Table S1. Monthly performance statistics for the sensor at Laney, relative to the co-located EPA AQS site, before and after the calibration was applied (r: Pearson Correlation Coefficient, MFB: Mean Fractional Bias, NRMSE: Normalized Root-Mean-Square Error).

Month	Before Calibration			After Calibration		
	r	MFB	NRMSE	r	MFB	NRMSE
Jan 2021	0.818	0.455	0.918	0.842	-0.021	0.43
Feb 2021	0.740	-0.023	0.666	0.808	-0.101	0.529
Mar 2021	0.711	-0.305	0.558	0.789	-0.152	0.461
Apr 2021	0.666	-0.335	0.486	0.768	-0.087	0.343
May 2021	0.611	-0.406	0.553	0.755	-0.145	0.365
Jun 2021	0.728	-0.433	0.702	0.84	-0.205	0.479
Jul 2021	0.564	-0.154	0.54	0.714	0.035	0.452
Aug 2021	0.825	0.134	0.47	0.863	0.203	0.519
Sep 2021	0.782	0.107	0.606	0.836	-0.021	0.543
Oct 2021	0.727	-0.358	0.581	0.815	-0.575	0.684
Nov 2021	0.862	0.809	1.051	0.914	-0.1	0.263
Dec 2021	0.902	0.971	1.563	0.914	-0.004	0.425
Jan 2022	0.886	0.925	1.157	0.924	0.202	0.363
Feb 2022	0.862	0.446	0.896	0.896	0.187	0.555
Mar 2022	0.622	-0.2	0.57	0.726	-0.272	0.491
Apr 2022	0.647	-0.325	0.549	0.731	-0.201	0.459
May 2022	0.721	-0.406	0.577	0.808	-0.208	0.427
Jun 2022	0.674	-0.345	0.537	0.77	-0.127	0.431
Jul 2022	0.716	-0.263	0.57	0.783	-0.112	0.5
Aug 2022	0.741	-0.109	0.533	0.794	-0.015	0.517
Sep 2022	0.570	-0.201	0.515	0.705	-0.211	0.453
Oct 2022	0.728	0.123	0.556	0.764	-0.164	0.417
Nov 2022	0.870	0.181	0.627	0.901	-0.27	0.412
Dec 2022	0.916	0.391	0.918	0.934	-0.253	0.384

Table S2. Performance statistics for the sensor in LA relative to its nearest EPA AQS site with different calibration schemes applied (R^2: Coefficient of Determination, RMSE: Root-Mean-Square Error)

Calibration Scheme	R^2	**RMSE** ($\mu g/m^3$)
No Calibration	0.312	6.96
National EPA Calibration	0.116	7.89
Seasonal RH Calibration	0.472	6.09

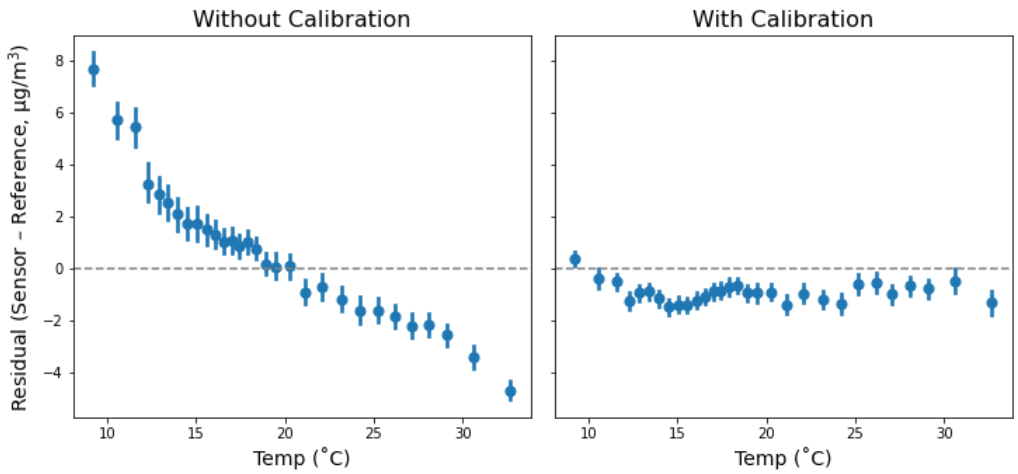

Figure S1. Measurement residuals (Sensor output – EPA AQS values) for Laney data without and with the seasonal RH dependence calibration, binned into 30 temperature bins.

