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Evaluation of calibration performance of a low-cost particulate matter sensor using collocated and distant NO_2

Kabseok Ko et al.

Correspondence to: Seokheon Cho (justinshcho@gmail.com)

Figure S1: Geographical locations of an air quality monitoring site (06-065-8001) and 14 PurpleAir PA-II units. The red dot represents BAM-1020 instrument, and the black dots represent 14 PurpleAir PA-II units.

Table S1 Distance of PurpleAir PA-II units from BAM-1020 instrument at the monitoring site of 06-065-8001

Sensor Name	RIVR_Co-loc1	RIVR_Co-loc2	RIVR_Co-loc3	RIVR_Co-loc4	RIVR_Co-loc5	RIVR_Co-loc6
Distance (m)	82.09	8.61	82.09	82.09	82.09	82.09
Sensor Name	RIVR_Co-loc7	RIVR_Co-loc8	RIVR_Co-loc9	RIVR_Co-loc10	RIVR_Co-loc11	RIVR_Co-loc12

Distance (m)	9.10	82.09	22.13	9.61	11.22	14.82
Sensor Name	RIVR_Co-loc13	RIVR_Co-loc14	RIVR_Co-loc15	RIVR_Co-loc16	RIVR_Co-loc17	
Distance (m)	17.05	18.44	26.33	36.35	44.78	

Table S2 Number of data points processed for each step of pre-processing in PA-II 7.

Applied Method	Number of data points
Original (01/01/2018 – 12/31/2019)	703,369
Remove data with N/A	703,369
Valid data with 0<=Temperature<=200	703,368
Valid data with 0<=RH<=100	703,339
Valid data with $PM_{2.5}$ <= 2,000	703,339
Averaging data for hourly $PM_{2.5}$	17,507
Hourly Averaging with sufficient data points	17,198
Comparison of PMS 5003 A and B using SPE	16,966

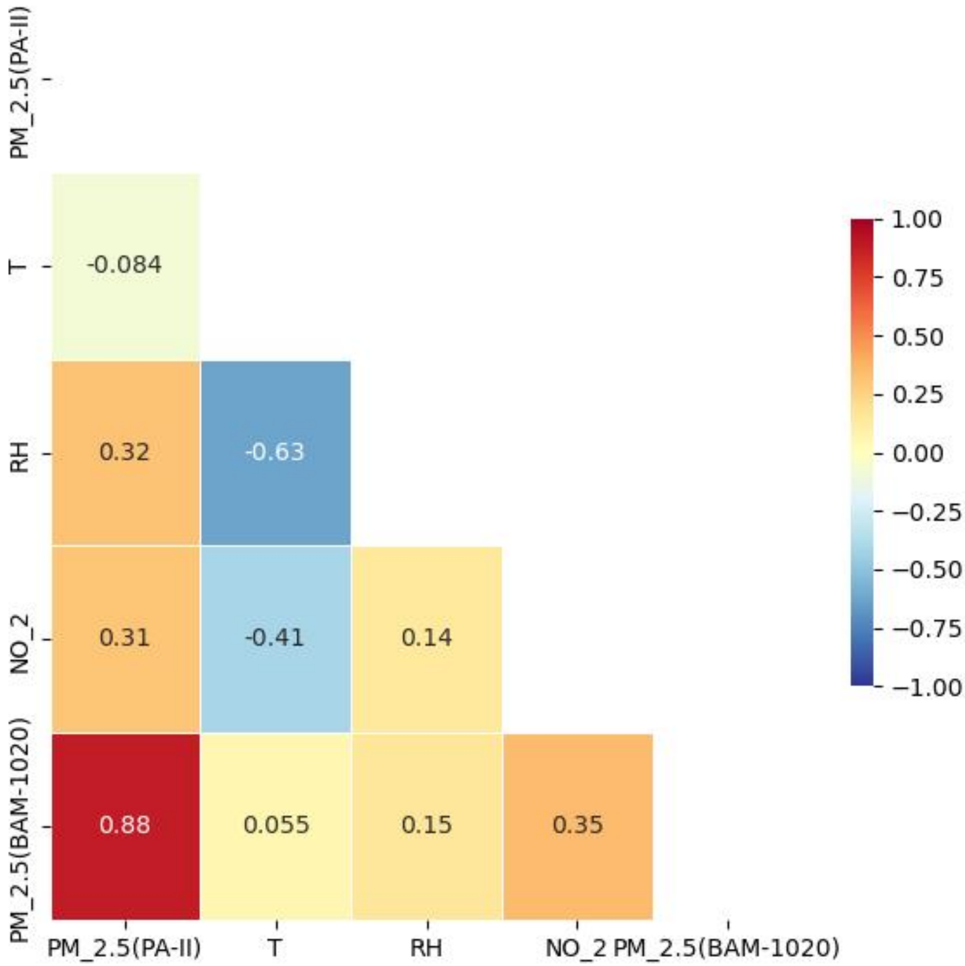

Figure S2 Correlation of feature variables, $PM_{2.5}$ (PA-II 7), temperature, relative humidity, and $PM_{2.5}$ (BAM-1020).

