

# Air Quality Monitoring during extreme events: Observations during record-breaking smoke and heat events in Oregon

2022 National Ambient Air Monitoring Conference

August 25, 2022  
Pittsburgh, PA

# Previously, on *NAAMC*

- Portland during August 2018



Credit: EPA, NAAMC Website



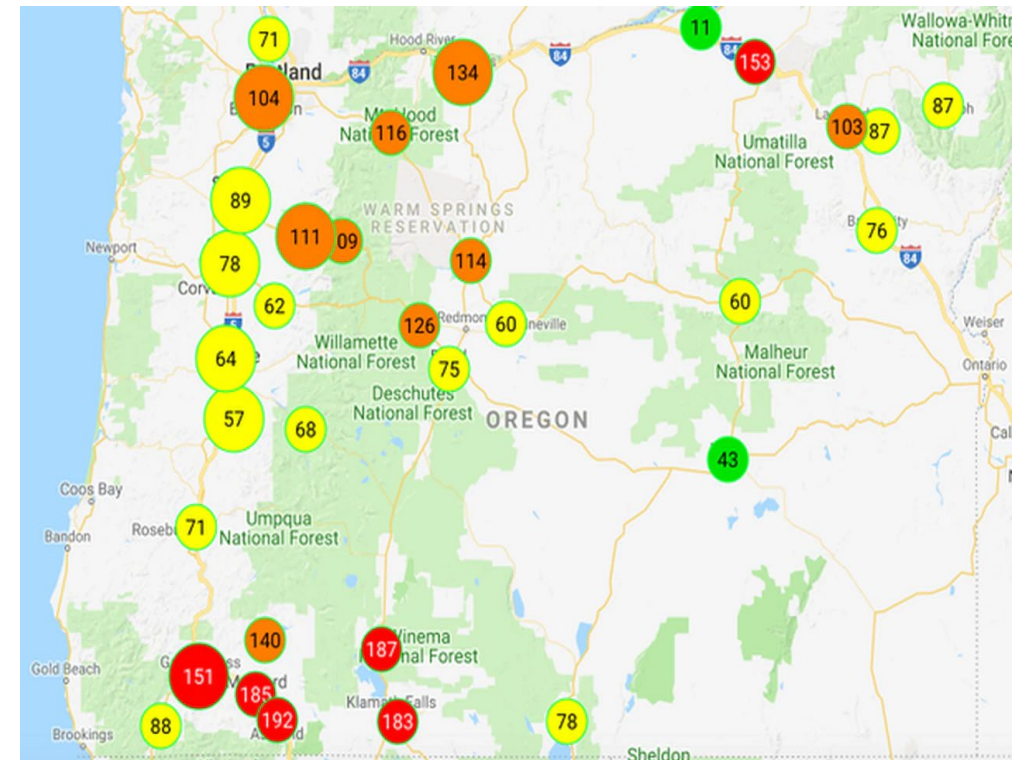
Credit: Oregon DEQ Twitter Feed

