Low-cost sensors for informational PM-2.5 monitoring in Oregon

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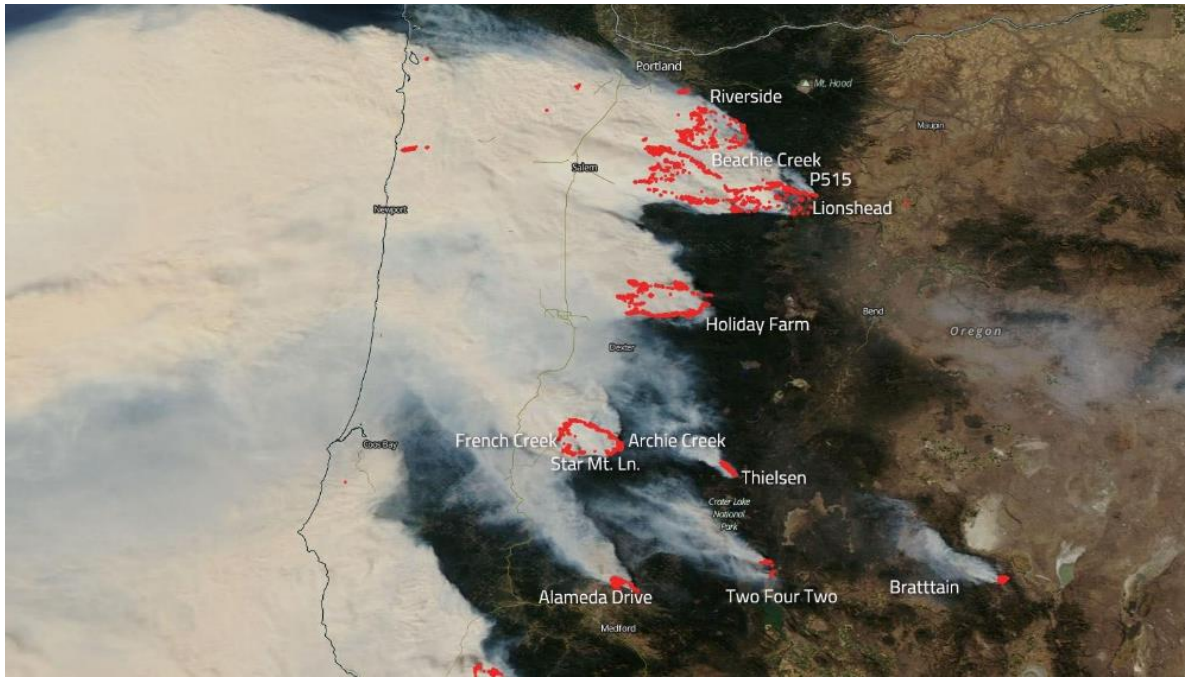

September 2020 Wildfires and Smoke

The West Coast is suffering from some of the worst air in the world — these apps show how bad it is

