Innovative Air Quality Applications of Low-Cost Consumer Sensors

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Lane Regional Air Protection Agency

LRAPA

Applications of Purple Air Sensors

- Characterization of Airsheds for Particulate Matter
- Confirmation of FRM Network Locations
- Responses to Neighborhood Concerns
- Site-Specific Responses to Concerns of Athletic Directors
- Indoor – Outdoor Air Quality Comparisons

South Coast Air Quality Management District

AQ-SPEC

Air Quality Sensor Performance Evaluation Center

South Coast AQMD

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Recently added/updated:

- **NEW!** SCAQMD visit at the US Embassy in Paris (posted, 7/27/18)
- **NEW!** Article by Wong M et al. in Int J Environ Res Public Health (posted, 7/27/18)
- **NEW!** Article by Carvlin et al. in J Air Waste Manag Assoc (posted, 7/27/18)
- Clarity Node - Field Evaluation (posted, 6/29/18)
- Article by Hagler et al. in Environmental Science & Technology
- Article by Papapostolou et al. in Atmospheric Environment

Background

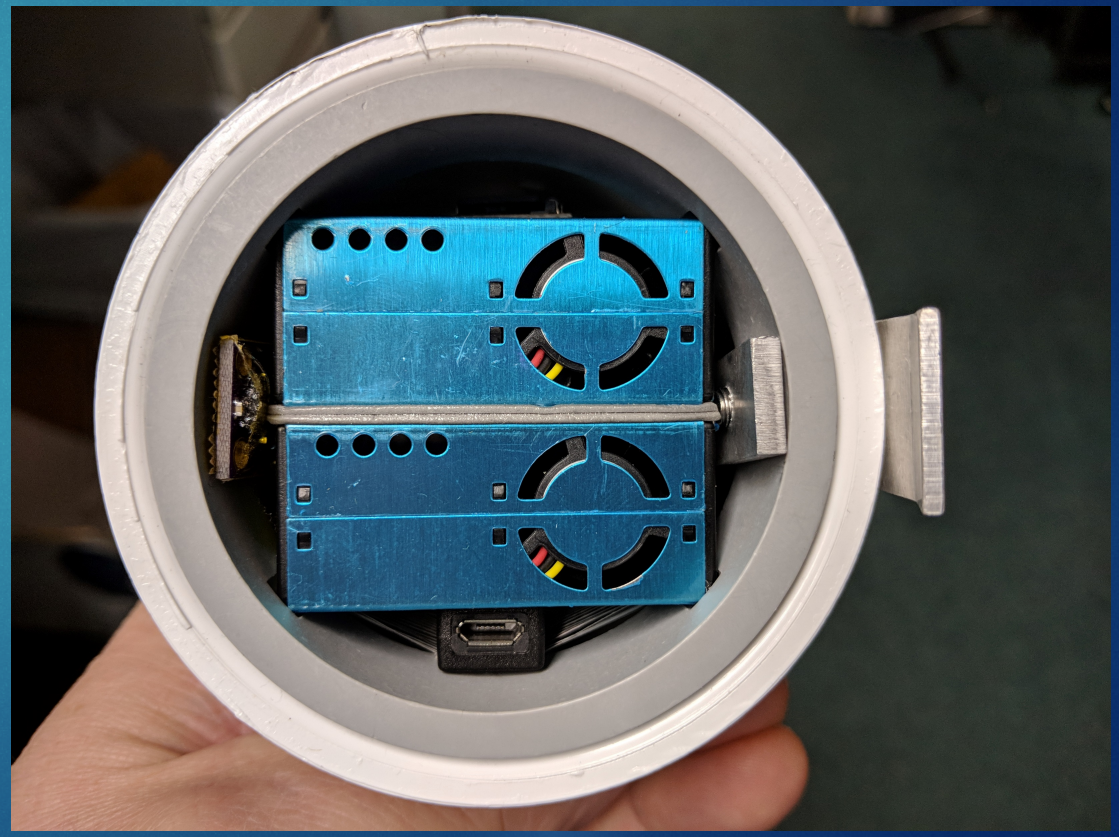
In an effort to inform the general public about the actual performance of commercially available "low-cost" air quality sensors, the SCAQMD has established the Air Quality Sensor Performance Evaluation Center (AQ-SPEC) program. The AQ-SPEC program aims at performing a thorough characterization of currently available "low-cost" sensors under ambient (field) and controlled (laboratory) conditions.

