Supplementary Information for:

Indoor black carbon and brown carbon concentrations from cooking and outdoor penetration: Insights from the HOMEChem study

Sumit Sankhyan[1], Sameer Patel[1‖], Erin F. Katz[2,3], Peter F. DeCarlo[4], Delphine K. Farmer[5], William W Nazaroff[6], Marina E. Vance[1]*

[1]Department of Mechanical Engineering, University of Colorado Boulder.
[2]Department of Chemistry, University of California at Berkeley
[3]Department of Environmental Science, Policy, and Management, University of California at Berkeley
[4]Department of Environmental Health and Engineering, Johns Hopkins University.
[5]Department of Chemistry, Colorado State University.
[6]Department of Civil and Environmental Engineering, University of California at Berkeley

‖: Now at Department of Civil Engineering, IIT Gandhinagar, Gandhinagar, GJ 382355, IN
*To whom correspondence should be addressed.
Tel: +1-303-735-4567
E-mail address: marina.vance@colorado.edu

Table of Contents:

Table S1. Mass absorption coefficient (α_{abs}) values used for this study.[a]

Table S2. BC and BrC concentrations (in μg m^{-3}) used for the analysis of indoor-to-outdoor (I/O) ratios for different events throughout the HOMEChem campaign. † The time averaging interval for each event is represented via series of footnotes.

Table S3. BC exposure values for an occupant present inside the kitchen during the different meals cooked throughout the HOMEChem campaign.

Fig. S1. Average daily RH values as reported by house sensors and MA200 internal sensor, showing the general efficiency of the diffusion drier used upstream of the aethalometer.

Fig. S2. Penetration factor as a function of particle size calculated for the aerosol flow through the diffusion dryer used in this study.

Fig. S3. Intercomparison between indoor (MA-0030) and outdoor (MA-0104) aethalometers performed after the HOMEChem campaign. The indoor and outdoor aethalometers are represented as (I) and (O) respectively.

Fig. S4. Particle loss characterization through the diffusion dryers for (a) BC (880 nm) and (b) UVPM (375 nm) wavelength channels.

Fig. S5. Post-HOMEChem assessment of the effect of relative humidity (RH) cycling on the aethalometer BC measurements. After the first 40 minutes of room air sampling, a HEPA filter

was attached to the inlet while the ambient RH was cycled from 35-70% as shown on the right-hand *y* axis. Although the raw BC concentrations reported by the aethalometer varied between 0.7 and -0.9 μg m^{-3}, the corrected BC concentrations using the ONA algorithm resulted in readings of -0.02 ± 0.00 μg m^{-3} after the start of RH cycling.

Fig. S6. Intercomparisons between MA200 and ModelAE33 for BC concentrations on different experimental days.

Fig. S7. Intercomparisons between MA200 and ModelAE33 for BrC concentrations on different experimental days.

Fig. S8. AAE data intercomparisons between MA200 and ModelAE33 aethalometers for (a) June 17 Sequential Stir-fry Day and (b) June 18 Thanksgiving Day.

Fig. S9. Temporal variability of BC and BrC concentrations on June 8th Layered Day.

Fig. S10. Sequential Stir-fry Day (June 12): (a) the AAE time series; (b) the time series of BC and BrC concentrations throughout the day. Data are smoothed using a 10-minute moving average. (1) represents stir-fry cooked on a gas stove in a stainless-steel wok, (2) represents stir-fry cooked on an electric hot plate (medium setting) in a stainless-steel wok and (3) represents stir-fry meal cooked on a gas stove in a cast-iron pan.

Fig. S11. Sample RH as measured by the aethalometer internal sensors on the June 6th Sequential Stir-fry Day. House open periods are highlighted in green.

Fig S12. Outdoor BC and BrC concentrations as measured by the outdoor aethalometer on the June 6th Sequential Stir-Fry Day.

Fig. S13. BC and BrC time series comparison with size-resolved PM concentrations on June 18th Thanksgiving Day.

Table S1. Mass absorption coefficient (α_{abs}) values used for this study.[a]

Wavelength (nm)	α_{abs} **(m^2 g^{-1})**
375	24.1
470	19.1
528	17.0
625	14.1
880	10.1

[a] Source: correspondence with the manufacturer

Table S2. BC and BrC concentrations (in μg m^{-3}) used for the analysis of indoor-to-outdoor (I/O) ratios for different events throughout the HOMEChem campaign. † The time averaging interval for each event is represented via series of footnotes.