# Previously, on *NAAMC*

- Air Quality in Portland during August 2018

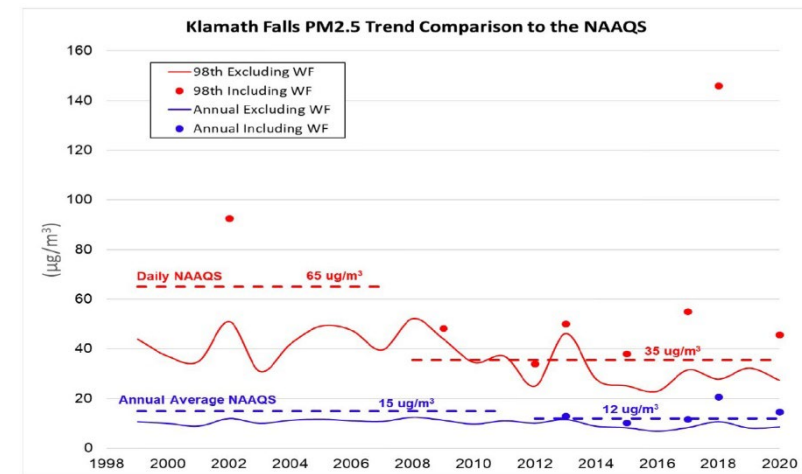
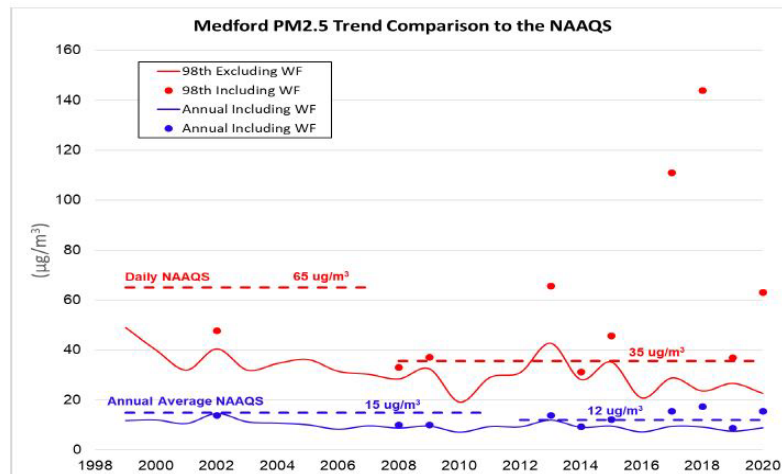
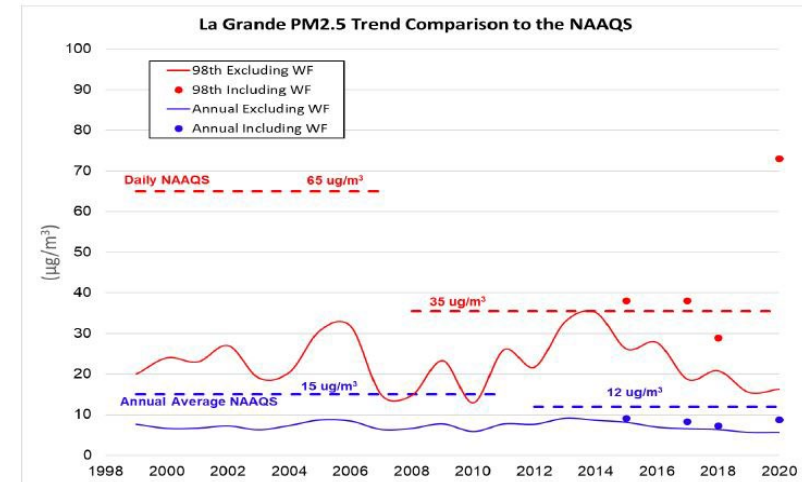
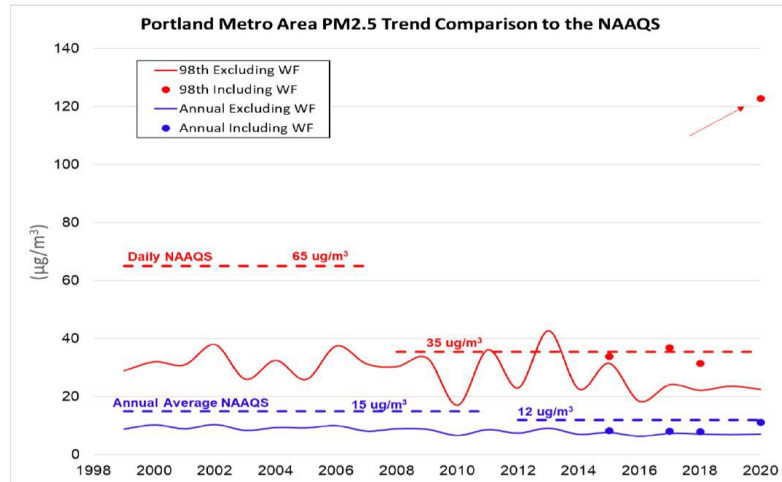


Credit: Mark Graves, Oregonian/Oregonlive



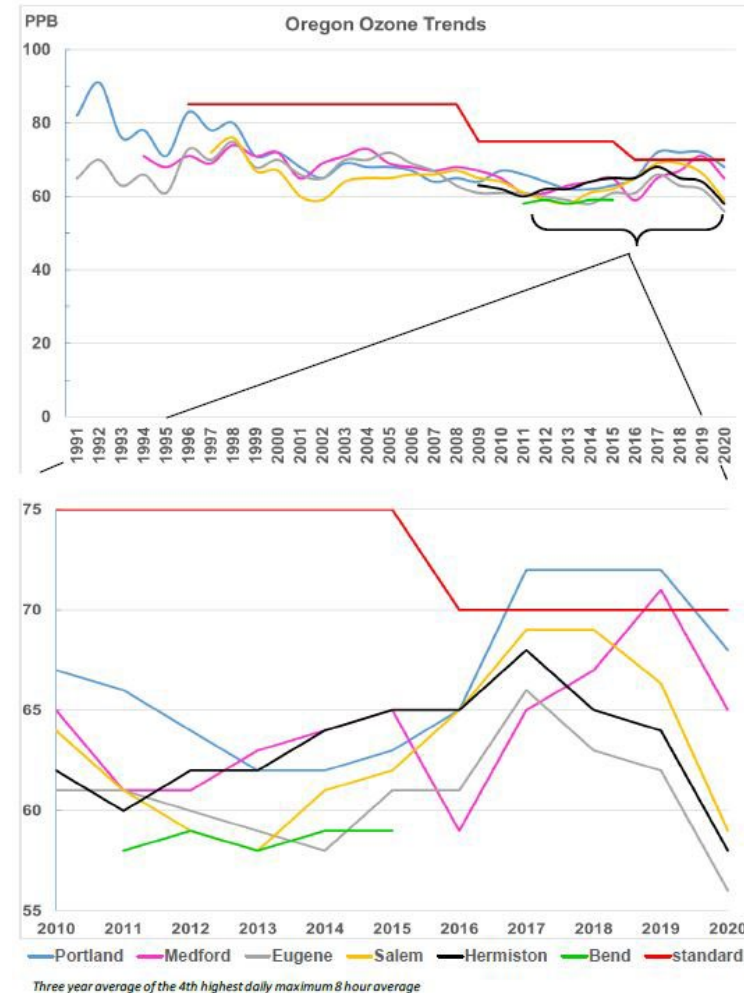
Credit: Oregon DEQ AQI Screenshot 9-17-2018

