Supplementary Material

LOD

Table S-1 details the estimated LOD range.

Table S-1. Estimated LOD under different conditions.

	Laboratory	Ambient
LOD ($\mu g/m^3$)	0.721, 2.26, 3.22	10.5
k ($m^3/\mu g$, ambient, wind tunnel)	0.254,0.178	0.794 (no wind tunnel)
Number of observations	194	28
σ_{blk} ($\mu g/m^3$)	0.191	2.78

Ambient Conditions

Table S-2. Ambient meteorological conditions.

Measure	Mean	Median	Max	Min
Relative humidity (%)	69.2	70.9	88.6	26.6
Temperature (°C)	0.0298	-0.256	15.9	-8.98
Solar radiation (W/m^2)	113	-0.192	853	-0.476
Wind speed (m/s)	1.20	1.0	5.3	0.3

Schematic of wind-tunnel experiment

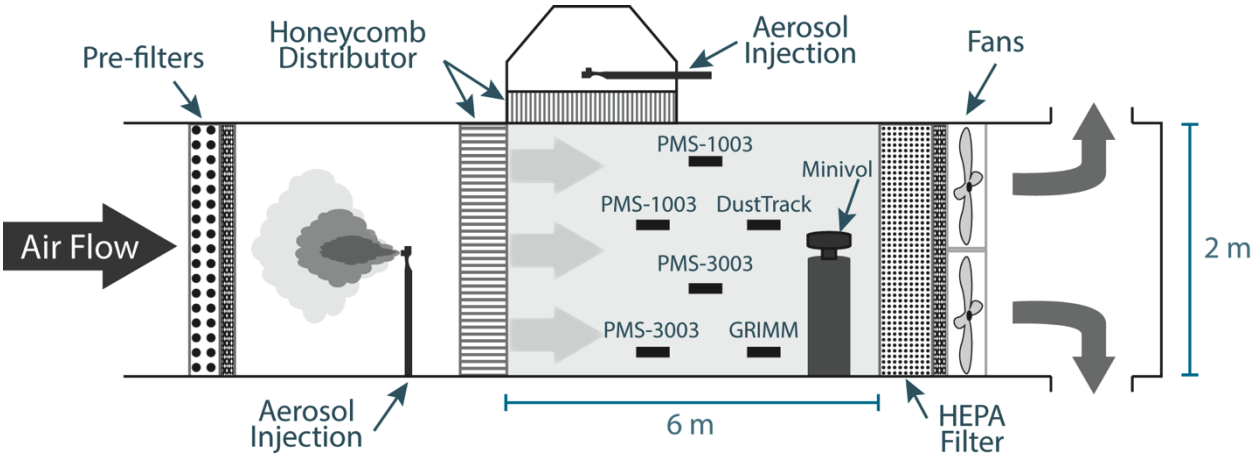


Figure S-1. Schematic of the wind tunnel illustrating the aerosol injection, general location of the PM sensors, research-grade instrumentation and the MiniVol sampler, adapted from Schmees et al. (2008). Note that the sensors and instrumentation are not drawn to scale so that they can be seen in the figure.