Purple Air PM Sensor

Optical Sampler

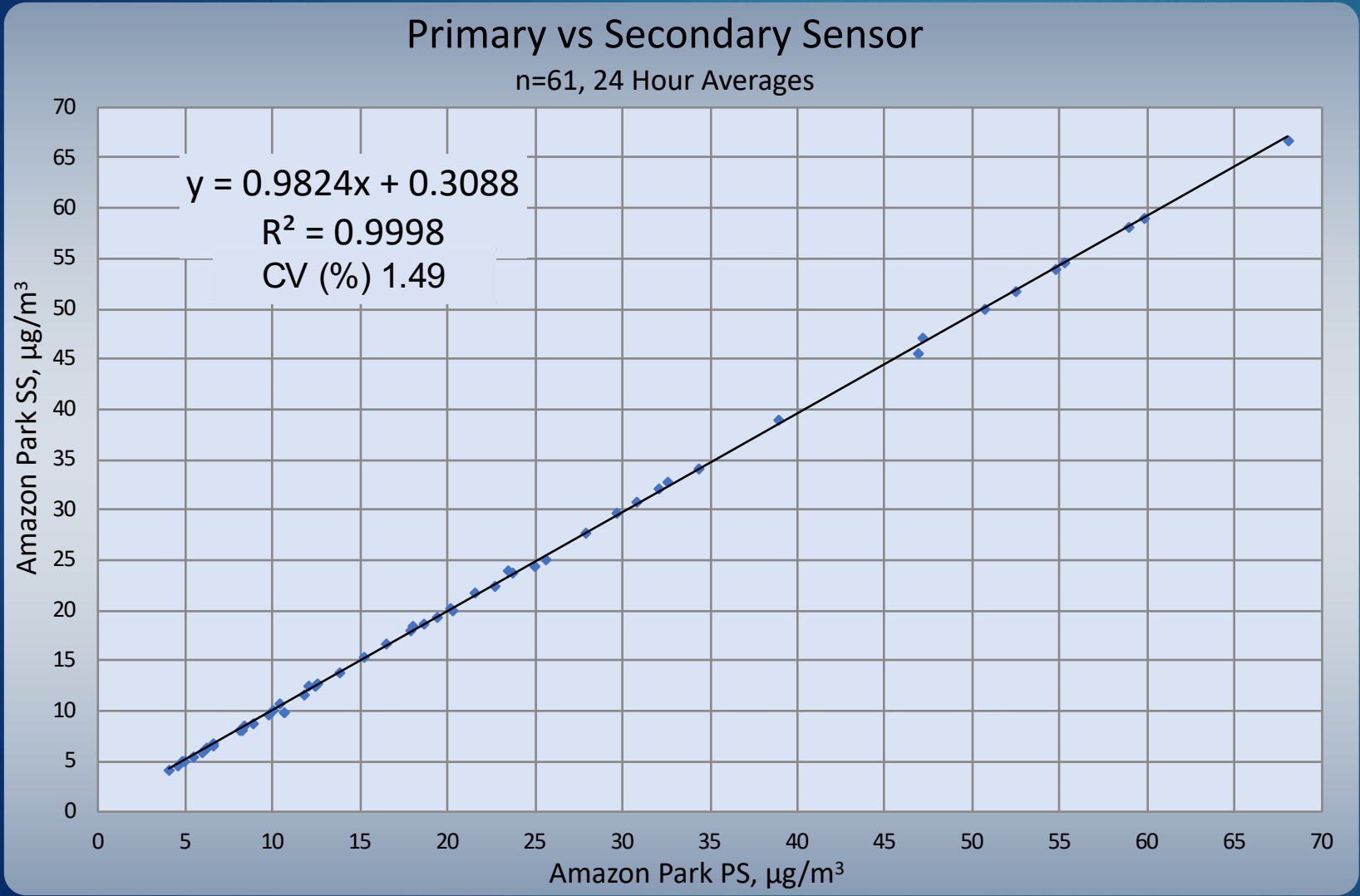
Light Scattering

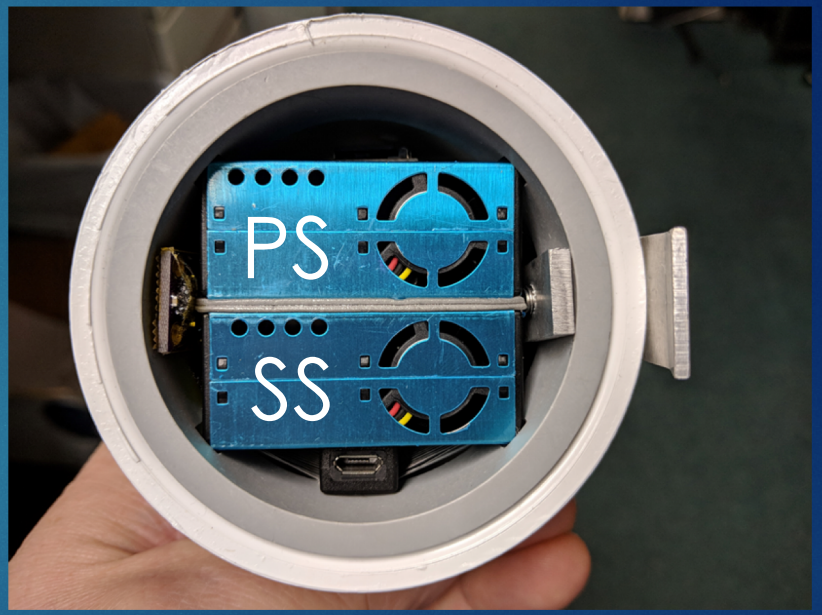
Cost ~ $230



Purple Air Sensor Data

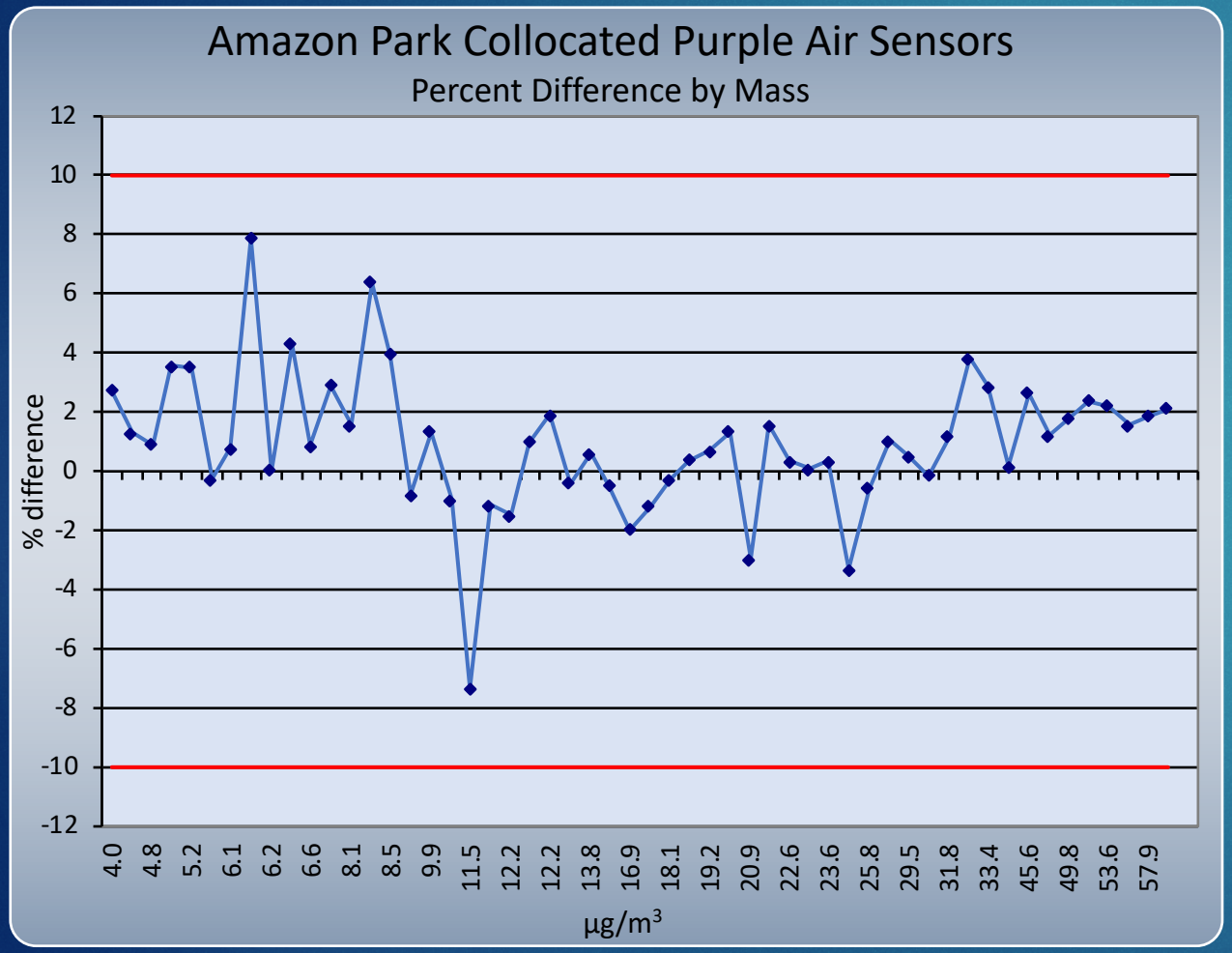
- Amazon Park Primary to Secondary, Internal Sensor Comparison, >3 µg/m^3

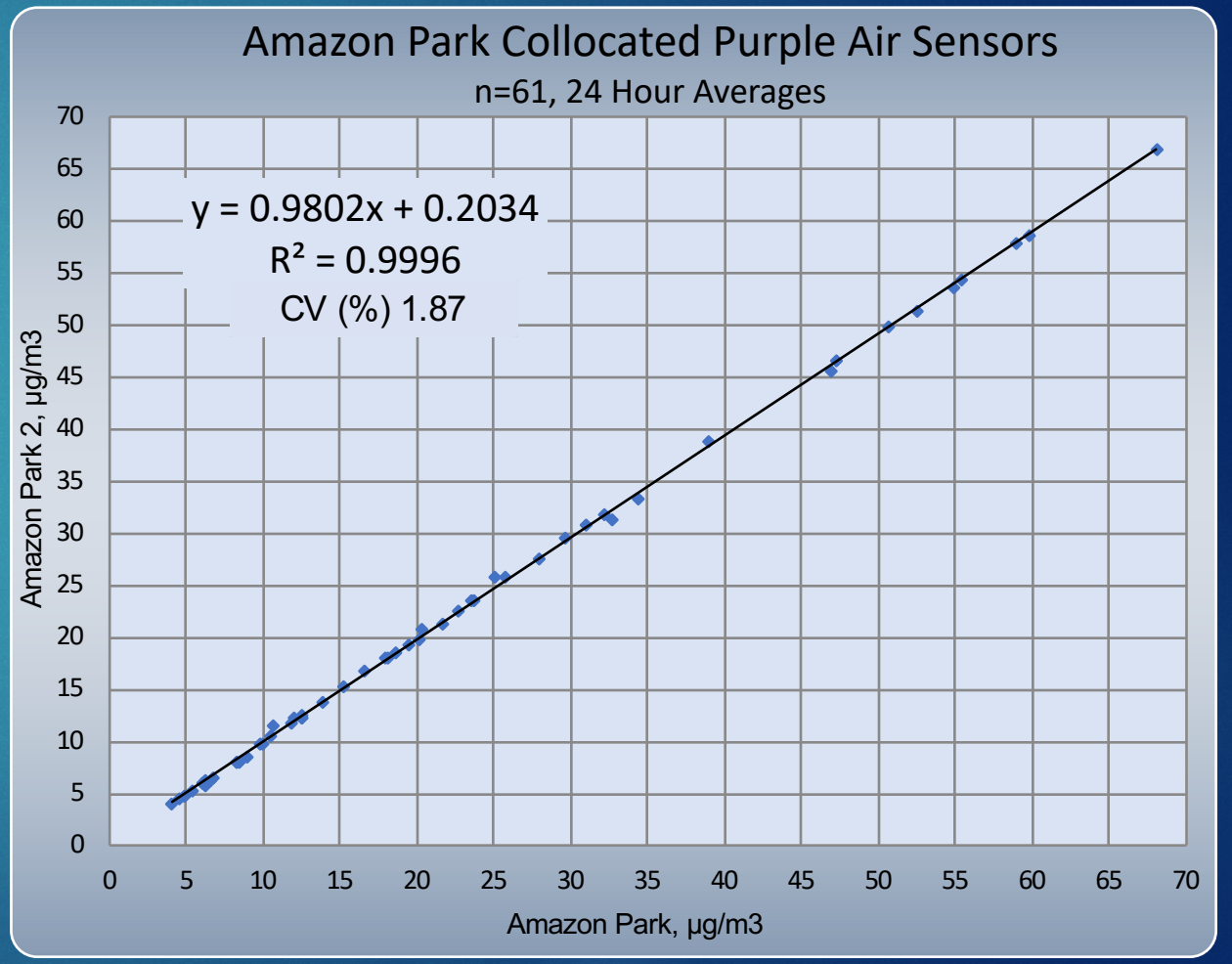




Purple Air Sensor Data

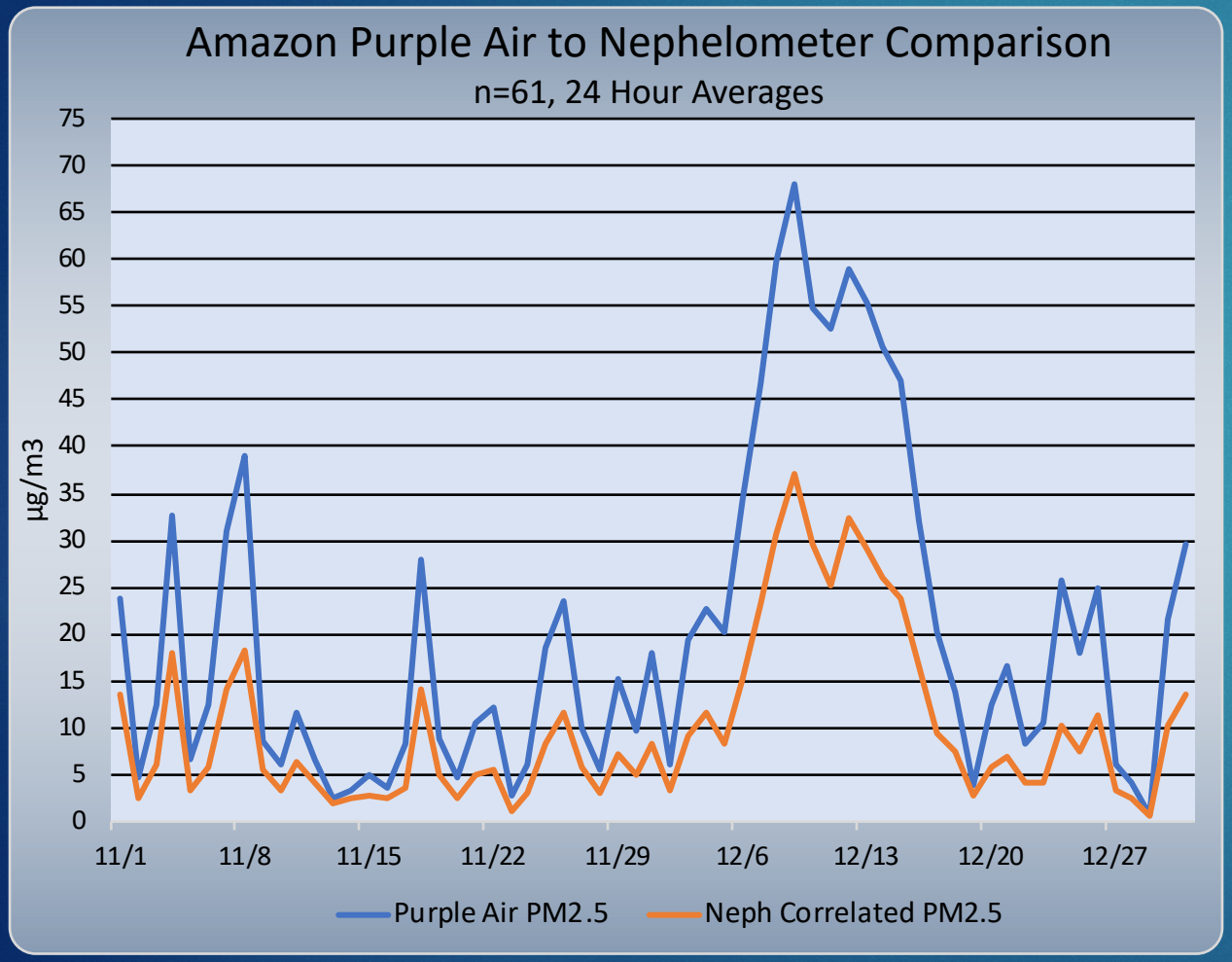
- Comparison of Amazon Park Collocated Sensors, >3 µg/m^3

