Supplementary Material

Indoor Particle Concentrations, Size Distributions, and Exposures in Middle Eastern Microenvironments

Hussein et al.

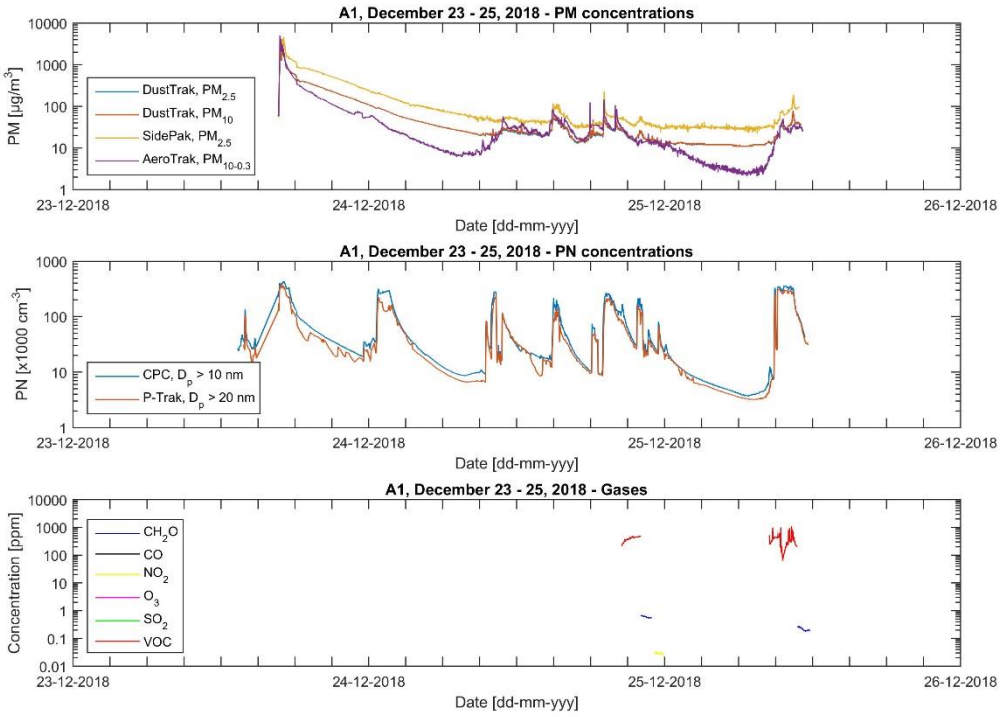


Figure S1: Aerosol concentrations inside apartment A1 during the winter campaign (December 23–25, 2018): (a) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}), SidePak ($PM_{2.5}$), and AeroTrak ($PM_{10–0.3}$); (b) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm); and (c) selected gaseous pollutant concentrations measured with the AeroQual.

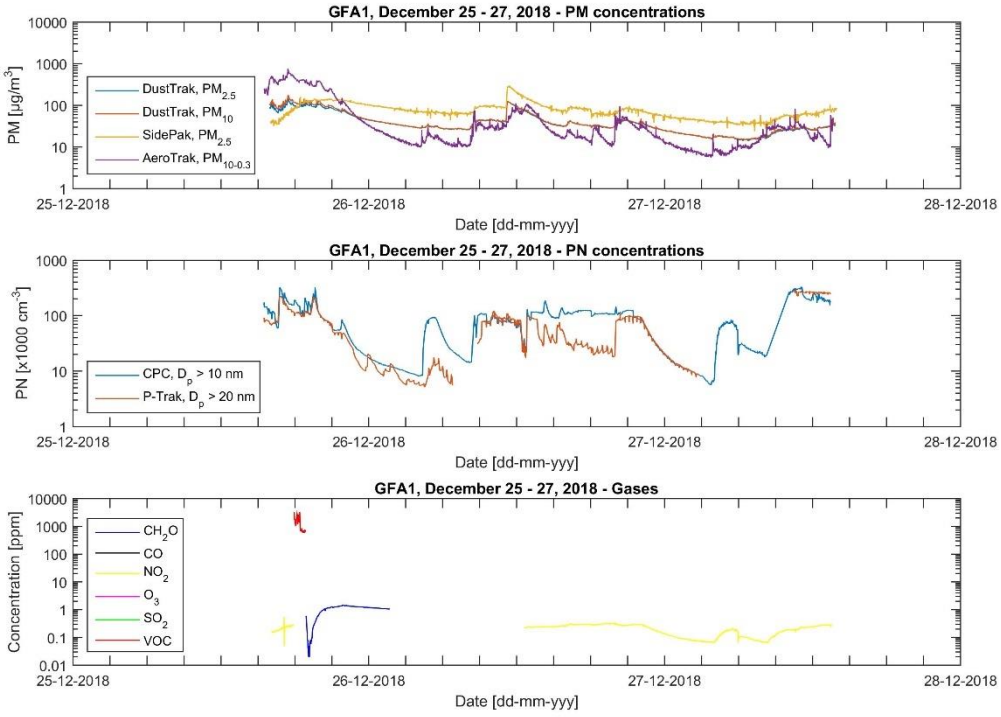


Figure S2: Aerosol concentrations inside ground floor apartment GFA1 during the winter campaign (December 25–27, 2018): (a) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}), SidePak ($PM_{2.5}$), and AeroTrak ($PM_{10–0.3}$); (b) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm); and (c) selected gaseous pollutant concentrations measured with the AeroQual.

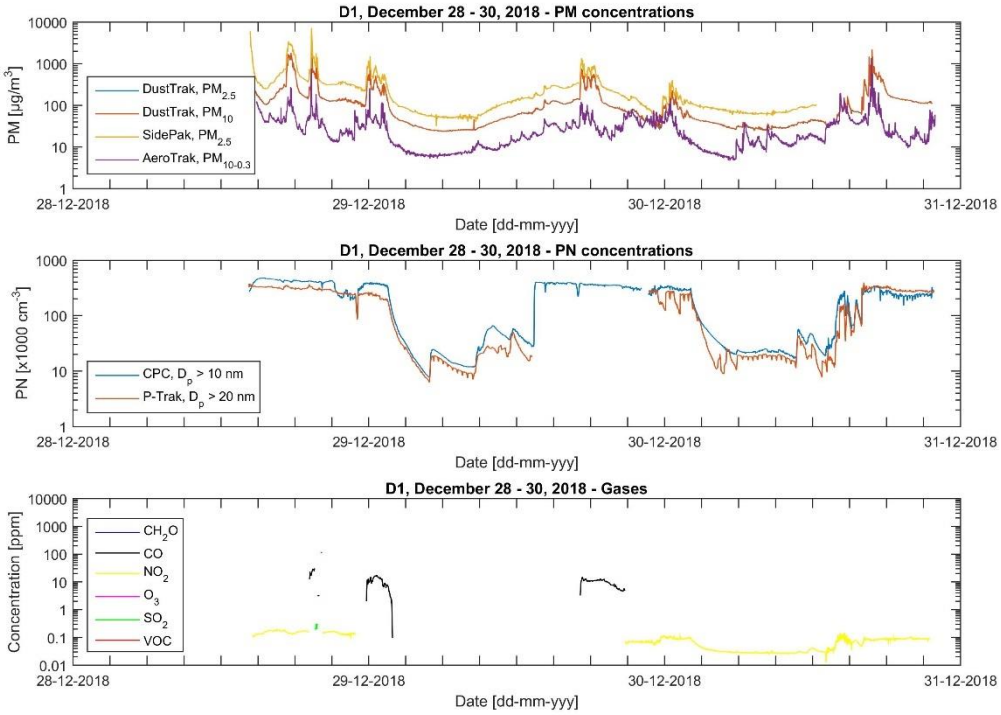


Figure S3: Aerosol concentrations inside duplex apartment D1 during the winter campaign (December 28–30, 2018): (a) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}), SidePak ($PM_{2.5}$), and AeroTrak ($PM_{10–0.3}$); (b) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm); and (c) selected gaseous pollutant concentrations measured with the AeroQual.