Date	No Activity[1]				Breakfast[2]				Stir-fry[3]				Lasagna[4]				Chili[5]				Thanksgiving Day[6]			
	BC		BrC		BC		BrC		BC		BrC		BC		BrC		BC		BrC		BC		BrC	
	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O
06/05[A]	0.17	0.29	0.16	0.17																				
06/06[B]	0.15	0.24	0.14	0.16					0.23	0.45	0.17	0.17												
06/06[C]									0.33	0.34	0.30	0.19												
06/06[D]									0.40	0.28	0.16	0.23												
06/07[E]	0.15	0.23	0.12	0.15																				
06/08[F]	0.15	0.23	0.09	0.12	1.60	0.39	0.77	0.17	0.39	0.33	0.31	0.11	0.28	0.26	0.13	0.11								
06/09[G]	0.15	0.28	0.09	0.23																				
06/10[H]	0.18	0.30	0.13	0.38																				
06/11[I]	0.15	0.25	0.09	0.26																				
06/12[J]									0.9	0.36	0.71	0.35												
06/12[K]									0.33	0.21	0.22	0.19												
06/12[L]									0.40	0.15	0.40	0.20												
06/16[M]	0.14	0.23	0.15	0.13																				
06/17[N]	0.11	0.13	0.06	0.09					0.24	0.14	0.59	0.11												
06/17[O]									0.25	0.12	0.92	0.79												
06/18[P]																					0.66	0.15	1.74	0.09
06/19[Q]					0.30	0.17	0.58	0.15	0.33	0.23	0.11	0.17												
06/20[R]	0.13	0.21	0.07	0.17																				
06/21[S]					0.43	0.60	0.42	0.37									0.35	0.39	0.38	0.26				

† Outdoor aethalometer data are available only for June 5-June 21 period.

A1 June 5th 04:00 pm to June 6th 06:30 am

B1 June 6th 10:00 pm to June 7th 06:30 am; B3 08:35-09:15 am; C3 12:05-01:00 pm; D3 9:05-09:55 pm

E1 June 7th 04:30 pm to June 8th 06:30 am

F1 June 8th 05:00 pm to June 9th 06:30 am; F2 08:35-09:30 am; F3 11:35 am-12:20 pm; F4 03:35-05:15 pm

G1 June 9th 05:00 pm to June 10th 06:30 am

H1 June 10th 09:06 pm to June 11th 06:30 am

I1 June 11th 06:35 pm to June 12th 06:30 am

J3 08:35-10:25 am; K3 12:35-02:00 pm; L3 04:35-06:00 pm

M1 June 16th 10:00 pm to June 17th 06:30 am

N1 June 17th 10:30 pm to June 18th 06:30 am; N3 08:35-10:30 am; O3 04:35-06:00 pm

P6 08:40 am to 05:50 pm

Q2 08:36-09:54 am; Q3 11:35 am to 12:44 pm

R1 June 20th 09:30 pm to June 21st 06:30 am

S3 08:35-09:50 am; S5 03:35-04:48 pm

Table S3. BC exposure values for an occupant present inside the kitchen during the different meals cooked throughout the HOMEChem campaign.

Event	**BC Exposure ($\mu g\ m^{-3}\ h$)**
Breakfast (June 8)	1.53
Breakfast (June 19)	0.38
Breakfast (June 21)	0.54
Breakfast (June 25)	0.64
Stir-fry 1 (June 6)	0.34
Stir-fry 2 (June 6)	0.30
Stir-fry 3 (June 6)	0.73
Stir-fry 4 (June 6)	0.33
Stir-fry (June 8)	0.30
Stir-fry 1 (June 12)	1.78
Stir-fry 2 (June 12)	0.47
Stir-fry 3 (June 12)	0.56
Stir-fry 1 (June 17)	0.44
Stir-fry 2 (June 17)	0.34
Stir-fry 3 (June 17)	0.26
Stir-fry (June 19)	0.20
Stir-fry (June 21)	0.28
Stir-fry (June 25)	0.85
Chili (June 19)	0.17
Chili (June 21)	0.42
Chili (June 25)	0.37
Lasagne (June 8)	0.47
Toast (June 8)	0.28
Toast (June 19)	0.03
Toast (June 21)	0.06
Toast (June 25)	0.13

