

1. How does a Purpleair AQM (low-cost sensor) differ from an EPA (Environmental Protection Agency) AQM?

Definition of Terms

AQM means Air Quality Monitor. PM means Particulate Matter, PM 2.5 means a particulate the of size 2.5 microns. found within per one cubic meter M3. **Higher Correction Factor for 24 hour average Purpleair Reading** (PM2.5_CF1_ug/m3) for **Wood Smoke** used by Wisconsin Department of Natural Resources is **PA * 0.5140 +1.8304.**

DEFINITION OF MICRON Like inches, meters and miles, a micron is a unit of measurement for distance. There are about 25,000 microns in an inch. DEFINITION OF PM2.5: The term fine particles, or particulate matter 2.5 (PM_{2.5}), refers to tiny particles or droplets in the air that are **two and one half microns or less in width.**

PM 2.5 and ILLNESS: **PM 2.5 is the perfect size to infiltrate the human lung** and can begin a cascade of illness familiar to those living next to a smokestack of a residential wood burner, one who burns wood repeatedly and continually, not acutely like a wildfire, as a heat source, or perhaps as recreation.

Fine particulate matter (PM_{2.5}) is **an air pollutant that is a concern for people's health when levels in air are high.**

CONTRIBUTORS TO CLIMATE CHANGE: PM 2.5 also contributes to climate change.

But **other sources of climate change in the air** such as methane which unfortunately is a byproduct of natural gas burning but fortunately dissipates more quickly than ozone, **are not as imminent a threat to human health as PM 2.5.**

The six major pollutants according to the EPA are carbon monoxide, lead, nitrogen oxides, ground-level ozone, particle pollution (often referred to as particulate matter), and sulfur oxides.

2. How does a Purpleair AQM differ from an EPA AQM?

2.a. A Purpleair AQM **costs under \$300** and is purchased by residents in a residential area who want to know how healthy and free from unhealthy particulates their air quality is on a scale from green (healthy) to red (unhealthy).

2.b. An EPA AQM **costs over \$100,000**, and needs a trained and highly paid analyst to use. Therefore, few EPA AQMs are owned and used by the U.S. Government compared to the many owned by U.S. residents. On maps the healthiness of the air is shown from green (healthy) to red (unhealthy).

3. How does a Purpleair AQM differ from an EPA AQM?

3.a. **Purpleair sensors use a laser particle counter to count the number of airborne particles** in the air. That count is used to calculate a mass concentration, assuming an average particle density in an algorithm developed by the laser counter manufacturer, Plantower. An average density must be used because not all PM of a particular size is made of the same stuff. For instance, PM2.5 from wildfire smoke will have a different density than PM2.5 from dust blowing off a gravel pit. This means that mass concentration reported by a PurpleAir sensor can vary depending on the specific composition of PM for a given area thus making the sensors appear to "read high."

3.b. **Federal reference sensors typically measure mass concentration of PM by drawing air through a filter and weighing the filter.** This method is expensive, difficult to install, requires a specialist to maintain the sensor, and reports on an hourly scale. Because of this, **many cities have a limited number of these sensors (or none at all)** and it's not feasible for the general public to have their own.

3c. **Wood & Gravel density** particulates are counted in a similar way in a Purpleair AQM but are of **different densities.**

3.d. A less dense particulate, such as a **wood density particulate** can be one quarter to one half the density of what is often pointed to as a very dense particulate in air, **gravel density.**

4. How does a Purpleair AQM differ from an EPA AQM?

4.a. Approximately 55 Purpleair AQMs (or similar resident-owned AQMs) are on the AirNow Map in Wisconsin in May 2022.

4.b. Approximately 15 EPA AQMs are on the AirNow Map in Wisconsin in May 2022.

In 2019 only about 1,000 EPA AQMs were on the AirNow Map, because of the cost of owning and running EPA AQMs.

Purpleair AQM residential sales in California spiked after the 2018 Camp Fire Wildfire in California.

5. How does a Purpleair AQM differ from an EPA AQM?

5.a. Purpleair Outdoor AQMs can measure non-wildfire wood smoke density in a local area because more of them are deployed locally, and more deployed in residential areas. The EPA uses data from Purpleair Outdoor AQMs to supplement their data from their own EPA Monitors.

Purpleair Outdoor AQMs are helpful during acute wildfire smoke incidents, to let people know if dense smoke is in their area. During these acute wildfire incidents, people are warned not to exercise outdoors, to avoid PM 2.5 infiltrating their lungs.

5.b. EPA AQMs can measure wildfire and non-wildfire wood smoke density, but they are also deployed to measure particulates of gravel density. Examples of when particulates of gravel density are in the air are sandstorms, and industrial production which produces particulates of high density.

6. How does a Purpleair AQM differ from an EPA AQM?

6.a. Purpleair (PA) Outdoor monitors can't distinguish between low density (wood particulates) and high density (gravel particulates). PA PM 2.5 readings are generally HIGHER than EPA under 200, and PA PM 2.5 readings are generally LOWER than EPA above 300.

6.b. EPA monitors collect both low density (wood particulates) and high density (gravel particulates) particulates. When they are weighed together, the correct PM 2.5 encompassing all KINDS of PM 2.5 particulates is determined.