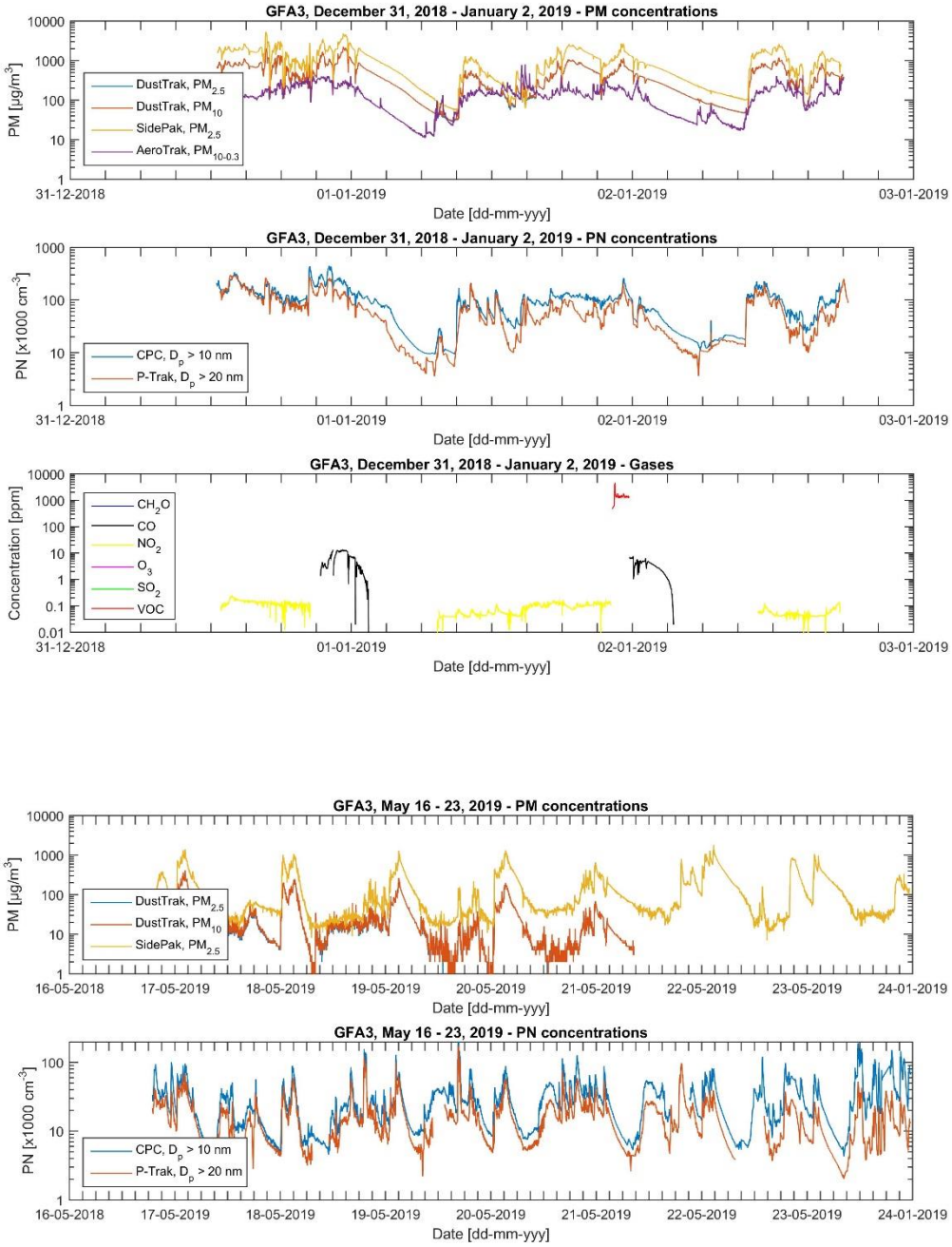


Figure S4: Aerosol concentrations inside ground floor apartment GFA3 during the winter campaign (December 31, 2018–January 2, 2019): (a) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}), SidePak ($PM_{2.5}$), and AeroTrak ($PM_{10–0.3}$); (b) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm); and (c) selected gaseous pollutant concentrations measured with the AeroQual. Also summer campaign (May 16–23, 2019): (d) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}) and SidePak ($PM_{2.5}$) and (e) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm).

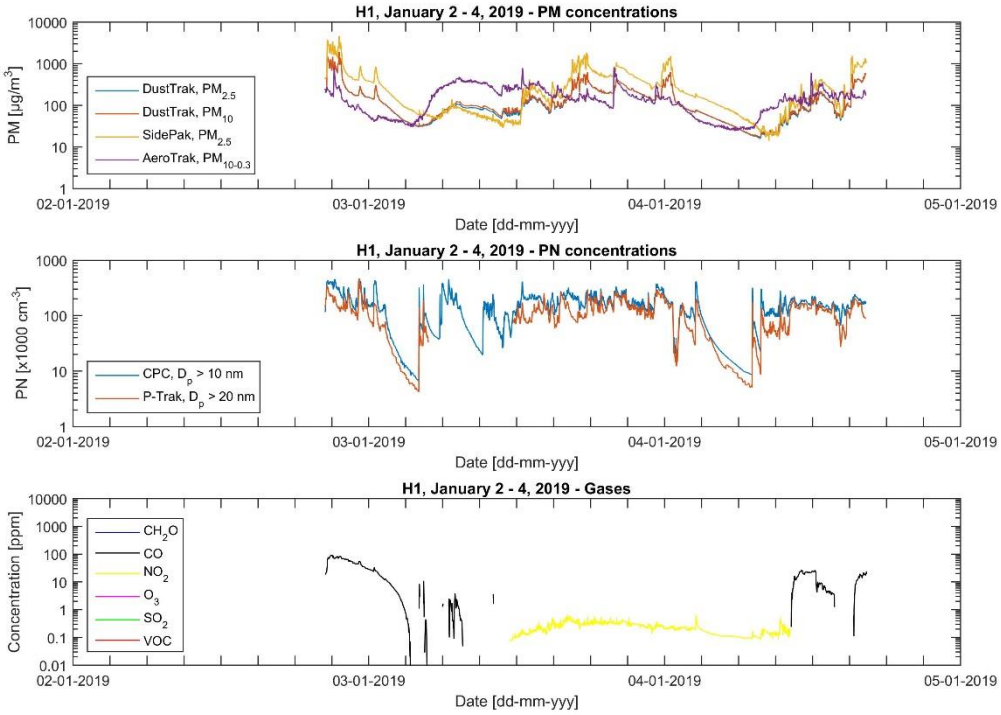


Figure S5: Aerosol concentrations inside house H1 during the winter campaign (January 2–4, 2019): (a) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}), SidePak ($PM_{2.5}$), and AeroTrak ($PM_{10–0.3}$); (b) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm); and (c) selected gaseous pollutant concentrations measured with the AeroQual.