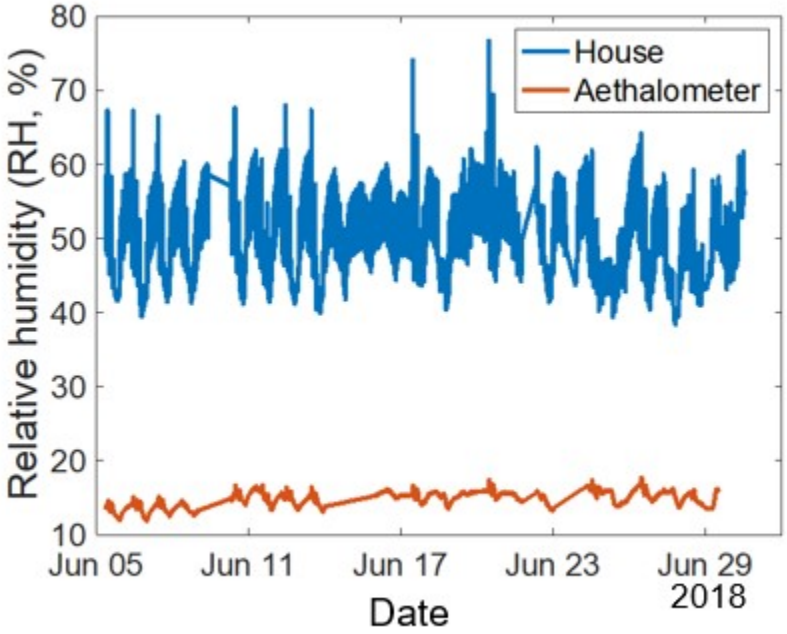

Fig. S1. Average daily RH values as reported by house sensors and MA200 internal sensor, showing the general efficiency of the diffusion drier used upstream of the aethalometer.

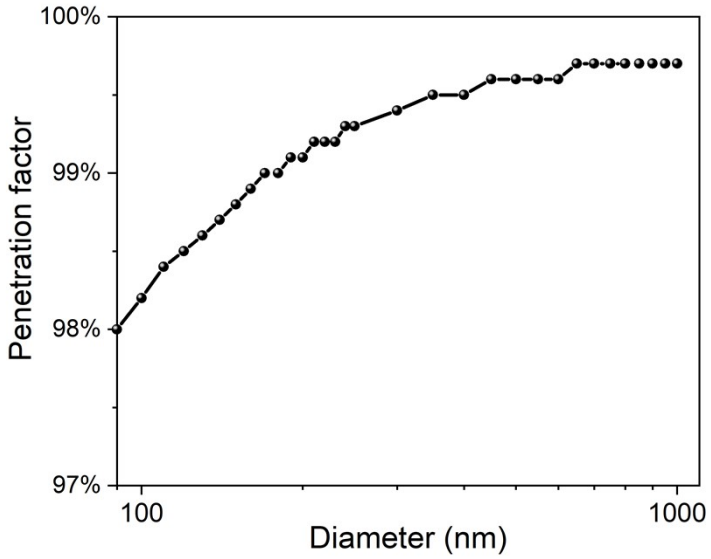

Fig. S2. Penetration factor as a function of particle size calculated for the aerosol flow through the diffusion dryer used in this study.

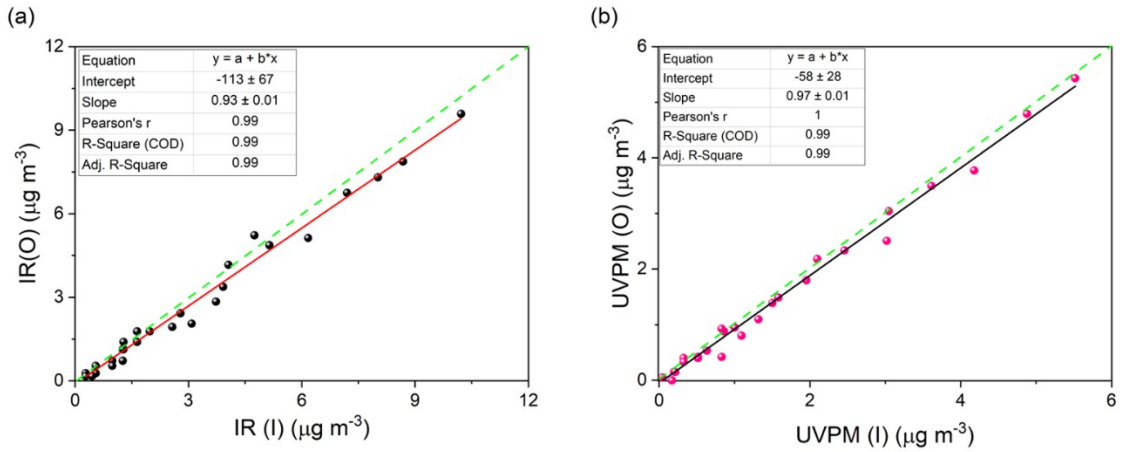

Fig. S3. Intercomparison between indoor (MA-0030) and outdoor (MA-0104) aethalometers performed after the HOMEChem campaign. The indoor and outdoor aethalometers are represented as (I) and (O) respectively.

