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Identifying optimal co-location calibration periods for low-cost sensors

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Table S1. Descriptive statistics of the reference data used in the calibration models from the full year.

	Mean	**Median**	**Range**
$PM_{2.5}$ (µg/m^3)	8.4	7	1-53
CO (ppb)	261	199	100 -2950
NO_2 (ppb)	8.5	5.5	1-58
O_3 (ppb)	30.1	32	1-110
NO (ppb)	3.1	0.5	0.1-136.5

Table S2. The median and range (1st to 99th percentile) of the normalized RMSE (NRMSE) from 250 calibration runs from six co-location lengths (1 day, 1 week, 6 weeks, 1 month, 3 months, and 6 months) for five low-cost sensors. This was calculated by RMSE/range. Lower NRMSE values indicate less residual variance for a model.

	1 Day	**1 Week**	**1 Month**	**6 Weeks**	**3 Months**	**6 Months**
$PM_{2.5}$ (μg/m^3)	0.85 (0.13 – 8.11)	0.12 (0.08 – 0.42)	0.09 (0.08 – 0.25)	0.09 (0.08 – 0.18)	0.09 (0.08 – 0.14)	0.08 (0.08 – 0.09)
CO (ppb)	4.21 (0.19 – 48.8)	0.24 (0.05 – 3.23)	0.09 (0.04 – 0.35)	0.07 (0.05 – 0.21)	0.06 (0.04 – 0.14)	0.06 (0.05 – 0.08)
NO_2 (ppb)	0.4 (0.11 – 2.27)	0.15 (0.08 – 0.35)	0.11 (0.07 – 0.19)	0.12 (0.07 – 0.15)	0.11 (0.07 – 0.14)	0.10 (0.07 – 0.13)
O_3 (ppb)	7.3 (0.14 – 119.59)	0.55 (0.11 – 2.43)	0.16 (0.08 – 0.31)	0.16 (0.08 – 0.24)	0.17 (0.08 – 0.28)	0.15 (0.12 – 0.18)
NO (ppb)	0.12 (0.03 – 5.06)	0.06 (0.02 – 0.56)	0.03 (0.02 – 0.06)	0.03 (0.02 – 0.04)	0.03 (0.02 – 0.03)	02 (0.02 – 0.03)

Figure S1. The start time of 250 randomly selected 24-hr calibration runs.

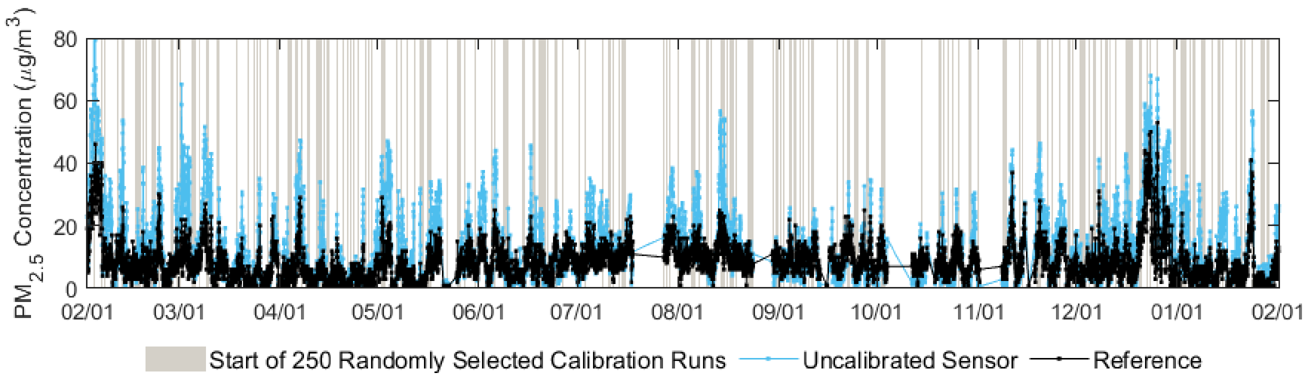

Figure S2. The potential range of Pearson correlation coefficients (r) for three low-cost sensors (NO_2, O_3, and NO) by co-location length. A calibration length of 1 day indicates that a random 24-hour period was selected out of all available days between February 2019 and February 2020. The correlation for a given test calibration period was determined by comparing the 1-hour averaged reference and the corrected sensor data (using that calibration) across all days not included in the calibration period.

