

Supplementary Materials:



Figure S1. Outdoor instrument rig (Left) and Indoor Instrument rig (Middle and Right). [Legend for labels: 1 = Weather station; 2 = Dylos-1700 Monitor (outdoor instrument covered with metallic bucket); 3 = microAeth AE51 Aethalometer (outdoor instrument covered with metallic bucket); 4 = Y-pod; 5 = Ogawa NO₂ passive sampler; 6 = weather-protected electrical connection point; 7 = tripod stand.]

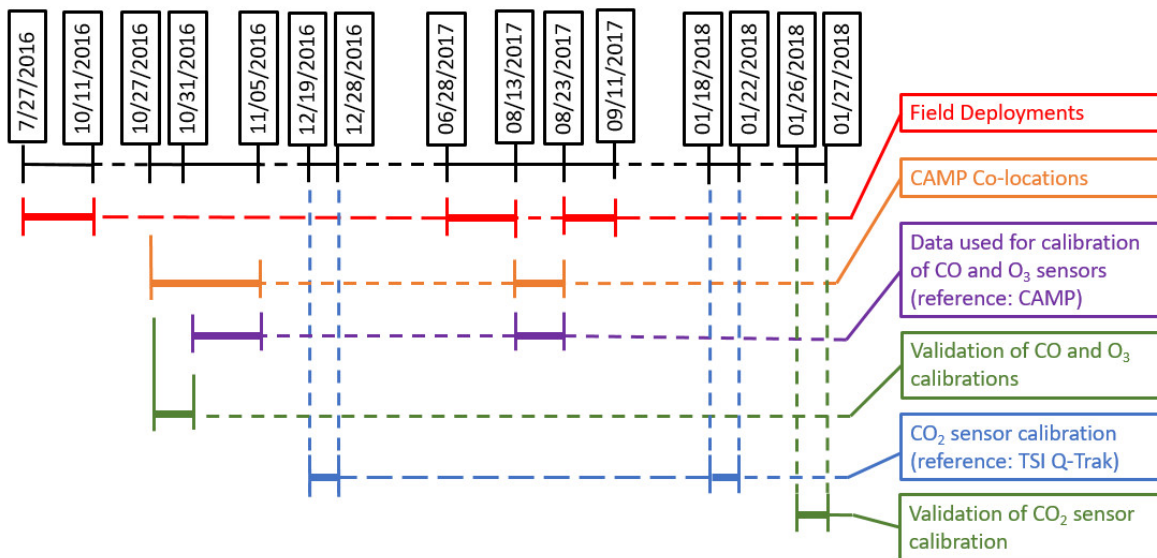
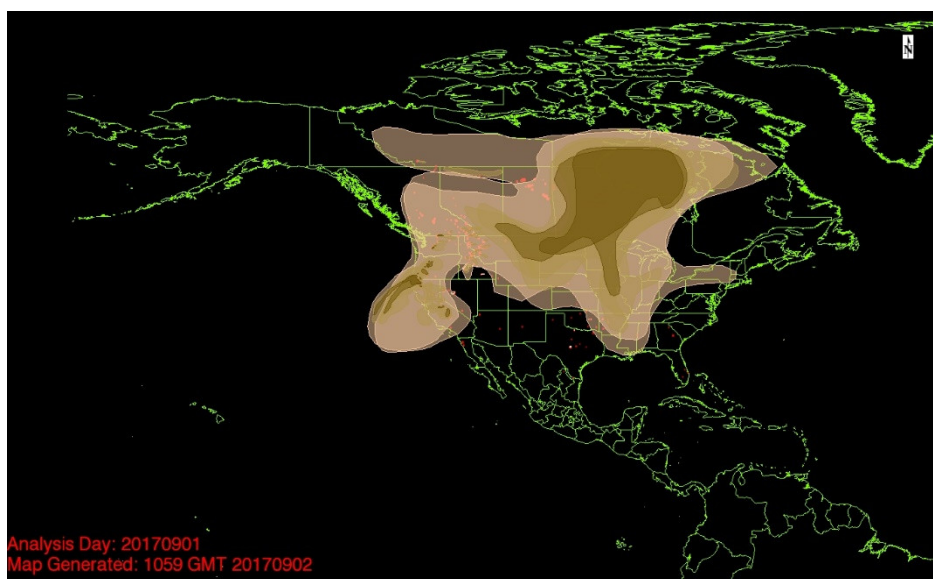
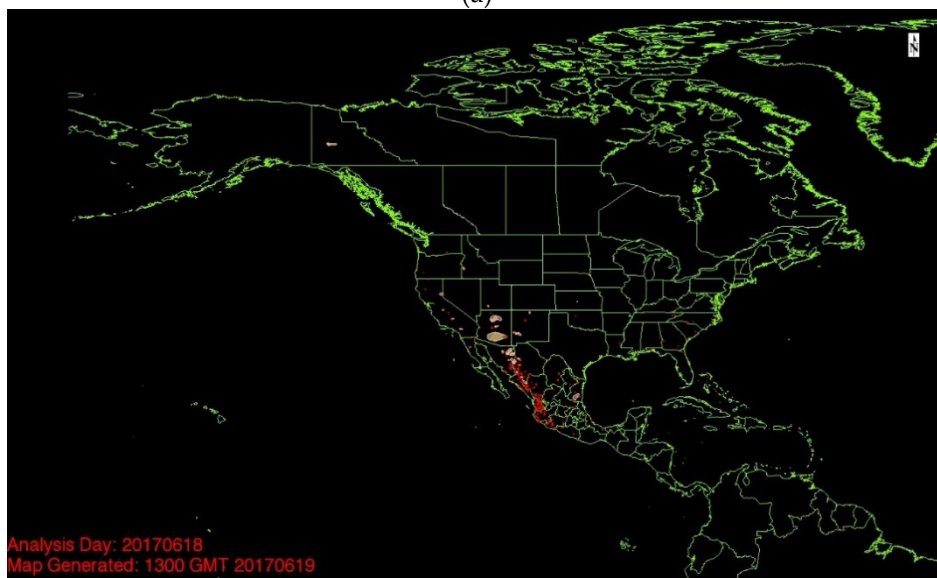