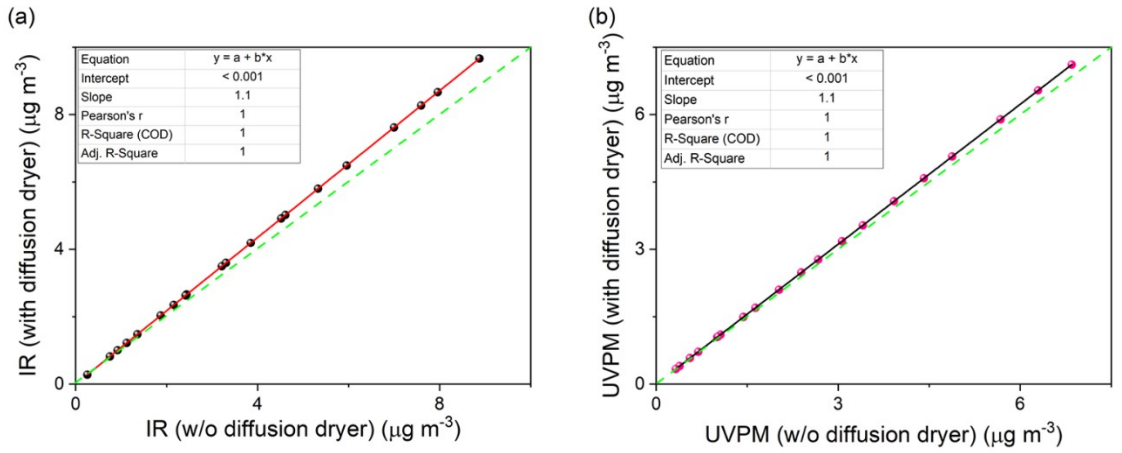

Fig. S4. Particle loss characterization through the diffusion dryers for (a) BC (880 nm) and (b) UVPM (375 nm) wavelength channels.