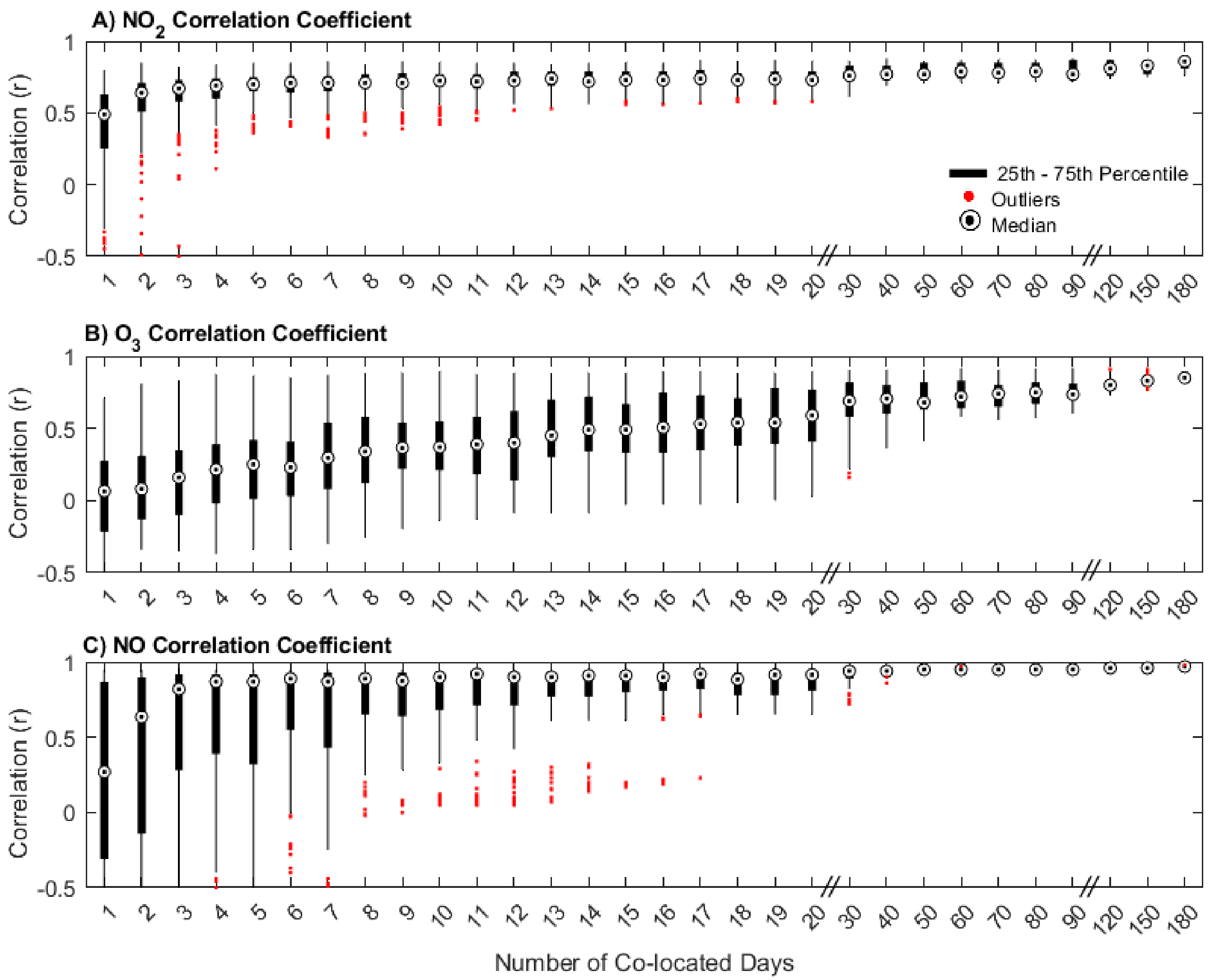

Figure S3. Comparison of two potential one-week calibration periods corresponding to Figure 3. These were selected to illustrate the range of potential RMSE values that can result from using different periods of the same co-location duration. In the example here, "Calibration Period 1" yielded more accurate concentrations (shown in green; RMSE = 3.1 μg/m^3), while "Calibration Period 2" performed poorly when considered across the whole evaluation period (shown in red; RMSE = 19.5 μg/m^3).