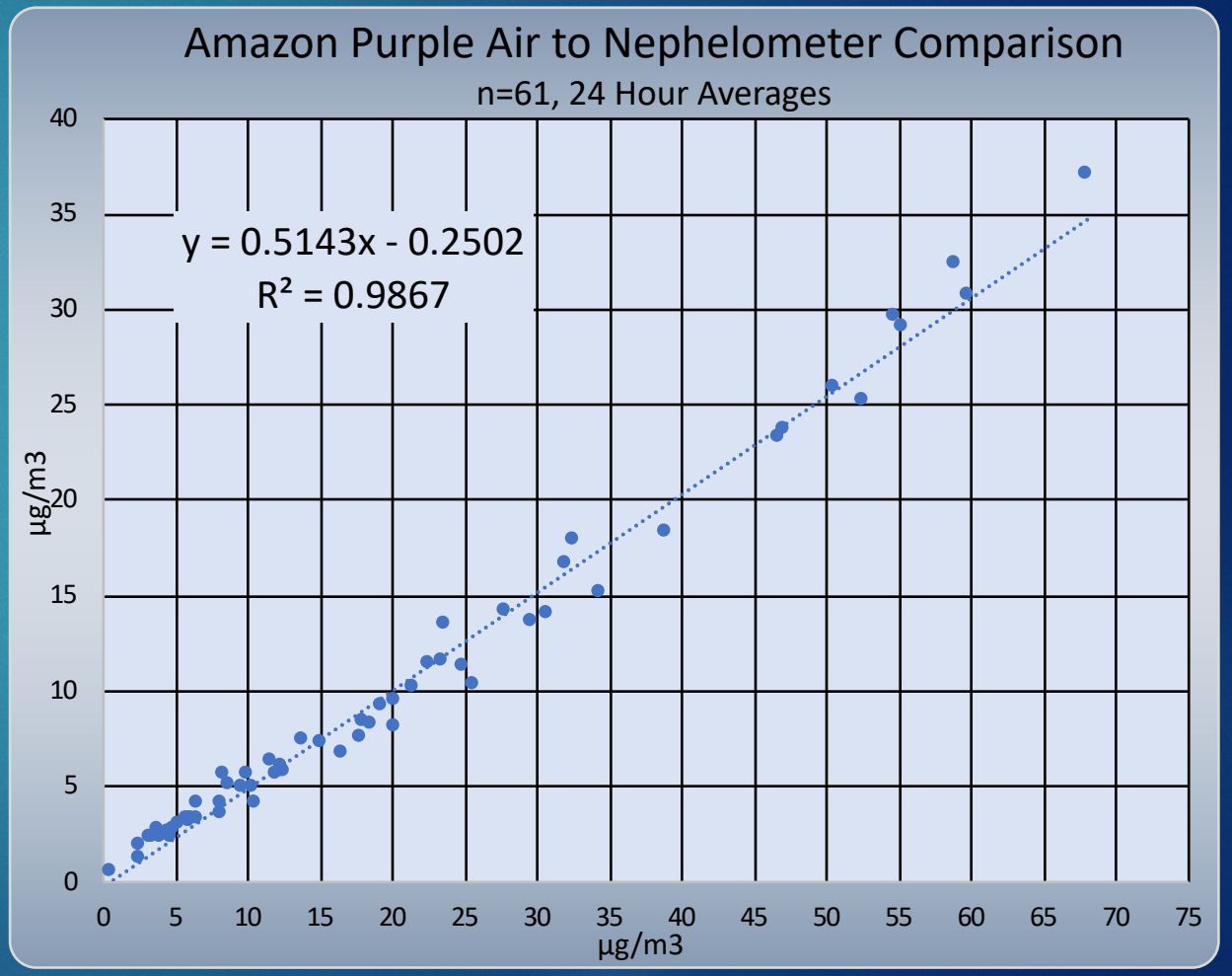




Purple Air Sensor Data

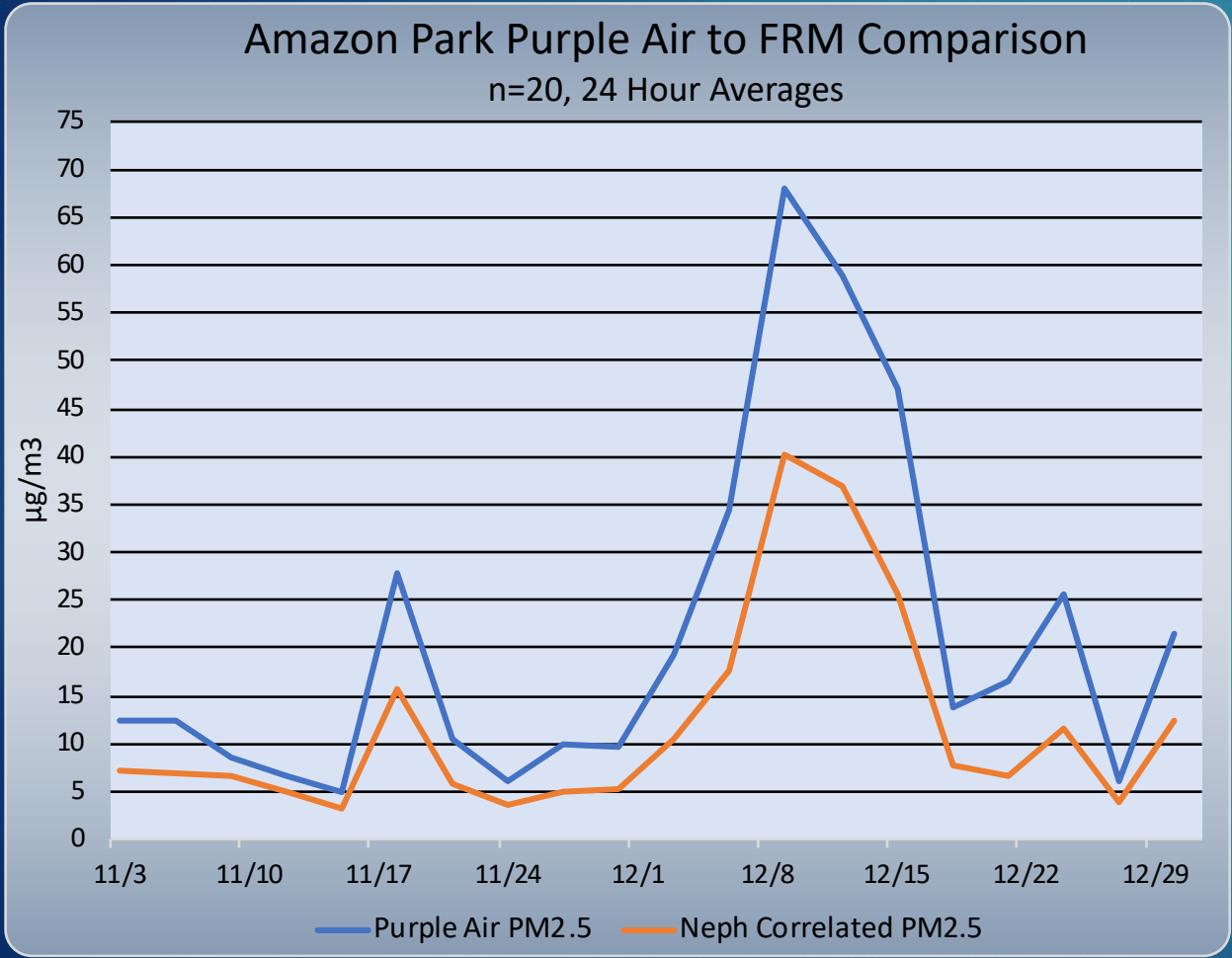
- Comparison of Amazon Park Purple Air and Nephelometer

