PM_{2.5}$ and limit activities during smoke episodes
  - Use portable air cleaners if necessary



https://www.ashrae.org/file%20library/technical%20resources/covid-19/guidance-for-commercial-building-occupants-from-smoke-during-wildfire-events.pdf

***ASHRAE = American Society of Heating, Refrigeration, and Air-conditioning Engineers**

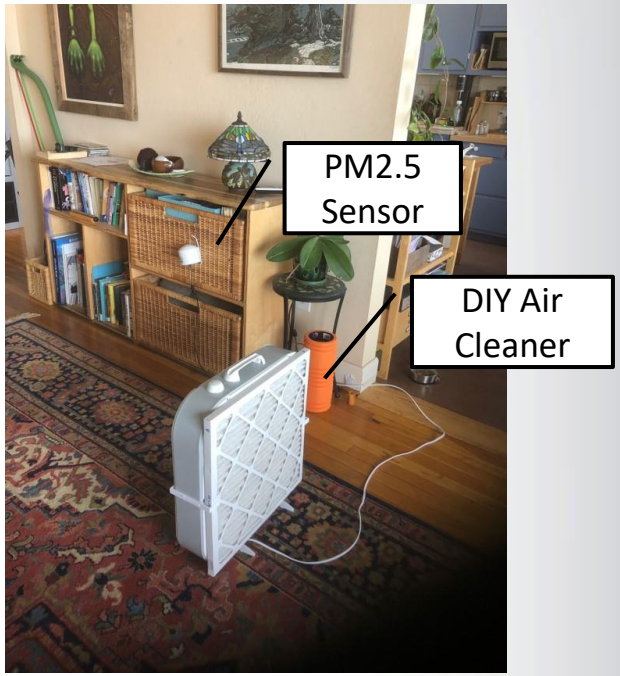
Work in Progress: Evaluating the safety and effectiveness of do-it-yourself (DIY) air cleaners

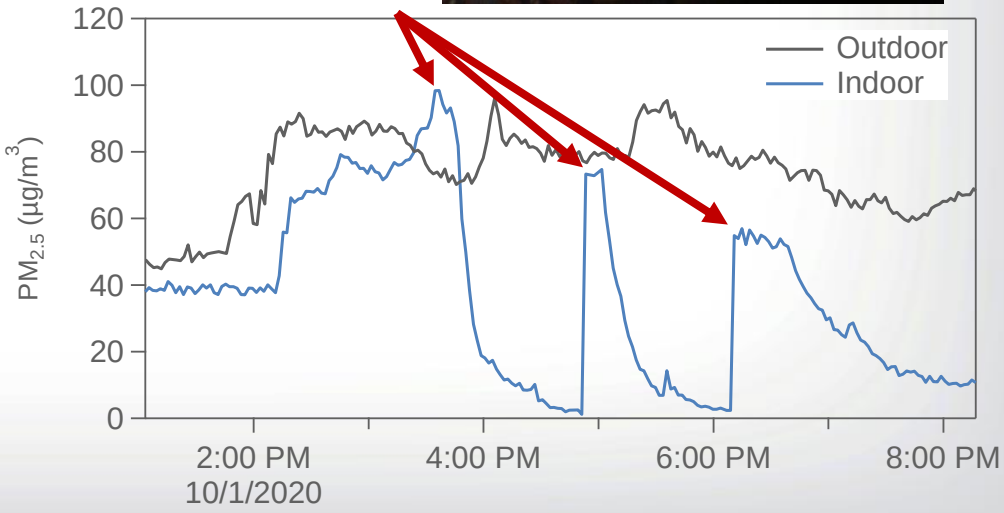
DIY Air cleaner = Box fan + furnace filter

- Low-cost and accessible approach to air cleaning
- How to instructions from Confederated Tribes of the Colville Reservation

  https://www.cct-enr.com/box-fan-filter
- Partnering with UL for safety evaluations expect results this year
- For now, recommend using only new (since 2012) box fans with added safety features
- Currently evaluating effectiveness in the lab and in homes
- Preliminary data show DIY air cleaner is as effective as small size commercial air cleaners (clean air delivery rate ~40 on low, ~110 on high)