# Air Quality Trends in Oregon



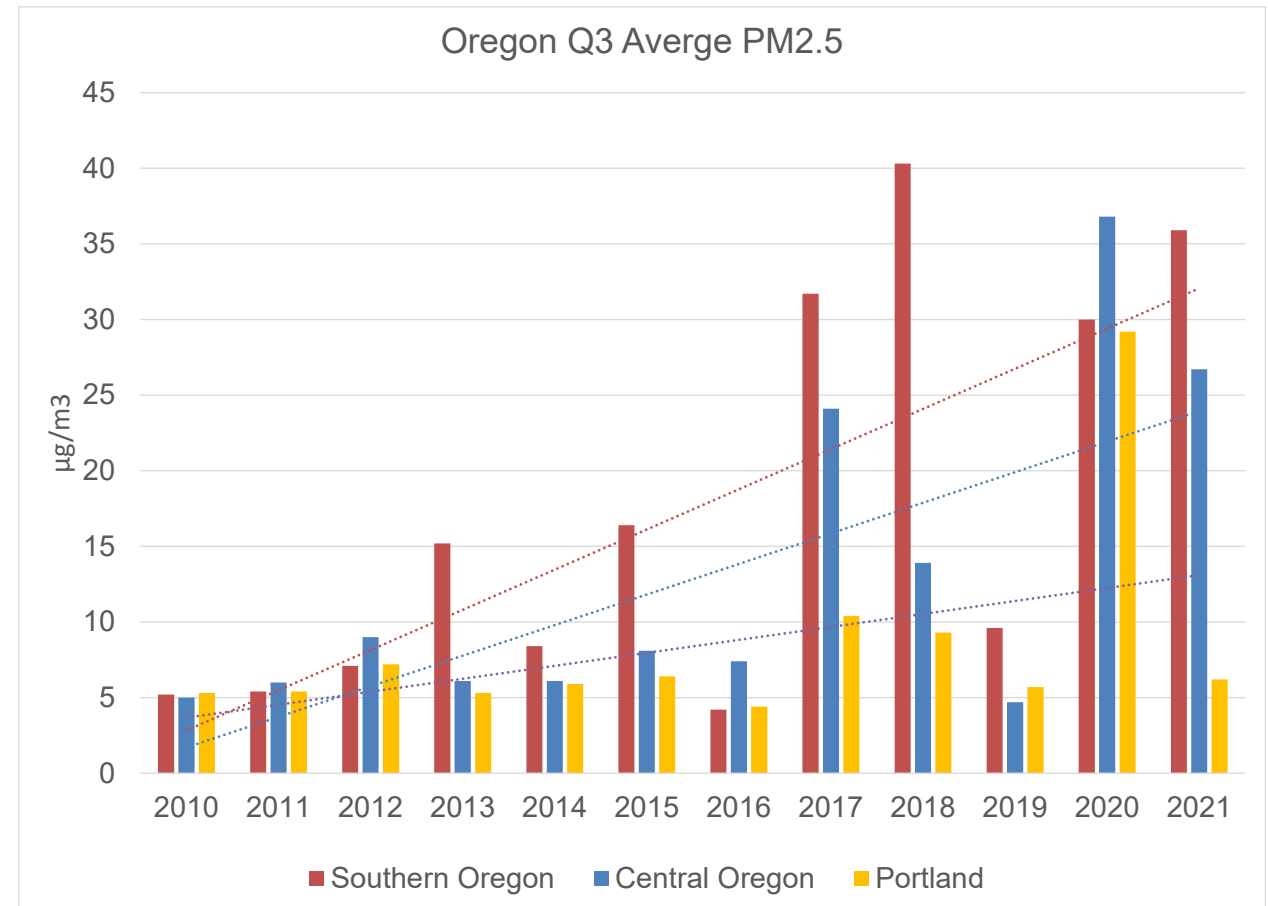
# Air Quality Trends in Oregon

- Ozone trend from the last 30 years
- Ozone dropping and remaining stable until a few years ago
- Higher temperatures, population growth, and increased wildfires may contribute to ozone increase
- Drop in 2020 due to pandemic