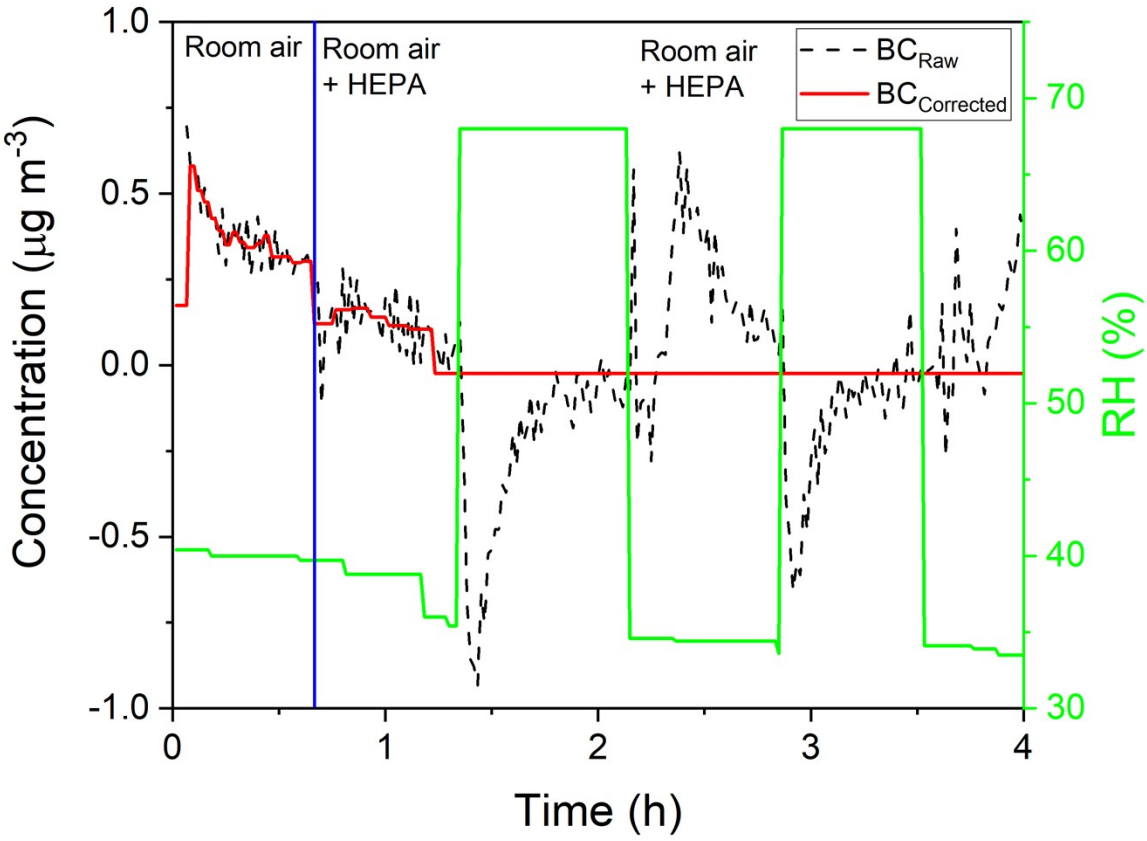

Fig. S5. Post-HOMEChem assessment of the effect of relative humidity (RH) cycling on the aethalometer BC measurements. After the first 40 minutes of room air sampling, a HEPA filter was attached to the inlet while the ambient RH was cycled from 35-70% as shown on the right-hand *y* axis. Although the raw BC concentrations reported by the aethalometer varied between 0.7 and -0.9 μg m^{-3}, the corrected BC concentrations using the ONA algorithm resulted in readings of -0.02 ± 0.00 μg m^{-3} after the start of RH cycling.

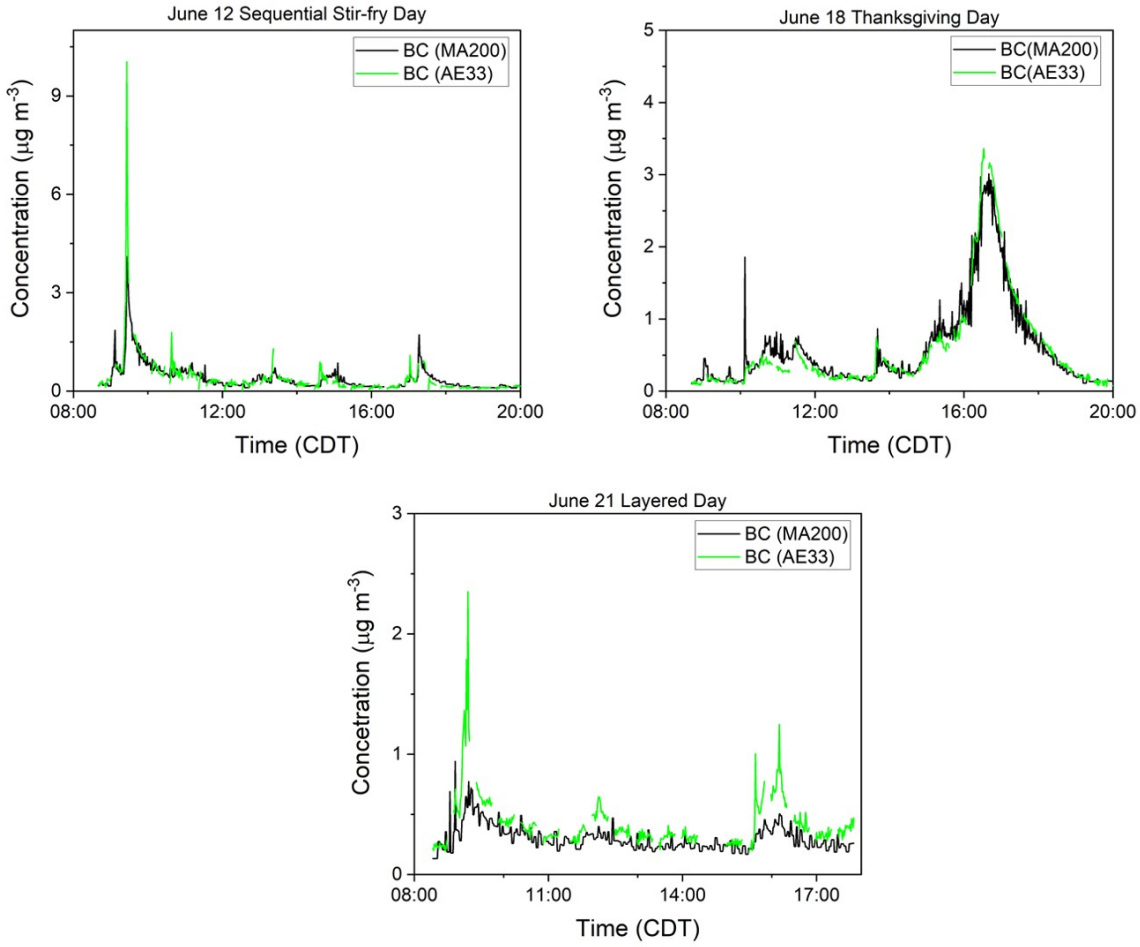

Fig. S6. Intercomparisons between MA200 and ModelAE33 for BC concentrations on different experimental days.