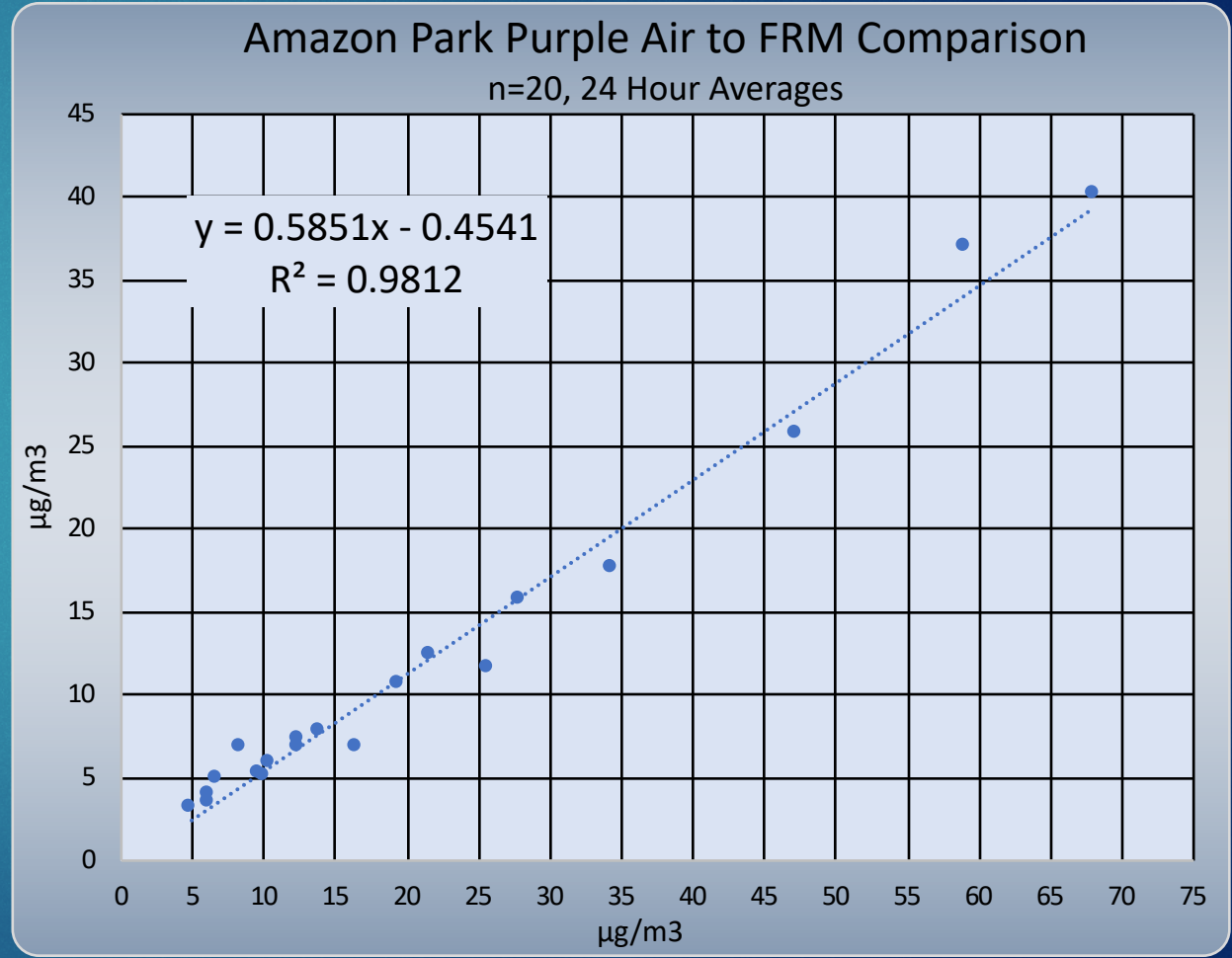




Purple Air Sensor Data

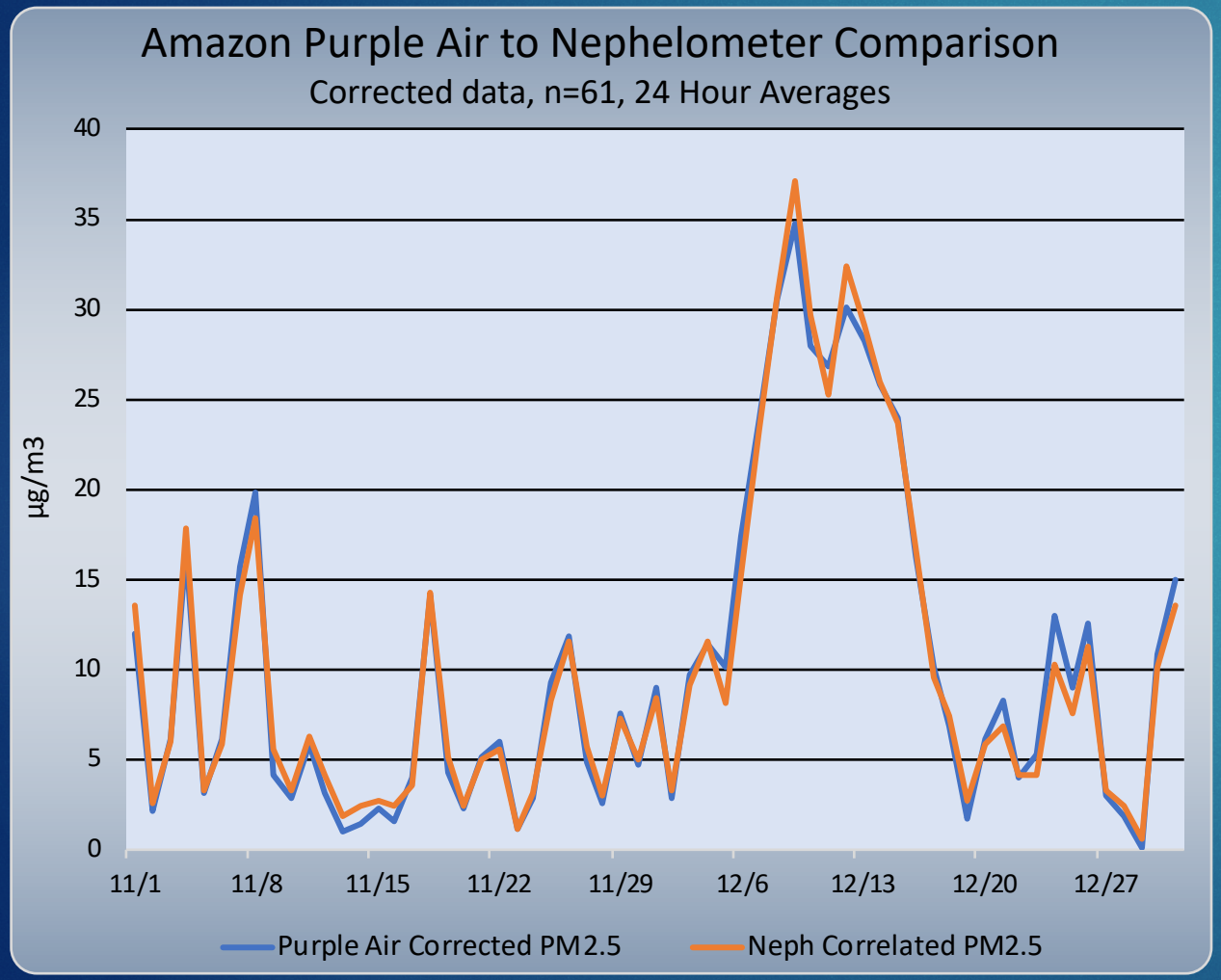
- Comparison of Amazon Park Purple Air and FRM

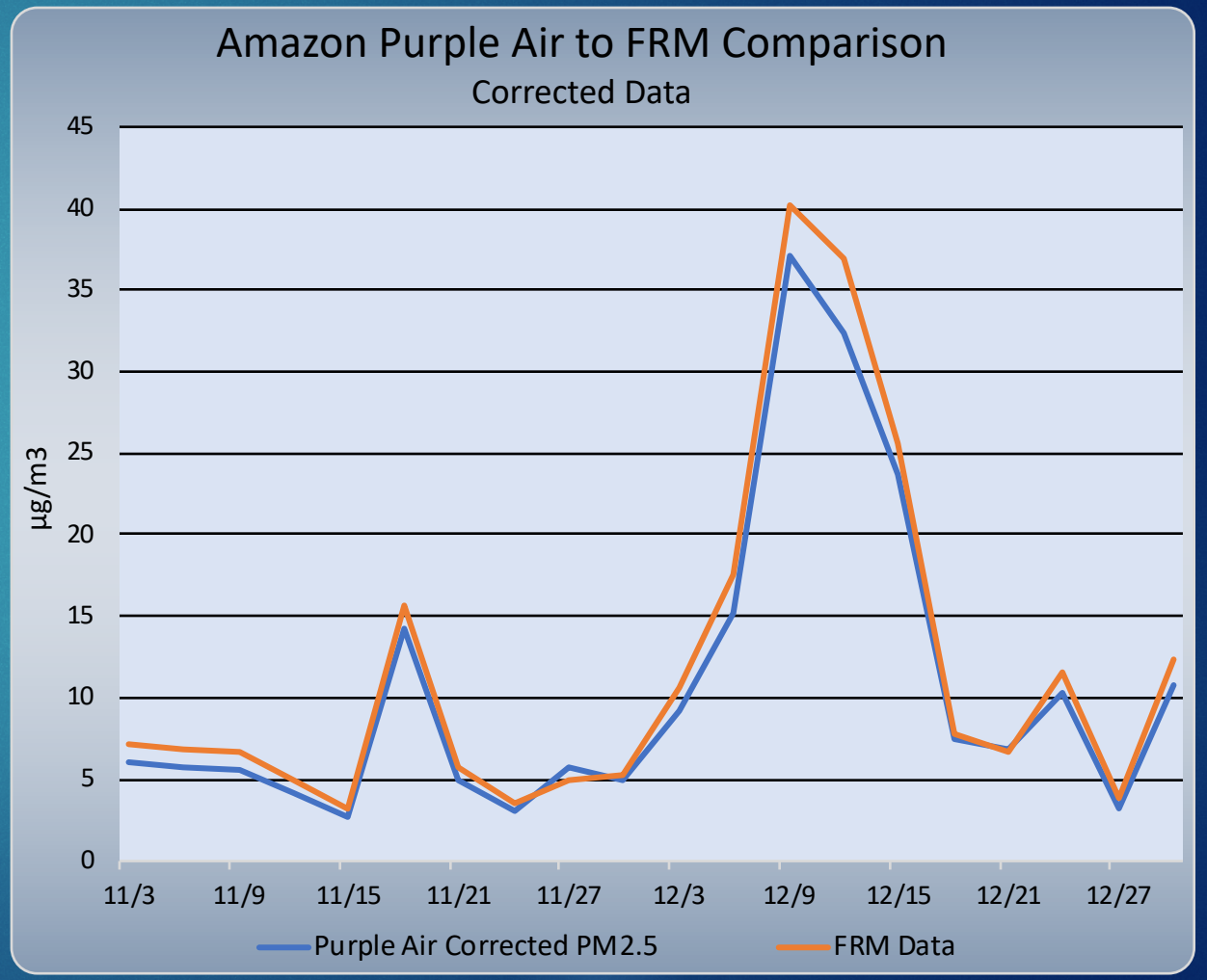




Purple Air Sensor Data

- Comparison of Amazon Park Purple Air and Nephelometer, Corrected Data





Purple Air Sensor Summary

Summary

- Low cost ~ $230
- Easy setup
- Low maintenance
- Small footprint
- Good precision between collocated sensors
- Correlates well with reference air samplers

Caveats

- Accuracy (correctable with correlation)
- Unknown lifespan (some running for over 2 years)
- Requires power outlet and Wi-Fi connection
- Raw data access can be cumbersome

2018 Summer Wildfire Data Correlations

	Slope	Intercept	R^2
Amazon	0.49	2.65	0.96
Cottage Grove	0.49	2.83	0.97
HWY 99	0.53	2.85	0.97
Oakridge	0.56	1.54	0.96
Average	0.52	2.47	0.96

2017 Winter Heating Data Correlations

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Applications of Purple Air Sensors