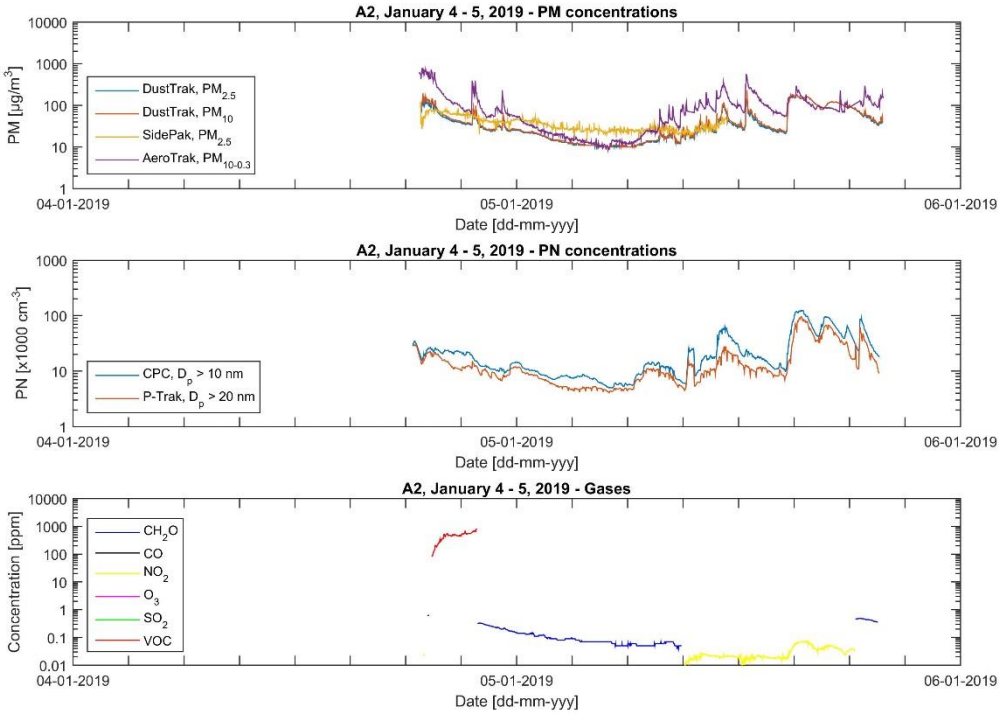


Figure S6: Aerosol concentrations inside apartment A2 during the winter campaign (January 4–5, 2019): (a) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}), SidePak ($PM_{2.5}$), and AeroTrak ($PM_{10–0.3}$); (b) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm); and (c) selected gaseous pollutant concentrations measured with the AeroQual.

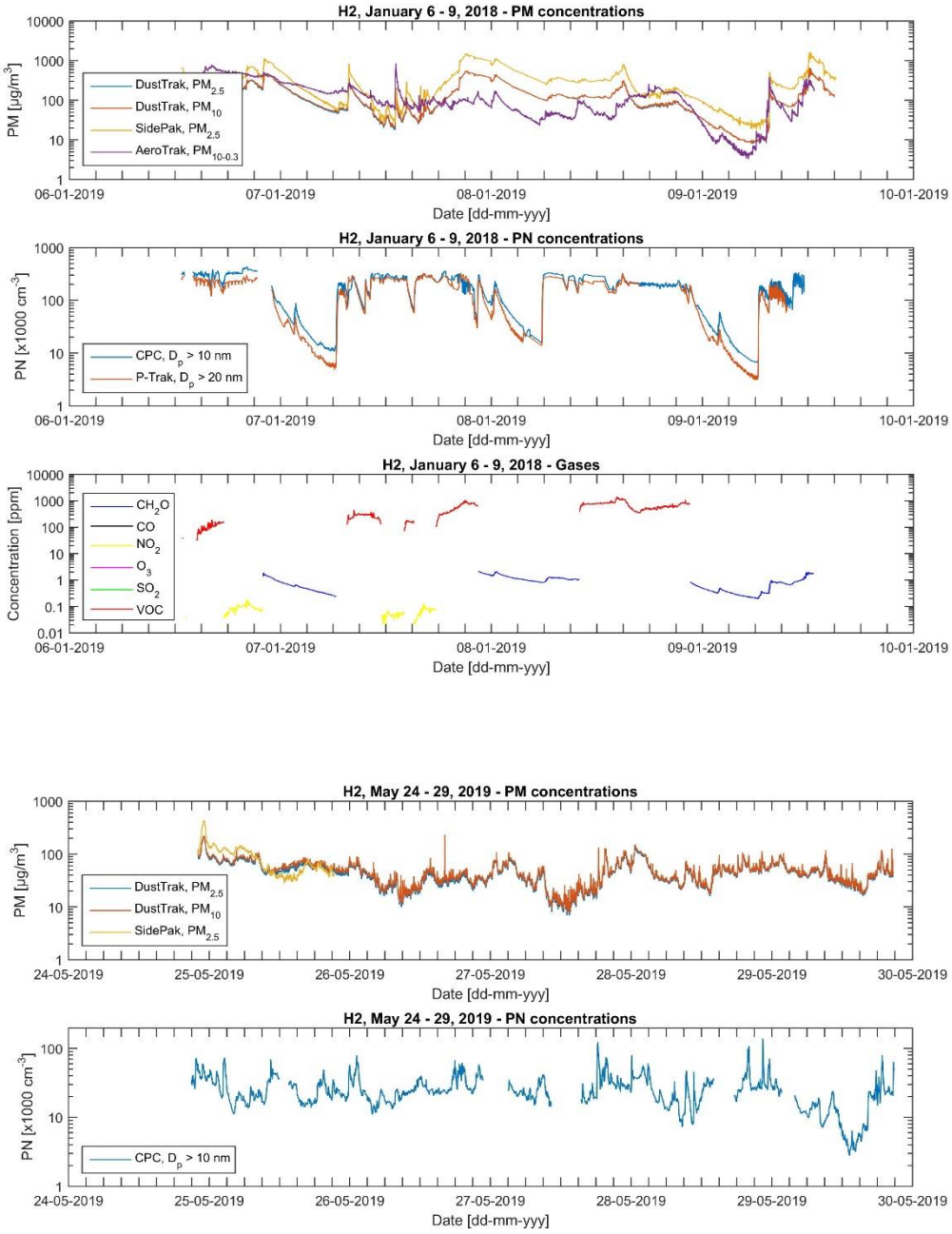


Figure S7: Aerosol concentrations inside house H2 during the winter campaign (January 6–9, 2019): (a) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}), SidePak ($PM_{2.5}$), and AeroTrak ($PM_{10–0.3}$); (b) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm); and (c) selected gaseous pollutant concentrations measured with the AeroQual. Also summer campaign (May 24–19, 2019): (d) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}) and SidePak ($PM_{2.5}$) and (e) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm).