To correlate the PA data with the EPA data, a simple equation was used by the Wisconsin Department of Natural Resources (DNR) in May 2022 $PA * 0.5140 + 1.8304$.

In other words, Higher Correction Factor for (1660 minute) 24 hour average PM 2.5 Purpleair Reading (PM2.5_CF1_ug/m3) for Wood Smoke used by Wisconsin Department of Natural Resources is $PA * 0.5140 + 1.8304$.

Exposure assessment of PM_{2.5} using smart spatial interpolation on regulatory air quality stations with clustering of densely-deployed microsensors

<https://www.sciencedirect.com/science/article/pii/S0269749121019837>

Abstract

Accurate mapping of [air pollutants](#) is essential for epidemiological studies and [environmental risk assessments](#). Concentrations measured by [air quality monitoring](#) stations (AQMS) have primarily been used to assess the exposure of PM_{2.5}. However, the low coverage and amount of monitoring stations affect the errors of spatial interpolation or geostatistical estimates. In contrast to other integrated approaches developed for improved air pollution estimates, this study utilizes data from low-cost microsensors densely deployed in Taiwan to improve the popular spatial interpolation approach called inverse distance weighting (IDW). A large dataset from thousands of low-cost sensors could improve spatial interpolation by describing the distribution of PM_{2.5} in detail. Therefore, this study presents a clustering-based method to assess the distribution of PM_{2.5}. Then, a smarter IDW is performed based on correlated observations from the selected air quality stations. The publicly available data chosen for this investigation pertained to Taiwan, which has deployed 74 monitoring stations and more than 11,000 low-cost sensors since December 2020. The results of leave-one-out cross-validation indicate that there are fewer PM_{2.5} estimation errors in the developed approach than in estimations that use kriging across almost all of the months and sampled dates of 2019 and 2020, particularly those with higher PM_{2.5} spatial heterogeneities. Spatial heterogeneities could result in more significant estimation errors in mainstream approaches. The [root mean square error](#) of the monthly average estimate for PM_{2.5} ranged from 1.17 to 3.86 µg/m³. We also found that the clustering of one month characterizing the pattern of PM_{2.5} distribution could perform well in spatial interpolations based on historical data from monitoring stations. According to the information on the openaq platform, low-cost sensors are in demand in cities and areas. This trend might pave the way for the application of the proposed approach in other areas for superior exposure assessments.

<https://www2.purpleair.com/community/faq#hc-how-do-purpleair-sensors-compare-to-regulatory-particulate-matter-sensors>

Page 1 of 2 How do PurpleAir sensors compare to regulatory particulate matter sensors?

There are two major differences between PurpleAir sensors and regulatory sensors: the method of measuring particulate matter and the averaging time of the data collected.

Methods:

PurpleAir sensors use a laser particle counter to count the number of airborne particles in the air. That count is used to calculate a mass concentration, assuming an average particle density in an algorithm developed by the laser counter manufacturer, Plantower. An average density must be used because not all PM of a particular size is made of the same stuff. For instance, PM2.5 from wildfire smoke will have a different density than PM2.5 from dust blowing off a gravel pit. This means that mass concentration reported by a PurpleAir sensor can vary depending on the specific composition of PM for a given area thus making the sensors appear to "read high." So far, two different research groups have completed studies for their areas and created conversion factors specific to the composition of particulates in their air: AQ&U and LRAPA.

Federal reference sensors typically measure mass concentration of PM by drawing air through a filter and weighing the filter. This method is expensive, difficult to install, requires a specialist to maintain the sensor, and reports on an hourly scale. Because of this, **many cities have a limited number of these sensors (or none at all)** and it's not feasible for the general public to have their own.

Averaging Time:

PurpleAir uses the AQI breakpoints established by the US EPA to convert the mass concentration into the AQI published on the PurpleAir map. However, most regulatory groups report AQI as a 24-hour average that gets updated every hour or so.

If you look at particulate matter data on a website like AirNow, a PM2.5 AQI of 150 means the average AQI in the last 24 hours was 150.

<https://www2.purpleair.com/community/faq#hc-how-do-purpleair-sensors-compare-to-regulatory-particulate-matter-sensors>

Page 2 of 2 How do PurpleAir sensors compare to regulatory particulate matter sensors?

PurpleAir sensors use laser particle counters to count the number of particles in sizes from 0.3um up to 10um. These get converted into a mass concentration (ug/m³) and reported every 120 seconds. Since air quality can fluctuate greatly throughout the day, the real time PurpleAir AQI reading may appear "high" when compared to 24-hour averaged AQI data. If you want to **compare 24-hour averaged AirNow data with 24-hour averaged PurpleAir data**, you can look at longer term averages on the PurpleAir map by selecting the averaging period from the options in the bottom left, or by checking the "Averages as Rings" in the map legend in the lower left-hand corner of the map.

Each ring represents an average for a time range:

Center of the circle = Real time average

1st ring = Short-term average

2nd ring = 30-minute average

3rd ring = 1-hour average

4th ring = 6-hour average

5th ring = 24-hour average

6th ring = 1-week average