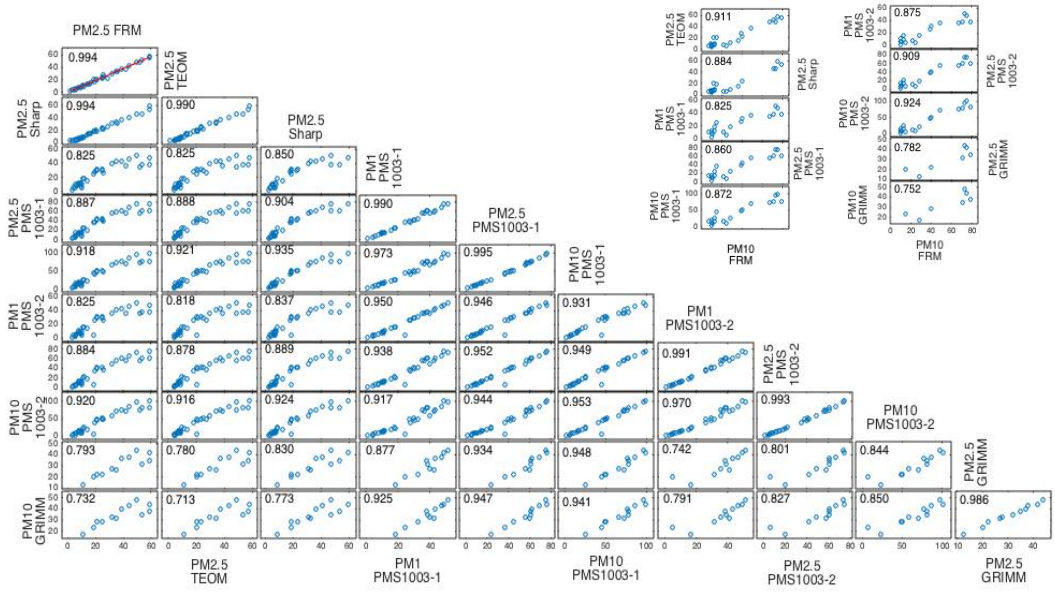


Figure S-2. Scatter plots and correlation coefficients for DAQ's 24-hour PM concentrations measured by DAQ's FRM ($PM_{2.5}$), FEMs (DAQ TEOM $PM_{2.5}$ and DAQ Sharp), research-grade monitor (GRIMM), and PMS1003-1/2 from January 11, 2016 to February 17, 2016. The PM concentrations are in ($\mu g/m^3$).

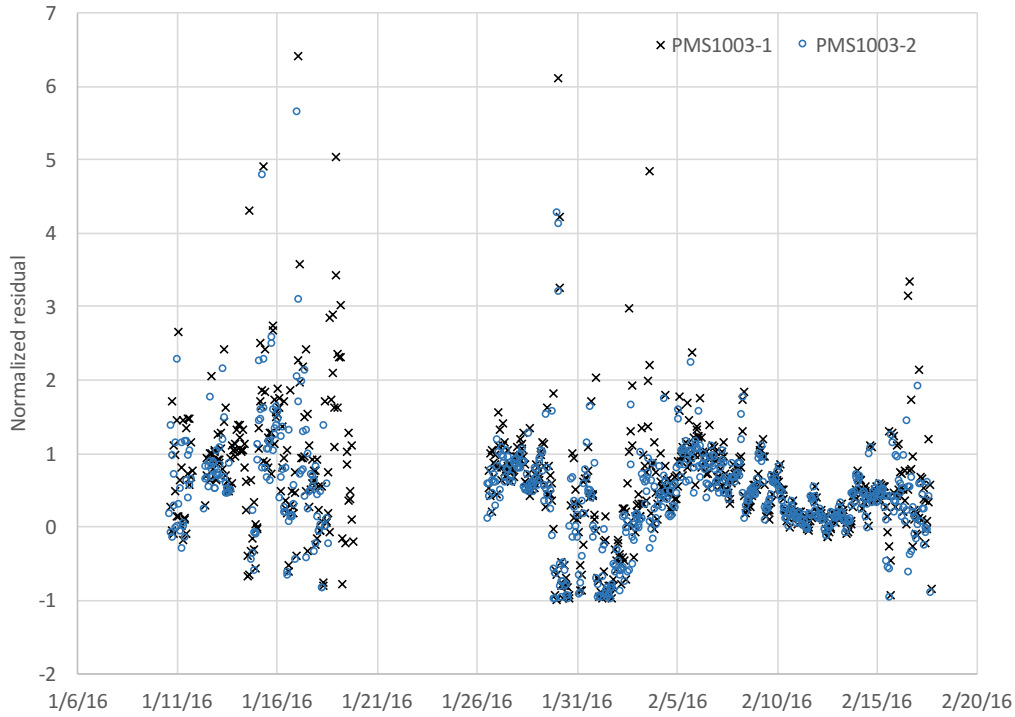


Figure S-3. Normalized residuals [(TEOM $PM_{2.5}$– PMS $PM_{2.5}$)/TEOM $PM_{2.5}$] during the course of the study. Note that TEOM $PM_{2.5}$ concentrations below 1 $\mu g/m^3$ were excluded from this analysis. The data gap from the 20th through the 26th (both sensors) was caused by a power loss.