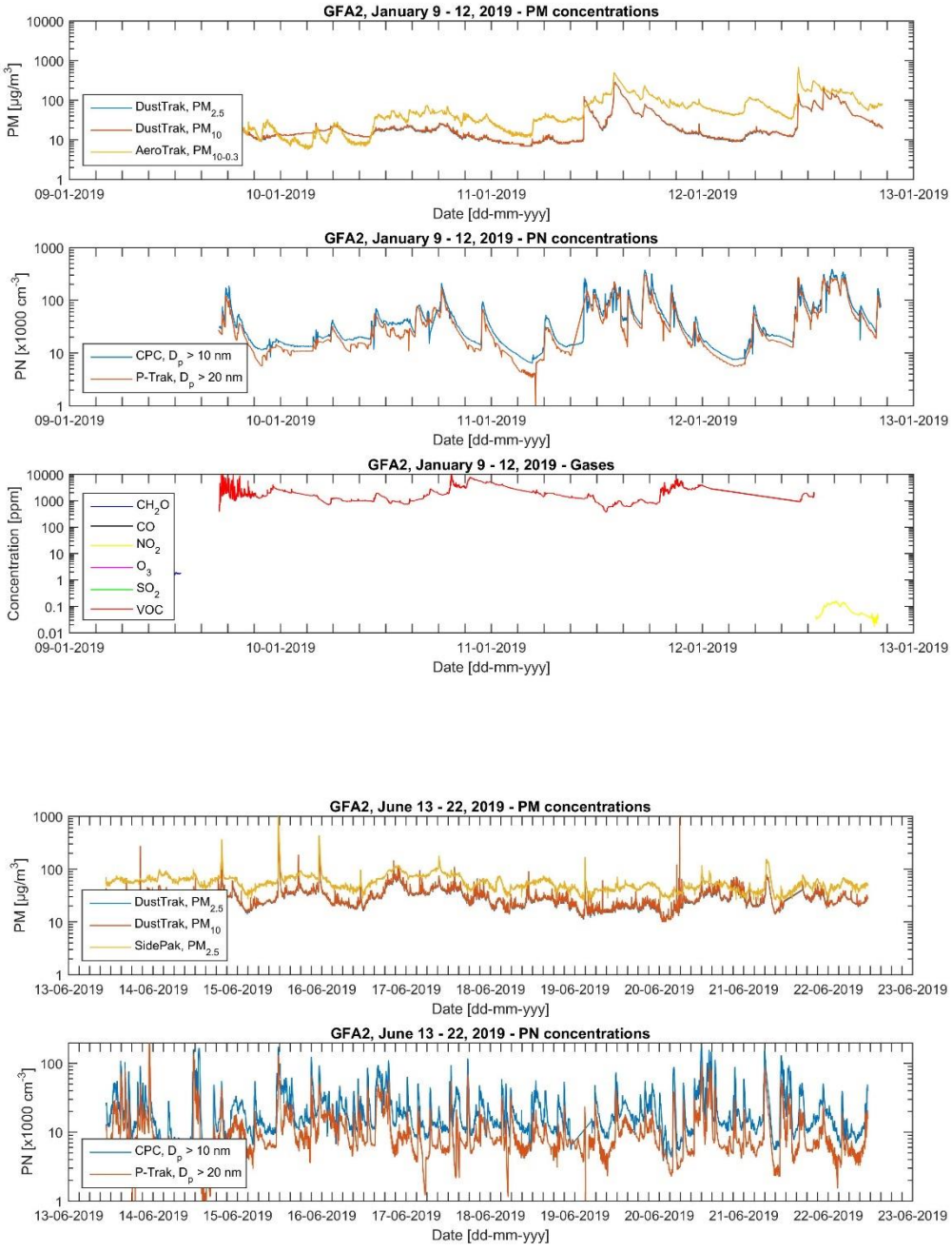


Figure S8: Aerosol concentrations inside ground floor apartment GFA2 during the winter campaign (January 9–12, 2019): (a) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}) and AeroTrak ($PM_{10–0.3}$); (b) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm); and (c) selected gaseous pollutant concentrations measured with the AeroQual. Also summer campaign (May 13–22, 2019): (d) particle mass concentrations measured with the DustTrak ($PM_{2.5}$ and PM_{10}) and SidePak ($PM_{2.5}$) and (e) particle number concentrations measured with the CPC 3007 (D_p 0.01–2 µm) and P-Trak (D_p 0.02–2 µm).