Figure S2. Schematic showing timeline of instrument deployment periods, sensor calibration periods for Y-Pods and validation periods for sensor calibrations. CO₂ data were calibrated using TSI Q-Trak as the reference instrument, but the data showed poor results during validation and, hence, CO₂ data were discarded.



(a)



(b)

Figure S3. Example of National Oceanic and Atmospheric Administration’s Hazard Mapping System (NOAA HMS) remote sensing data showing a day with plume cover (a) and no plume cover (b) over the state of Colorado.

Table S1. Cross-tabulation of indoor and outdoor temperature and relative humidity with various home characteristics (raw dataset). Total $N = 28$.

	n (% of Total)	Temperature (°C)		Relative Humidity (%)	
		Indoor Median (Range)/Outdoor Median (Range)	I/O Ratio	Indoor Median (Range)/Outdoor Median (Range)	I/O Ratio
Location					
Aurora	4 (14.3)	27.3 (21.2–33.8) / 23.5 (10.9–46.8)	1.16	34.92 (25.3–46.4) / 41.6 (9.22–81.9)	0.84
Boulder/ Longmont	9 (32.1)	23.2 (18.9–30.2) / 16.8 (1.4–41.1)	1.38	30.9 (13.7–55.0) / 35.3 (9.10–88.5)	0.87
West Denver	11 (39.3)	26.4 (17.1–34.0) / 21.4 (1.70–45.7)	1.23	34.8 (14.6–61.2) / 37.7 (6.57–86.0)	0.92
Central/North Denver	4 (14.3)	26.4 (19.7–30.0) / 20.9 (9.79–44.4)	1.26	34.1 (19.7–60.0) / 42.5 (7.11–84.4)	0.80
Building Type [†]					
BG	5 (17.9)	22.4 (18.9–30.16) / 12.9 (1.4–39.1)	1.74	26.6 (13.7–46.7) / 29.4 (9.10–83.2)	0.90
EER	13 (46.4)	27.1 (17.1–34.0) / 22.2 (1.69–46.8)	1.22	34.6 (14.6–55.0) / 39.9 (6.57–88.5)	0.87
Non-EER	10 (35.7)	25.7 (19.74–31.1) / 21.6 (9.79–44.4)	1.19	40.6 (14.8–61.7) / 43.1 (7.11–86.0)	0.94
Road Proximity					
<100 m	15 (53.6)	25.3 (19.5–33.8) / 19.6 (1.56–44.4)	1.29	34.1 (14.5–61.7) / 39.4 (7.11–86.0)	0.86
100–200 m	7 (25.0)	26.7 (17.1–34.4) / 22.6 (1.69–46.8)	1.18	35.2 (15.3–55.0) / 39.1 (7.54–88.5)	0.90