CNBC
9/12/2020

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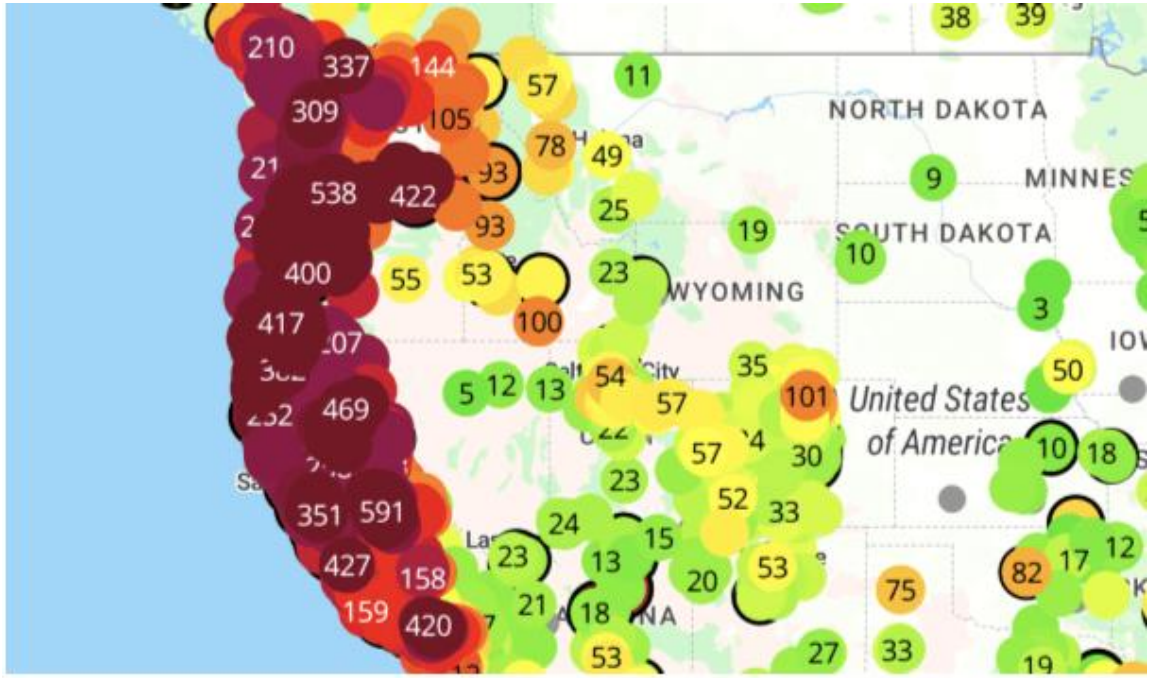
- Portland, Oregon suffered from the worst air quality in the world for days. It's currently second only to Vancouver, Canada, which is choking on smoke from the U.S. blazes.
- The city of Seattle ranks third, San Francisco seventh and Los Angeles ninth.