Table S3 Summary of MLR models and their p-values and VIF values with the selected combinations of features

	MLR model	p-values	VIF
1	$0.460PM_{2.5} + 13.186$	(0.000)	X
2	$0.466PM_{2.5} + 0.0684T + 13.186$	(0.000, 0.000)	(1.010, 1.010)

3	$0.480PM_{2.5} - 0.0535RH + 13.186$	(0.000, 0.000)	(1.145, 1.145)
4	$0.502PM_{2.5} - 0.0631RH - 0.00243PM_{2.5} \times RH + 13.499$	(0.000, 0.000, 0.000)	(1.417, 1.203, 1.234)
5	$0.474PM_{2.5} + 0.0453T - 0.0313RH + 13.186$	(0.000, 0.000, 0.000)	(1.171, 1.582, 1.793)
6	$0.496PM_{2.5} + 0.0335\mathrm{T} - 0.0457\ RH - 0.00217PM_{2.5} \times RH + 13.467$	(0.000, 0.000, 0.000, 0.000)	(1.492, 1.650, 1.965, 1.295)
7	$0.495PM_{2.5} + 0.0497\mathrm{T} - 0.0391\ RH - 0.00204PM_{2.5} \times RH - 0.00146T \times RH + 13.700$	(0.000, 0.000, 0.000, 0.000, 0.000)	(1.494, 2.132, 2.101, 1.313, 1.308)
8	$0.488PM_{2.5} + 0.0496\mathrm{T} - 0.0395\ RH - 0.00177PM_{2.5} \times T - 0.00288PM_{2.5} \times RH + 0.00187T \times RH + 13.830$	(0.000, 0.000, 0.000, 0.000, 0.000, 0.000)	(1.637, 2.132, 2.101, 2.335, 2.086, 1.417)
9	$0.500PM_{2.5} + 0.0442\mathrm{T} - 0.0415\ RH - 0.00165PM_{2.5} \times T - 0.00261PM_{2.5} \times RH + 0.00196T \times RH + 0.00005PM_{2.5} \times T \times RH + 13.838$	(0.000, 0.000, 0.000, 0.000, 0.000, 0.000)	(2.586, 2.264, 2.133, 2.360, 2.269, 1.438, 2.355)
10	$0.451PM_{2.5} + 0.0459NO_2 + 13.186$	(0.000, 0.000)	(1.111, 1.111)
11	$0.445PM_{2.5} + 0.0461NO_2 + 0.0010PM_{2.5} \times NO_2 + 13.119$	(0.000, 0.000, 0.000)	(1.412, 1.111, 1.297)
12	$0.447PM_{2.5} + 0.104T + 0.107NO_2 + 13.186$	(0.000, 0.000, 0.000)	(1.114, 1.254, 1.379)
13	$0.438PM_{2.5} + 0.106T + 0.108NO_2 + 0.00148PM_{2.5} \times NO_2 + 13.083$	(0.000, 0.000, 0.000, 0.000)	(1.422, 1.262, 1.382, 1.306)
14	$0.445PM_{2.5} + 0.110T + 0.109NO_2 + 0.00188PM_{2.5} \times T + 0.00264PM_{2.5} \times NO_2 + 13.054$	(0.000, 0.000, 0.000, 0.000, 0.000)	(1.533, 1.283, 1.382, 1.860, 1.830)
15	$0.4424 + 0.112T + 0.115NO_2 + 0.00170PM_{2.5} \times T + 0.00256PM_{2.5} \times NO_2 + 0.00098T \times NO_2 + 13.131$	(0.000, 0.000, 0.000, 0.000, 0.000, 0.006)	(1.547, 1.382, 1.719, 2.030, 1.855, 1.376)
16	$0.451PM_{2.5} + 0.0954T - 0.0953RH + 0.102NO_2 + 13.186$	(0.000, 0.000, 0.000, 0.005)	(1.390, 2.164, 1.980, 1.523)
17	$0.468PM_{2.5} + 0.0814T - 0.00223RH + 0.0913NO_2 - 0.00156PM_{2.5} \times RH + 13.388$	(0.000, 0.000, 0.000, 0.000, 0.000)	(1.860, 2.356, 2.252, 1.599, 1.360)
18	$0.467PM_{2.5} + 0.102T - 0.0138RH + 0.094NO_2 - 0.00139PM_{2.5} \times RH + 0.00172T \times RH + 13.661$	(0.000, 0.000, 0.002, 0.000, 0.000, 0.000)	(1.868, 2.927, 2.418, 1.607, 1.383, 1.314)