>200 m	6 (21.4)	25.4 (19.0–32.2) / 17.8 (1.4–44.8)	1.43	31.1 (13.7–44.0) / 34.9 (6.57–83.5)	0.89
Wildfire Plume Density					
None	10 (35.7)	22.7 (17.1–34.0) / 16.5 (1.40–46.7)	1.37	31.1 (13.7–55.0) / 34.5 (9.10–88.5)	0.90
Low	6 (21.4)	26.7 (19.8–32.0) / 22.8 (9.79–45.7)	1.17	36.7 (14.7–59.8) / 40.1 (6.62–84.4)	0.91
Medium	9 (32.1)	26.5 (20.1–32.2) / 21.6 (10.6–44.7)	1.23	36.8 (14.6–61.7) / 41.8 (6.57–86.0)	0.88
High	3 (10.7)	24.5 (21.2–29.5) / 21.5 (10.9–39.1)	1.14	40.4 (22.9–46.7) / 35.5 (9.26–71.1)	1.14
Mechanical Ventilation					
Present	5 (17.9)	23.5 (19.5–34.0) / 17.8 (1.56–44.7)	1.32	28.5 (14.5–47.5) / 36.9 (10.3–88.5)	0.77
Absent	23 (82.1)	26.0 (17.1–33.8) / 20.5 (1.40–46.8)	1.27	34.7 (13.7–61.7) / 38.1 (6.57–86.0)	0.91
Hours Windows Open					
0	3 (10.7)	24.7 (19.9–28.3) / 18.4 (1.56–40.9)	1.34	31.7 (16.1–44.3) / 44.8 (12.9–88.5)	0.71
1–6	4 (14.3)	26.0 (17.1–33.0) / 21.4 (1.69–46.8)	1.21	34.0 (15.3–55.0) / 36.1 (7.54–84.4)	0.94
7–12	5 (17.9)	22.8 (19.0–29.5) / 16.8 (2.64–41.5)	1.36	32.6 (13.7–53.9) / 36.4 (9.10–83.5)	0.89
>12	16 (57.1)	26.2 (19.0–34.0) / 21.4 (1.40–44.8)	1.22	34.6 (14.6–61.7) / 38.1 (6.57–86.0)	0.91

Gas Stoves					
Present	5 (17.9)	26.0 (19.8–31.0) / 21.1 (9.79–42.0)	1.23	40.8 (14.8–61.7) / 41.2 (7.11–86.0)	0.99
Absent	23 (82.1)	25.6 (17.1–34.0) / 19.7 (1.40–46.8)	1.30	33.4 (13.7–55.0) / 37.5 (6.57–88.5)	0.89
Stove Hood Types					
Exhaust	8 (28.6)	23.9 (17.1–29.5) / 17.6 (1.56–41.1)	1.36	34.0 (15.3–52.1) / 41.0 (9.07–84.4)	0.83
Recirculating	13 (46.4)	25.7 (18.9–34.0) / 20.4 (1.4–46.75)	1.26	34.4 (13.7–61.7) / 35.3 (6.62–86.0)	0.97
Absent	7 (25.0)	27.1 (19.7–32.2) / 21.5 (9.79–44.7)	1.26	32.6 (14.6–59.9) / 39.8 (6.57–88.5)	0.82

[†]BG = Built Green; EER = Energy Efficiency Retrofitted; Non-EER = Non-Energy Efficiency Retrofitted (conventional homes as a control group).
I/O ratios across all categories were statistically significant at $\alpha = 0.05$ (K-W test).