DIY operated indoors in San Francisco during 2020 smoke episode





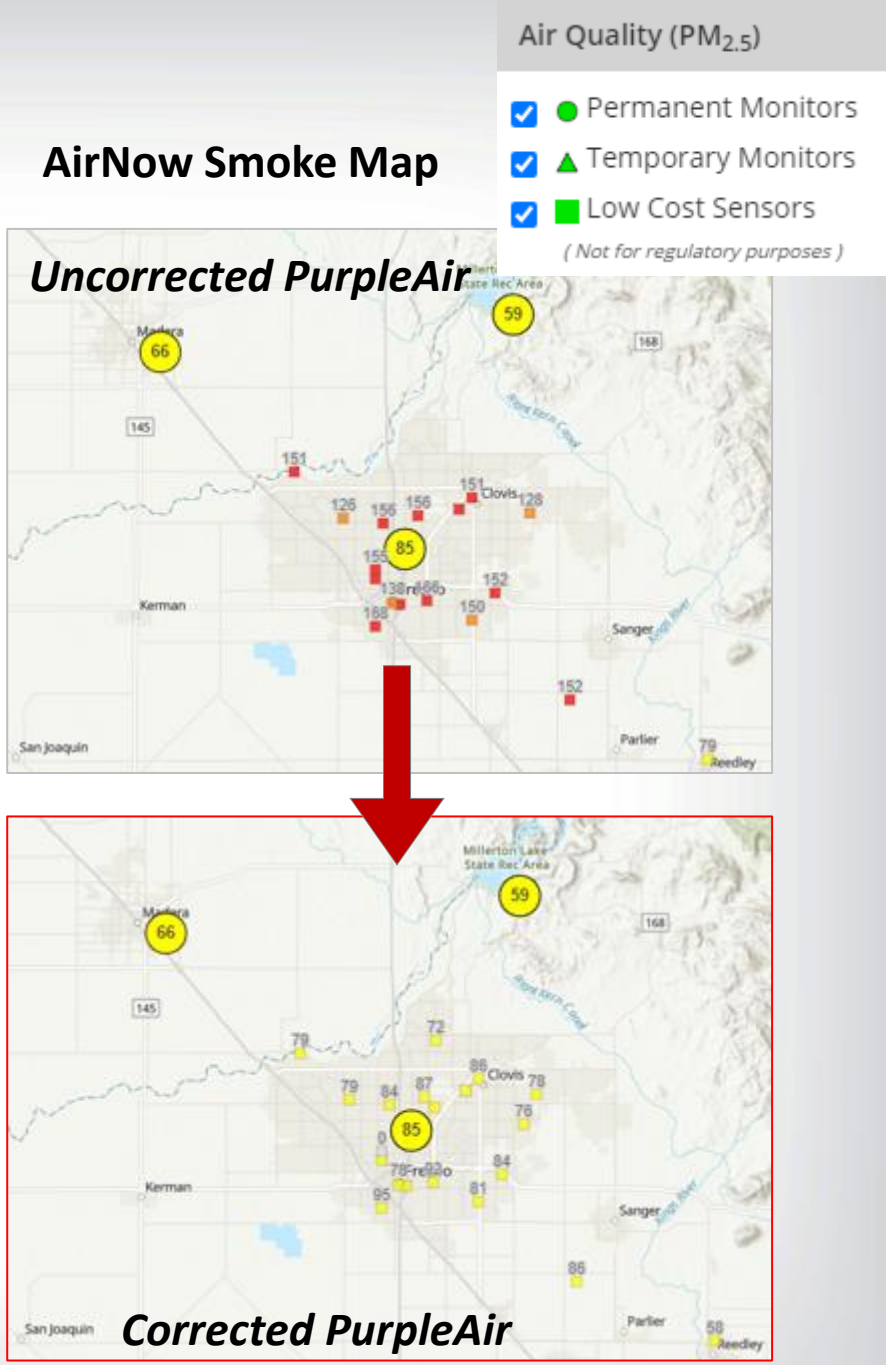
Prize-based Challenge to Create Low-Cost Devices to Clean Indoor Air

- Encourages development of new, effective, low-cost approaches to remove $PM_{2.5}$ from indoor air, particularly high concentrations due to smoke events or high pollution episodes
- Identifies approaches that provide cooling and can operate during a power outage as desirable
- More information on the challenge can be found on these sites:
  - EPA webpage
  - Press release
  - InnoCentive page
  - Challenge.gov