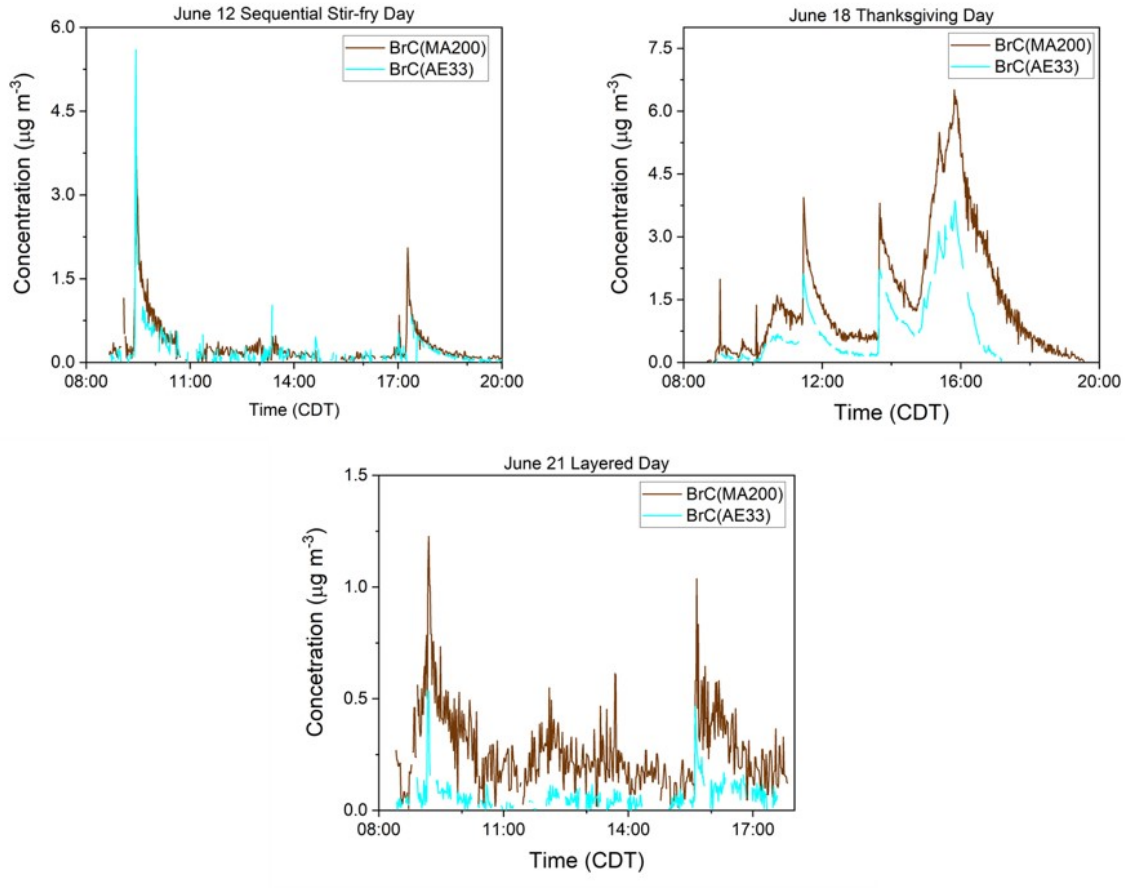

Fig. S7. Intercomparisons between MA200 and ModelAE33 for BrC concentrations on different experimental days.