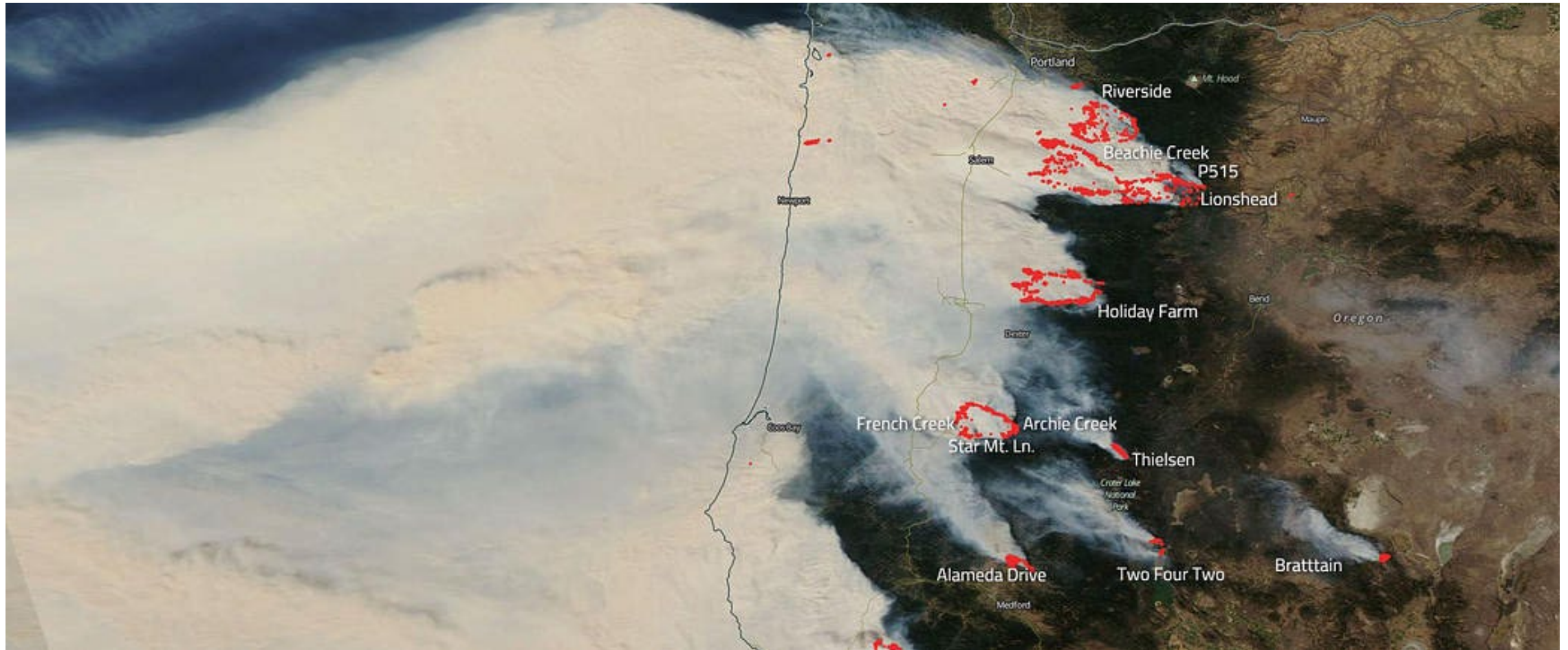
# Air Quality Wildfire Trends in Oregon

- Increased PM2.5 levels in Quarter 3 due to wildfires
- Southern and Central Oregon usually impacted the most during wildfire season
- Observing increased PM2.5 levels in the Portland Metro



Credit: Anthony Barnack, Oregon DEQ

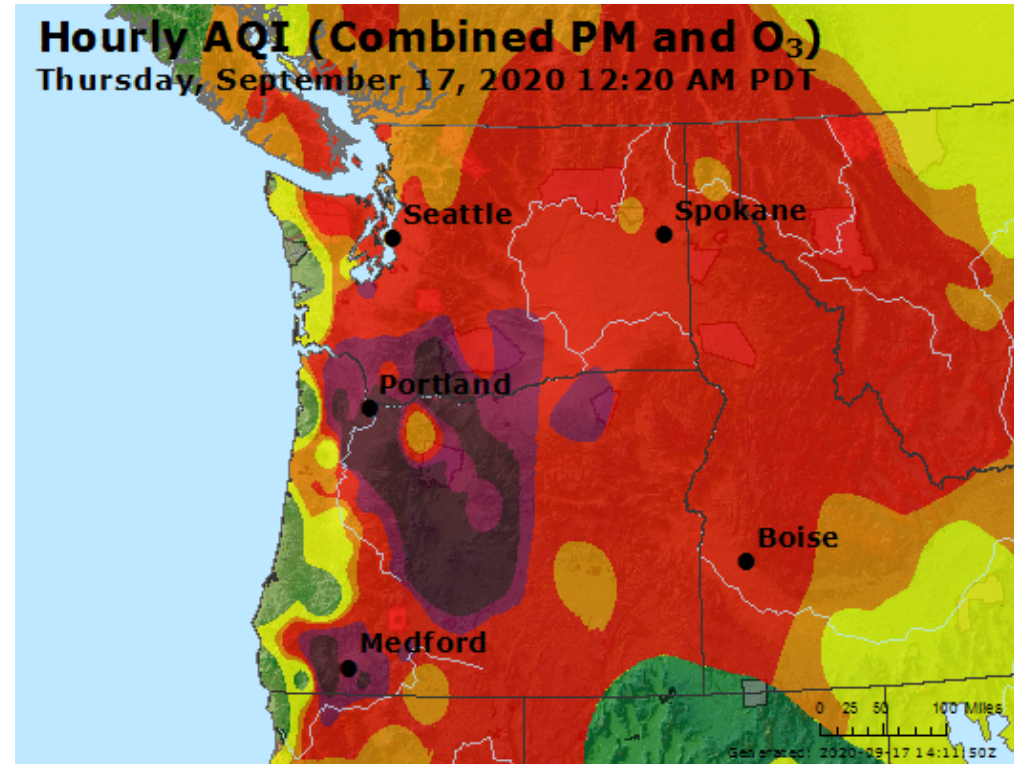
# September 2020 Wildfires



NASA's Aqua captured this during the September 2020 wildfires in Oregon. Credit: NASA Worldview

# September 2020 Wildfires

- Increased public interest in AQM real time data
- DEQ AQI webpage experienced high number of visits during the event.
- Server experienced slow downs due to traffic.