Table S2. Concentration comparisons between indoor and outdoor pollutants before and after data filtration.

	Concentrations		
	Raw data	Filtered data	p ₂ -value ³
PN_{0.5-2.5} [# /cm³]			
Indoor	1.40 (0–203)	1.17 (0.0494–199)	<0.000
Outdoor	1.66 (0.0850–79.1)	1.69 (0.0850–79.1)	<0.000
r _s ¹	0.311	0.374	
p ₁ -value ²	<0.000	<0.000	
BC [ng/m³]			
Indoor	532 (82.2–15900)	512 (82.2–5081)	<0.000
Outdoor	768 (54.5–39100)	766 (54.5–39100)	0.629
r _s	0.507	0.525	
p ₁ -value	<0.000	<0.000	
CO [ppm]			
Indoor	0.485 (0–28.2)	0.450 (0–10.5)	<0.000
Outdoor	0.150 (0–14.9)	0.144 (0–14.0)	0.000467
r _s	0.434	0.252	
p ₁ -value	<0.000	<0.000	

¹ Spearman’s rank correlation coefficient between indoor and outdoor medians.

² p-values for K-W test between indoor and outdoor medians.

³ p-values for Wilcoxon Mann–Whitney (U) test between raw and filtered dataset medians (K-W test could not be performed due to different lengths of datasets).

** High value signifying outlier.

Present	1.30 (0.198–201)/ 1.30 (0.131–78.7)	4/ 1.00	480 (98.3–15900)/ 623 (98.3–6290)	3/ 0.77	0.333 (0–4.46)/ 0.0258 (0–7.88)	5/ 12.8	6.73 (3.58– 8.06)/ 5.56 (5.21–6.95)	3/ 1.21
Absent	1.43 (0–203)/ 1.75 (0.0847–79.1)	22/ 0.82	557 (82.2–14300)/ 793 (54.5–39100)	16/ 0.70	0.539 (0–28.2)/ 0.173 (0–14.9)	22/ 3.11	9.99 (5.04– 26.8)/ 9.40 (4.48–20.6)	16/ 1.06
p-values:		<0.01		<0.01		<0.01		0.65
Hours Windows Open								
0	1.19 (0.314–36.8)/ 1.57 (0.131–54.0)	3/ 0.76	250 (98.9–6360)/ 740 (54.4–39100)	2/ 0.34	0.466 (0–3.23)/ 0.0742 (0–7.88)	3/ 6.28	5.06 (3.58– 6.53)/ 7.40 (5.56–9.23)	2/ 0.68
1–6	0.611 (0.05–20.9)/ 1.50 (0.159–79.1)	4/ 0.41	316 (82.2–2120)/ 540 (97.0–6950)	4/ 0.58	0.713 (0–4.91)/ 0.252 (0–3.01)	4/ 2.83	7.20 (5.04– 8.62)/ 6.01 (4.48–7.78)	4/ 1.20
7–12	1.24 (0.0989–160)/ 1.41 (0.0848–78.7)	5/ 0.88	406 (109–3000)/ 800 (119–21500)	2/ 0.51	0.322 (0–10.5)/ 0 (0–14.0)	5/ –	20.2 (13.6– 26.8)/ 8.48 (6.07–10.9)	2/ 2.38
> 12	1.80 (0–203)/ 1.82 (0.120–59.2)	14/ 0.99	761 (83.3–15900)/ 860 (58.0–17800)	11/ 0.88	0.477 (0–28.2)/ 0.179 (0–14.9)	15/ 2.66	10.1 (6.48– 25.5)/ 9.58 (5.21–20.6)	11/ 1.05
p-values:		<0.01		<0.01		<0.01		0.035
Gas Stove								
Present	1.65 (0–203)/ 1.97 (0.275–59.2)	5/ 0.84	597 (109–4400)/ 858 (119–21500)	3/ 0.70	0.736 (0–12.9)/ 0.142 (0–1.23)	4/ 5.18	25.5 (13.6– 26.8)/ 10.9 (6.07–11.6)	3/ 2.34
Absent	1.33 (0.0494–201)/ 1.58 (0.0848–79.1)	21/ 0.84	522 (82.2–15900)/ 748 (54.5–39100)	16/ 0.70	0.435 (0–28.2)/ 0.151 (0–14.9)	23/ 2.88	8.34 (3.58– 13.8)/ 8.51 (4.48–20.6)	16/ 0.98
p-values:		<0.01		<0.01		<0.01		0.007
Stove Hood								
Exhaust	1.18 (0.0494–201)/ 2.40 (0.131–79.1)	8/ 0.49	499 (98.3–15900)/ 827 (54.4–39100)	5/ 0.60	0.478 (0–10.4)/ 0.160 (0–14.0)	8/ 2.99	6.73 (6.48– 13.6)/ 7.19 (5.21–9.60)	5/ 0.94
Recirculating	1.31 (0.0989–160)/ 1.27 (0.0848–78.7)	12/ 1.03	495 (82.2–12100)/ 695 (97.0–16200)	10/ 0.71	0.427 (0–7.33)/ 0.0628 (0–14.9)	12/ 6.80	8.96 (5.04– 26.8)/ 8.51 (4.48–11.6)	10/ 1.05
Absent	1.85 (0–203)/ 1.75 (0.265–53.1)	6/ 1.06	713 (98.9–14300)/ 904 (58.0–17800)	4/ 0.79	0.616 (0–28.2)/ 0.231 (0–7.88)	7/ 2.67	10.9 (3.58– 13.4)/ 9.88 (5.56–20.6)	4/ 1.10
p-values:		<0.01		<0.01		<0.01		0.18