PM_{10} Fit

Figure S-4 shows the correlation between hourly TEOM PM_{10} concentrations vs. PMS PM_{10} concentration.

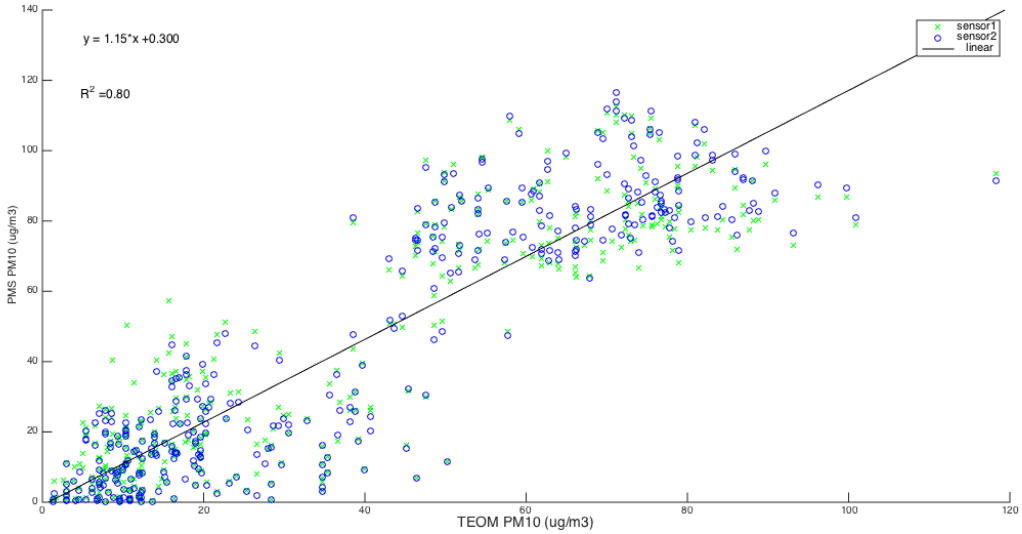


Figure S-4. Mass corrected hourly TEOM PM_{10} concentrations vs. PMS PM_{10} concentration at the Hawthorne monitoring station. FRM PM_{10} concentrations were more limited than the FRM $PM_{2.5}$ concentrations.