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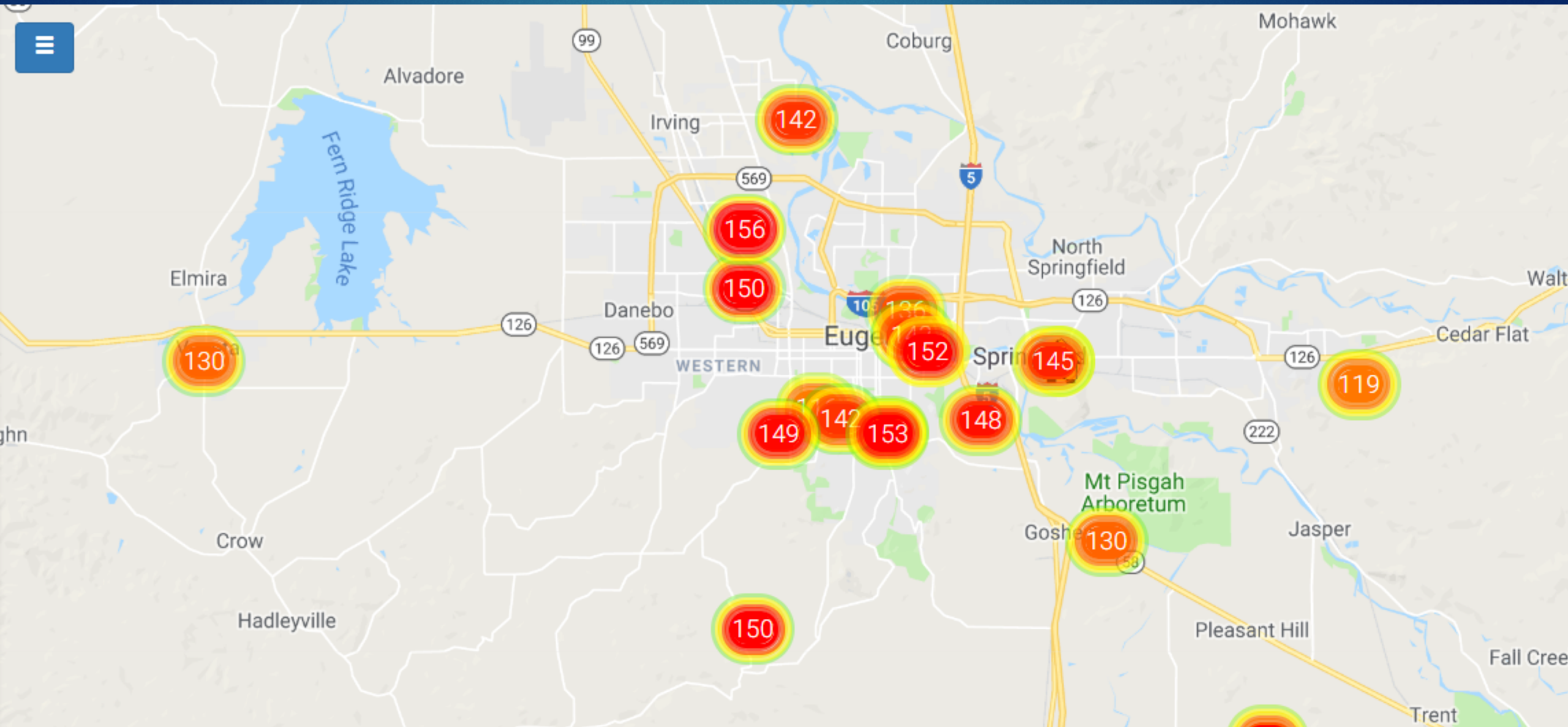
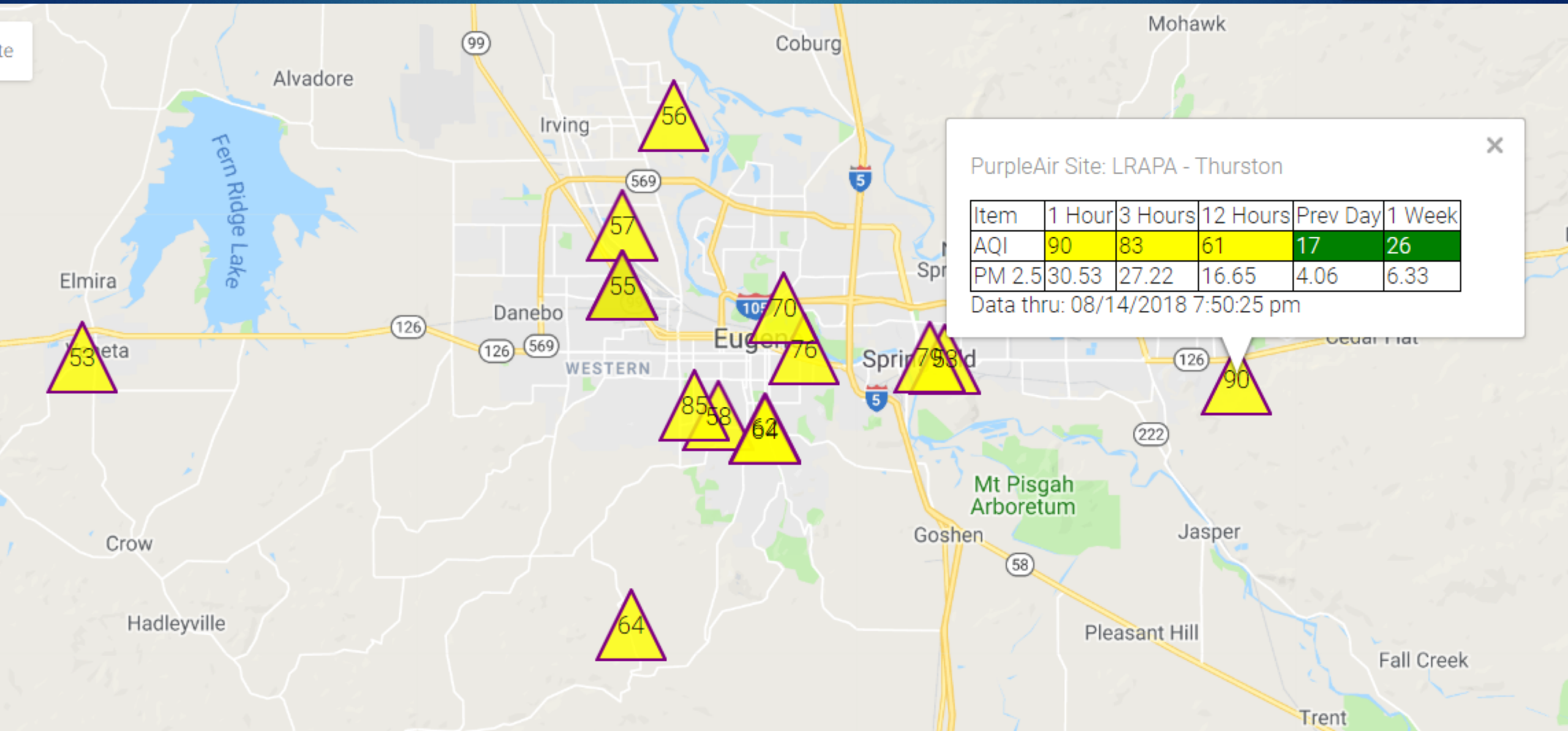
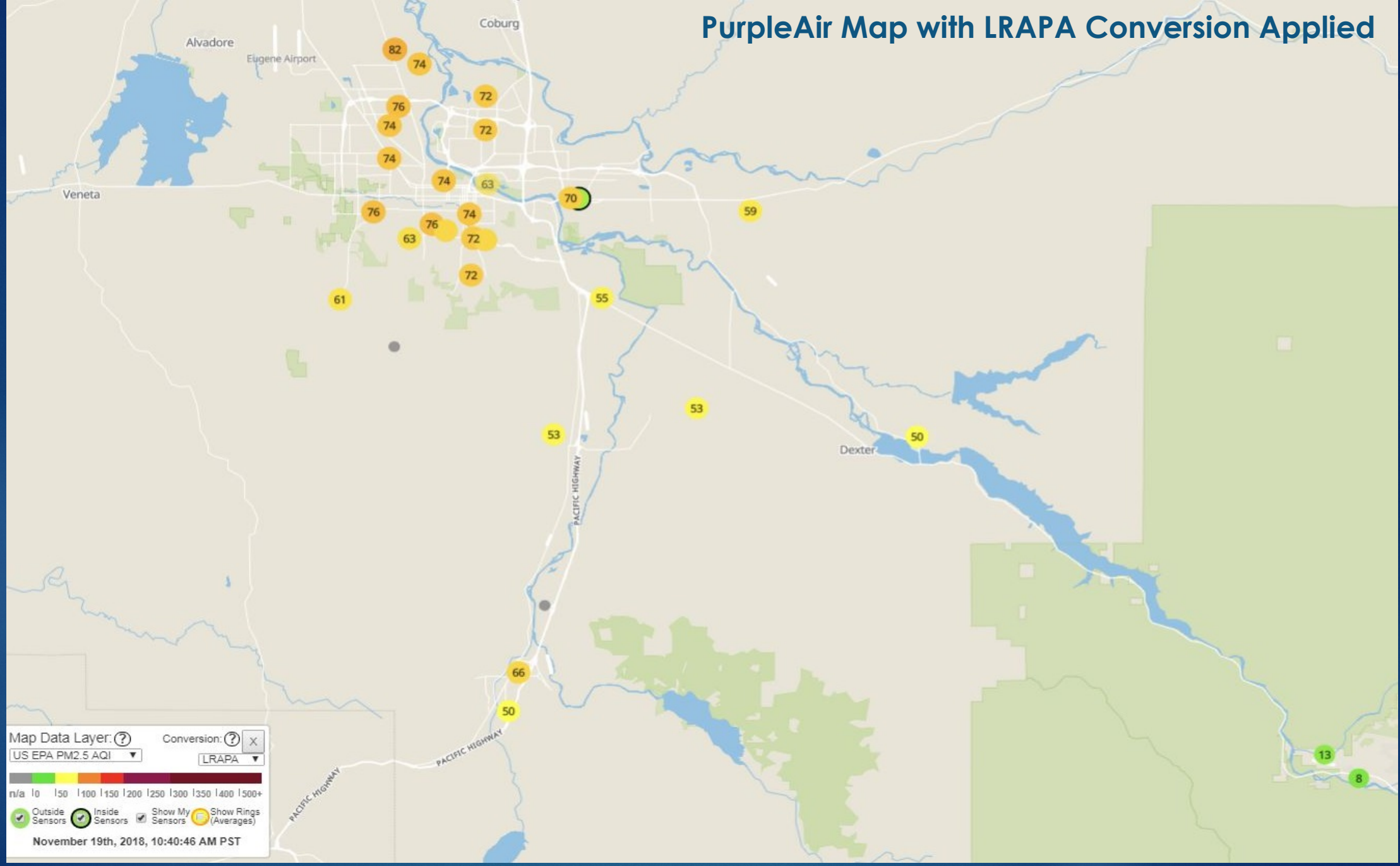
PurpleAir Sensor Map – Tuesday Evening, Aug 14



LRAPA PurpleAir Sensor Map – Tuesday Evening, Aug 14



PurpleAir Map with LRAPA Conversion Applied



https://www.purpleair.com/map?#10.11/43.9139/-122.7608

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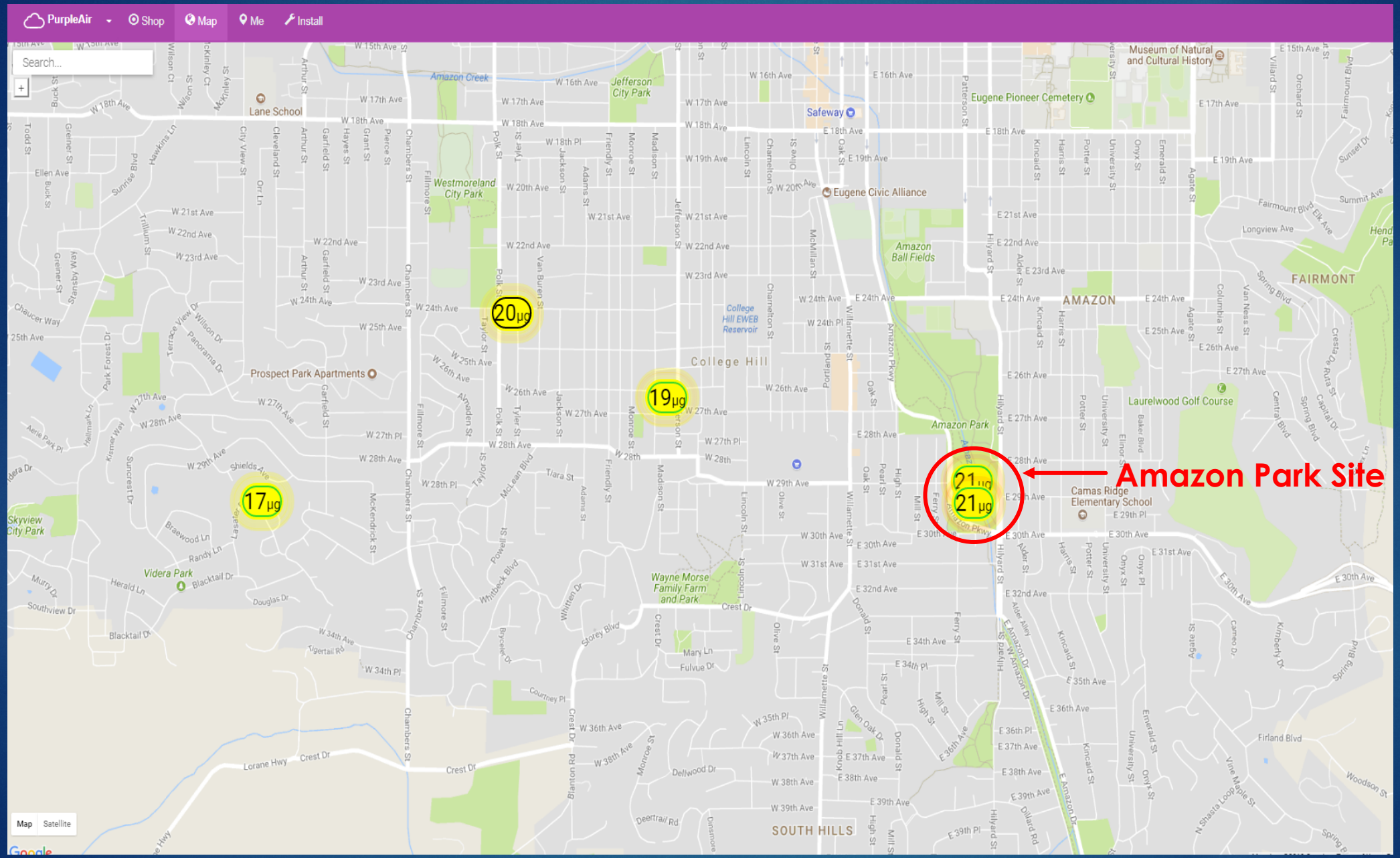