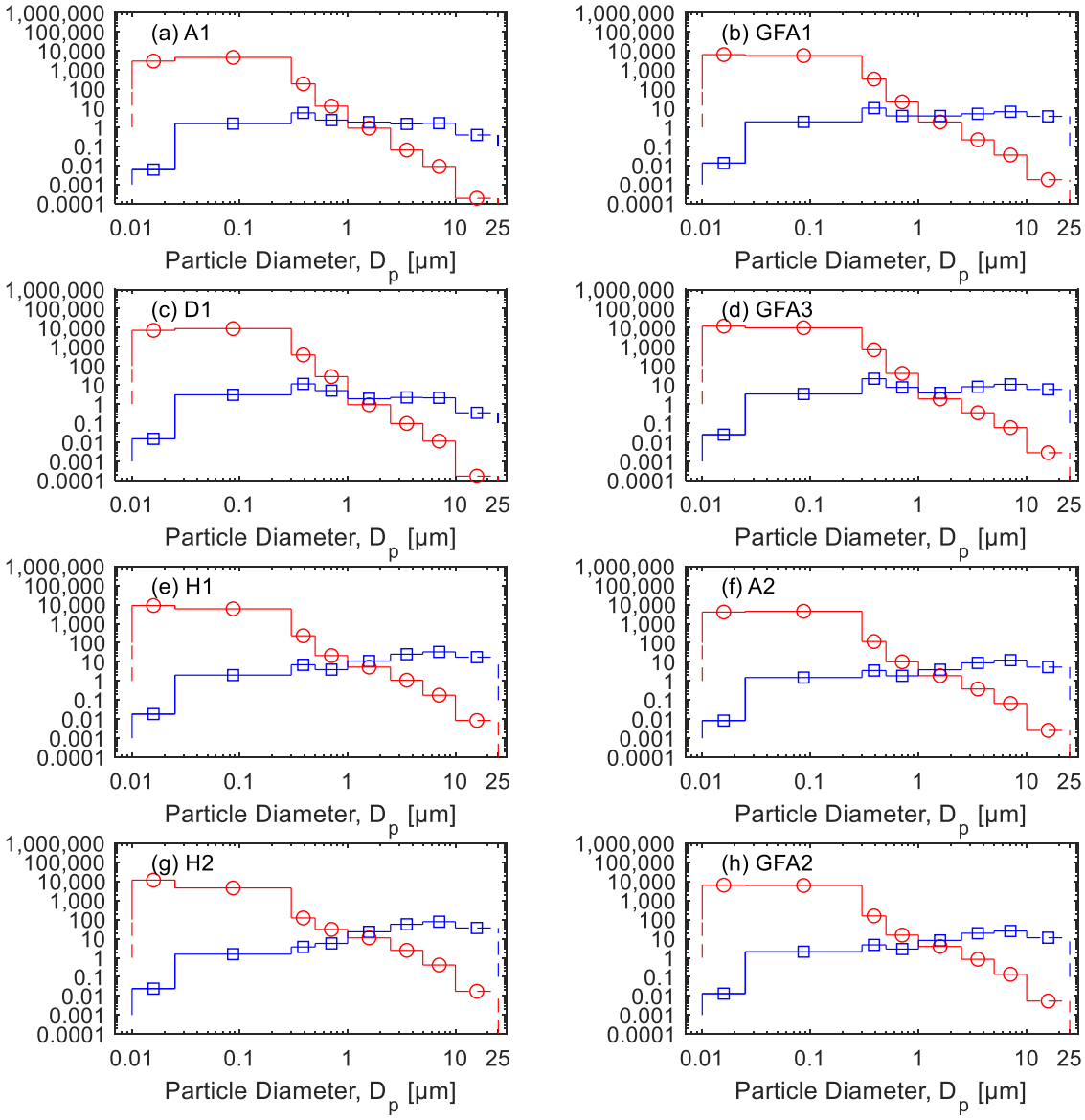


Figure S9: Mean particle number size distributions (red, dN/dlog(D_p), cm^{-3}) and corresponding particle mass size distributions (blue, dM/dlog(D_p), $\mu g/m^3$) in the absence of indoor activities during the winter campaign at each study site (a.-h.).

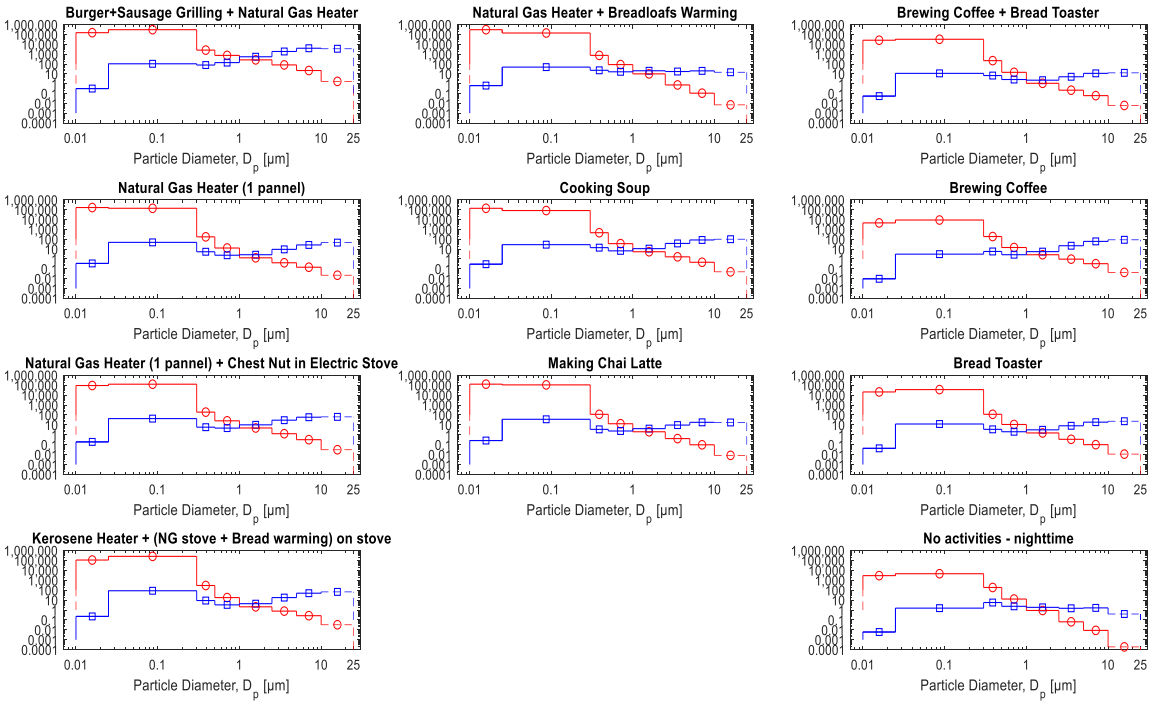


Figure S10: Mean particle number size distributions (red; dN/dlog(Dp)) and particle mass size distributions (blue; dM/dlog(Dp)) during selected activities reported inside Apartment A1 during the winter campaign (December 23–25, 2018).

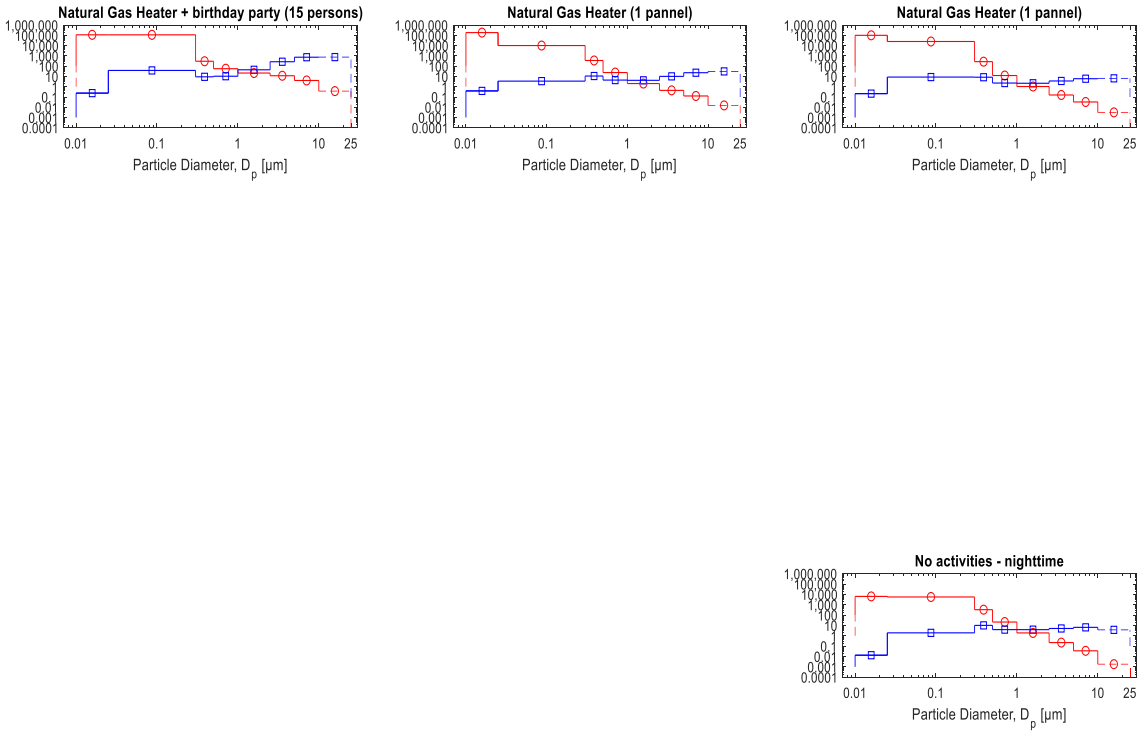
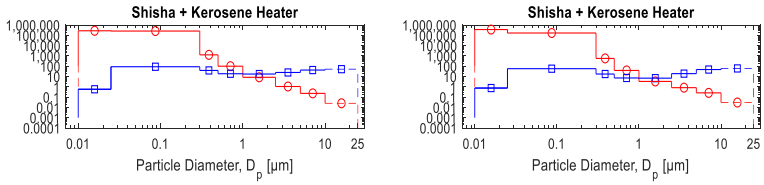


Figure S11: Mean particle number size distributions (red; dN/dlog(Dp)) and particle mass size distributions (blue; dM/dlog(Dp)) during selected activities reported inside ground floor apartment GFA1 during the winter campaign (December 25–27, 2018).