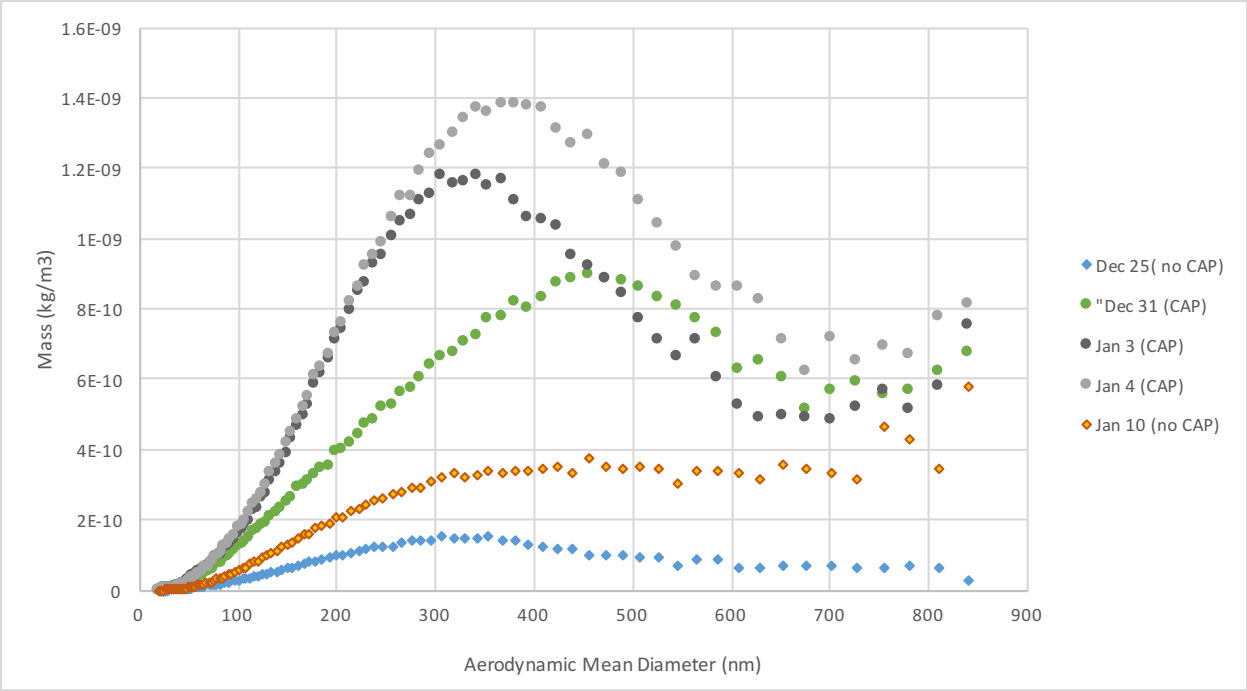


Figure S-5. Mass distributions for three daily average CAP days and two no-CAP days measured by a SMPS during the winter of 2015/2016. Note that these measurements were collected approximately 4.2 km away from the Hawthorne monitoring site (study site). $PM_{2.5}$ concentrations for each day are: December 25: 3.4 μg/m^3, December 31: 22.5 μg/m3, January 3: 26.5 μg/m^3, January 4: 34.1 μg/m^3, and January 10: 8.83 μg/m^3.

Table S-3. Goodness of fit estimates for several model types for the full dataset (All) and for a linear response for PM concentrations below 40 μg/m^3. The fits combine the measurements from both sensor 1 and sensor 2 (DMS = x, RH = r; PMS = y).

	All linear	**All linear 40**	**All linear-RH**	**All 5th**	**All Exp**	**Sensor1 linear**	**Sensor1 linear-RH**	**Sensor1 5th**	**Sensor1 Exp**	**Sensor2 linear**	**Sensor2 linear-RH**	**Sensor2 5th**	**Sensor2 Exp**
Params	2	2	3	6	3	2	2	6	6	2	3	6	2
Fit	1.26x+5.22	1.81x-1.4	(1)	(2)	(3)	1.27x+6.08	(4)	(3)	(5)		(6)	(7)	
Obs	1428	1077	1428	1428	1428	741	741	741	741	687	687	687	687
BIC	10,664	7,334	10,153	9,740	9,994	5,609	5,320	5,128	5,256	5,034	4,811	4,507	4,924
R^2-adj	0.845	0.877	0.892	0.919	0.920	0.831	0.886	0.912	0.895	0.863	0.901	0.884	0.905
SSE	145,700	56,200	101,660	75,850	67,056	83,391	56,200	43,165	51,842	60,739	43,870	28,876	14,432

RH: relative humidity (%) interaction term; 5th: 5th-order polynomial; BIC: Bayesian information criterion, R^2: Adjusted R^2; SSE: sum of squares due to error.

Fits:

(1) $1.27x+6.94\ x10^{-3}\ x * r - 0.137$

(2) $-3.59 \cdot 10^{-7}x^5+7.87 \cdot 10^{-5}x^4 - 6.17 \cdot 10^{-3}x^3+0.183x^2 - 0.0526x+3.14$

(3) $90.9(1-e^{-0.0333x}) -7.16$

(4) $0.408+1.27x +0.00746*r*x$

(5) $89.9(1-e^{-0.0350x}) -6.61$

(6) $1.27x+6.31x10^{-3}\ x*r -0.689$

(7) $6.49 \cdot 10^{-8}x^5 - 2.07 \cdot 10^{-5}x^4 – 2.00 \cdot 10^{-3}x^3+0.183x^2 – 1.17x+1.80$

Additional Model Fits

This section includes model fits where PMS = x, and DMS = y, RH = r.

