Blue Lake Rancheria's Community Air Quality Monitoring Projects

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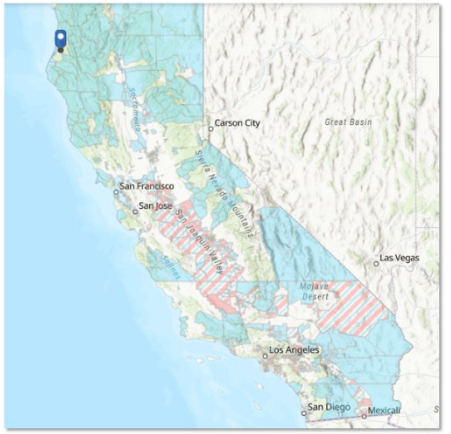
Photo credit: https://www.bluelakerancheria-nsn.gov/

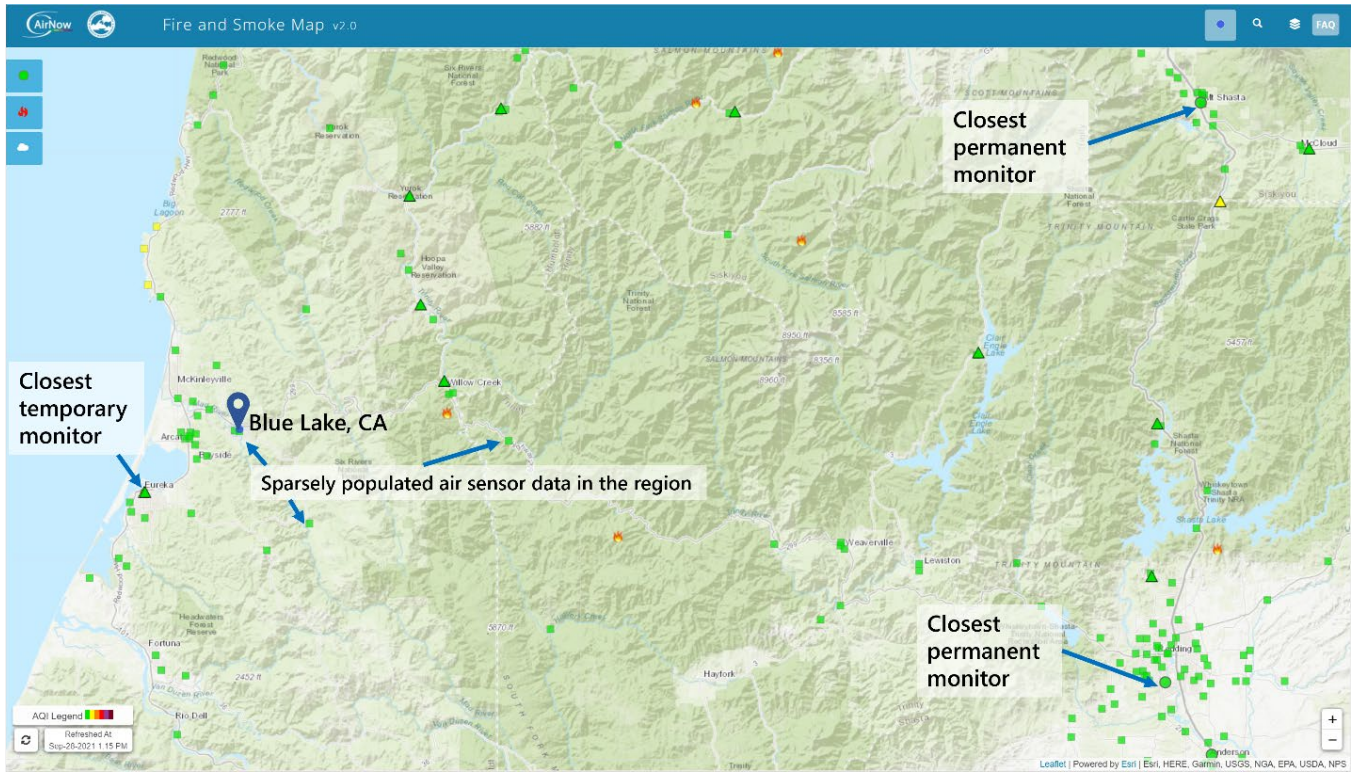
Outline

- About Blue Lake Rancheria
- Current and future measurements
- T640 data
  - Wildfire impacts
  - Seasonal trends
  - Summary
- Air quality education efforts

About Blue Lake Rancheria



- Blue Lake Rancheria is in northwestern California, near Eureka and Arcata, five miles inland from the Pacific Coast
- Impacted by pollution from Hwy 299, local sources, wood burning, and wildfire smoke
- (At the time) Nearest regulatory $PM_{2.5}$ monitors are:
  - Redding (~ 87 miles southeast)
  - Base of Mt. Shasta (~ 92 miles northeast).
- Complex mountainous terrain and microclimates make air quality highly variable



Blue Lake Air Monitoring Efforts: CARB

Received a **CARB Community Air Protection Program grant** to:

- Monitor $PM_{2.5}$ concentrations with an FEM instrument
- Develop an air sensor network to assess the spatial variability of $PM_{2.5}$ concentrations
- Engage with and educate community members

Establish regulatory grade air quality monitoring for PM (T640) + met data.

Establish a $PM_{2.5}$ sensor network for hyperlocal air quality information

Air quality education for students and community members

kids making sense®

Blue Lake Air Monitoring Efforts: EPA

Received an **EPA Enhanced AQ Monitoring for Communities** to:

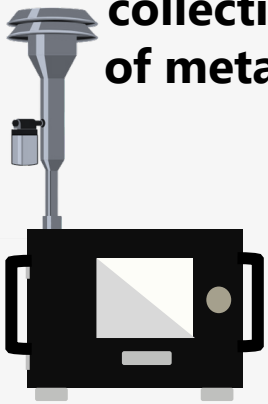
- Continue FEM monitoring for $PM_{2.5}$ concentrations
- Determine the contribution of fossil fuel burning and woodsmoke burning to total BC
- Determine possible sources of metals and BC in the community

Establish regulatory grade air quality monitoring for PM (T640) + meteor

Establish a $PM_{2.5}$ sensor network for hyperlocal air quality information

Air quality education for students and community members

Black carbon and air toxics monitoring (AE33 & filter collection of metals)



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TODAY:

Establish regulatory grade air quality monitoring for PM (T640) + met. data

Establish a $PM_{2.5}$ sensor network for hyperlocal air quality information

Air quality education for students and community members

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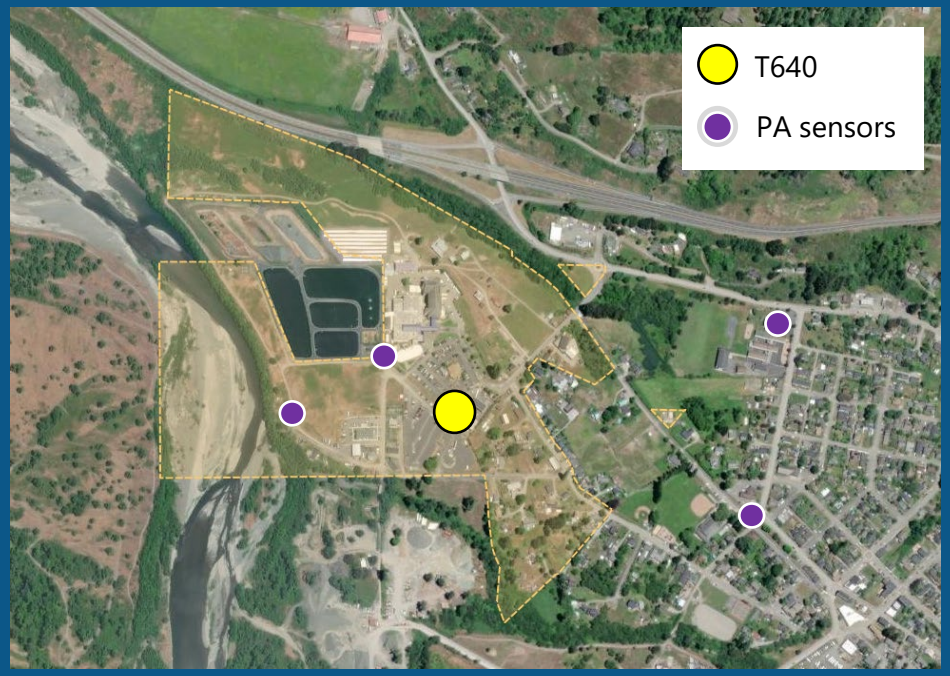
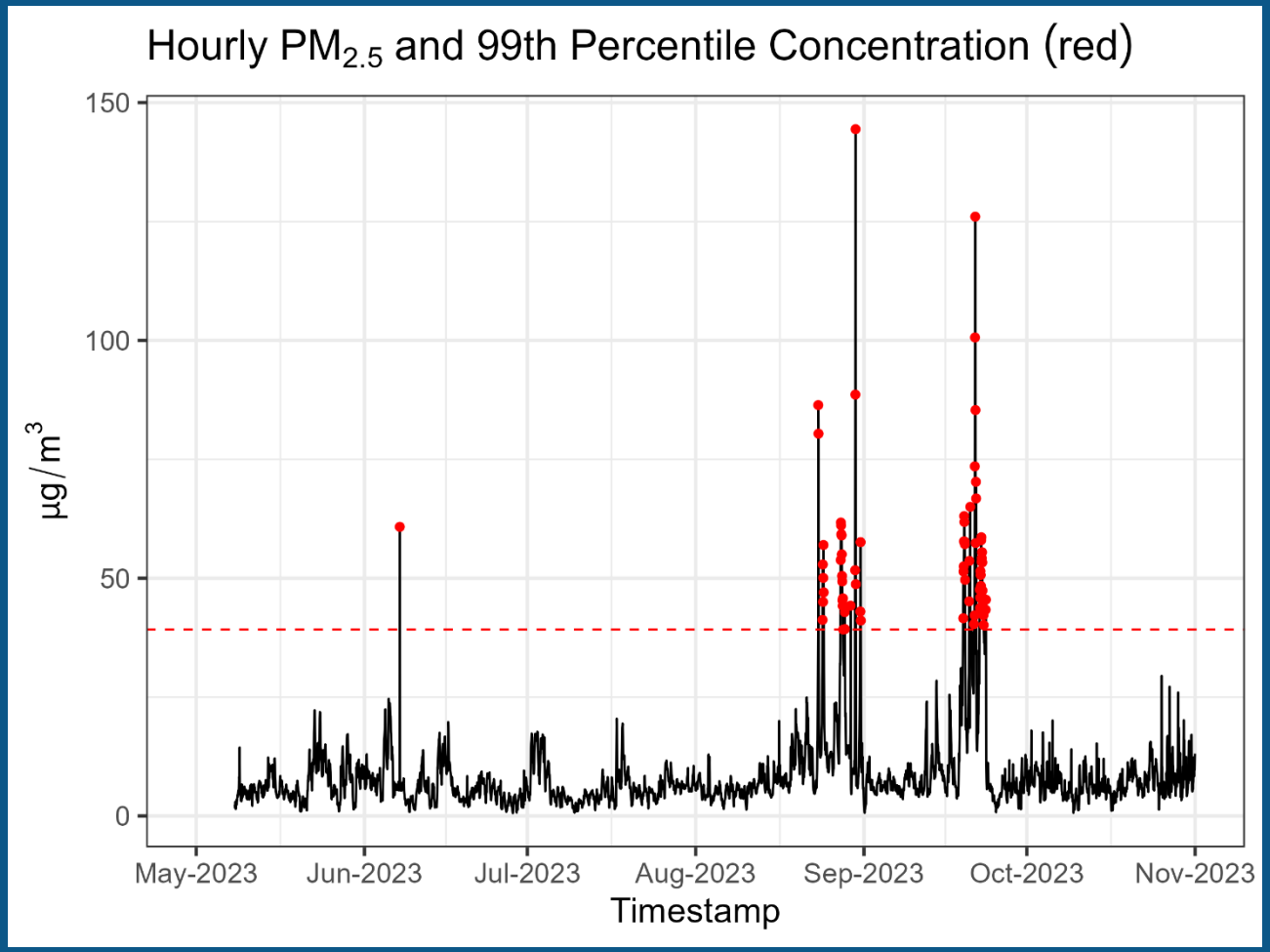
Timeseries Overview



- Daily $PM_{2.5}$ concentrations are mostly in the "good" AQI range
- Air quality in the summer and fall is strongly influenced by wildfire events