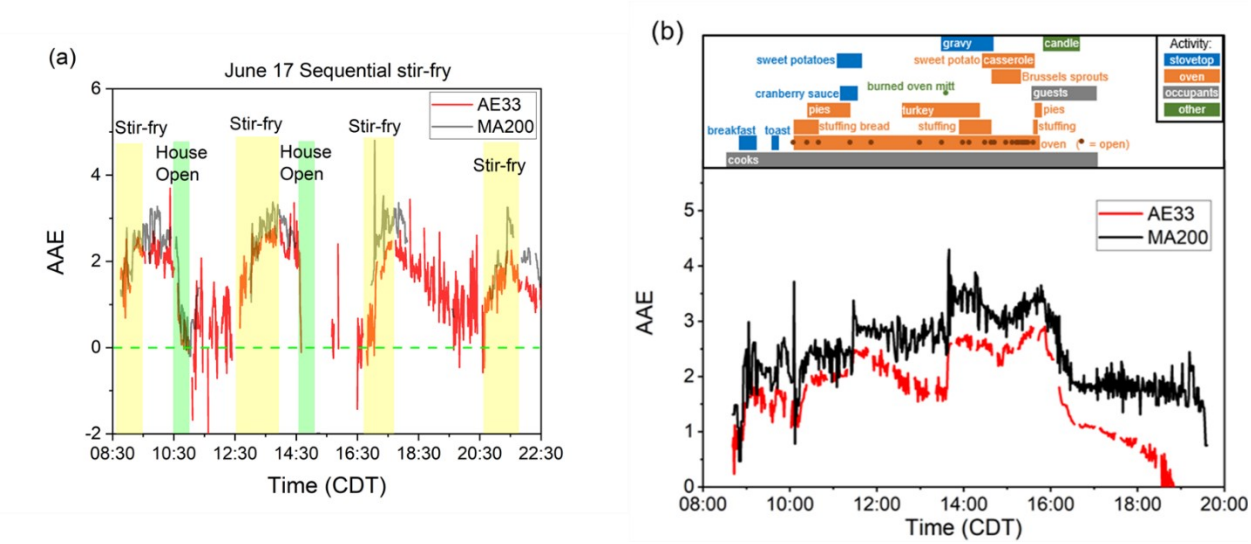

Fig. S8. AAE data intercomparisons between MA200 and ModelAE33 aethalometers for (a) June 17 Sequential Stir-fry Day and (b) June 18 Thanksgiving Day.

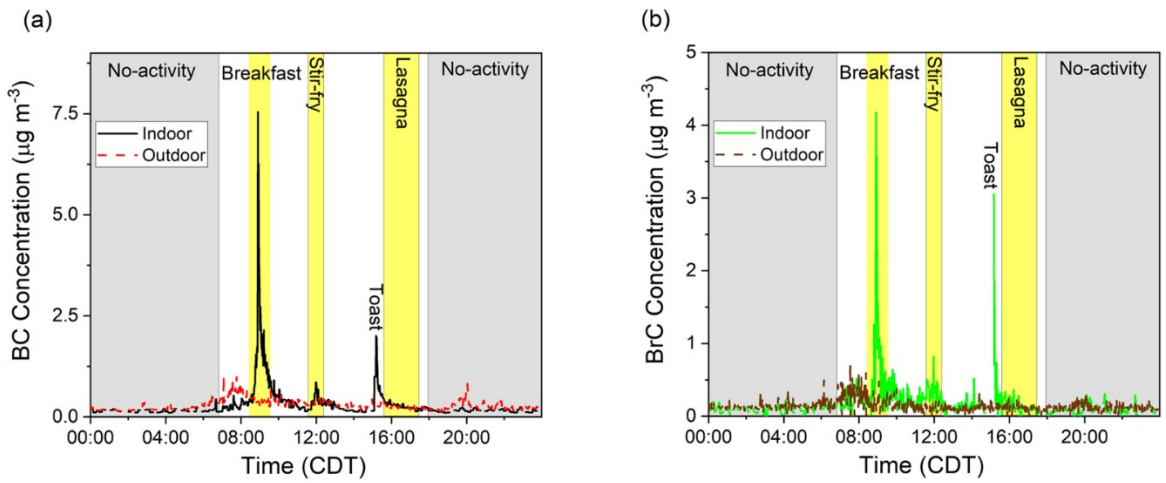

Fig. S9. Temporal variability of BC and BrC concentrations on June 8th Layered Day.

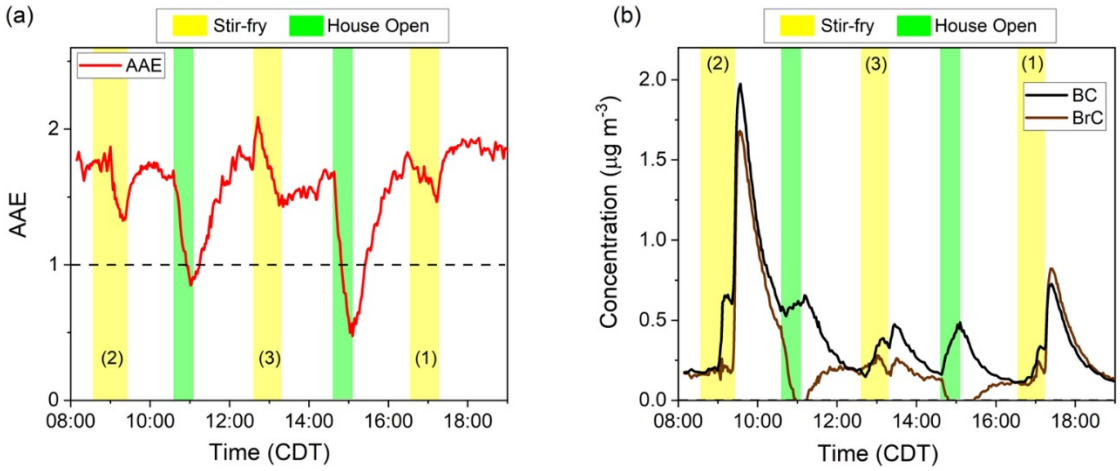

Fig. S10. Sequential Stir-fry Day (June 12): (a) the AAE time series; (b) the time series of BC and BrC concentrations throughout the day. Data are smoothed using a 10-minute moving average. (1) represents stir-fry cooked on a gas stove in a stainless-steel wok, (2) represents stir-fry cooked on an electric hot plate (medium setting) in a stainless-steel wok and (3) represents stir-fry meal cooked on a gas stove in a cast-iron pan.