* NO₂ concentrations were TWA measurements, all other pollutants were time resolved (one-minute resolution).

^a BG = Built Green; ^b EER = Energy Efficiency Retrofitted; ^c Non-EER = Non-Energy Efficiency Retrofitted (conventional homes as a control group).

[†]I/O ratios that showed statistical significance (K-W test) in the mean differences (p<0.05) are shown in bold.

Table 4. Pollutant concentrations indoors and outdoors from filtered datasets with the corresponding p-values from K-W test on I/O ratios between categories.

	Concentrations: Indoor Median (Indoor Range) / Outdoor Median (Outdoor Range)							
	PN _{0.5-2.5} [# /cm ³]	n/ (I/O)	BC [ng/m ³]	n/ (I/O)	CO [ppm]	n/ (I/O)	NO ₂ [ppb]*	n/ (I/O)
Location								
Aurora	2.54 (0.680–26.2)/ 6.13 (0.780–165)	4/ 0.41	386 (109–3490)/ 739 (54.5–39100)	4/ 0.52	0.790 (0–2.95)/ 0.185 (0–1.75)	4/ 4.27	6.53 (6.39–10.1)/ 9.23 (4.48–9.24)	3/ 0.71
Boulder/ Longmont	2.88 (0.280–44.8)/ 3.42 (0.240–111)	7/ 0.84	409 (82.3–4460)/ 657 (122–11000)	4/ 0.62	0.458 (0–10.5)/ 0.156 (0–14.0)	9/ 2.94	5.76 (3.58–6.73)/ 9.59 (5.21–7.19)	4/ 0.60
West Denver	3.35 (0.140–563)/ 5.06 (0.450–224)	11/ 0.66	664 (119–4700)/ 787 (57.9–16300)	8/ 0.84	0.537 (0–5.3)/ 0.274 (0–3.45)	11/ 1.96	10.8 (8.00–13.8)/ 9.89 (6.55–11.1)	6/ 1.1
Central/ North Denver	5.20 (0.790–34.8)/ 7.14 (0.780–101)	4/ 0.73	599 (83.3–5080)/ 943 (128–17800)	3/ 0.64	0.73 (0–2.18)/ 0.279 (0–2.80)	3/ 2.62	9.30 (8.62–13.4)/ 9.55 (7.78–20.6)	3/ 0.97
p-values:	<0.01		<0.01		<0.01		0.33	
Building Type								
BG ^a	2.99 (0.280–44.8)/ 2.92 (0.240–111)	5/ 1.02	434 (98.3–1300)/ 564 (176–3180)	1/ 0.77	0.335 (0–4.46)/ 0.085 (0–4.10)	5/ 3.94	6.73 (6.73–6.73)/ 5.21 (5.21–5.21)	1/ 1.29