Wildfire Impacts

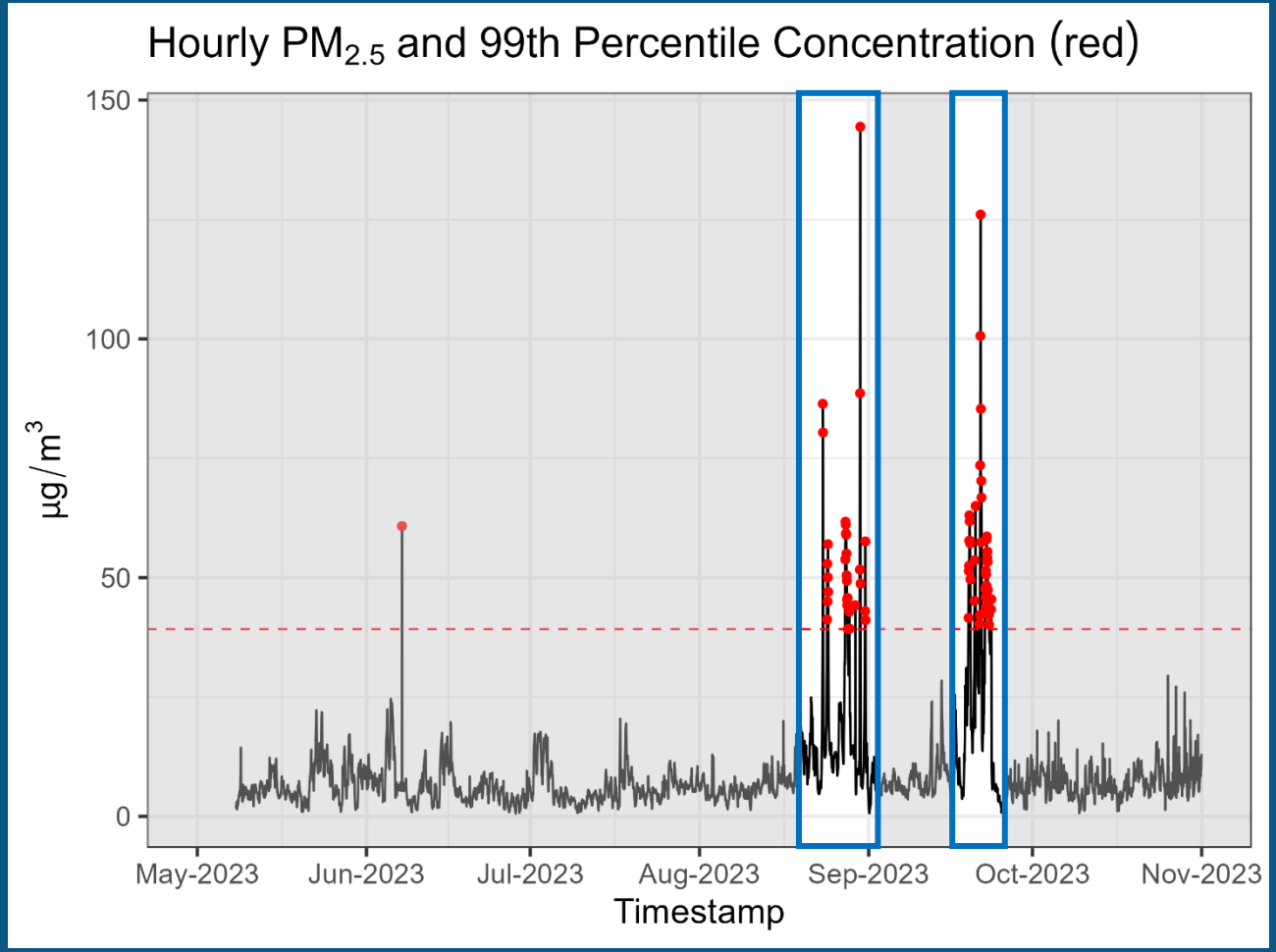
2023 Wildfire Events

Wildfire smoke blanketed Blue Lake during two main wildfire events in 2023

August 15-28 and September 19-23

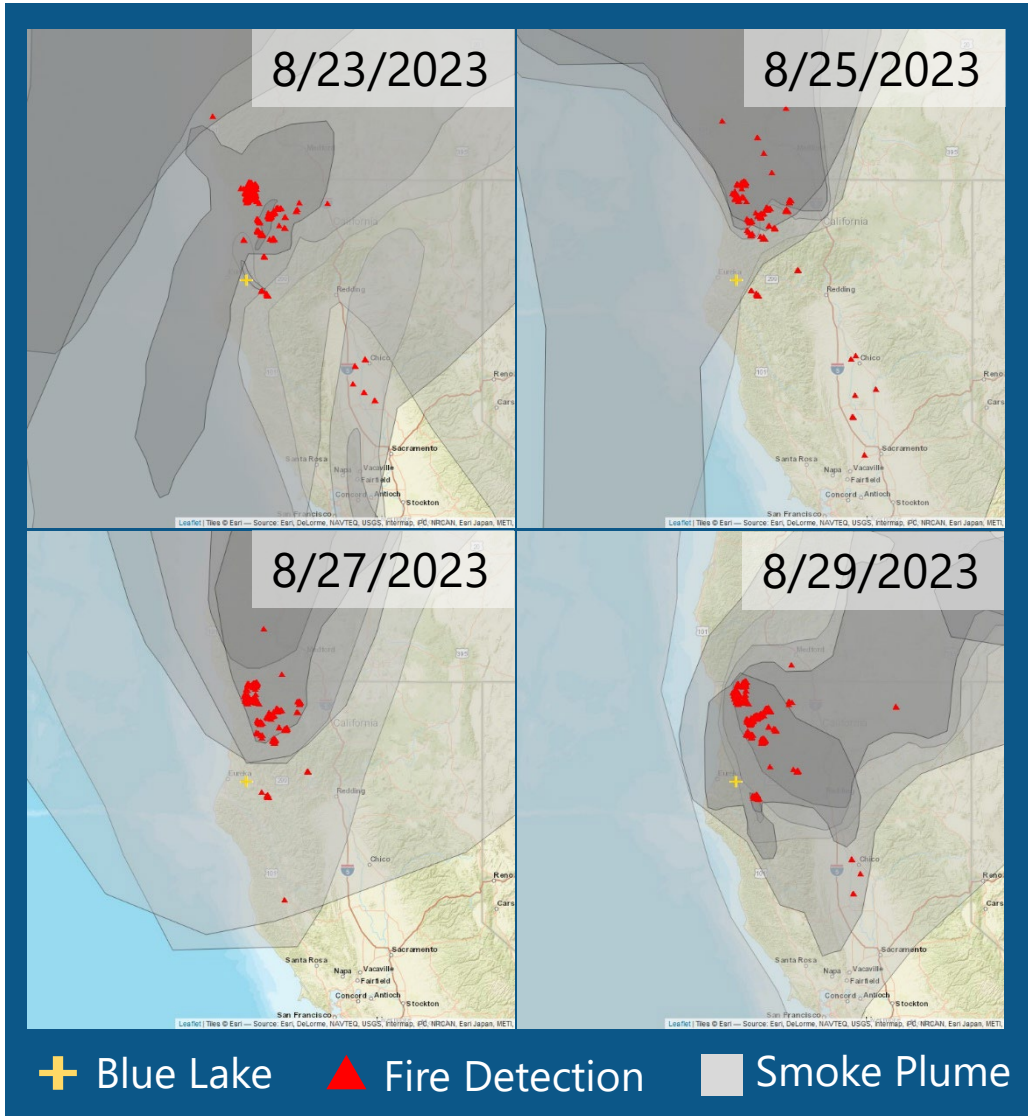
Contributing fires:

- SRF Lightning Complex (CA)
- Smith River Complex (CA)
- South Fork Complex (CA)
- Anvil Fire (OR)
- Flat Fire (OR)

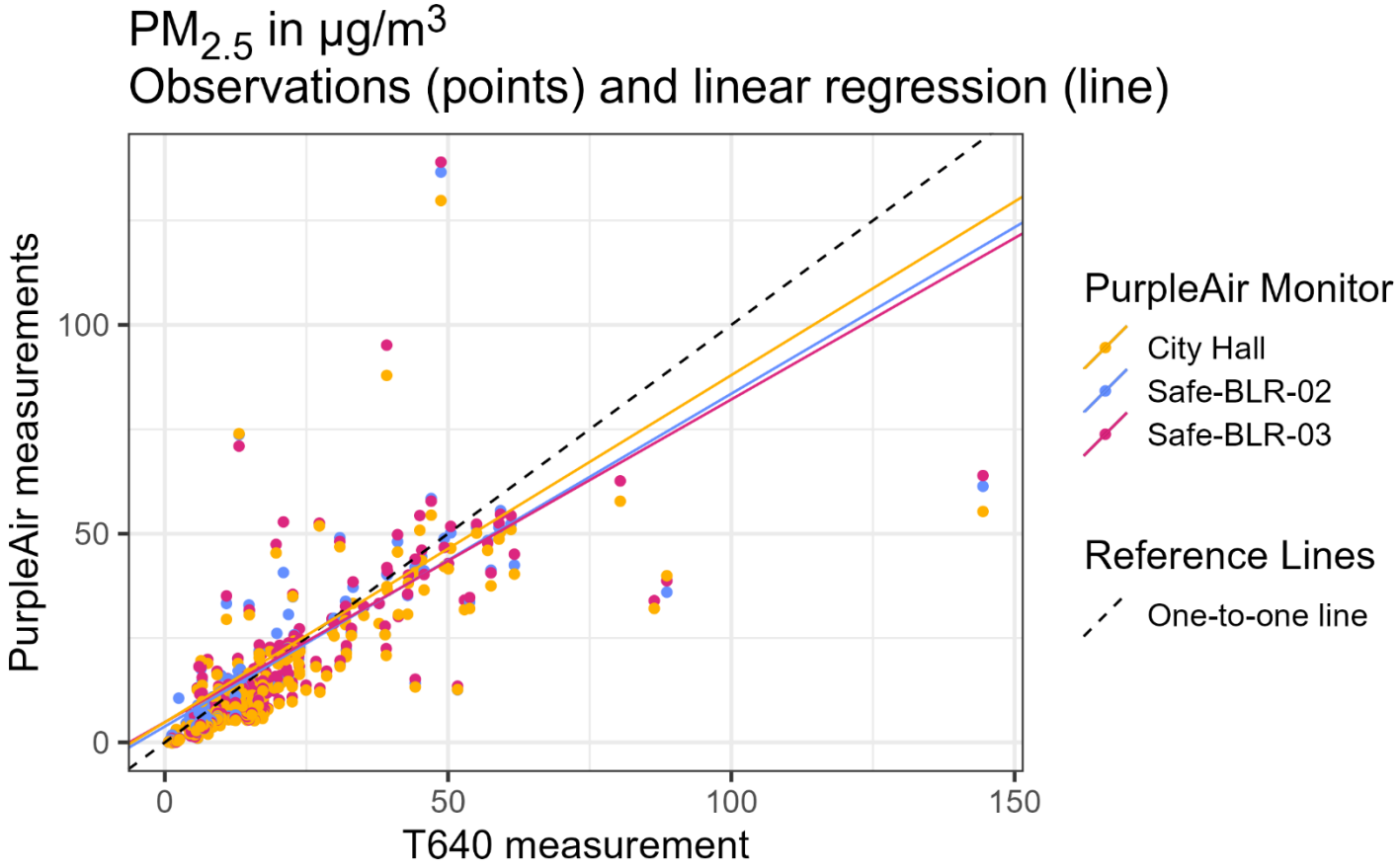


August Wildfire Event

Date	Max Hourly $PM_{2.5}$	Daily Mean $PM_{2.5}$	Daily Median $PM_{2.5}$	AQI
8/23/2023	86.4	19.9	13.5	Moderate
8/24/2023	57.0	25.7	18.3	Moderate
8/25/2023	15.4	12.1	12.7	Moderate
8/26/2023	23.9	16.3	14.2	Moderate
8/27/2023	61.7	30.3	20.7	Moderate
8/28/2023	4.3	28.2	29.7	Moderate
8/29/2023	44.2	12.6	12.7	Good
8/30/2023	144.4	21.3	8.9	Moderate
8/31/2023	57.6	18.1	12.3	Moderate