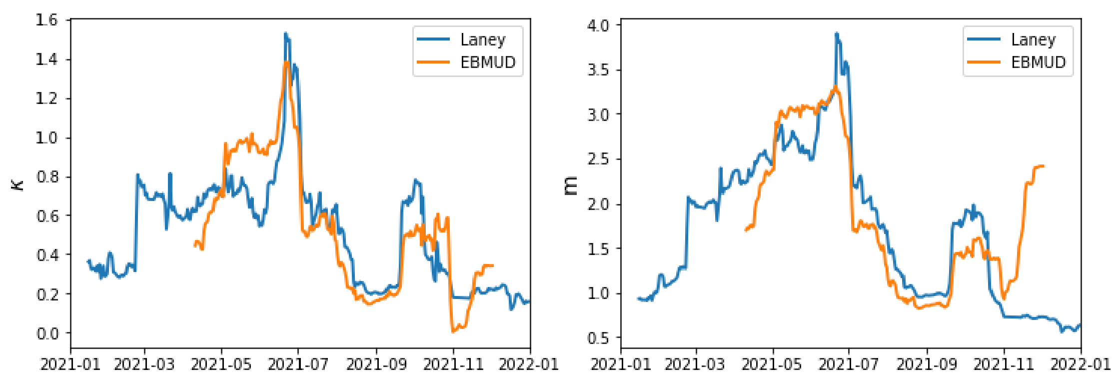

Figure S2. Calculated calibration parameters for two co-location sites in the Bay Area, CA: Laney and EBMUD.

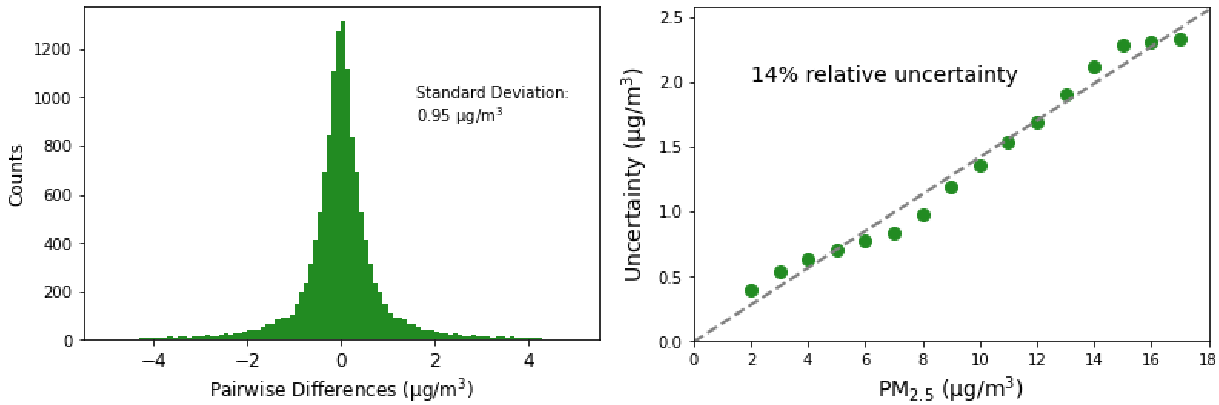

Figure S3. Pairwise differences of 10 co-located Plantowers over 1 month in lab show that instrument noise is about 1 μg/m³, similar to the manufacturer's reported uncertainty. Analysis by size bin shows that the uncertainty is a relative uncertainty of about 14%.

Derivation of the RH-Dependent Multiplicative Factor

From κ-Köhler Theory, the saturation ratio for an aqueous particle is given by

$$S = \left(1 + \kappa \frac{V_s}{V_w}\right)^{-1} \exp\left(\frac{4\gamma M_w}{\rho_w R T d_p}\right)$$

where the pre-exponential term is the activity of water:

$$a_w = \left(1 + \kappa \frac{V_s}{V_w}\right)^{-1}$$

where κ is the hygroscopic growth factor, V_s is the volute of the dry matter in the particle, and V_w is the volume of water in the particle. Rearrangement of the equation yields:

$$\frac{V_w}{V_s} = \frac{\kappa}{\frac{1}{a_w} - 1}$$

To convert the "wet" measured aerosol mass to a "dry" mass, we define the necessary scalar as $V_s/(V_s+V_w)$. We can manipulate the above equation to get:

$$\frac{V_s}{V_s} + \frac{V_w}{V_s} = \frac{V_s + V_w}{V_s} = 1 + \frac{\kappa}{\frac{1}{a_w} - 1}$$

And subsequently:

$$\frac{V_s}{V_s + V_w} = \frac{1}{1 + \frac{\kappa}{\frac{1}{a_w} - 1}}$$

We can then relate the activity of water to the relative humidity. To start, consider the thermodynamic equilibrium of water between the gas and aqueous phases:

$$\mu^{\circ}{}_{H_2O} + RT\ln(p_w) = \mu^{*}_{H_2O} + RT\ln(a_w)$$

For pure water, a_w=1 and p_w=p_w° (the saturation vapor pressure), so

$$\mu^{*}_{H_2O} - \mu^{\circ}{}_{H_2O} = RT\ln(p^{\circ}{}_w)$$

Combining these two equations, we get:

$$RT\ln(p_w) - RT\ln(p^{\circ}{}_w) = RT\ln(a_w)$$

Which simplifies to

$$a_w = \frac{p_w}{p^{\circ}{}_w} = \frac{RH}{100}$$

Substituting this into the above equation, we arrive at our RH-dependent scaling factor:

$$\frac{V_s}{V_s + V_w} = \frac{1}{1 + \frac{\kappa}{100/RH - 1}}$$