Take Home Summary

- **A significant amount of research** has been done by EPA, local agencies, and academia to better understand PurpleAir performance giving us more confidence in reported measurements
- EPA's PurpleAir **correction equation** improves the accuracy of $PM_{2.5}$ measurements for many different cases including during smoke conditions
- PurpleAir sensors provide **additional spatial variation** of $PM_{2.5}$ on the AirNow Smoke map
- **Air sensors are useful tools** for making indoor/outdoor measurements and in demonstrating the effectiveness of interventions aimed at reducing smoke exposures
- Work continues to develop methods to clean indoor air during wildfire smoke episodes

AirNow Smoke Map



Project Publications & Websites

EPA Air Sensor Research Overview

https://www.epa.gov/air-sensor-toolbox/epa-air-sensor-research-overview

Wildfire ASPIRE Study

https://www.epa.gov/air-research/wildfire-study-advance-science-partnerships-indoor-reductions-smoke-exposures

Project Publications:

- Holder, A., A. Mebust, L. Maghran, M. McGown, K. Steward, D. Vallano, R. Elleman, and K. Baker, 2020. 'Field Evaluation of Low-Cost Particulate Matter Sensors for Measuring Wildfire Smoke', Sensors, DOI:10.3390/s20174796
- Barkjohn (Johnson), K, B. Gantt, A. Clements, 2020 'Development of a United States Wide Correction for $PM_{2.5}$ Data Collected with the PurpleAir Sensor', Atmospheric Measurement Techniques Discussion, DOI:10.5194/amt-2020-413
- Davison, G., K. Barkjohn (Johnson), G. Hagler, A. Holder, S. Coefield, C. Noonan, B. Hassett-Sipple, 2021 'Creating Clean Air Spaces During Wildland Fire Smoke Episodes: Web Summit Summary', Frontiers in Public Health, DOI:10.3389/fpubh.2021.508971
- Barkjohn (Johnson), K, A. Holder, S. Frederick, A. Clements, (in preparation) 'PurpleAir $PM_{2.5}$ U.S. Correction and Performance During Smoke Events'

Acknowledgements

AK: State of Alaska, Citizens for Clean Air

AZ: Maricopa County Air Quality Department

CA: Hoopa Valley Tribe, San Luis Obispo County Air Pollution Control District, Mojave Desert Air Quality Management District, Antelope Valley Air Quality Managment District, California Air Resources Board, Santa Barbara County Air Pollution Control District, Air Quality Sensor Performance Evaluation Center, Ventura County Air Pollution Control District, Bay Area Air Quality Management District

CO: Colorado Department of Public Health and Environment

DE: Delaware Division of Air Quality

FL: Sarasota County Government

GA: EPA Region 4, Georgia Environmental Protection Division

IA: Iowa Department of Natural Resources, Polk and Linn County Local Programs, and the State Hygienic Laboratory at the University of Iowa

MT: Missoula County, Montana Department of Environmental Quality

NC: Forsyth County Office of Environmental Assistance & Protection, Clean Air Carolina, UNC Charlotte, North Carolina Department of Environmental Quality

OH: Akron Regional Air Quality Management District

OK: Quapaw Nation, Oklahoma Department of Environmental Quality

UT: University of Utah, Utah Department of Environmental Quality

VA: Virginia Department of Environmental Quality

VT: State of Vermont

WA: Washington Department of Ecology, Puget Sound Clean Air Agency

WI: Wisconsin Department of Natural Resources

Federal: Forest Service, Wildland Fire Air Quality Response Program, National Park Service, EPA Region 9, EPA Region 10, Lauren Maghran, Ed Brunson, Mike McGown, Sam Frederick, Brett Gantt, Ian Vonwald, Heidi Vreeland, Gayle Hagler