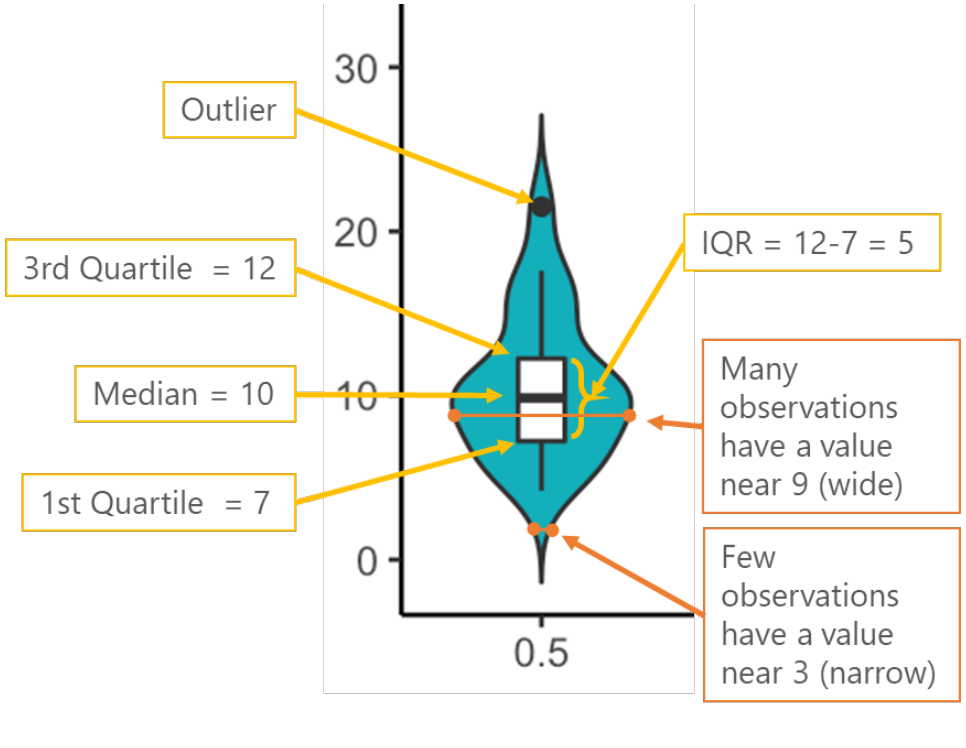
PurpleAir Network

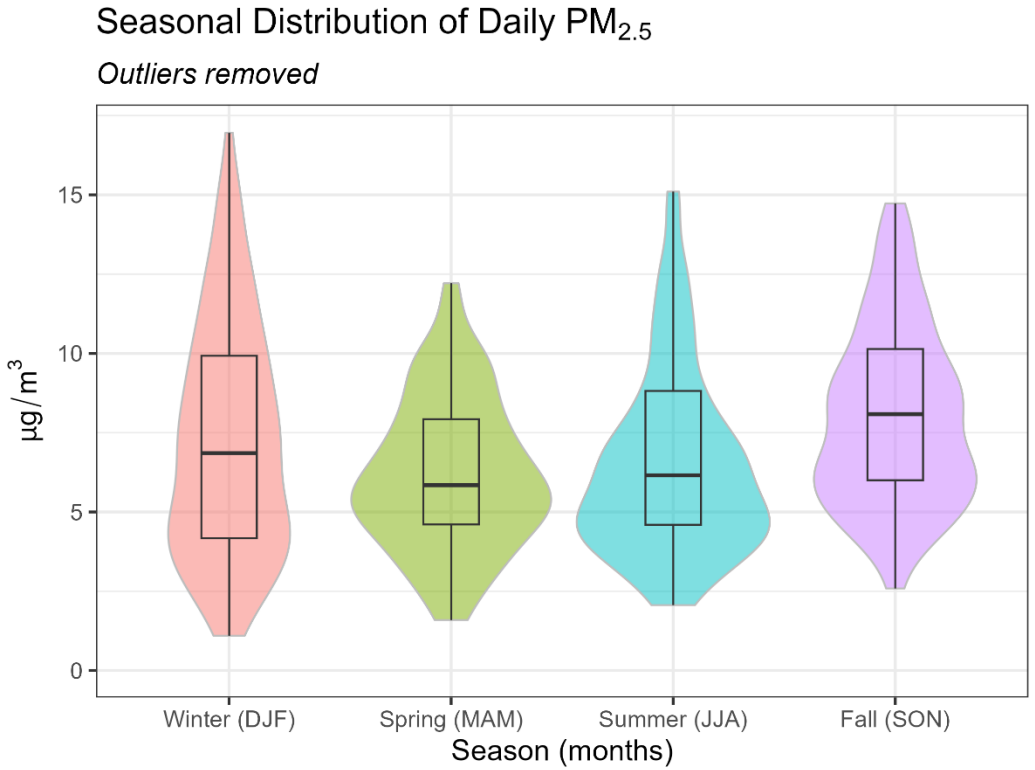


- 20 sensors (indoor and outdoor)
  - 3 sensors online during August fires
  - PA data corrected using EPA correction
- R^2 between sensors and T640 = 0.76-0.77
- PA sensors are in good agreement with T640, though slightly underpredict $PM_{2.5}$ concentrations