- Worried residents are turning to maps and apps like AirNow, PurpleAir, and IQAir to see how bad the air is outside and where they can go to escape.



The Purple Air air-quality map on Friday Sept. 11, 2020, shows most of the west coast with hazardous levels of pollution from wildfire smoke.

Screenshot

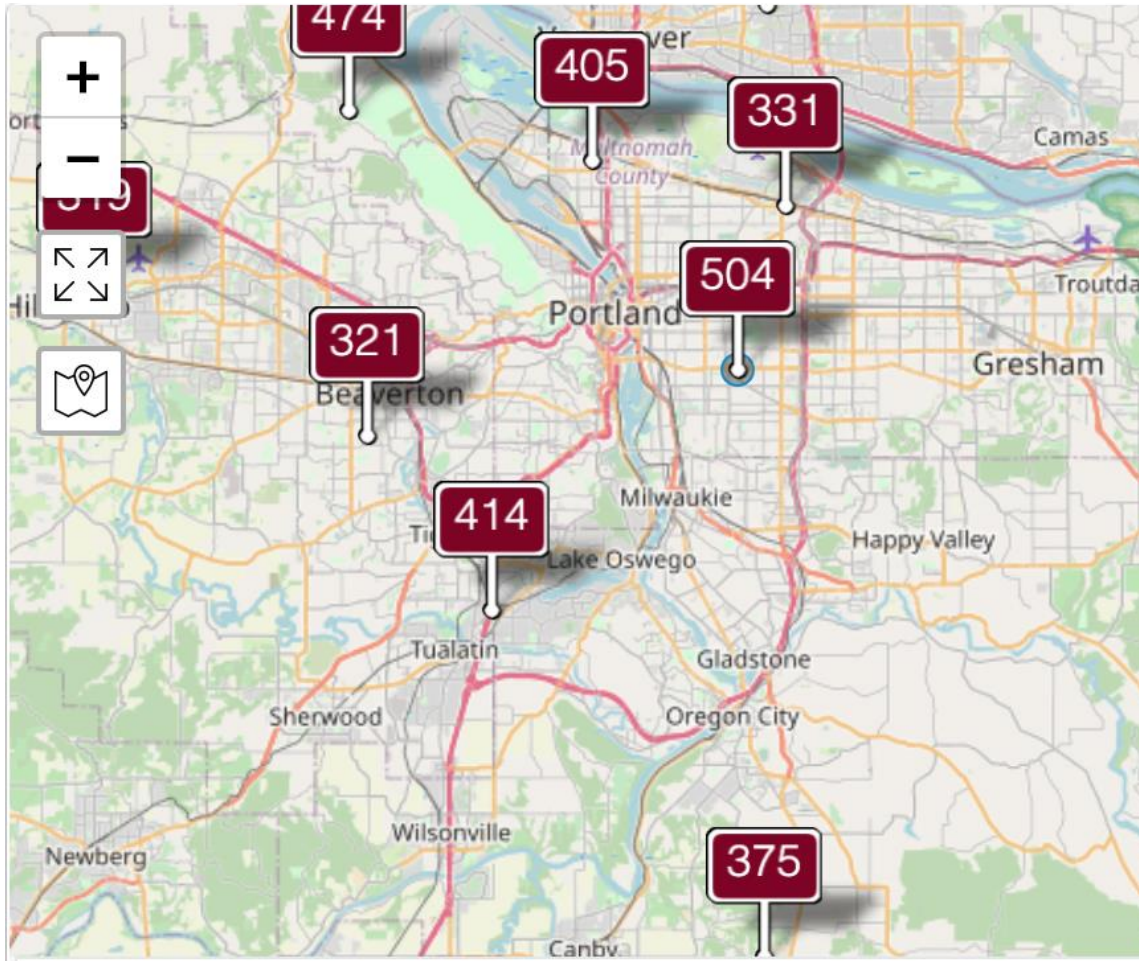
Portland, Oregon Air Pollution: Real-time Air Quality Index (AQI)