Credit: EPA AirNow 9-17-2020



# September 2020 Wildfires

## PM Network Methods

Highly Accurate & Expensive



Lower Accuracy & Cheaper



FRM



FEM



Nephelometer



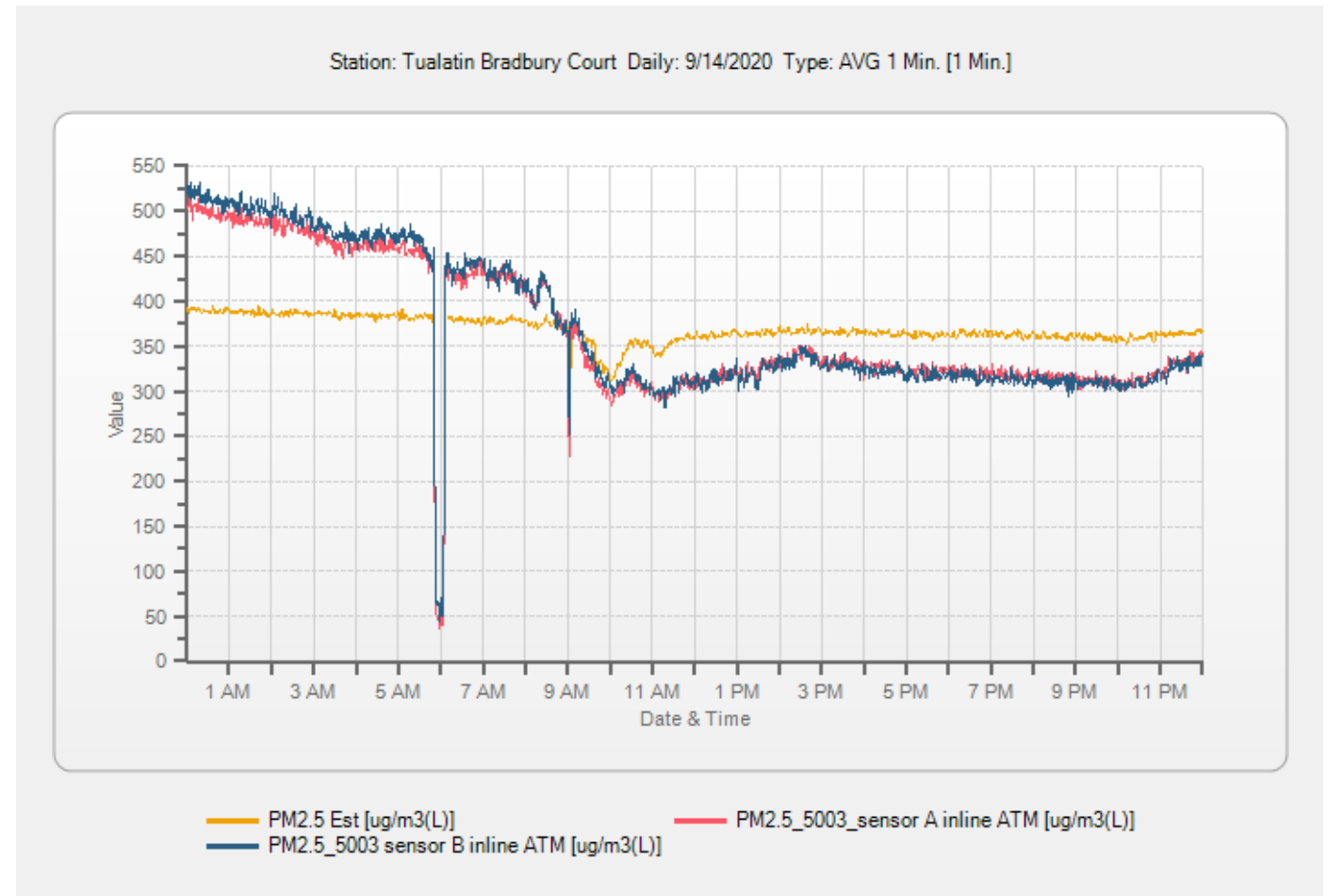
SensOR



Low-Cost Sensors

# September 2020 Wildfires

- Mixed results from different PM monitors
- Public concerned with healthy/unhealthy
- Public does not care (much) about standards and methods
- FEM concentrations can already diverge by more than 20% from filter data
- For informational purposes, accuracy matters less when PM is  $> 300 \mu\text{g}/\text{m}^3$