EER ^b	2.56 (0.140–563)/ 4.49 (0.450–224)	11/ 0.57	381 (82.3–3490)/ 633 (54.5–39100)	10/ 0.60	0.573 (0–10.5)/ 0.242 (0–14.0)	13/ 2.37	8.00 (3.58–11.9)/ 6.95 (4.48–9.58)	9/ 1.15
Non-EER ^c	5.96 (0.280–52.4)/ 9.08 (0.780–168)	10/ 0.66	792 (83.3–5080)/ 956 (128–21500)	8/ 0.83	0.691 (0–2.95)/ 0.248 (3.45)	9/ 2.79	10.8 (6.48–13.8)/ 9.89 (7.19–20.6)	6/ 1.09
p-values:	<0.01		<0.01		<0.01		0.34	
Road Proximity								
<100 m	1.540 (0.198–15.8)/ 2.57 (0.194–29.2)	15/ 0.60	642 (83.3–5080)/ 870 (54.5–39100)	12/ 0.74	0.524 (0–4.46)/ 0.129 (0–4.10)	15/ 4.06	10.1 (6.53–13.8)/ 9.58 (5.21–20.6)	9/ 1.05
100–200 m	0.685 (0.050–7.97)/ 1.71 (0.159–79.1)	5/ 0.40	388 (82.3–4460)/ 614 (97.0–11000)	7/ 0.63	0.621 (0–2.75)/ 0.251 (0–3.01)	7/ 2.47	6.48 (3.58–8.62)/ 6.55 (4.48–7.78)	7/ 0.99
>200 m	1.09 (0.10–198)/ 1.27 (0.085–22.4)	6/ 0.85	- -	0/ -	0.222 (0–10.5)/ 0 (0–14.0)	5/ -	- -	0/ -
p-values:	<0.01		<0.01		<0.01			
Wildfire Plume Density								
None	2.15 (0.140–44.8)/ 3.36 (0.240–224)	7/ 0.64	422 (82.3–3490)/ 590 (98.3–6900)	5/ 0.72	0.526 (0–3.23)/ 0.224 (0–4.10)	9/ 2.35	6.39 (3.58–10.1)/ 5.56 (4.48–9.24)	5/ 1.14
Low	3.25 (0.280–52.4)/ 4.81 (0.650–58.3)	7/ 0.68	568 (144–4700)/ 745 (97.0–8280)	3/ 0.80	0.605 (0–10.5) / 0.206 (0–14.0)	7/ 2.94	11.8 (8.00–13.8)/ 9.60 (6.55–11.1)	3/ 1.22
Medium	6.42 (0.710–563)/ 7.49 (0.750–168)	9/ 0.86	632 (83.3–5080)/ 857 (54.5–39100)	8/ 0.74	0.528 (0–5.30)/ 0.253 (0–1.90)	8/ 2.09	8.96 (6.48–11.9)/ 9.39 (7.19–10.2)	6/ 0.96
High	9.85 (4.08–30.4)/ 24.9 (8.44–165)	3/ 0.40	495 (98.3–4320)/ 948 (176–21500)	3/ 0.52	0.88 (0.26–4.46)/ 0.278 (0–2.80)	3/ 3.17	10.1 (6.73–13.4)/ 12.9 (5.21–20.6)	2/ 0.78
p-values:	<0.01		<0.01		<0.01		0.46	
Mechanical Ventilation								
Present	2.95 (0.560–44.8)/	4/	448 (98.3–2290)/	3/	0.442 (0–4.46)/	5/	6.73 (3.58–8.06)/	3/