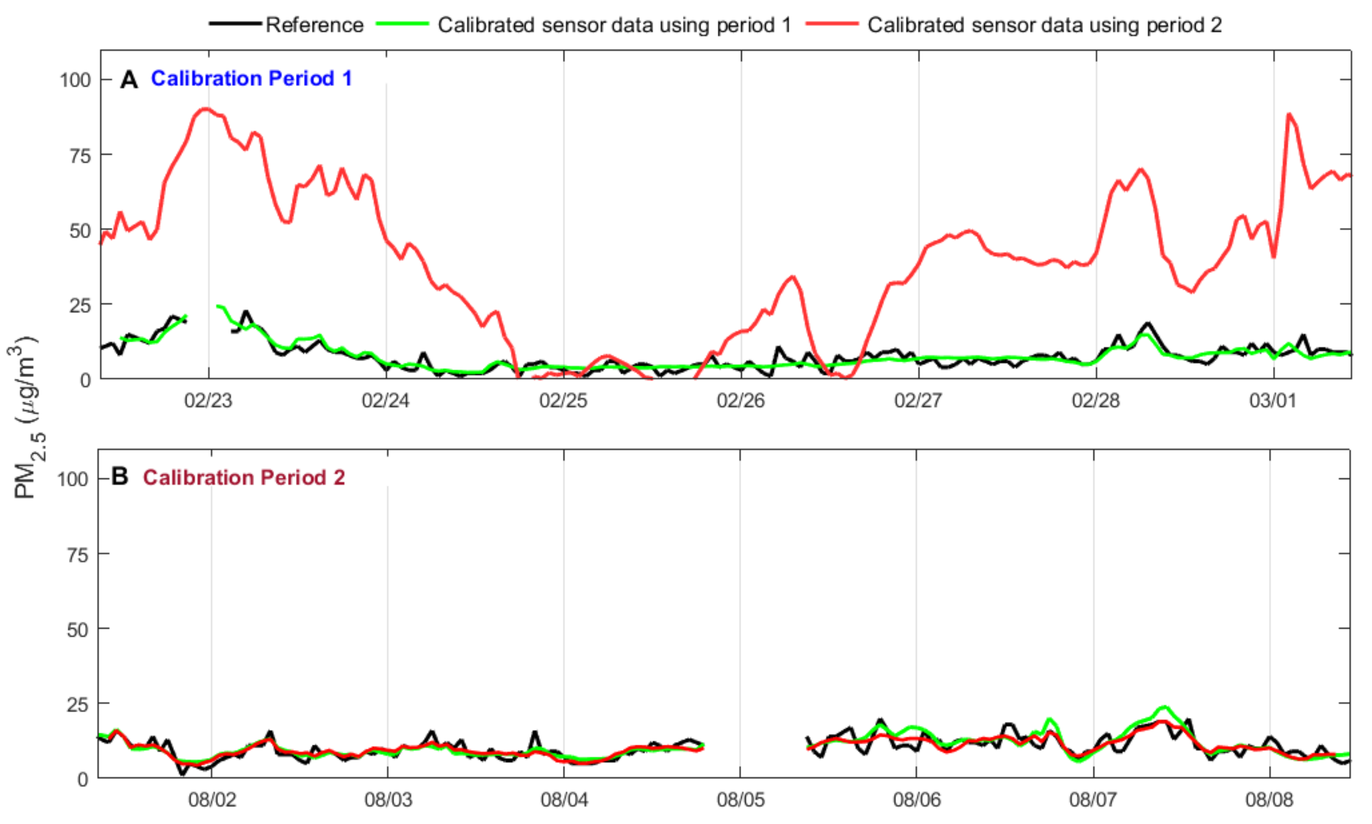

Figure S4. To supplement our current analysis method where the evaluation period is flexible in order to evaluate more seasons, here we show an analysis of the PM data where the 250 randomly selected calibration periods were from between 02/2019 and 11/2019 and the evaluation period was held to 11/2019-02/2020 for all of the considered calibrations. The potential range of A) RMSE and B) correlation coefficients (r) for a given co-location length. C) The starting times for each of the 250 calibrations for the one-day analysis are indicated in red, and the evaluation period is shown in gray.