19	$0.462PM_{2.5} + 0.101T - 0.0147RH + 0.092NO_2 - 0.00137PM_{2.5} \times T - 0.00205PM_{2.5} \times RH + 0.00203T \times RH + 13.763$	(0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000)	(1.974, 2.934, 2.423, 1.620, 2.354, 2.205, 1.420)
20	$0.462PM_{2.5} + 0.103T - 0.0110RH + 0.0935NO_2 - 0.00138PM_{2.5} \times T - 0.00225PM_{2.5} \times RH + 0.00235T \times RH + 0.00119RH \times NO_2 + 13.802$	(0.000, 0.000, 0.004, 0.000, 0.000, 0.000, 0.000, 0.000)	(1.976, 2.970, 2.566, 1.630, 2.353, 2.342, 1.636, 1.447)
21	$0.461PM_{2.5} + 0.104T - 0.0130RH + 0.103NO_2 - 0.00156PM_{2.5} \times T - 0.00238PM_{2.5} \times RH + 0.00220T \times RH + 0.00159T \times NO_2 + 0.00165RH \times NO_2 + 13.895$	(0.000, 0.000, 0.001, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000)	(1.977, 2.972, 2.609, 2.000, 2.437, 2.400, 1.689, 1.766, 1.674)

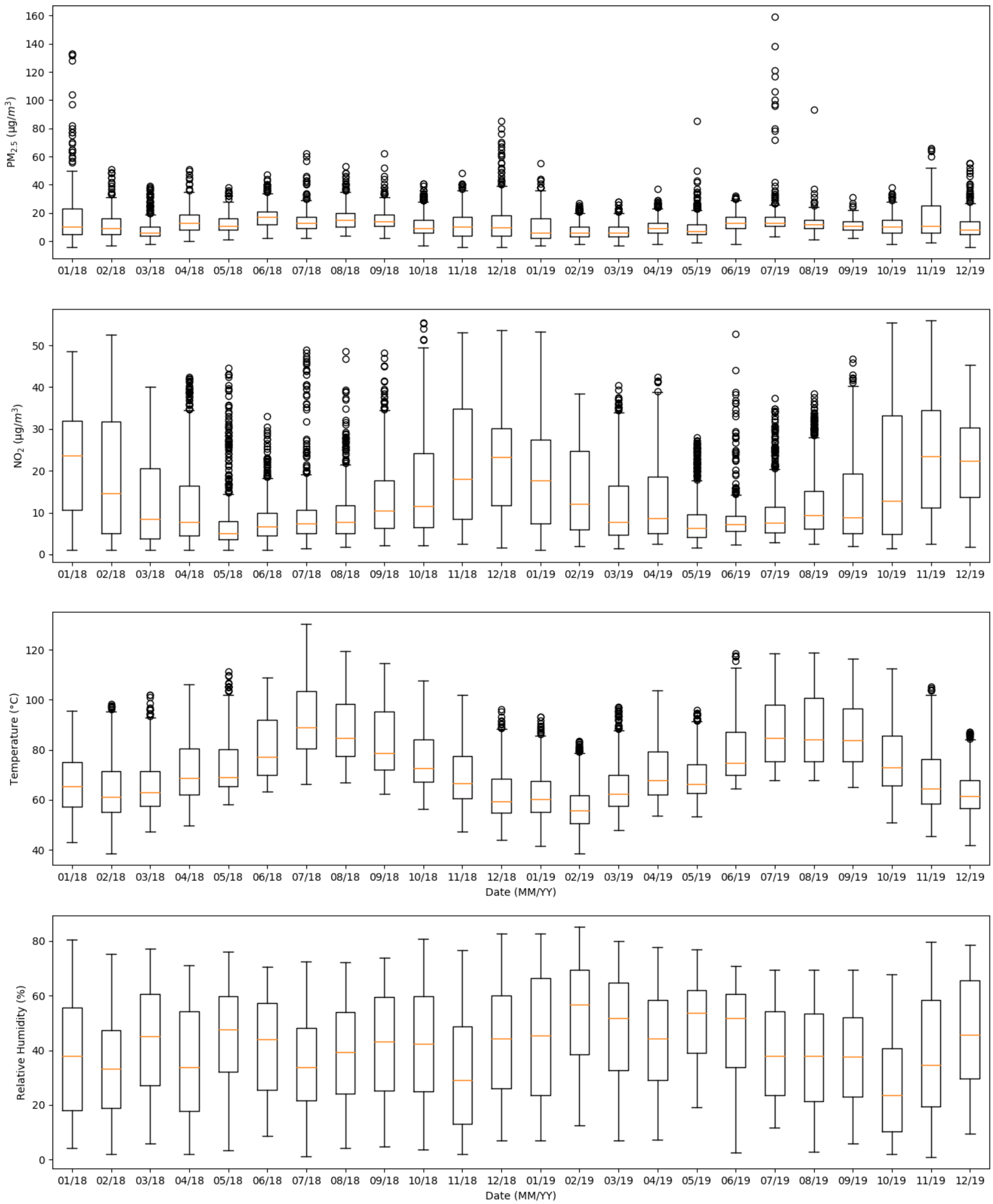

Figure S3 Distributions of PM$_{2.5}$ (regulatory monitor), NO$_2$ (regulatory monitor), temperature (PA-II), and relative humidity (PA-II) for each month over 2-year period

Table S4 Effect of training periods (3, 6, 9, and 12 months) on calibration performance using MLR models

	3			6			9			12		
Feature Vector	R^2	RMSE	MAE	R^2	RMSE	MAE	R^2	RMSE	MAE	R^2	RMSE	MAE
1	0.738	4.447	3.193	0.750	4.344	3.204	0.729	4.524	3.436	0.731	4.513	3.418
2	0.746	4.382	3.132	0.775	4.125	2.925	0.763	4.231	3.110	0.755	4.305	3.194