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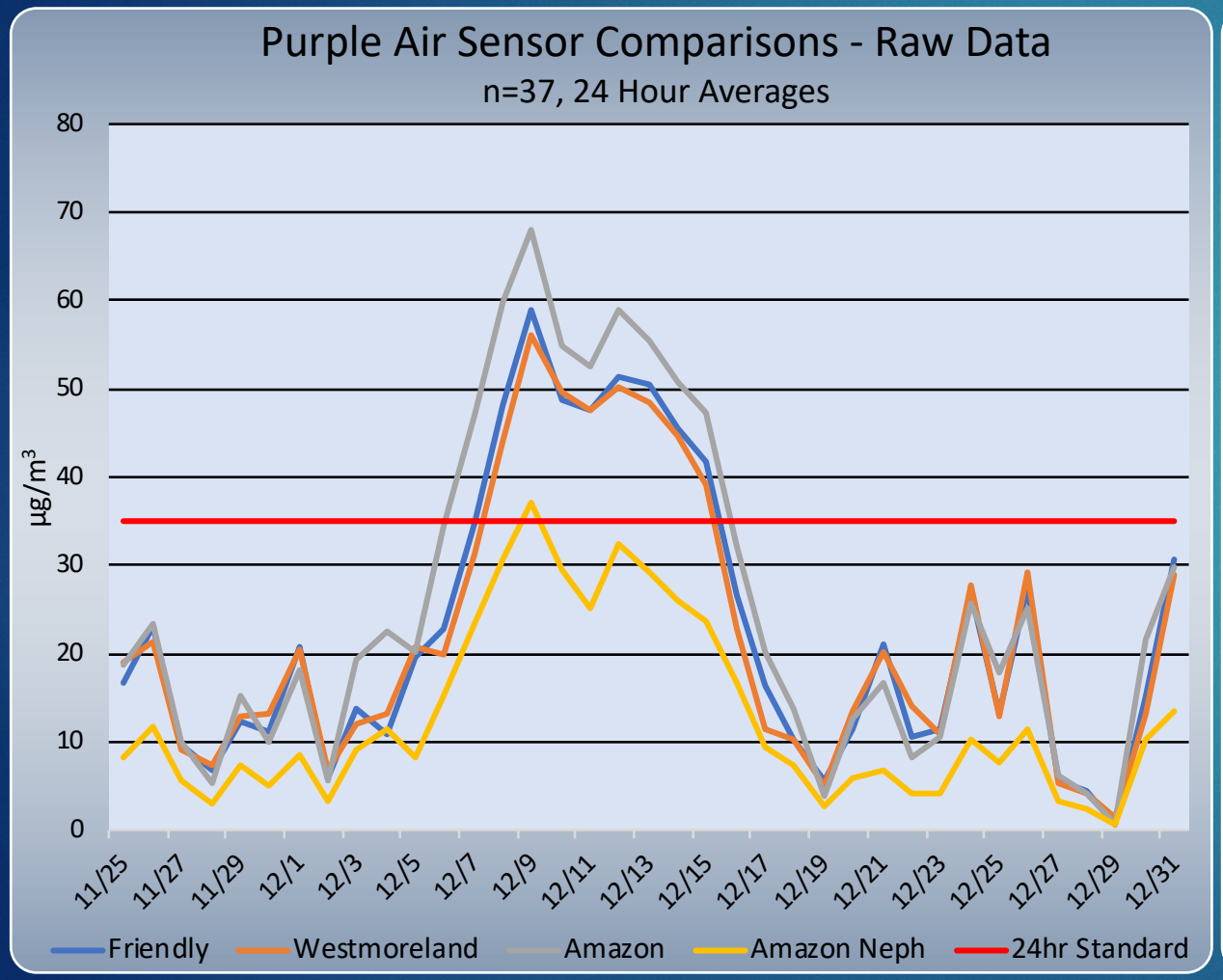
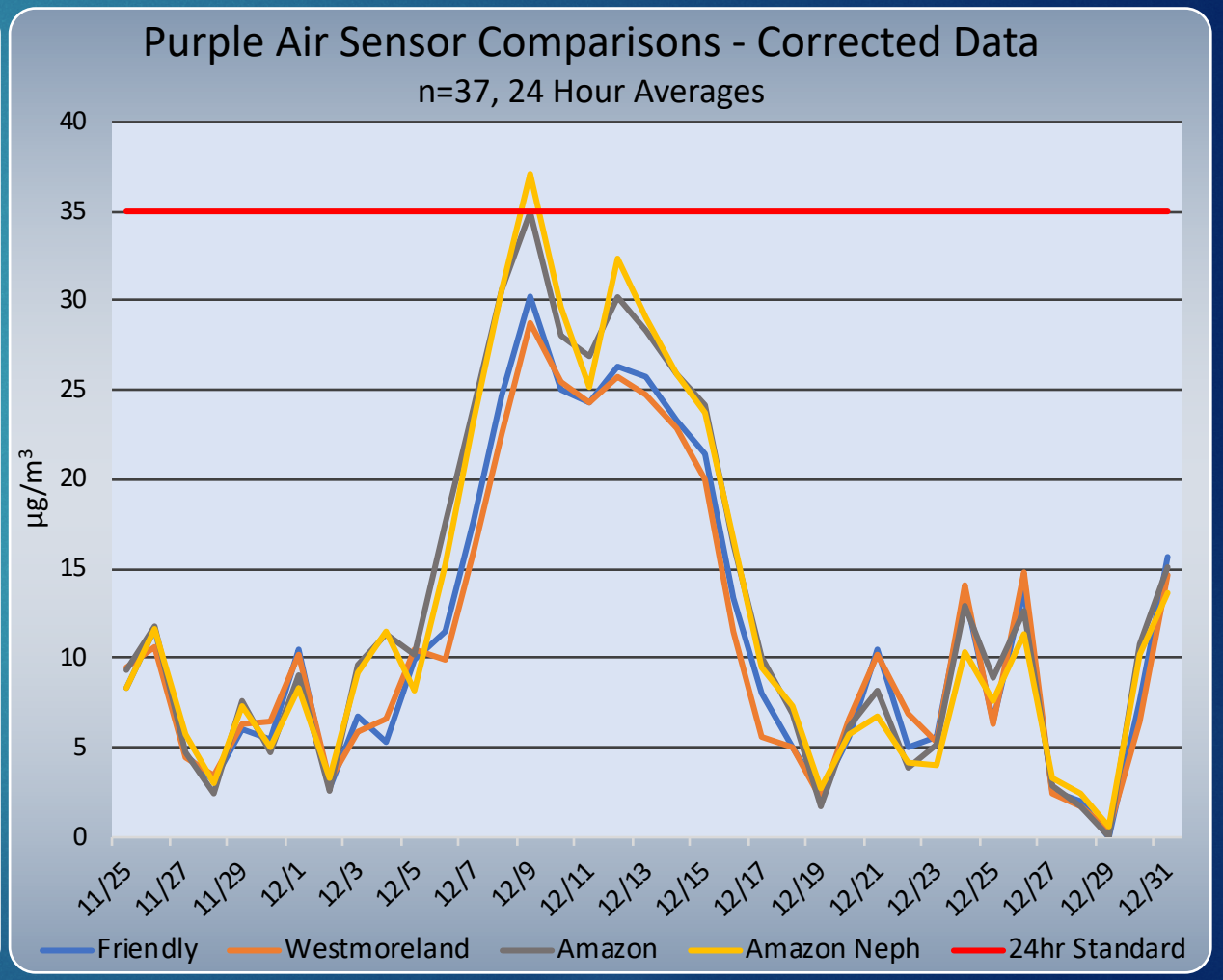
Purple Air Sensor Data

- Comparison of Amazon Park to Friendly Neighborhood





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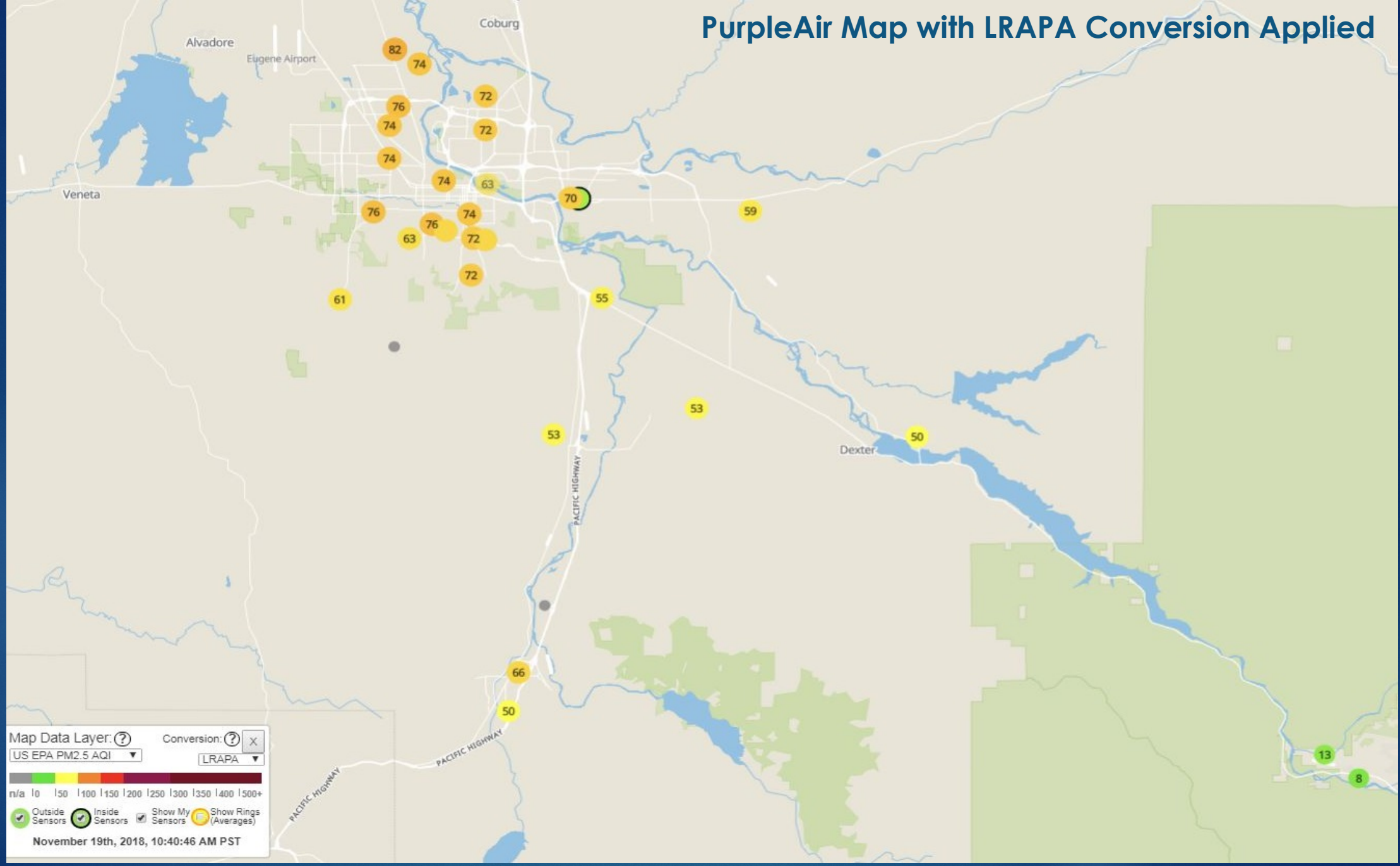