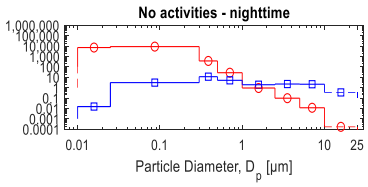


Figure S12: Mean particle number size distributions (red; dN/dlog(Dp)) and particle mass size distributions (blue; dM/dlog(Dp)) during selected activities reported inside duplex D1 during the winter campaign (December 28–30, 2018).

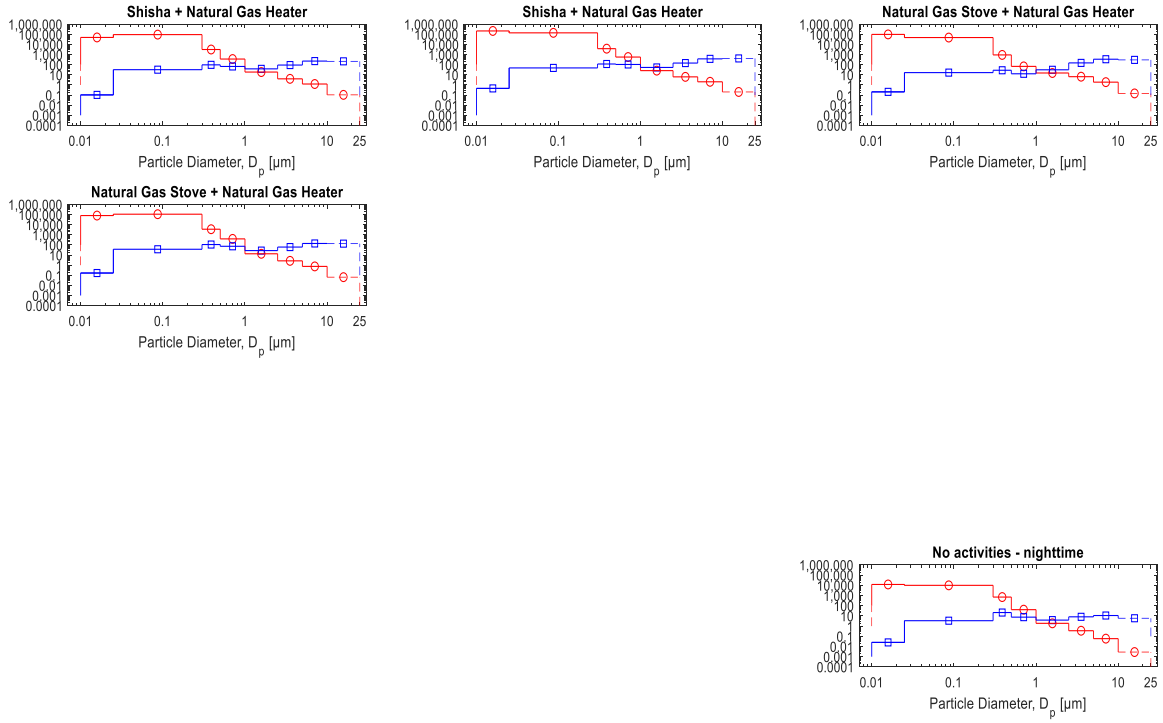


Figure S13: Mean particle number size distributions (red; dN/dlog(Dp)) and particle mass size distributions (blue; dM/dlog(Dp)) during selected activities reported inside ground floor apartment GFA3 during the winter campaign (December 31, 2018–January 2, 2019).

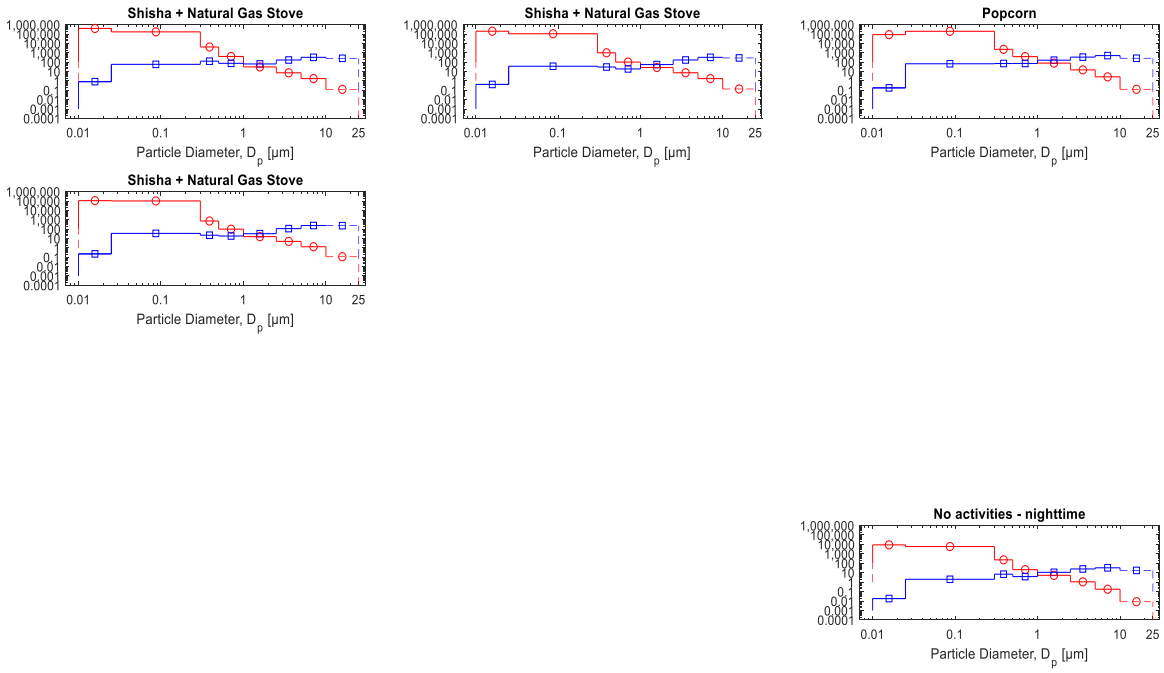


Figure S14: Mean particle number size distributions (red; dN/dlog(Dp)) and particle mass size distributions (blue; dM/dlog(Dp)) during selected activities reported inside house H1 during the winter campaign (January 2–4, 2019).