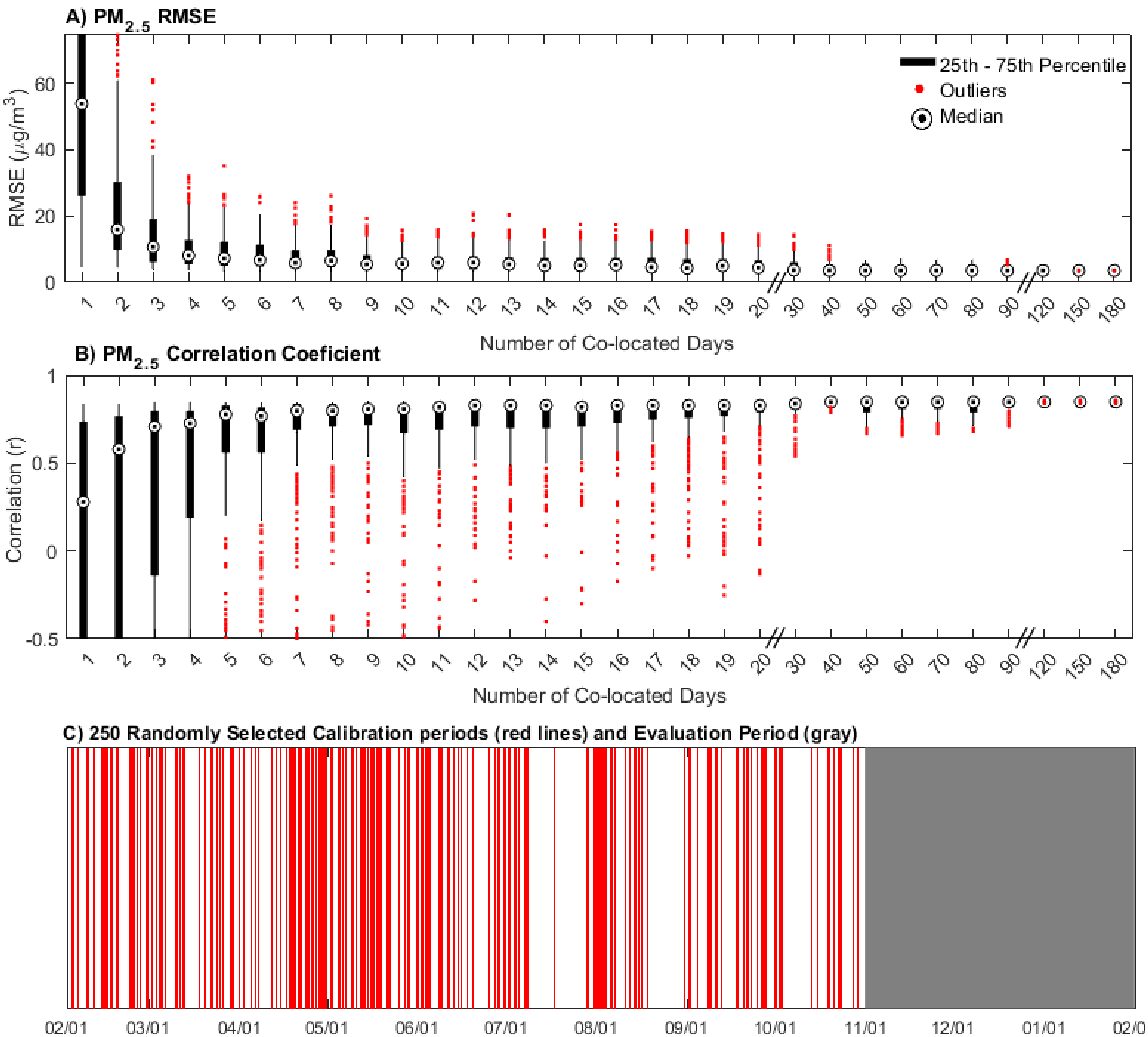

Figure S5. Additional examples of coverage of key variables for all five sensors using 1-week calibration scenarios. A-C) PM (Temperature, RH, and PM concentration range), D-F) CO (Temperature, RH, and CO concentration range), G-I) NO_2 (Temperature, RH, NO_2 concentration range, O_3 concentration range, and NO concentration range), J-L) NO (Temperature, RH, NO concentration range, and CO concentration range), and M-O) O_3 (Temperature, RH, O_3 concentration range, and NO_2 concentration range). The bluer squares indicate lower RMSE values (more accurate calibrations).