All data points

Linear: $y = 5.23 + 1.26x$

Linear-RH interaction: $y = DMS = 2.64+0.722x - 0.000340*x*r$

5th order polynomial: $y = -3.59\cdot10^{-7}x^5+7.87\cdot10^{-5}x^4 - 6.17\cdot10^{-3}x^3+0.183x^2 - 0.0526x+3.14$

Exponential: $y = 6.70e^{0.0276x}$

Sensor1

Linear: $y = -0.105+0.668x$

Linear RH interaction: $y = 2.40+ 0.719x-0.0349*x*r$

5th order polynomial: $= -3.60\cdot10^{-7}x^5+8.04\cdot10^{-5}x^4 – 6.36\cdot10^{-3}x^3+0.188x^2 – 0.0473x + 3.66$

Exponential: $y=6.63e^{0.0269x}$

Sensor2

Linear: $y =0.293 + 0.686x$

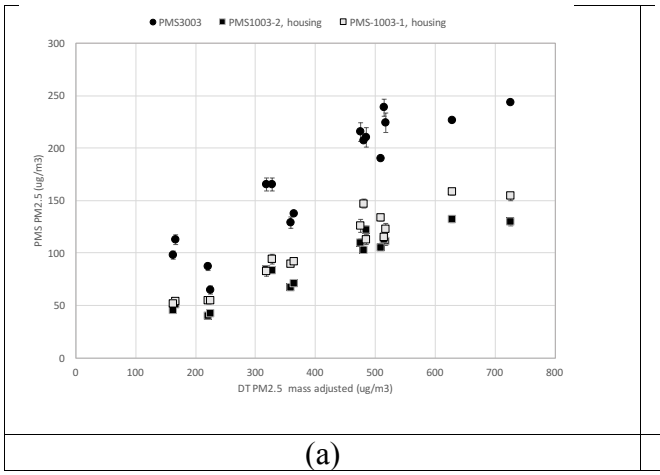
Linear RH interaction: $y = 2.81+0.72639*23C-0.0032401*RH*23C$

5th order polynomial: $= -3.55\cdot10^{-7}x^5+7.60\cdot10^{-5}x^4 – 5.87\cdot10^{-3}x^3+0.174x^2 – 9.28\cdot10^{-3}x+2.39$

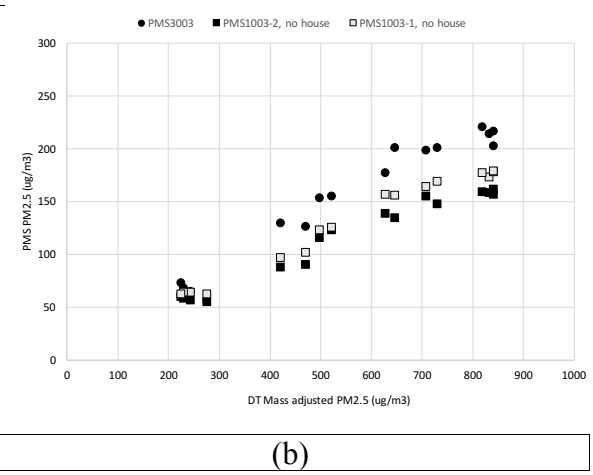
Exponential: $y = 6.77e^{0.0282x}$

Effect of Housing

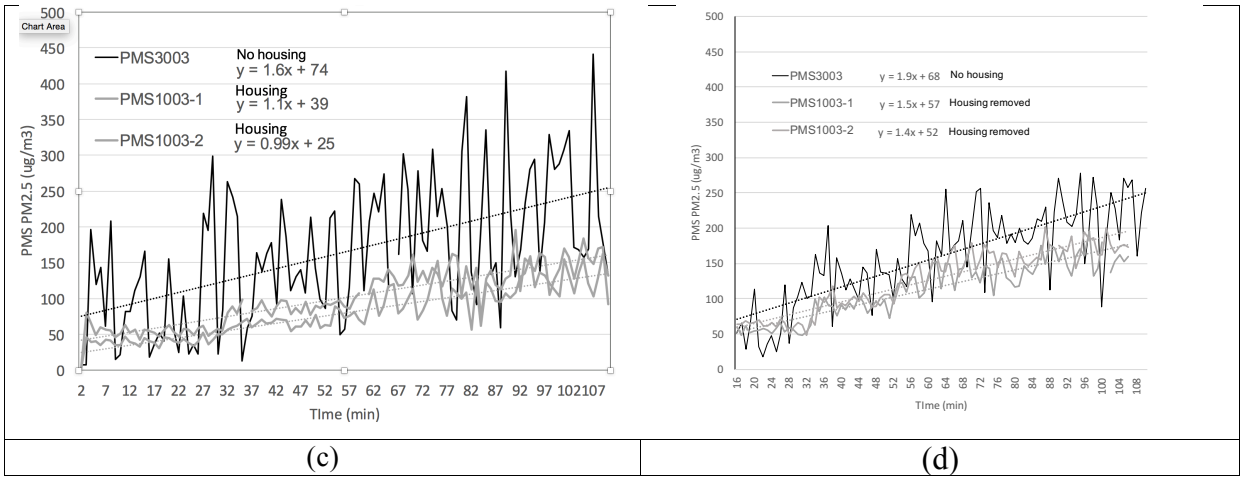
Figure S-7 compares the effect of the PurpleAir housing.