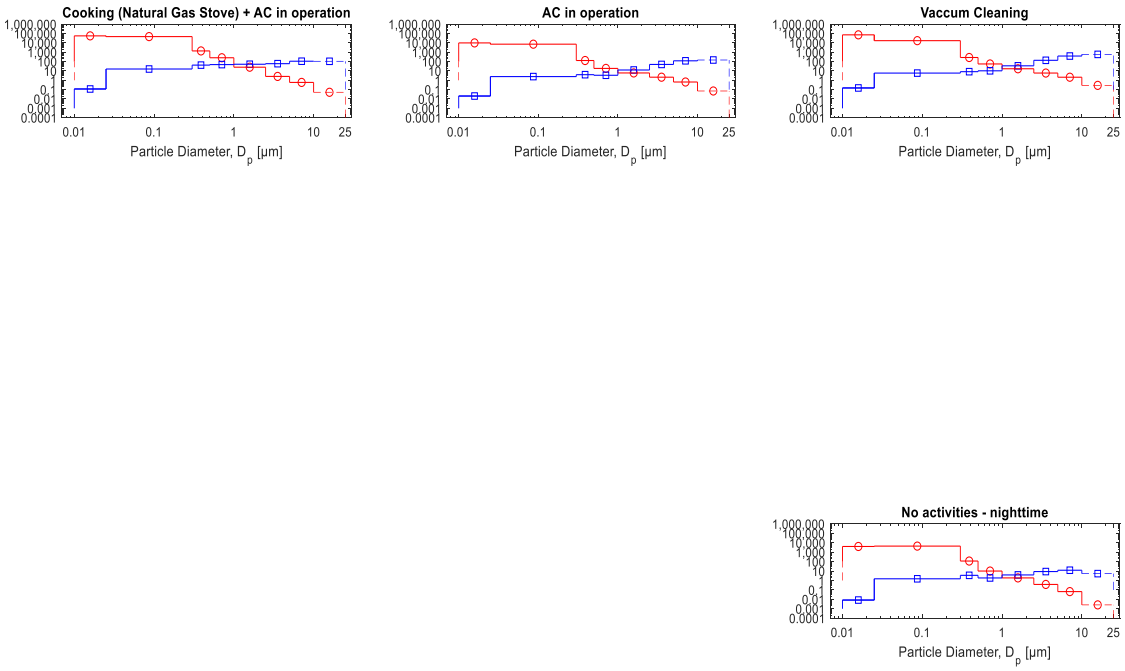


Figure S15: Mean particle number size distributions (red; dN/dlog(Dp)) and particle mass size distributions (blue; dM/dlog(Dp)) during selected activities reported inside apartment A2 during the winter campaign (January 4–5, 2019).

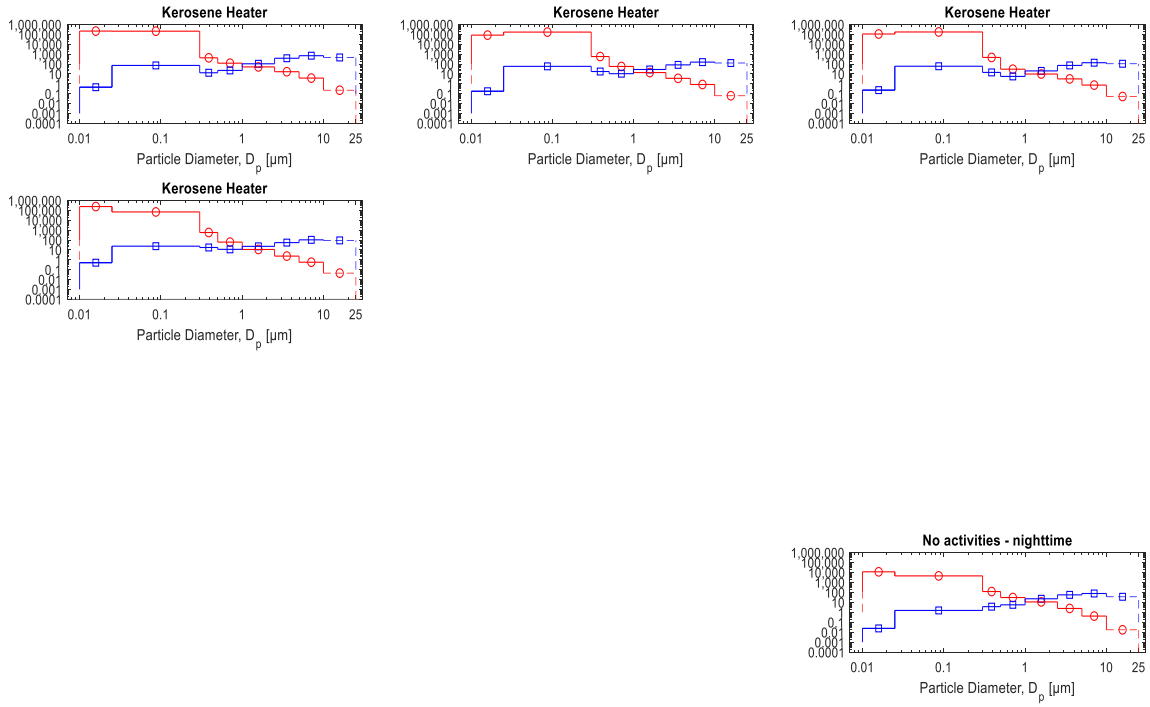


Figure S16: Mean particle number size distributions (red; dN/dlog(Dp)) and particle mass size distributions (blue; dM/dlog(Dp)) during selected activities reported inside house H2 during the winter campaign (January 6–9, 2019).

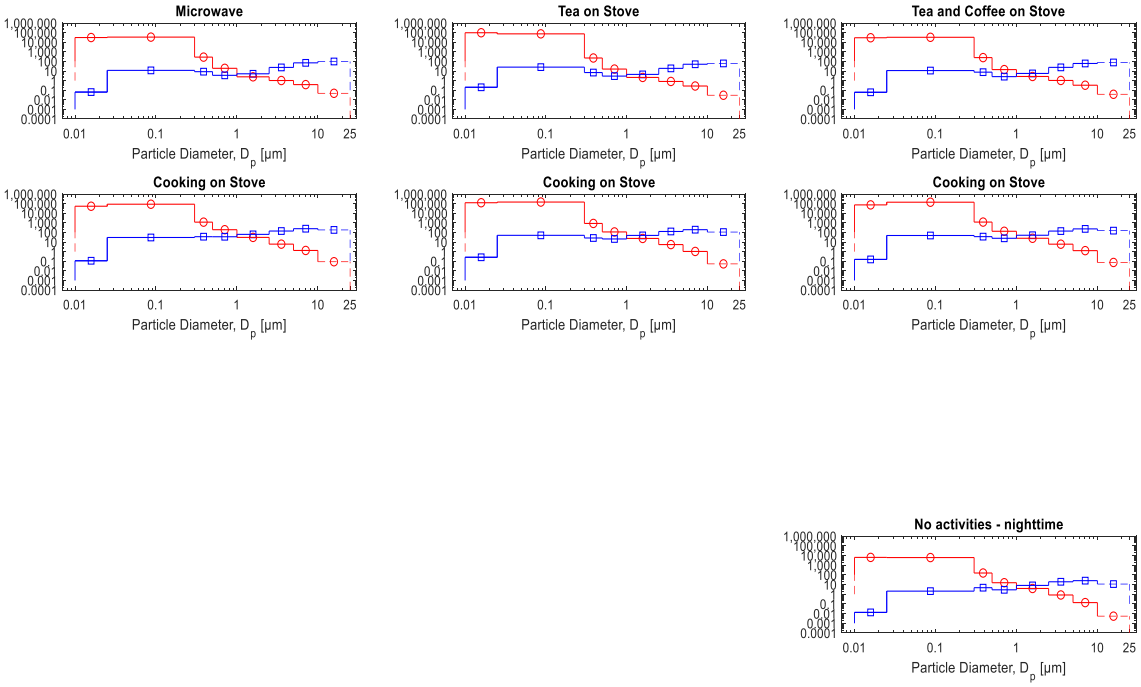


Figure S17: Mean particle number size distributions (red; dN/dlog(Dp)) and particle mass size distributions (blue; dM/dlog(Dp)) during selected activities reported inside ground floor apartment GFA2 during the winter campaign (January 9–12, 2019).