T640 $PM_{2.5}$ Seasonal Results

Seasonal Variation in $PM_{2.5}$ Concentrations

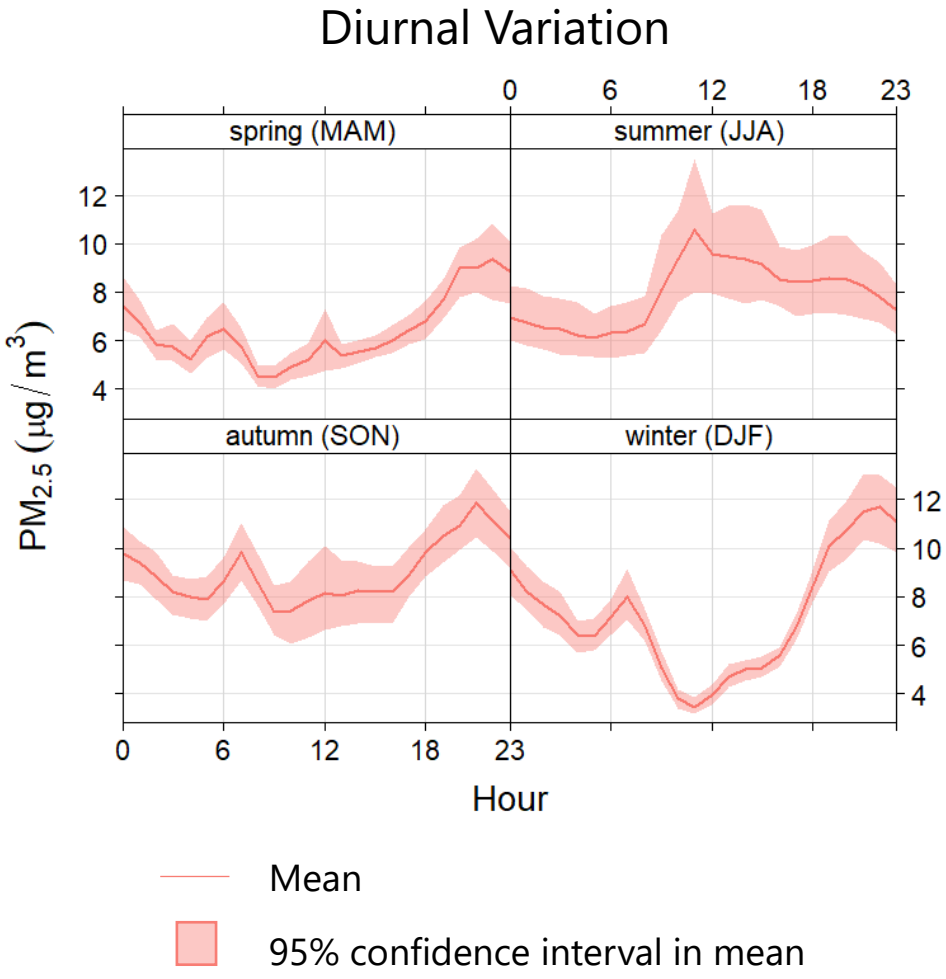




- High outliers in summer and fall related to wildfire smoke have been removed.
- Winter has the largest range, and the highest maximum concentrations, excluding outliers.
- Springtime shows the lowest overall concentration.

Seasonal Variation in $PM_{2.5}$ Concentrations

- Winter, fall, and spring have highest $PM_{2.5}$ concentrations in the evening.
  - Possibly woodsmoke and/or boundary layer compression effects.
- Diurnal variation is most pronounced in the winter.

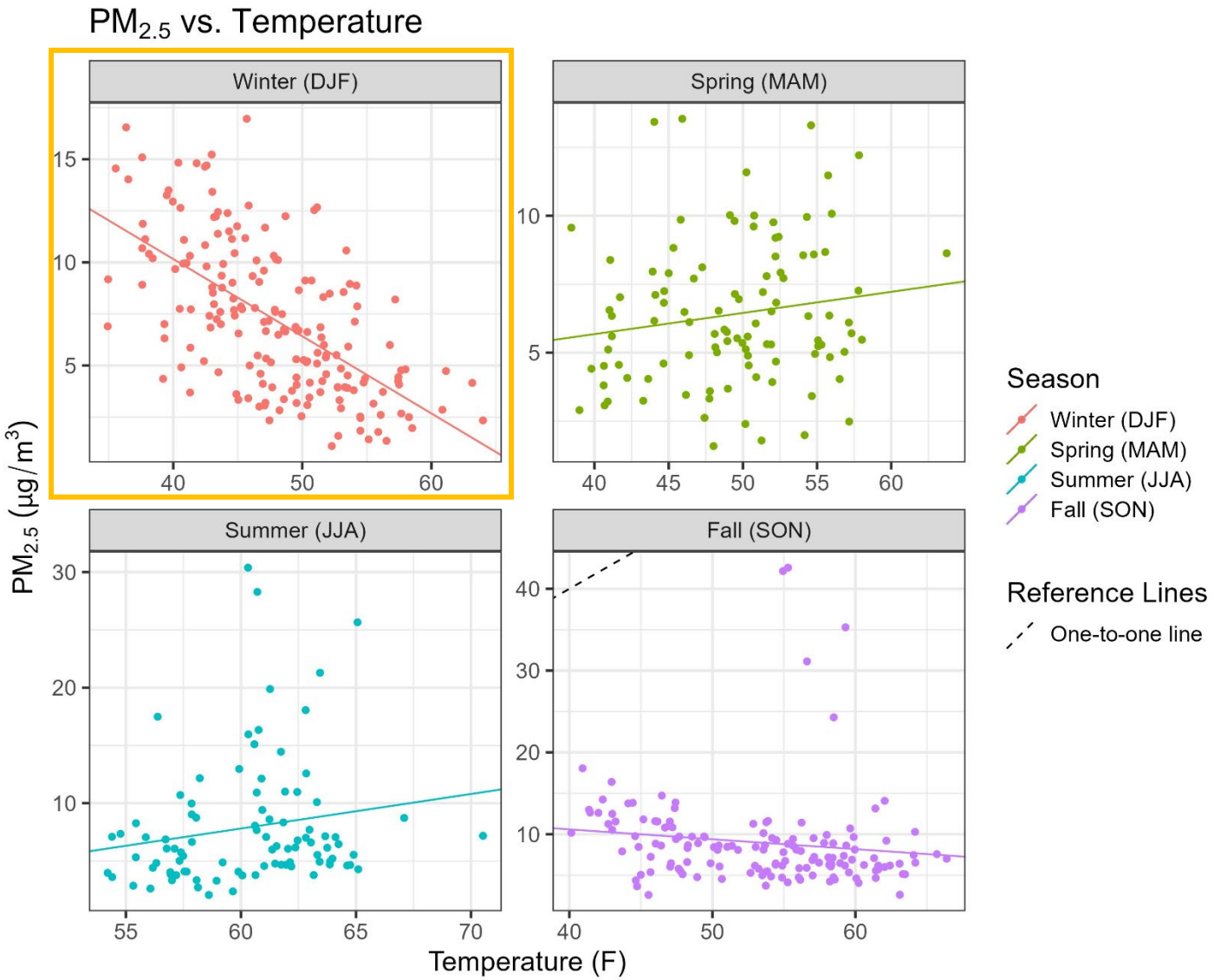


Wintertime $PM_{2.5}$

Wintertime $PM_{2.5}$ concentrations are inversely correlated with temperature.