(a)



(b)



(c) (d)

Figure S-7. Response of the PMS sensors compared to the mass-adjusted DustTrack (DT). Panels a and c show co-located sensors with PurpleAir's housing on PMS1003-1 and 2. Panel B and d show co-located sensors with the housing removed on PMS1003-1 and 2. In (a) and (b), each point is the average of 10, 1-minute readings with the standard error. Panels (c) and (d) show PMS sensor readings over time, with trend lines showing the slopes. The PMS3003 (AirU) was tested without a housing. Note that the difference between the slopes of the PMS1003 and 3003 sensors differ when the PMS1003 sensors had a housing but not when the housing was removed (student's t-test at 95% confidence level).

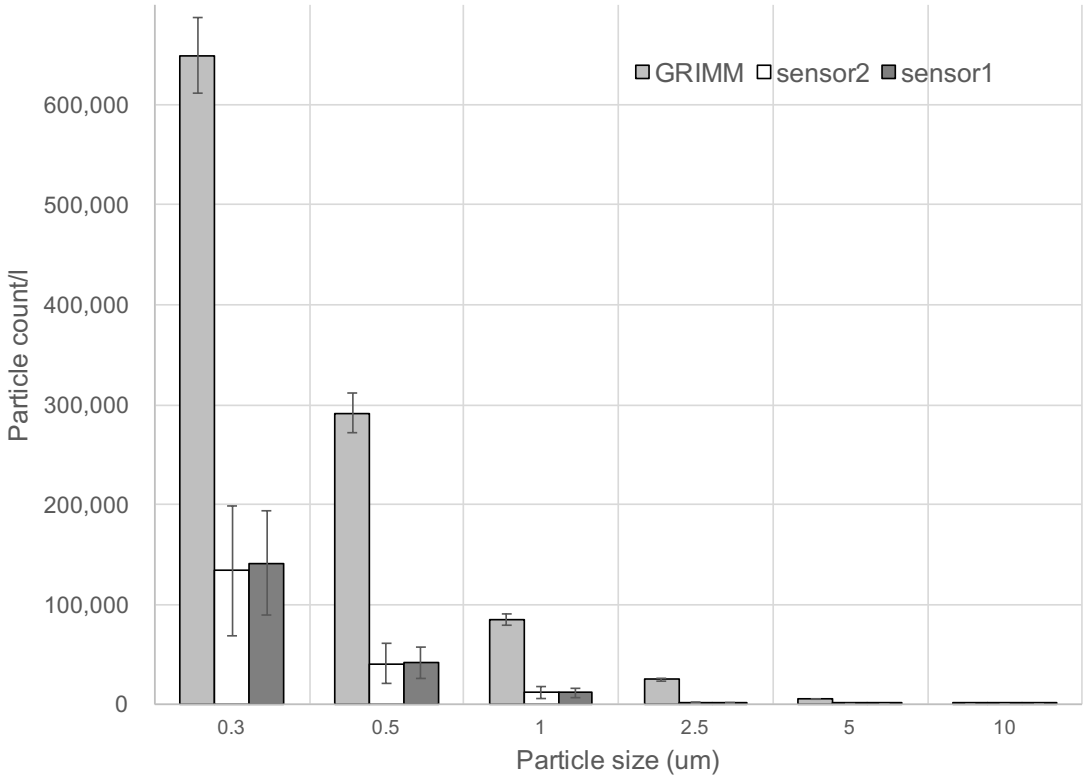


Figure S-8. Mean and standard deviation of the particle counts from the GRIMM and the two PMS sensors from the wind tunnel experiments.