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Oregon Health Authority

Public Health Guidance: School Outdoor Activities During Wildfire Events

Check the local Air Quality Index (AQI) online (http://www.deq.state.or.us/aqi/) and do a visual inspection outside.* Compare the AQI and visibility test to determine the air conditions in your community. Then, use the guide below to determine activity level for your students.**

Air Quality Index	Visibility Scale	Recess (15 min)	P.E. (1 hr)	Athletic events and practices (2–3 hrs)
Good	Over 5 miles	Great day to be active outdoors!	Great day to be active outdoors!	Great day to be active outdoors!
Moderate	5–15 miles	It is a good day for students to be active outside. • Watch students who are unusually sensitive to air pollution for symptoms of shortness of breath or coughing.	• Watch students who are unusually sensitive to air pollution. • Look for symptoms of shortness of breath or coughing. • Monitor symptoms and reduce or cease activity if symptoms arise.	• Watch students who are unusually sensitive to air pollution. • Look for symptoms of shortness of breath or coughing. • Increase rest periods and make substitutions for these students as needed. • Monitor symptoms and reduce or cease activity if symptoms arise.
Unhealthy for sensitive groups	3–5 miles	It is an OK day for students to be active outside. • Allow students who are unusually sensitive to air pollution to stay indoors if they'd like.	• Move activities indoors for students sensitive to air pollution. • Limit other students to light outdoor activities or move the activities indoors. • Increase rest periods and make substitutions. • Monitor symptoms and reduce or cease activities if symptoms arise.	• Move activities indoors for students sensitive to air pollution. • Limit other students to light outdoor activities or move the activities indoors. • Increase rest periods and make substitutions. • Monitor symptoms and reduce or cease activities if symptoms arise.
Unhealthy	1–3 miles	• Consider keeping all students indoors or allowing only light outdoor activity. • Move activities indoors for students sensitive to air pollution.	• Move activities indoors for students sensitive to air pollution. • Consider moving all activities indoors. • Limit all students to light activities. • Increase rest periods and make substitutions.	Consider any of the following: • Cancel the event. • Move the event indoors. • Postpone the event. • Move the event to an area with "good" air quality.
Very unhealthy/ hazardous	1 mile or less	Keep all students indoors.	• Move all activities indoors. • Limit all students to light activities. • Increase rest periods and make substitutions.	Do any of the following: • Cancel the event. • Move the event indoors. • Postpone the event. • Move the event to an area with "good" air quality.

* If you get conflicting results when you compare the AQI to your visual inspection, err on the side of caution. Follow the recommendations for the worse of the two assessments.

**Students with asthma action plans should follow them closely. They should monitor their breathing and exposure to wildfire smoke. Anyone experiencing symptoms should contact a health care provider for further advice. They should call 911 in an emergency.

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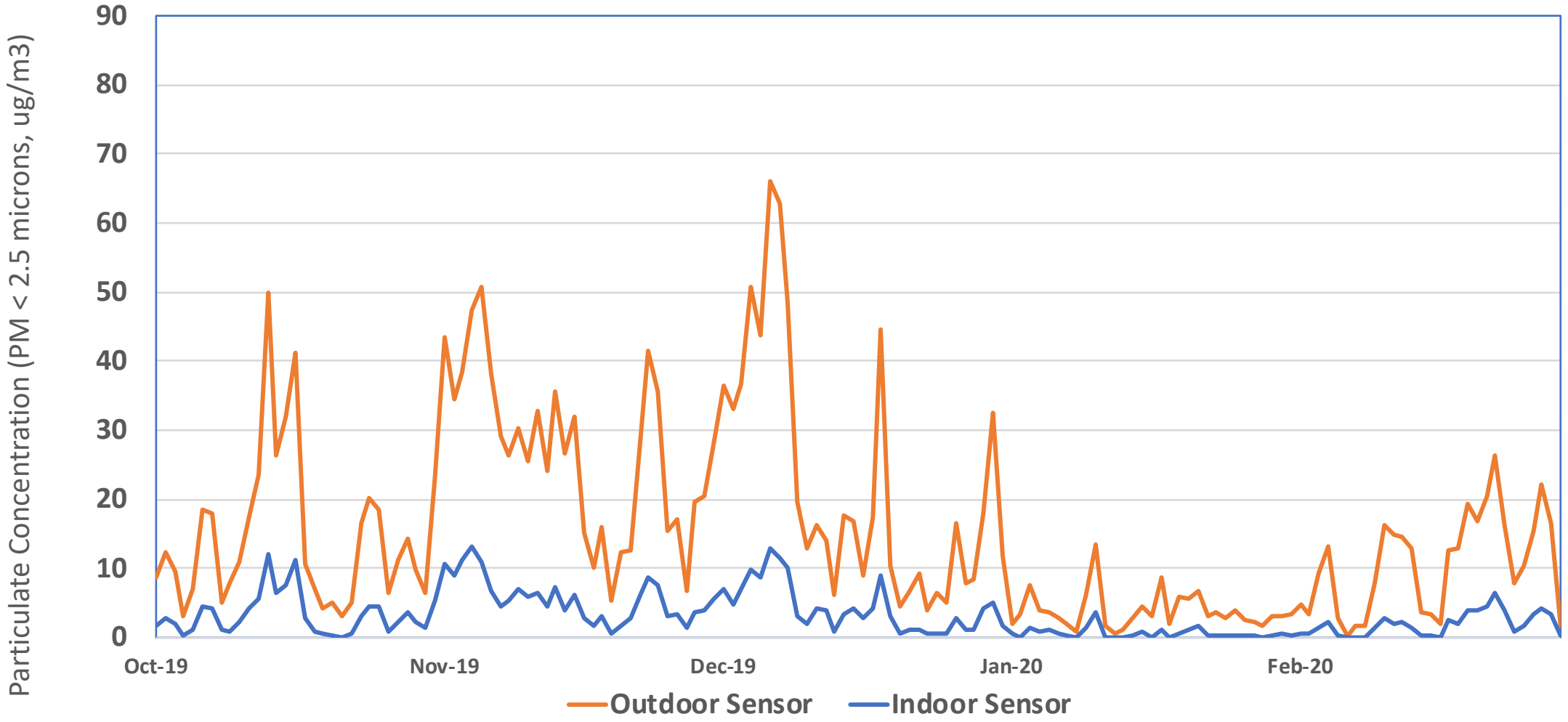
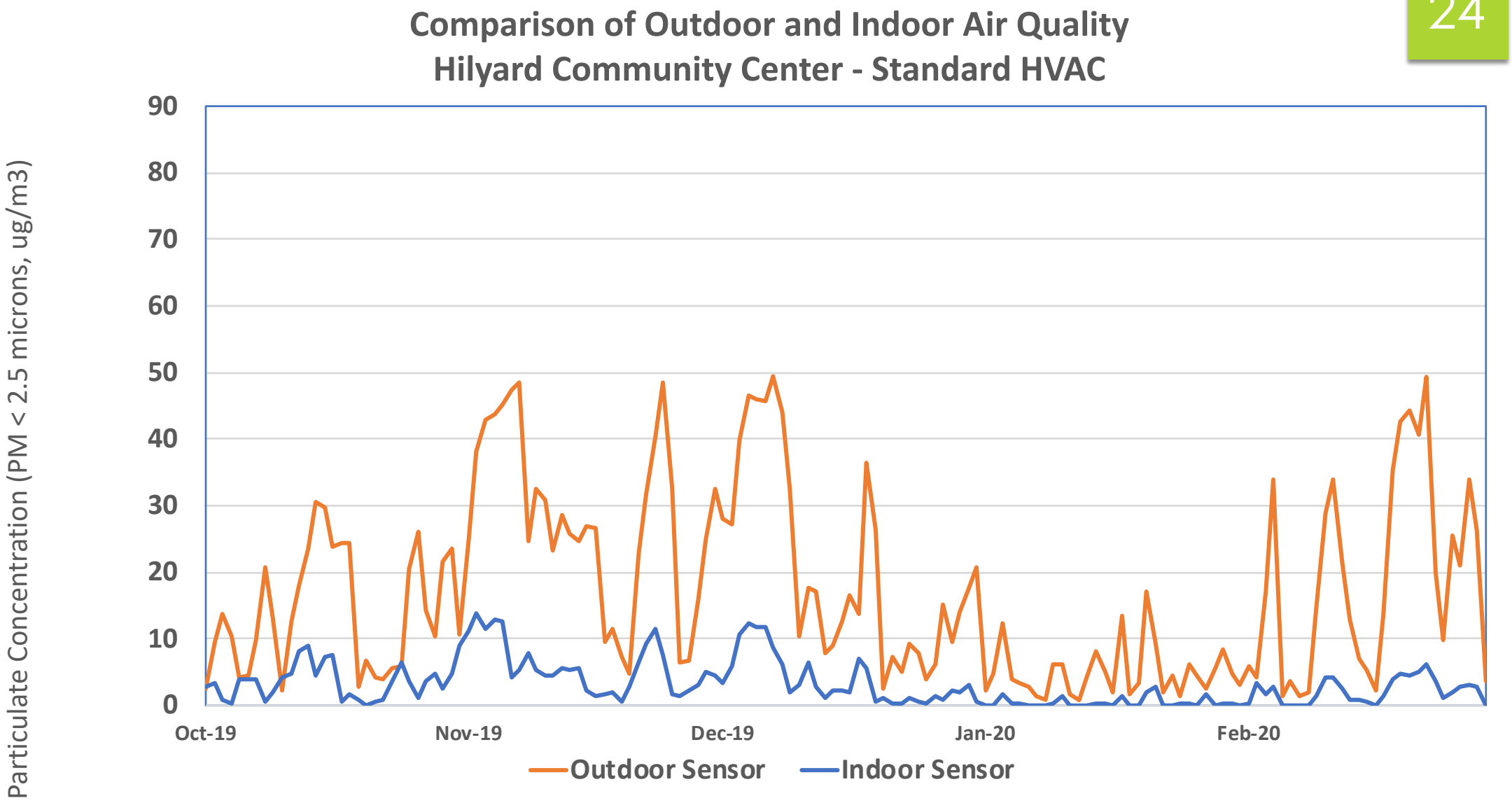
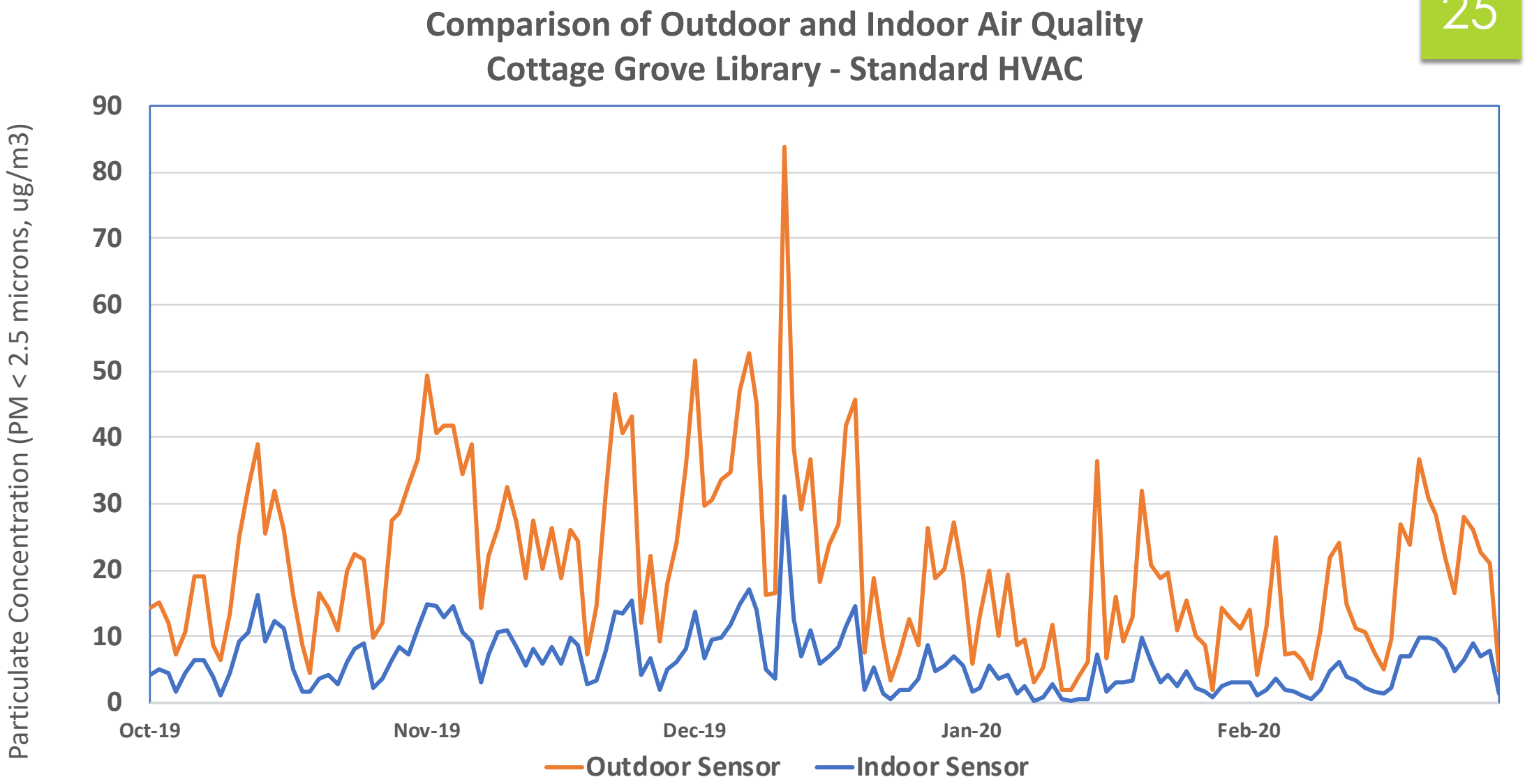
Comparison of Outdoor and Indoor Air Quality
LRAPA Office - Standard HVAC