# September 2020 Wildfires

## Air Monitoring Equipment Wildfire Impacts



Nephelometer Mesh Screen



PM2.5 FRM Filters



Ozone Filter



Credit: AP Photo/John Loche

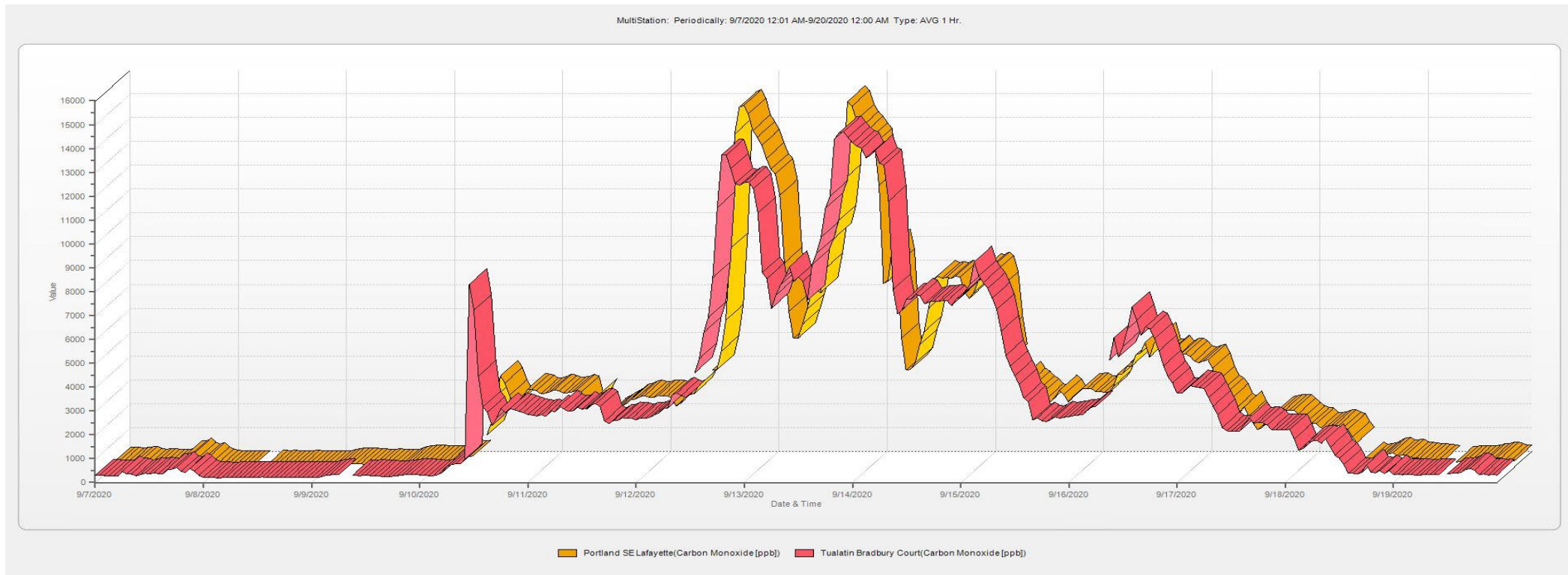
# September 2020 Wildfires

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- Interference resulting from high PM – Ozone scrubbing?
- Many factors contribute to lower Ozone levels during high PM events
- Had trouble passing Ozone QC checks
- Ozone PM filters clogged
- Few anthropogenic contributions during smoke that may have also contributed to lower ozone levels

# September 2020 Wildfires

- Highly elevated CO concentrations



# September 2020 Wildfires

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- Resulting changes from wildfire events
  - Oregon Senate bills increasing funding for wildfire PM monitoring, Increased staffing
  - Seasonal sites now monitoring year round
  - New Oregon OSHA Rules
  - OAR 437-002-1081 and OAR 437- 004-9791
    - OSHA Smoke Rules – when AQI equals or exceeds 101
    - AQI of 101 NIOSH N95 mask provided (voluntary use)
    - AQI of 251 NIOSH respirators (employers ensure usage)
    - AQI of 501 NIOSH respirators (medical monitoring, fit testing)

# September 2020 Wildfires

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- Where does AQM go from here?
- Plan for extreme wildfires
- Ensure that we are prepared to measure concentrations out-of-range
  - Switching to different nephelometer or particle counting low-cost sensor systems
  - Switching from FRMs to FEMs for continuous data
  - Added and calibrated second CO range to analyzer

# September 2020 Wildfires

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- Philosophical Questions
- How much data do communities want and need when we can't do much about it?
- Is this more of a locality support issue – clean air shelters, air purifiers?
- Is this an occupational health and safety issue? Oregon OSHA rules, firefighter exposures



# June 2021 Heat Dome



Credit: Glenn Ahrens



Credit: Dave Shaw



Credit: CBS News

**Portland Streetcar**  
@PDXStreetcar · Follow

In case you're wondering why we're canceling service for the day, here's what the heat is doing to our power cables.

4:07 PM · Jun 27, 2021

21K Reply Share

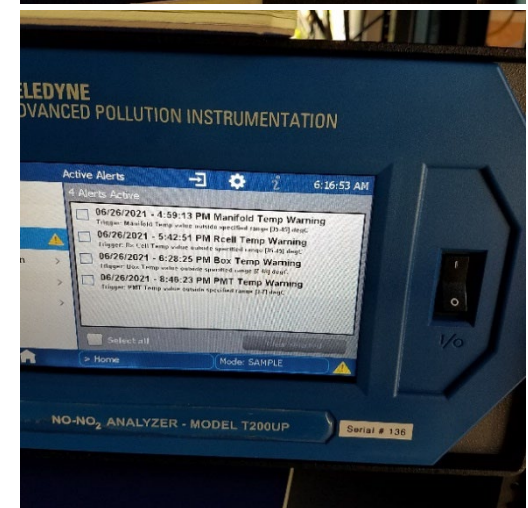
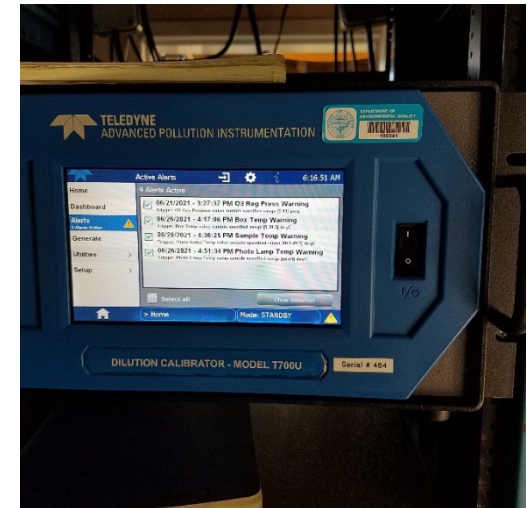
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Credit: Kenton Neighborhood Association