Table S1: Average particle mass and number concentrations (mean ± stdev) during selected indoor activities.

Combustion		Smoking		Non-Combustion		Additional Activity		Δt [min]	$PM_{2.5}$ [μg/m³]			PM_{10} [μg/m³]		PN_1 [×10³ cm⁻³]	PN_{10-1} [cm⁻³]	Figure
Heating	Stove	Shisha	Tobac.	Heating	Other				PMD	DustTrak	SidePak	PMD	DustTrak	PND	PND	
√ (NG)							A1	26	54 ± 26	20 ± 1	45 ± 2	64 ± 27	21 ± 1	214 ± 71	1 ± 0	S10
√ (NG)	√					Bread warming up	A1	59	70 ± 15	82 ± 6	188 ± 13	81 ± 17	83 ± 6	274 ± 38	4 ± 1	S10
√ (NG)	√					Grilling burger/sausages	A1	27	378 ± 101	1731 ± 381	2925 ± 955	2094 ± 882	1830 ± 398	383 ± 82	131 ± 47	S10
√ (NG)	√						GFA1	52	9 ± 2	31 ± 1	69 ± 5	19 ± 3	32 ± 1	85 ± 13	1 ± 0	S11
√ (NG)	√						GFA1	78	13 ± 7	18 ± 1	39 ± 2	16 ± 7	18 ± 1	68 ± 11	*null*	S11
√ (NG)	√		√				GFA3	46	40 ± 8	114 ± 8	194 ± 30	189 ± 57	122 ± 8	91 ± 18	8 ± 2	S13
√ (NG)	√		√				GFA3	145	98 ± 26	587 ± 225	1359 ± 525	158 ± 51	590 ± 226	151 ± 37	6 ± 3	S13
√ (NG)	√	√				Making popcorn	H1	39	173 ± 41	343 ± 63	795 ± 134	424 ± 152	345 ± 63	245 ± 53	36 ± 12	S14
√ (NG)	√				√	15 people	GFA1	270	65 ± 17	98 ± 14	88 ± 37	374 ± 91	115 ± 16	169 ± 52	13 ± 3	S11
√ (K)	√						H2	525	130 ± 15	159 ± 71	266 ± 199	458 ± 110	172 ± 71	318 ± 53	27 ± 9	S16
√ (K)	√						H2	1064	82 ± 24	150 ± 155	370 ± 428	154 ± 60	152 ± 154	220 ± 78	7 ± 5	S16
√ (K)	√						H2	979	78 ± 17	112 ± 42	278 ± 123	141 ± 36	113 ± 42	236 ± 52	5 ± 3	S16
√ (K)	√						H2	324	43 ± 17	84 ± 48	222 ± 126	91 ± 60	84 ± 48	174 ± 62	5 ± 5	S16
√ (K)	√						A1	84	99 ± 13	35 ± 12	79 ± 31	119 ± 14	36 ± 12	320 ± 45	1 ± 0	S10
√ (K)	√	√					D1	631	118 ± 33	289 ± 336	629 ± 680	139 ± 42	290 ± 336	397 ± 60	4 ± 8	S12
√ (K)	√	√					D1	750	72 ± 24	126 ± 114	255 ± 197	92 ± 30	127 ± 114	330 ± 46	2 ± 1	S12
√ (NG)	√	√ ×2					H1	64	139 ± 27	995 ± 278	2377 ± 696	288 ± 114	1000 ± 277	343 ± 72	15 ± 10	S14
√ (NG)	√	√					H1	369	75 ± 18	183 ± 127	414 ± 398	226 ± 76	189 ± 125	198 ± 47	14 ± 5	S14
√ (NG)	√	√					H1	520	61 ± 26	124 ± 126	261 ± 312	168 ± 60	128 ± 127	154 ± 39	8 ± 3	S14
√ (NG)	√	√	√				GFA3	123	92 ± 33	819 ± 435	1956 ± 1095	189 ± 46	825 ± 435	123 ± 34	9 ± 6	S13
√ (NG)	√	√ ×2	√				GFA3	221	132 ± 31	987 ± 484	2180 ± 1048	291 ± 61	995 ± 483	242 ± 77	13 ± 5	S13
	√					Cooking soup	A1	38	40 ± 11	49 ± 5	93 ± 14	76 ± 17	51 ± 5	144 ± 40	3 ± 1	S10
	√					Making chai latte	A1	34	41 ± 13	21 ± 3	47 ± 5	49 ± 13	22 ± 3	160 ± 44	1 ± 0	S10
	√			√ (C)		Intensive cooking	GFA2	174	76 ± 41	119 ± 77	--	191 ± 75	120 ± 77	116 ± 29	14 ± 10	S17
	√			√ (C)		Intensive cooking	GFA2	82	85 ± 32	61 ± 8	--	181 ± 56	61 ± 8	207 ± 78	11 ± 3	S17
	√			√ (C)		Intensive cooking	GFA2	348	88 ± 31	93 ± 30	--	201 ± 32	94 ± 30	183 ± 91	12 ± 2	S17
	√			√ (C)		Making tea	GFA2	43	31 ± 10	30 ± 2	--	52 ± 11	31 ± 2	117 ± 43	1 ± 0	S17
	√			√ (C)		Making tea and coffee	GFA2	73	16 ± 4	17 ± 1	--	42 ± 10	17 ± 2	46 ± 13	1 ± 0	S17
	√			√ (AC)		Intensive cooking	A2	194	62 ± 19	125 ± 29	--	112 ± 40	127 ± 29	74 ± 28	11 ± 5	S15
				√ (AC)		AC operation	A2	189	10 ± 3	21 ± 6	26 ± 4	61 ± 28	23 ± 8	12 ± 4	3 ± 1	S15
				√ (C)	√	Microwave	GFA2	19	17 ± 5	37 ± 3	--	44 ± 11	37 ± 3	47 ± 17	1 ± 0	S17
					√	Vacuum Cleaner	A2	38	25 ± 7	61 ± 23	40 ± 7	181 ± 64	67 ± 25	47 ± 15	9 ± 3	S15
					√	Brewing Coffee	A1	38	7 ± 2	20 ± 2	35 ± 2	31 ± 21	21 ± 3	11 ± 5	1 ± 1	S10

					√	Brewing Coffee + Toaster	A1	19	14 ± 10	22 ± 1	52 ± 3	18 ± 11	22 ± 1	42 ± 29	*null*	S10
					√	Toaster	A1	17	15 ± 6	14 ± 1	32 ± 2	23 ± 7	14 ± 1	44 ± 21	8 ± 2	S10