Portland, Oregon AQI: Portland, Oregon Real-time Air Quali

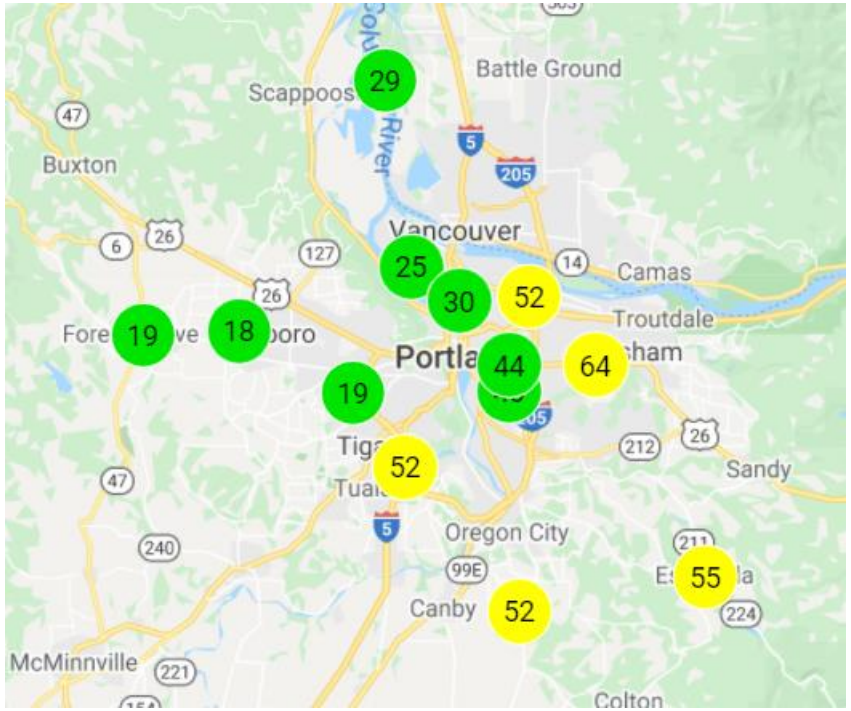
441 Hazardous

Updated on Saturday 17:00

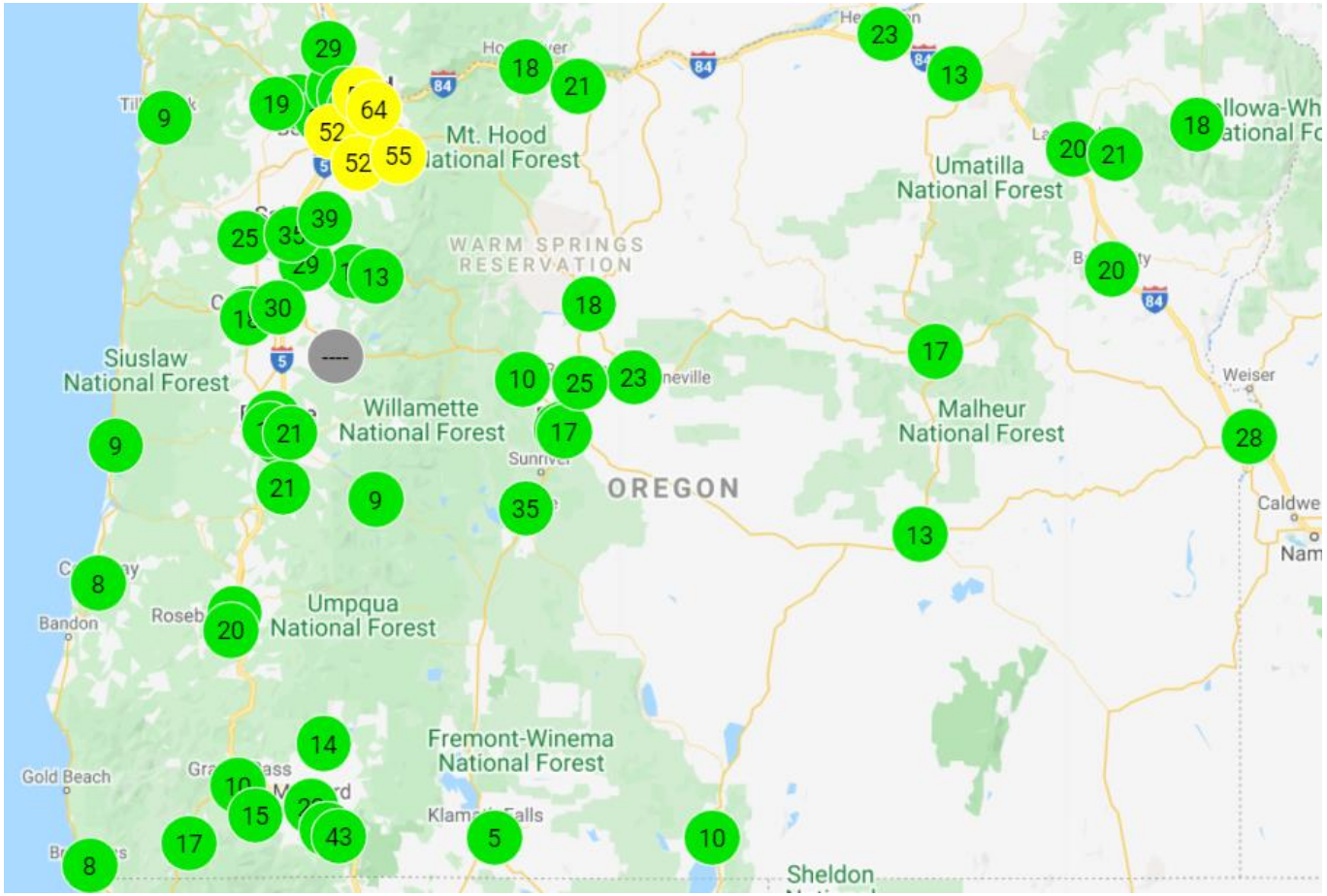
Temp.: 17°C



Oregon DEQ Particulate Monitoring Network



https://oraqi.deq.state.or.us/home/map



Monitoring Cost and Accuracy

Highly Accurate & Expensive → Lower Accuracy & Cheaper

Federal Equivalent Method

Teledyne T640

Radiance Nephelometer

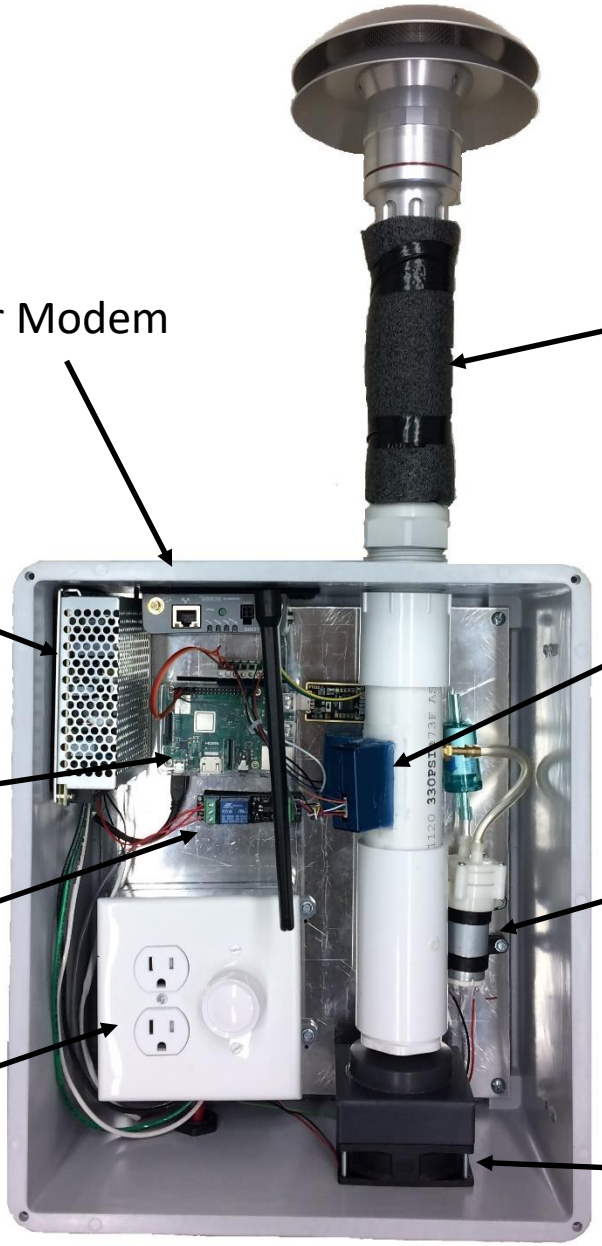
Oregon DEQ SensOR

Purpleair

Plantower

Sensor evaluation by South Coast AQMD at http://www.aqmd.gov/aq-spec

SensOR™



Heated Aluminum Inlet

Cellular Modem

Sample Chamber w/ 2 Plantower PMS5003ST Sensors

DC Power Supply

Raspberry Pi

Zero Air Pump

Zero Air Relay

AC Power Input

Fan (Flow ~2 LPM)

Oregon DEQ data quality objectives

- Data completeness >= 75%

https://www.oregon.gov/deq/FilterDocs/aqmlowcost.pdf

https://www.oregon.gov/deq/FilterDocs/aqmtargets.pdf

- Air Quality Index data should be within +/- 20% FRM Data

State of Oregon Department of Environmental Quality

Air Quality Monitoring Performance Targets[1]

Application	Pollutants	Precision & Accuracy[2]	Examples	Supporting Documentation