Contact:
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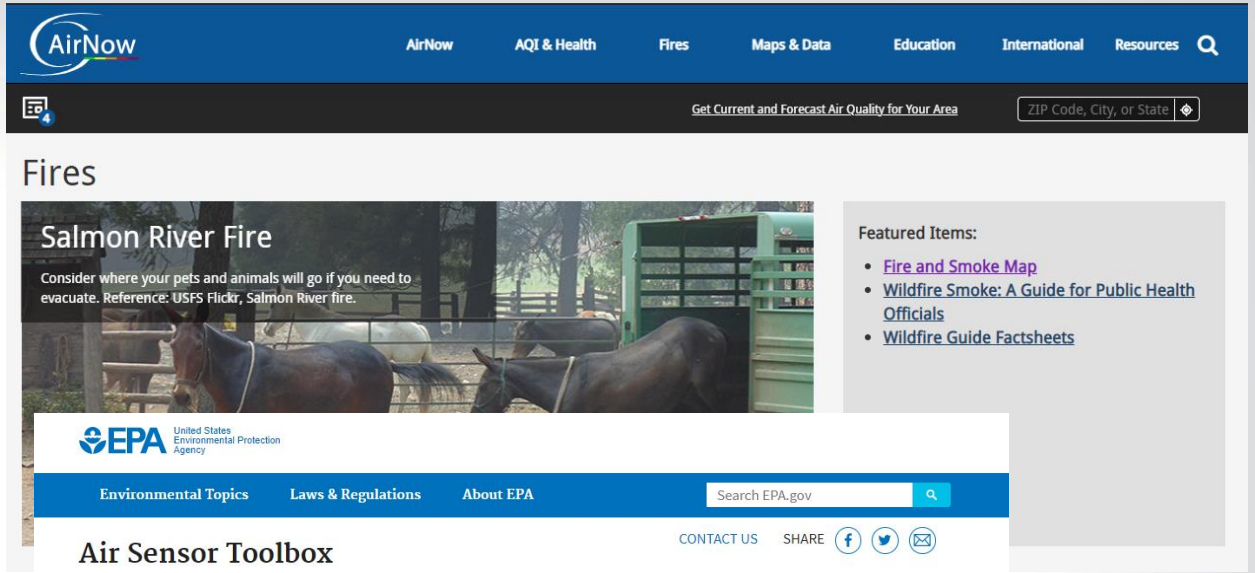
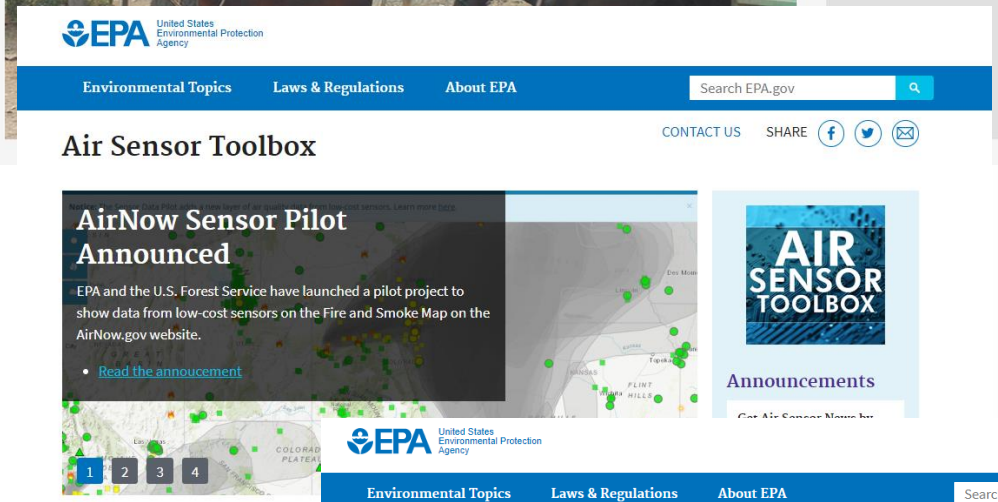
Clements.Andrea@epa.gov

Wildfire Smoke Resources

AirNow Fire Page https://www.airnow.gov/fires/

- AirNow fire and smoke map
- Factsheets
- Current Smoke Advisories
- Smoke Ready Toolbox
- Wildfire Smoke Guide for Public Health Officials
- For questions about AirNow Sensor Data Pilot Contact: Sensordatapilot@epa.gov





Air Sensor Resources

Air Sensor Toolbox http://www.epa.gov/air-sensor-toolbox

- Air Sensor Guidebook
- Air Sensor Loan Programs
- Sensor Evaluation Results
- Technical Information about U.S.-Wide Correction

Indoor Air Quality Resources

Wildfires and Indoor Air Quality (IAQ)

https://www.epa.gov/indoor-air-quality-iaq/wildfires-and-indoor-air-quality-iaq

- Smoke infiltration information
- Exposure reduction information (HVAC, Respirators, Portable Air Cleaners)

Supplemental Slides

Quality Assuring and Correcting Other Sensor Types

- Many PM **sensors show similar trends** to reference instruments
- **Sensor data must be corrected** to be more comparable
  - May be dependent on make/model even if similar internal components
- Data cleaning methods also dependent on make/model
  - PurpleAir is unique with duplicate PM measurements
- Good agreement between sensors of the same make/model is necessary for fleet-wide corrections