3	0.752	4.329	3.094	0.776	4.111	2.971	0.761	4.253	3.163	0.760	4.263	3.165
4	0.757	4.286	3.051	0.779	4.083	2.930	0.762	4.237	3.136	0.763	4.232	3.132
5	0.743	4.411	3.171	0.779	4.090	2.906	0.767	4.193	3.080	0.763	4.234	3.129
6	0.745	4.393	3.151	0.782	4.061	2.869	0.769	4.182	3.056	0.765	4.211	3.100
7	0.749	4.355	3.127	0.787	4.012	2.828	0.779	4.091	2.964	0.772	4.154	3.043
8	0.748	4.364	3.073	0.786	4.020	2.823	0.779	4.087	2.950	0.772	4.151	3.023
9	0.742	4.420	3.058	0.783	4.051	2.798	0.778	4.101	2.940	0.771	4.161	3.012
10	0.735	4.477	3.181	0.762	4.243	3.100	0.736	4.470	3.383	0.741	4.424	3.329
11	0.721	4.592	3.208	0.762	4.246	3.101	0.736	4.468	3.382	0.741	4.423	3.326
12	0.774	4.133	2.882	0.806	3.832	2.651	0.794	3.946	2.805	0.789	3.997	2.871
13	0.762	4.244	2.880	0.806	3.832	2.639	0.794	3.946	2.806	0.789	3.993	2.857
14	0.764	4.226	2.874	0.811	3.782	2.579	0.798	3.908	2.787	0.792	3.962	2.843
15	0.762	4.241	2.888	0.811	3.775	2.572	0.799	3.900	2.783	0.793	3.954	2.838
16	0.769	4.178	2.949	0.805	3.842	2.646	0.794	3.950	2.805	0.790	3.986	2.866
17	0.769	4.175	2.944	0.806	3.833	2.631	0.793	3.960	2.804	0.789	3.990	2.863
18	0.775	4.126	2.919	0.807	3.821	2.663	0.805	3.840	2.693	0.798	3.912	2.793
19	0.770	4.168	2.900	0.806	3.831	2.668	0.805	3.841	2.693	0.796	3.925	2.790
20	0.770	4.170	2.904	0.803	3.858	2.690	0.805	3.835	2.687	0.797	3.920	2.782
21	0.765	4.218	2.936	0.803	3.860	2.692	0.805	3.837	2.690	0.797	3.913	2.777