Season	Slope	P-value	R^2
Fall (SON)	-0.12	0.11	0.02
Winter (DJF)	**-0.37**	**0.00**	**0.38**
Spring (MAM)	0.08	0.13	0.02
Summer (JJA)	0.30	0.10	0.03

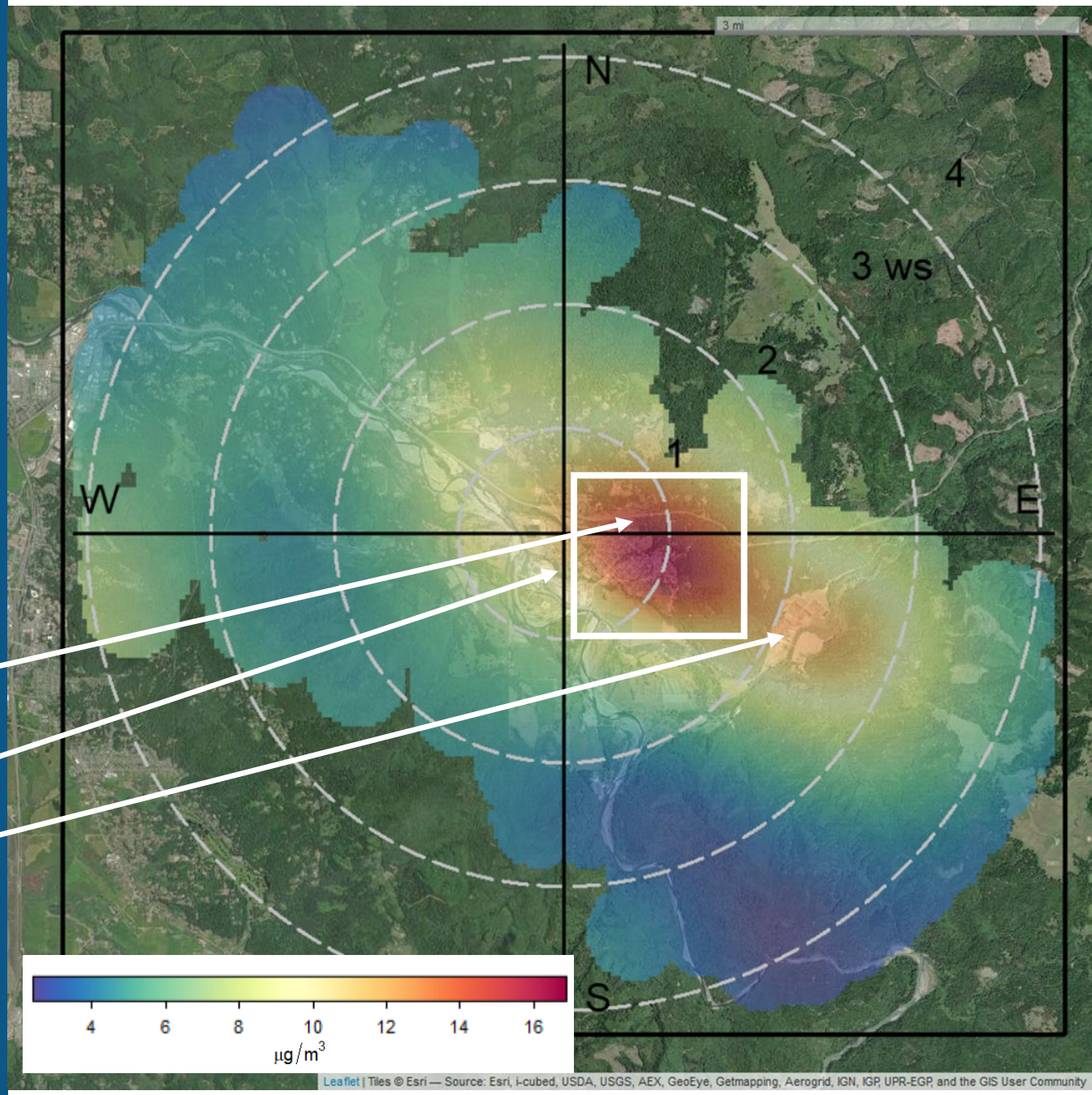
On average, a 1°F decrease in temperature is correlated with a 0.37 µg/m³ increase in $PM_{2.5}$ concentrations.



Wintertime $PM_{2.5}$

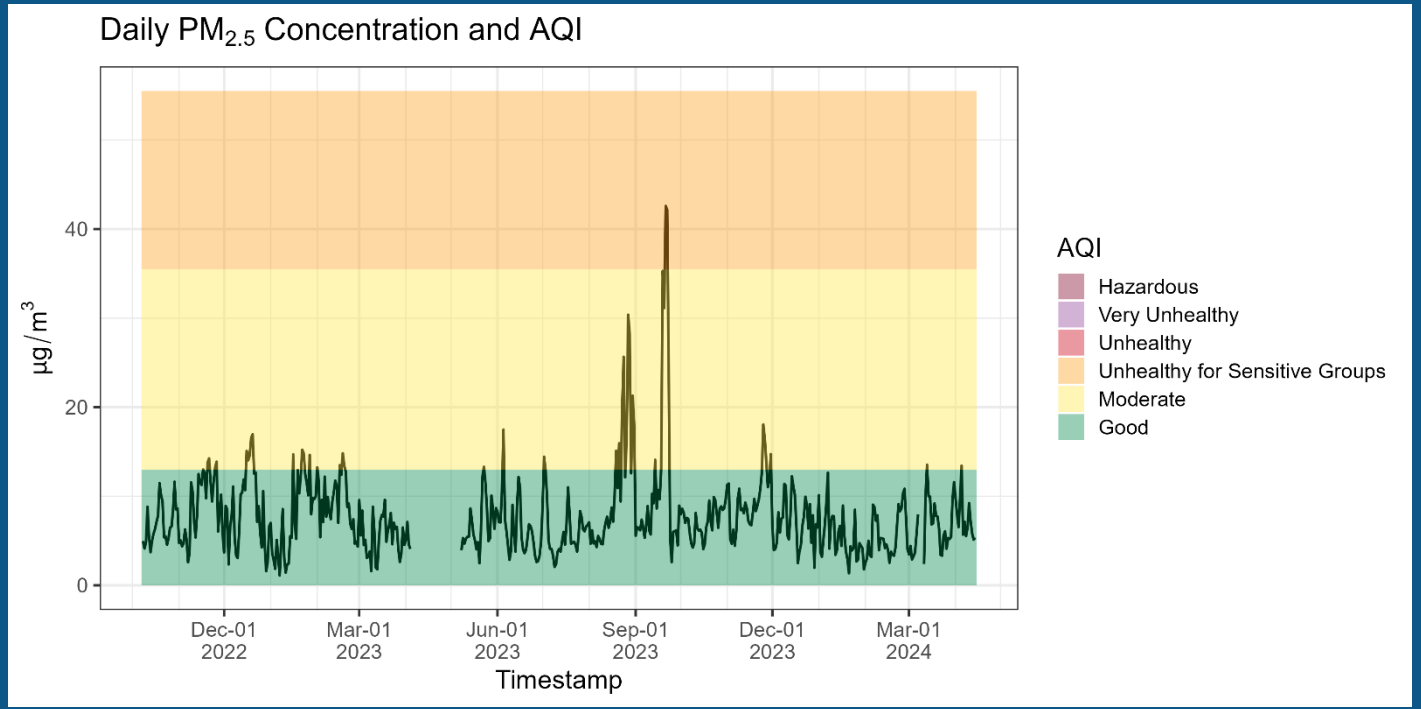
- Polar plot to determine $PM_{2.5}$ "hot spot" locations and how they relate to wind speed
- Hourly data from December – February
- Highest concentrations occur under low wind speeds, indicative of local sources
- Possible $PM_{2.5}$ sources:
  - Subsection of Hwy 299
  - Local residential woodburning
  - Timber mill, lumber company

