# Democratizing Access to Accurate Air Quality Measurements: Alternative Calibration Approaches

#### **EPA correction formula**

The U.S. Environmental Protection Agency has developed a correction formula for PM<sub>2.5</sub> measurements from Plantower sensors. It accounts for the influence of relative humidity and the sensors' non-linear response at high concentrations.



ink to the EPA documentation (correction formula on page 12)

### Calibration with a remote reference

When no access to a local reference instrument is available, a regional station with public data might be used. The background extraction method enables calibration of entire sensor networks based on remote reference data.

#### A monitoring network in Pai

Background PM<sub>25</sub> concentrations were extracted from a network of 16 air monitors in Pai, Thailand, and compared to the background PM<sub>2.5</sub> levels measured at a reference monitoring station **50** km away from the network (Mae Hong Son). This comparison was used to calibrate the entire network in Pai.





**Raw** PM<sub>25</sub> measurements of 16 monitors (grey), raw extracted background levels ue) and reference packground concentrations neasured in Mae Hong Son

PM2.5 measurements of 16 calibrated onitors (grey), xtracted background evels (blue) and ference background oncentrations (red, ame as above).





*Raw (left) and EPA-corrected (right) PM<sub>2.5</sub> readings of AirGradient monitors compared to* reference measurements in Chiang Mai, Thailand.

### **Overcoming barriers to accurate air quality measurements**

• Communities most exposed to air pollution often lack the tools and technical know-how to monitor it effectively. • Sensor calibration is essential to ensure data accuracy but usually requires specialized knowledge and access to

reference-grade instruments.

We present alternative calibration approaches that are simple, accessible, and do not require technical expertise or costly equipment – empowering communities to take control of their air quality.

## Manufacturer's calibration with reference

Many sensor manufacturers either do not calibrate their sensors or fail to provide transparent documentation of their calibration methods. Open-source calibration approaches, using reference-grade instruments at the manufacturing site, offer a way to improve sensor accuracy for communities without access to local or remote reference data.



AirGradient uses a Palas Fidas 200 as reference instrument to test and calibrate every sensor before shipping.

#### **OPEN QUESTION: Impact of testing aerosol**

How to generate a reproducible testing aerosol that is representative for ambient air?



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**Globally validated formula** 





Link to the full *performance analysis of the EPA correction* 

*The raw and EPA-corrected PM*<sub>25</sub> *readings from AirGradient monitors were compared* to co-located reference instruments in 16 locations across the globe.

> **BEFORE:** Raw data reference



08:01:3 08:17:1 08:17:1 08:33:1 08:33:1 08:49:1 08:57:1 08:57:1 09:05:1 09:21:1 09:21:1 09:27:1 09:27:1 09:37:1

AFTER: Calibrated c reference

- PM2.5





*Comparison of raw (left) and EPA-corrected (right) PM<sub>2.5</sub> readings with reference data.* Hourly data of 16 locations. The Root Mean Square Error (RMSE) improved on average from 11  $\mu$ g/m<sup>3</sup> to 5.5  $\mu$ g/m<sup>3</sup>.

#### Automated calibration tool

Calibration with a reference instrument typically requires complex data management and analysis. An automated calibration tool can ease this burden and save time.



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