	3.71 (0.550–111)	0.80	622 (98.3–6290)	0.72	0.180 (0–4.10)	2.46	5.56 (5.21–6.95)	1.21
Absent	3.43 (0.140–563)/	22/	541 (82.3–5080)/	16/	0.602 (0–10.5)/	22/	9.30 (5.04–13.8)/	13/
	5.03 (0.240–224)	0.68	787 (54.5–39100)	0.69	0.237 (0–1.40)	2.54	9.24 (4.48–20.6)	1.01
p-values:	<0.01		<0.01		<0.01		0.94	
Hours Windows Open								
0	1.13 (0.314–6.71)/	3/	219 (98.9–924)/	2/	0.385 (0–3.23)/	3/	5.05 (3.58–6.53)/	2/
	2.44 (0.194–54.0)	0.46	784 (54.5–39100)	0.28	0.0582 (0–2.89)	6.61	7.39 (5.56–9.23)	0.68
1–6	0.544 (0–4.31)/	4/	317 (82.2–2120)/	4/	0.692 (0–2.75)/	4/	7.19 (5.04–8.62)/	4/
	1.49 (0.160–79.1)	0.36	540 (97–6950)	0.59	0.258 (0–3.01)	2.68	6.01 (4.48–7.78)	1.20
7–12	0.932 (0.10–15.8)/	5/	406 (109–3000)/	2/	0.301 (0–10.4)/	5/	-	0
	1.48 (0.085–58.1)	0.63	800 (119–21500)	0.51	0 (0–14.0)	-	-	-
>12	1.50 (0.10–199)/	14/	739 (83.3–5100)	11/	0.448 (0–5.30)/	15/	9.98 (6.48–13.8)/	10/
	1.78 (0.120–59.2)	0.84	857 (58–17700)	0.86	0.175 (0–3.45)	2.56	9.56 (5.21–9.23)	1.05
p-values:	<0.01		<0.01		<0.01		0.11	
Gas Stove								
Present	1.47 (0.100–18.5)/	5/	597 (109–4400)/	3/	0.672 (0.08–2.95)/	4/	-	-
	2.02 (0.275–59.2)	0.73	858 (119–21500)	0.70	0.147 (0–1.13)	4.57	-	-
Absent	1.11 (0.050–199)/	21/	503 (82.3–5080)/	16/	0.420 (0–10.4)/	23/	8.34 (3.58–13.8)/	16/
	1.60 (0.085–79.1)	0.69	745 (54.5–39100)	0.67	0.144 (0–14.0)	2.92	8.51 (4.48–20.6)	-
p-values:	<0.01		<0.01		<0.01			
Stove Hood Type								
Exhaust	0.978 (0.05–9.24)/	8/	479 (98.3–4460)/	5/	0.473 (0–10.4)/	8/	6.63 (6.48–11.8)/	4/
	2.39 (0.160–79.1)	0.41	829 (54.4–39100)	0.58	0.159 (0–14.0)	2.97	8.21 (5.21–9.60)	0.81
Recirculating	1.04 (0.10–15.8)/	12/	490 (82.3–5080)/	10/	0.389 (0–2.75)/	12/	8.34 (5.04–13.8)/	8/
	1.24 (0.085–59.2)	0.81	693 (97.0–16200)	0.71	0.050 (0–4.10)	7.78	7.37 (4.48–11.1)	1.13
Absent	1.62 (0.10–199)/	6/	685 (99.0–4320)/	4/	0.592 (0–5.30)/	7/	10.9 (3.58–13.4)/	4/
	1.76 (0.264–53.1)	0.92	908 (57.9–17700)	0.75	0.258 (0–2.80)	2.29	9.88 (5.56–20.6)	1.10
p-values:	<0.01		<0.01		<0.01		0.30	

* NO₂ concentrations were TWA measurements, all other pollutants were time resolved (one-minute resolution). Data from homes with gas stoves were not included in the filtered dataset.

^a BG = Built Green; ^b EER = Energy Efficiency Retrofitted; ^c Non-EER = Non-Energy Efficiency Retrofitted (conventional homes as a control group).

I/O ratios that showed statistical significance (K-W test) in the mean differences (p<0.05) are shown in bold.