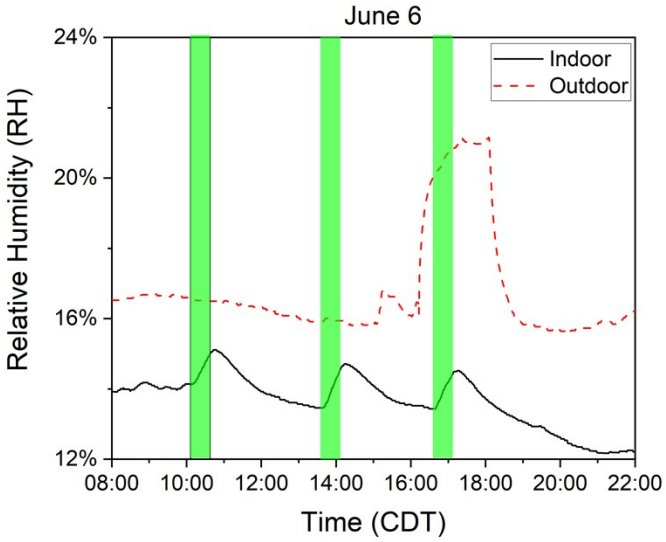

Fig. S11. Sample RH as measured by the aethalometer internal sensors on the June 6th Sequential Stir-fry Day. House open periods are highlighted in green.

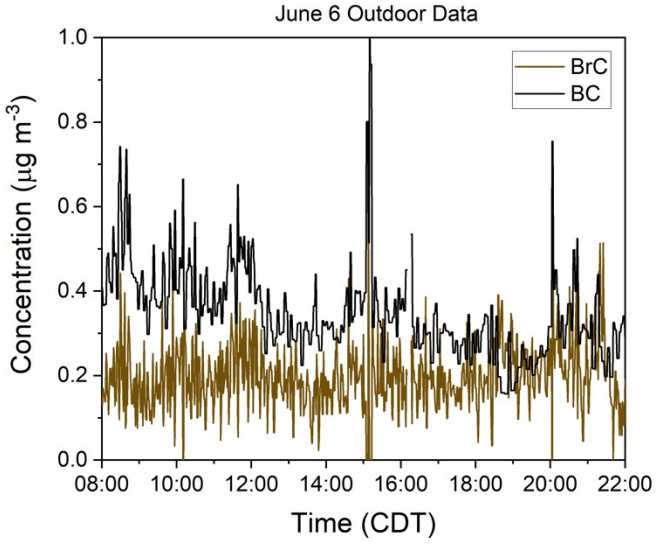

Fig S12. Outdoor BC and BrC concentrations as measured by the outdoor aethalometer on the June 6th Sequential Stir-Fry Day.

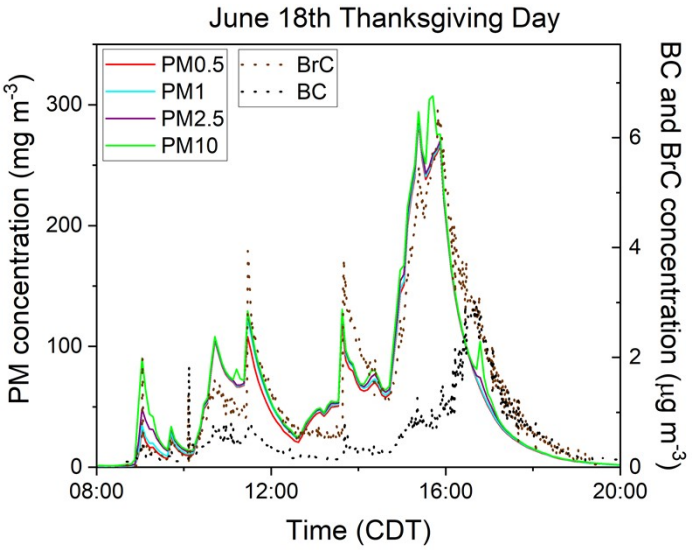

Fig. S13. BC and BrC time series comparison with size-resolved PM concentrations on June 18th Thanksgiving Day.