Next step: Black carbon monitoring to determine burning contribution vs. fossil fuel combustion component, under EPA grant funding



Summary

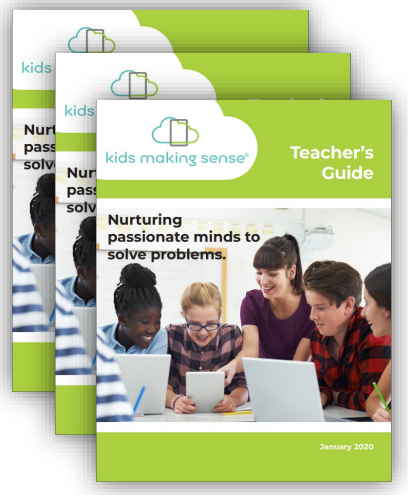
- Daily $PM_{2.5}$ concentrations are mostly in the "good" AQI range
- Air quality tends to be best during the spring
- Air quality in the summer and fall is strongly influenced by wildfire events
- Air quality in the winter is correlated to temperature – likely a relationship between lower temperatures and increased residential woodsmoke

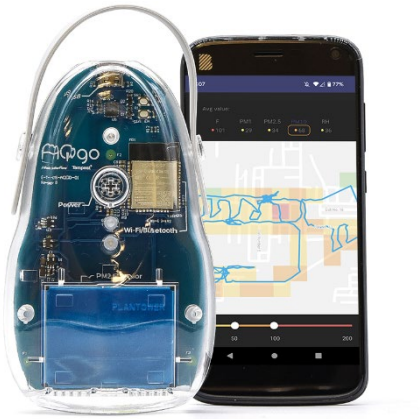


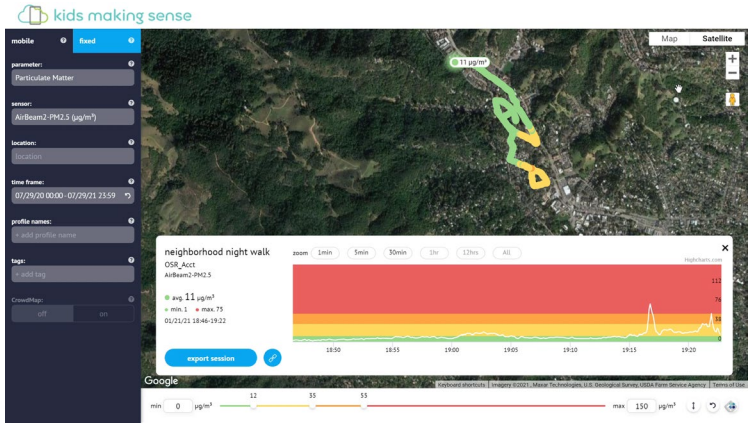
Air Quality Education

Kids Making Sense

Kids Making Sense® is an educational program to teach youth how to measure pollution using air quality sensors, to interpret the data they collect, and to take action to reduce emissions and air pollution exposure.







Flexible Curriculum

Student Workbook (Grades 6-12)

Teacher's Guide

Labs and experiments

Aligned with NGSS & CC

Small Sensors

Particulate matter

Interactive data collection

Data Visualization

Data map for sharing and visualization

Online resources

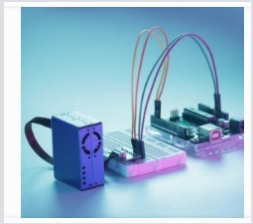
Teacher Training

Classroom sessions with air quality scientists

Air Quality Education at Blue Lake Rancheria

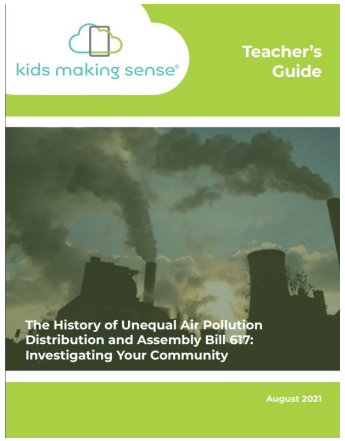
Air Quality Kits

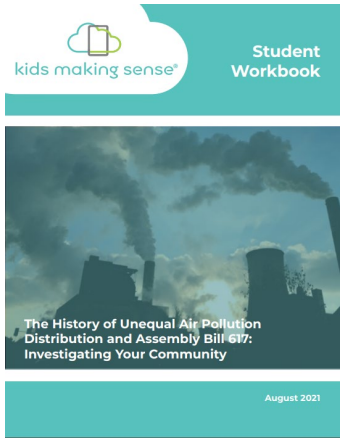
Build a Sensor Kits



Learn about the various components that make up a particle sensor, the purpose of each piece, and then build a complete sensor!

Air Quality Modules Created for Blue Lake Rancheria





Air Sensor Learning Module

In progress

Air Sensor Data Interpretation Module

In progress

Indoor vs. Outdoor AQ Module

In progress

Fire and Smoke Module

In progress

Local Emission Sources Module

In progress

Implementation

- Educators from Blue Lake Rancheria and the Humboldt County Office of Education have brought the program to 11 schools in the region
- Have also provided training to teachers to continue to increase program reach

"Orick Elementary loved the training so much that they have requested a Summer School Program inspired by it!"

- Alder Grove Charter School
- Alice Birney Elementary
- Arcata High School
- Blue Lake Elementary
- Eureka High School
- Hoopa High School
- McKinleyville High School
- Orick Elementary
- Redwood Coast Montessori
- Six Rivers Charter School
- South Fork High School

Thank You

Blue Lake Rancheria

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