Regulatory or compliance monitoring, Air toxics monitoring[3]	Ozone, PM2.5, CO, NO2, SO2, Lead, VOCs, HAPs[3]	+/- 10%	Filter-based FRM[4] sampler, Continuous FEM[5] PM monitor, FEM ozone analyzer, EPA laboratory protocols	40 CFR parts 50, 53, and 58, National Air Toxics Trend Station Technical Assistance document
Supplemental monitoring, Special studies, Real-time Air Quality Index	Ozone, PM2.5, H2S, VOCs, Meteorology	+/- 20%	Nephelometer, E-BAM, H2S monitor for odors, Calibrated met station, Sensor-based with quality control and validation	Organization's approved quality assurance plan or sampling analysis plan
Area and source surveys, Screening; Fenceline monitoring, Personal exposure	Ozone, PM2.5, NO2, VOCs, Meteorology	+/- 30%	Calibrated sensors, Home met station	EPA Air Sensor Toolbox
Information, Education, Community monitoring	Ozone, PM2.5, NO2, CO, VOCs and others	+/- 50%	Low-cost sensors, Personal monitors	South Coast AQMD Air Quality Sensor Performance and Evaluation Center

1 This document is for informational use only. DEQ makes no claim, warranty or guarantee of instrument performance when operated by users for their specific applications.