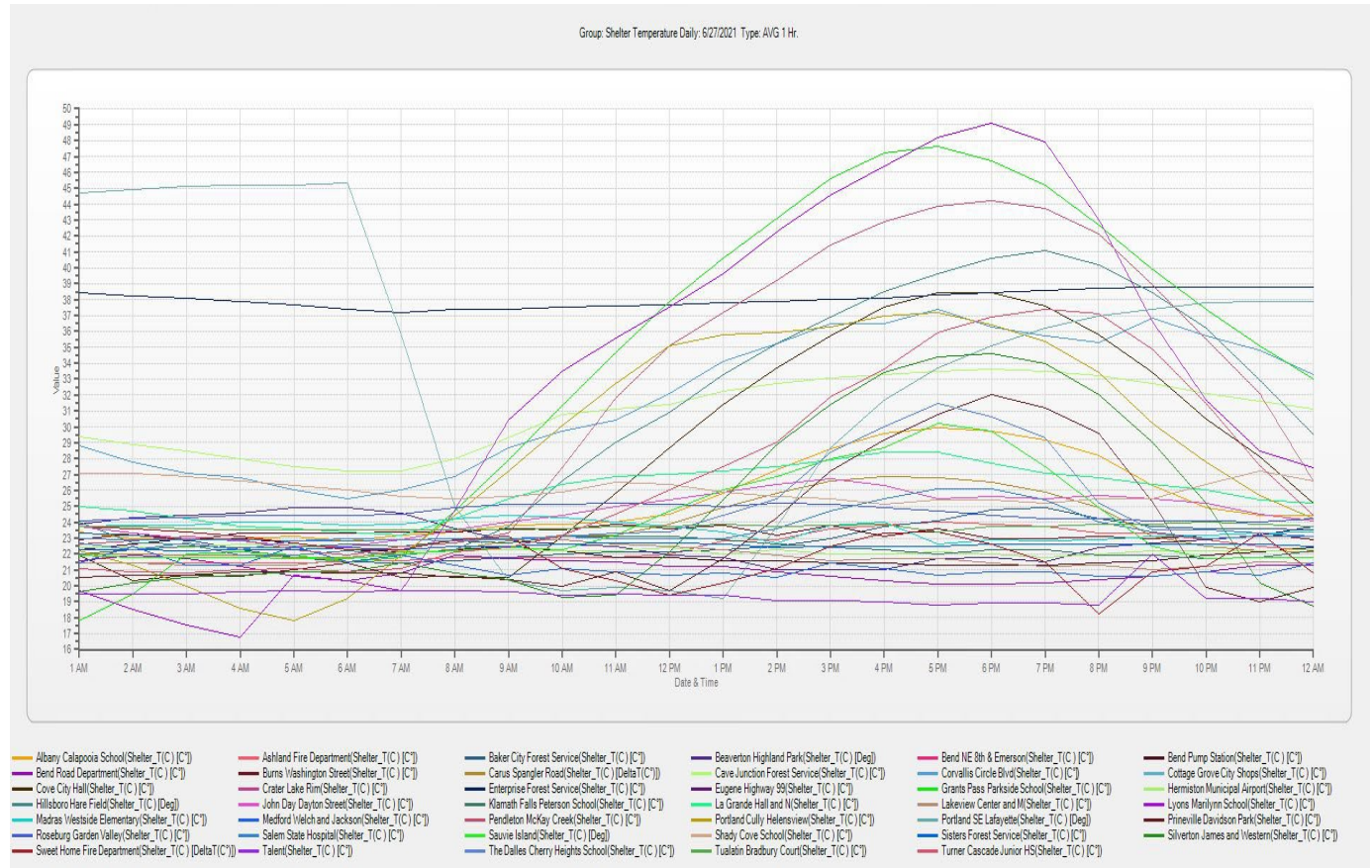
# June 2021 Heat Dome

- Challenges of monitoring during extreme heat
- Monitoring sites and equipment impacted by high temperatures
- Shelter temperatures
- Gas analyzer temperature alerts
- Data loss due to high shelter temperature



# June 2021 Heat Dome

- Pacific NW shelters not built for extreme temperatures
- Shelter replacements are expensive
- Had to make decisions to collect data or shut down sites
- AC failures, power failures



# June 2021 Heat Dome

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- Air quality measurements made during heat dome event
  - PM Measurements
    - Fairly normal levels— possibly due to reduction of emitting activities
    - No fire impacts during the heat but increased the possibility of future fires by stressing vegetation and trees
  - Ozone Measurements
    - Lower than expected – possibly due to reduction of emitting activities
    - Suggests that past a certain temperature, ozone formation not heat-limited in Oregon – not as much clear evidence of this in the past

# June 2021 Heat Dome

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- Future planning and mitigation efforts
  - Need to replace/re-insulate existing monitoring shelters
  - Replace air conditioning units?
  - Some air conditioning units simply unable to cope with such high temperatures – specialty equipment required?
  - Monitoring trailers may not be insulated enough to maintain viable temperatures during these kinds of events – supplement insulation or replace with fixed shelters?