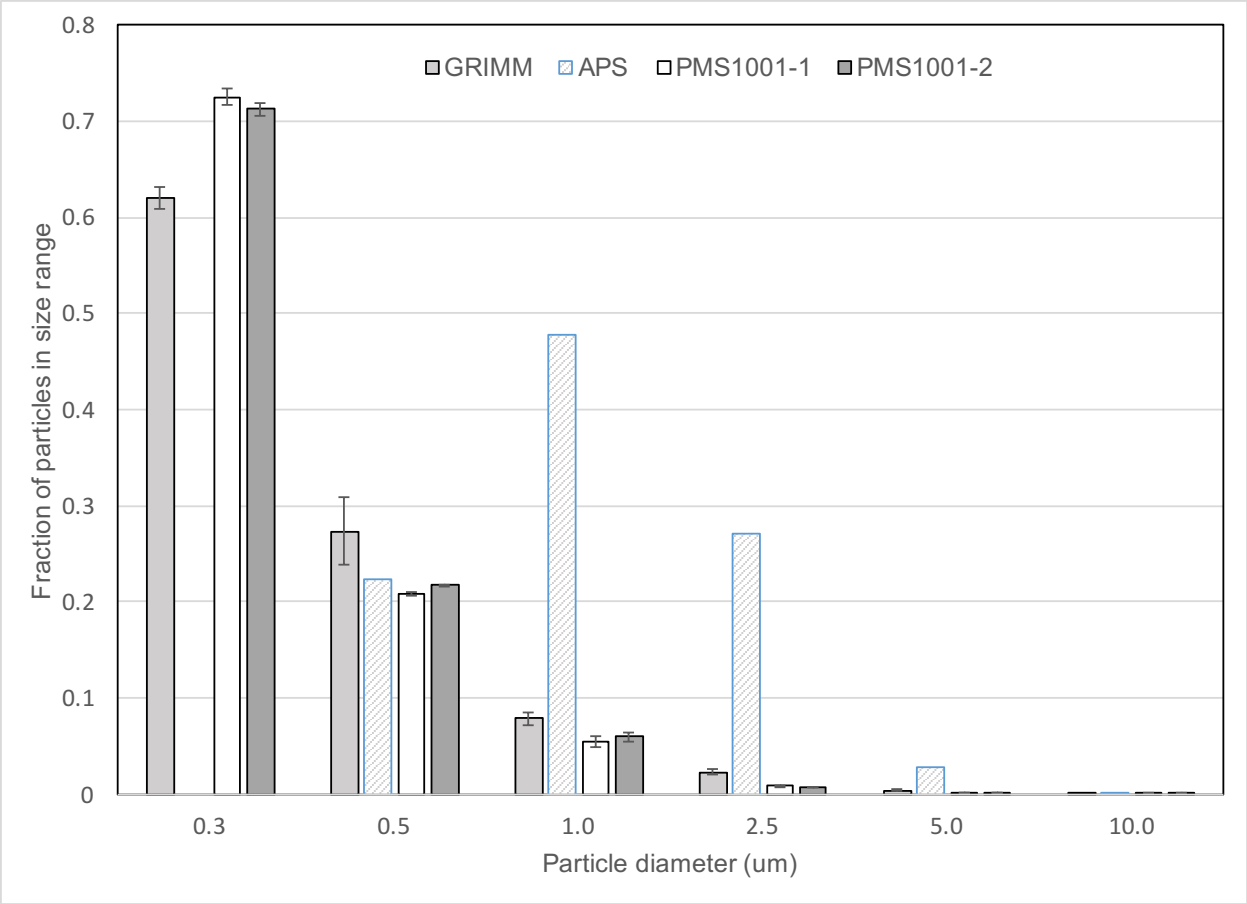


Figure S-9. Normalized mean and standard deviation of wind-tunnel particle counts, average of five conditions. Standard deviation measurements from the APS were not available. Note that the GRIMM and the PMS sensors provide optical diameter while the APS provides aerodynamic diameter.