2 These guidelines are likely to evolve as technology and science advance.

3 Hazardous air pollutants or air toxics

4 Federal Reference Method

5 Federal Equivalent Method

Next steps

- Current focus
  - 22 DEQ SensOR sites currently on line - adding more
  - Expanded use for PM monitoring during field burning & wildfires
  - Address network-scale challenges (e.g. maintenance, data QA)
  - Implement QA performance audits using a federal equivalent monitor

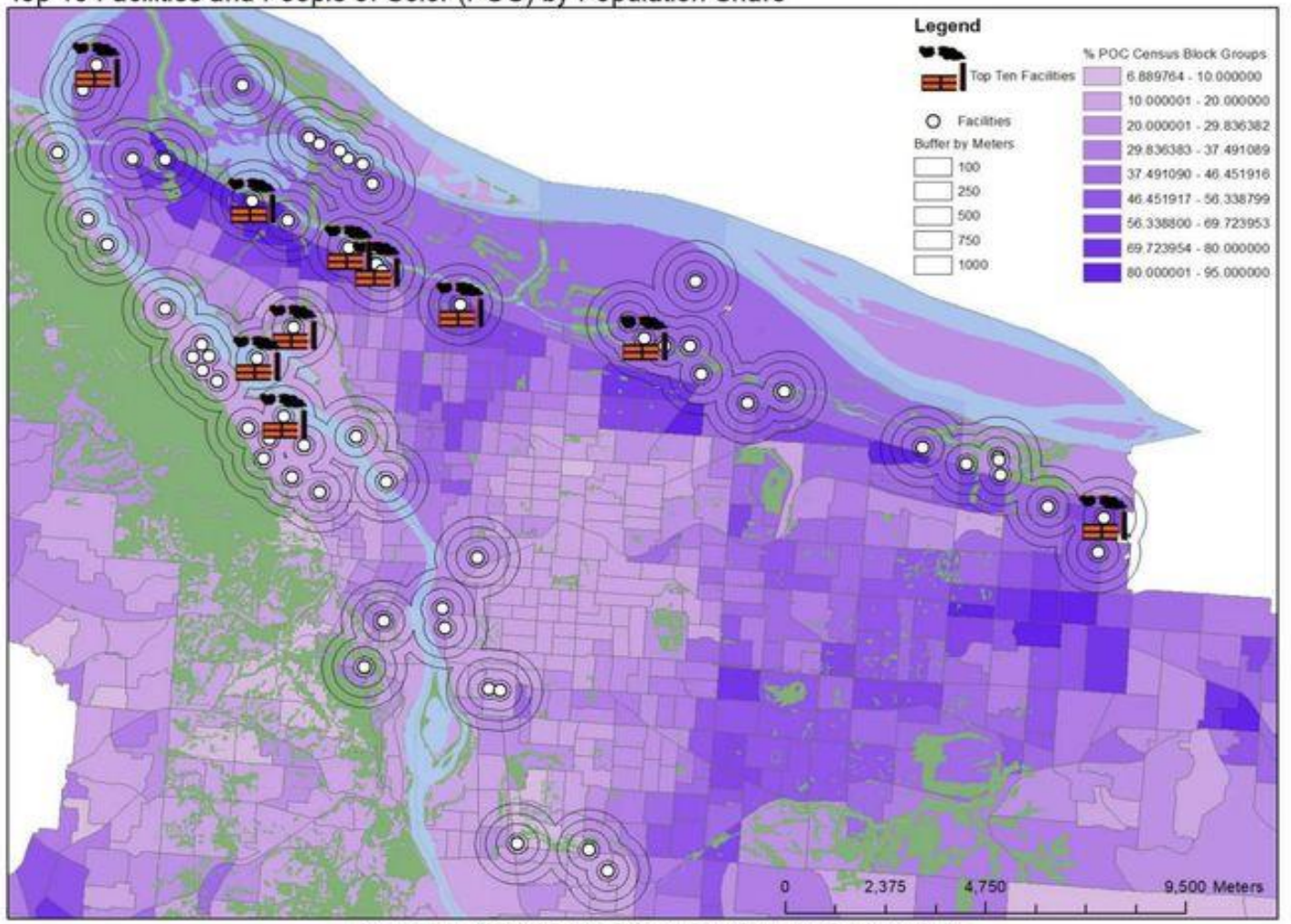
- Long-term possibilities
  - Replace aging Nephelometers with SensORs
  - Incorporate other pollutants/meteorology
  - Validate/improve PM forecasting models
  - Feedback/collaboration from the larger community

Community Monitoring

- DEQ offers technical support and collaboration
- Goal is to produce defensible data that support monitoring objectives
- Encouraged to follow guidelines presented in EPA's ***Handbook for Citizen Science Quality Assurance and Documentation*** https://www.epa.gov/citizen-science

Portland Air Toxics – Area Risk Program and Environmental Justice

Top 10 Facilities and People of Color (POC) by Population Share



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