# June 2021 Heat Dome

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- Do we want to plan for continued valid *extreme* events?
  - 69 **deaths** in Multnomah county during this heat event. Is losing a couple days of air quality data worth losing sleep over?
- Is this an extreme event in the future? Should we expect reoccurrence and plan accordingly?
- Oregon OSHA Heat Rules 437-002-0156 and 437-004-1131
  - Heat Rules applied when heat index is 80 degrees Fahrenheit
  - Provides water, shade, rest to employees during heat events
  - Heat illness prevention plans

# Bonus: August 2021 Formaldehyde concentrations

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- Formaldehyde as omnipresent air toxic of concern
- Modeled concentrations in NATA, very little data aside from NATTS/Oregon Air Toxics monitoring sites
  - Only 24-hour data on 1-in-6 basis
  - Is formaldehyde an issue during wildfires and smoke events?

# Bonus: August 2021 Formaldehyde concentrations

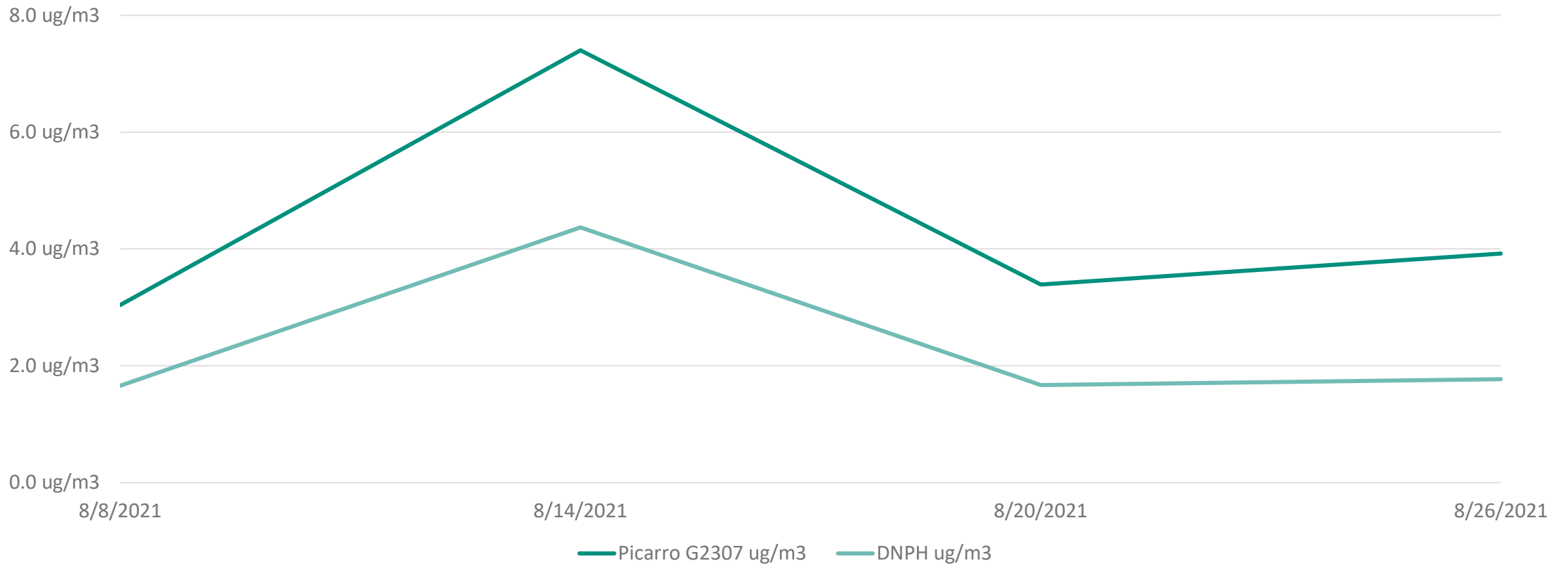
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- Borrowed loaner Picarro G2307 continuous formaldehyde analyzer during August of 2021
- “Lucky” enough to have analyzer running at near-road monitoring site during a smoke intrusion into Portland metro area
- Data compared well to DNPH sample and gave us time-resolved data of formaldehyde concentrations during event
- Attempted comparison with low-cost sensors; low-cost sensors were effectively useless



# Bonus: August 2021 Formaldehyde concentrations

Picarro G2307 vs DNPH (Near Road Site -Tualatin Bradbury Court)



# Conclusions

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- “Extreme” events may or may not be a lot more common in the future. Predicting the future is hard!
- To what extent should an agency plan for these events? DEQ is proceeding under the assumption that similar events **will** happen again.

Questions or Comments? Please email us at:

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