Comparison of Outdoor and Indoor Air Quality
Hilyard Community Center - Standard HVAC
Particulate Concentration (PM < 2.5 microns, ug/m3)
90
80
70
60
50
40
30
20
10
0
Oct-19
Nov-19
Dec-19
Jan-20
Feb-20
Outdoor Sensor
Indoor Sensor


Comparison of Outdoor and Indoor Air Quality
Cottage Grove Library - Standard HVAC
Particulate Concentration (PM < 2.5 microns, ug/m3)
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Dec-19
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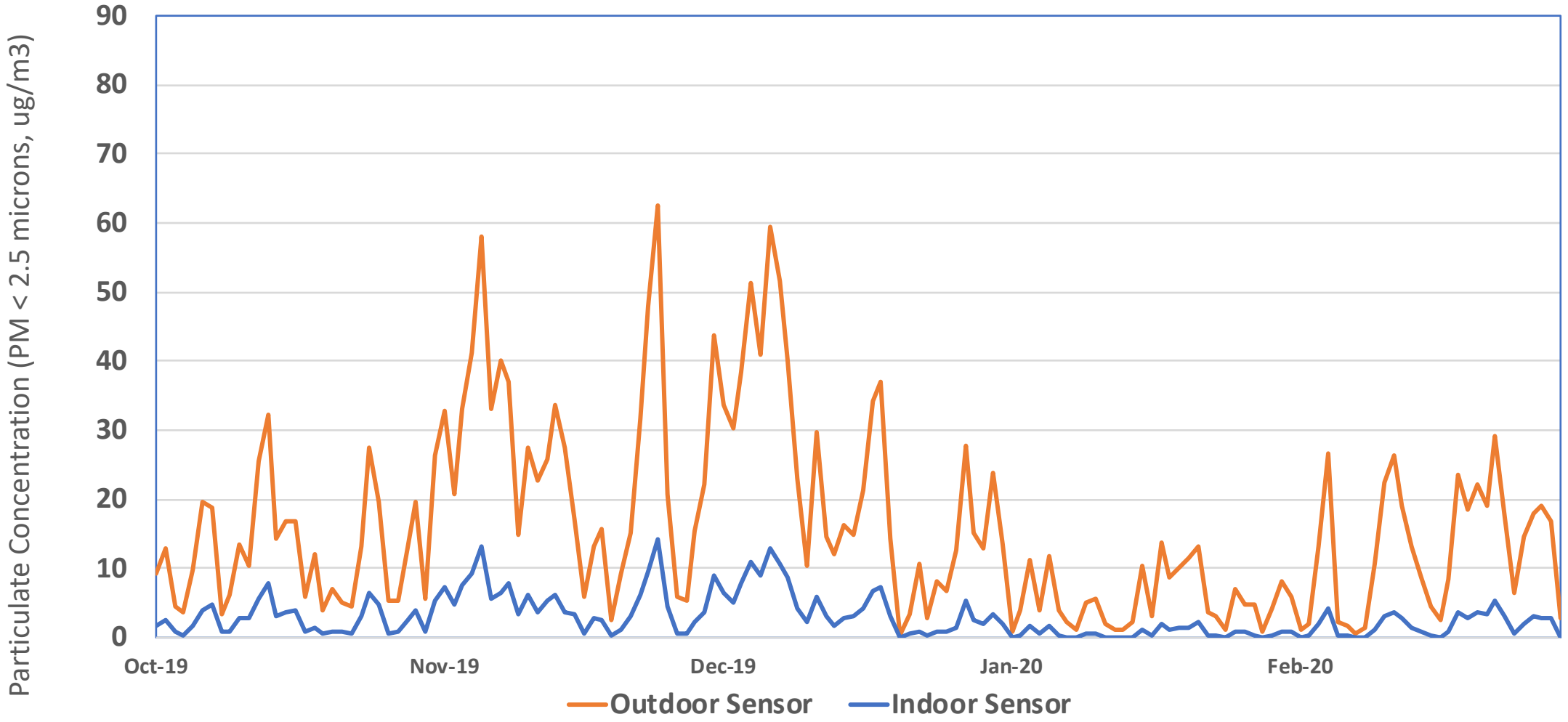
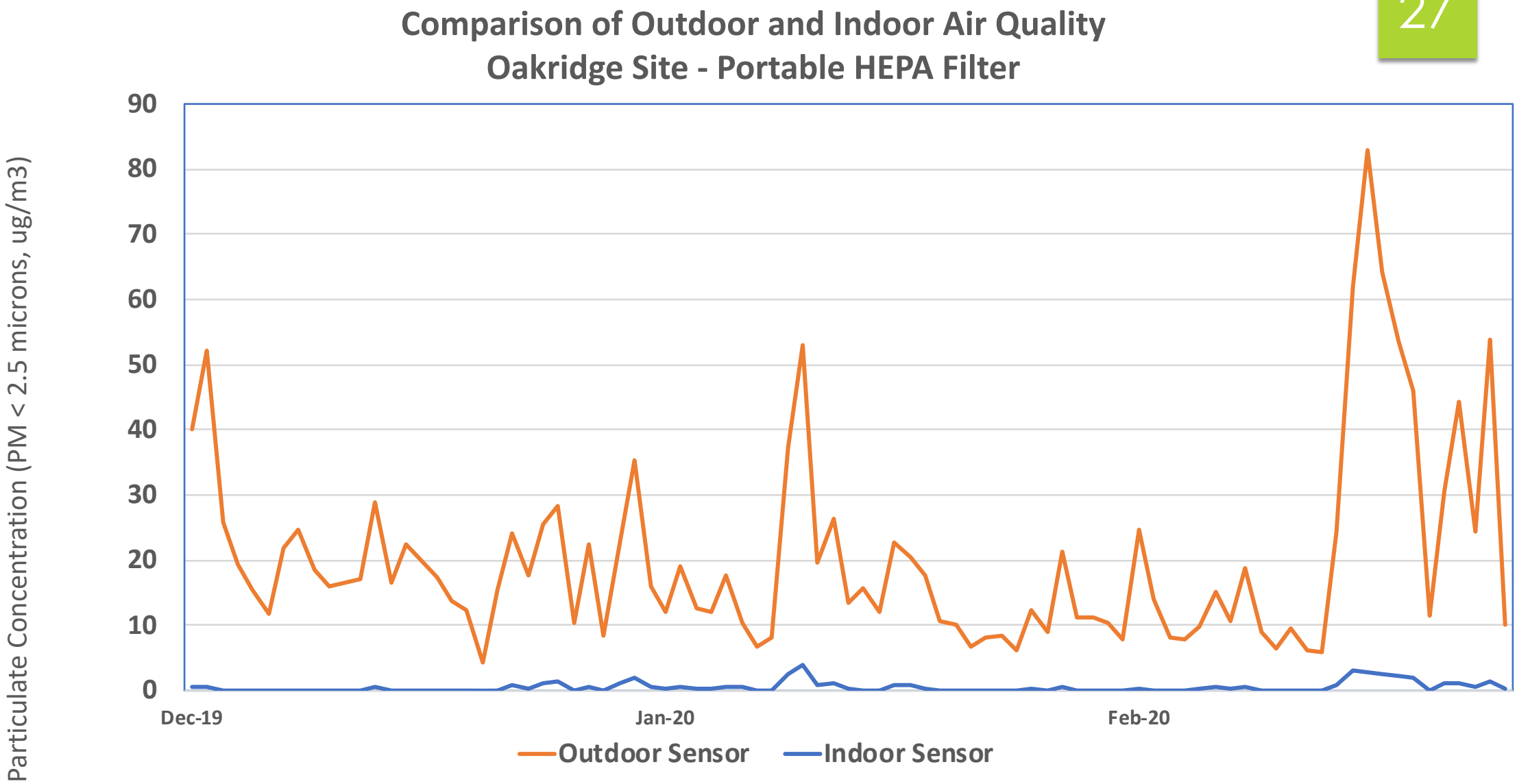
Veneta Library - Standard HVAC




Comparison of Outdoor and Indoor Air Quality
Oakridge Site - Portable HEPA Filter
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