Characterization of the light absorbing properties, chromophores composition and sources of brown carbon aerosol in Xi'an, Northwest China

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Table S1. List of target compounds and their abbreviations measured in this study.

Compounds	Abbreviation
PAHs	
Fluoranthene	FLU
Pyrene	PYR
Chrysene	CHR
Benzo(a)anthracene	BaA
Benzo(a)pyrene	BaP
Benzo(b)fluoranthene	BbF
Benzo(k)fluoranthene	BkF
Indeno[1,2,3-cd]pyrene	IcdP
Benzo(ghi)perylene	BghiP
9,10-Anthracenequinone	9,10AQ
Benzanthrone	BEN
Benzo[b]fluoren-11-One	BbF11O
Picene	PI
MOPs	
Syringyl Acetone	SyA
Vanillin	VAN
Vanillic Acid	VaA
NACs	
4-Nitrophenol	4NP
4-Nitro-1-Naphthol	4N1N
2-Methyl-4-Nitrophenol	2M4NP
3-Methyl-4-Nitrophenol	3M4NP
2,6-Dimethyl-4-Nitropheol	2,6DM4NP
4-Nitrocatechol	4NC
3-Methyl-5-Nitrocatechol	3M5NC
4-Methyl-5-Nitrocatechol	4M5NC
3-Nitrosalicylic Acid	3NSA
5-Nitrosalicylic Acid	5NSA
Hopanes	
17α(H),21β(H)-30-Norhopane	HP1
17α(H),21β(H)-Hopane	HP2
17α(H),21β(H)-(22S)-Homohopane	HP3
17α(H),21β(H)-(22R)-Homohopane	HP4
Others	
Levoglucosan	LEV
Phthalic Acid	*o*-ph

Table S2. *F* matrix elements constrained in the ME-2/chemical species 4 factors solution. The profiles are normalized to the $Abs_{365,MSOC}$. The 0 value denote the $f_{h,j}$ values constrained in ME-2c, while hyphens denote unconstrained elements.

Species	Secondary Formation	Biomass burning	Coal Burning	Vehicle emission
$Abs_{365,MSOC}$	-	-	-	-
o-ph	-	0	0	0
HP1	0	0	-	-
HP2	0	0	-	-
HP3	0	0	-	-
HP4	0	0	-	-
PI	0	-	-	-
FLU	0	-	-	-
PYR	0	-	-	-
CHR	0	-	-	-
BaA	0	-	-	-
BaP	0	-	-	-
BbF	0	-	-	-
BkF	0	-	-	-
IcdP	0	-	-	-
BghiP	0	-	-	-
9,10AQ	-	-	-	-
BEN	-	-	-	-
BbF11O	-	-	-	-
LEV	0	-	0	0
VaA	0	-	0	0
VAN	0	-	0	0
SyA	0	-	0	0

Table S3. Seasonal mean and standard deviation (value in bracket) of measured parameters in this study.

	OC ($\mu gC\ m^{-3}$)	WSOC ($\mu gC\ m^{-3}$)	$Abs_{365,MSOC}$ (Mm^{-1})	$Abs_{365,WSOC}$ (Mm^{-1})	$MAE_{365,WSOC}$ ($m^2\ gC^{-1}$)	$MAE_{365,MSOC}$ ($m^2\ gC^{-1}$)	AAE_{MSOC}	AAE_{WSOC}	WSOC/OC	$Abs_{365,WSOC}$/$Abs_{365,MSOC}$
Spring	6.48(3.35)	2.78(0.81)	4.73(1.63)	2.75(1.03)	1.01(0.31)	0.79(0.22)	4.75(0.39)	5.74(0.39)	0.47(0.15)	0.60(0.18)
Summer	3.36(1.08)	2.22(0.81)	4.05(2.08)	1.89(0.68)	0.91(0.30)	1.21(0.46)	4.59(0.62)	6.15(0.49)	0.66(0.16)	0.52(0.16)
Fall	11.10(6.58)	5.69(2.53)	15.41(7.47)	6.75(3.28)	1.18(0.16)	1.52(0.40)	4.45(0.42)	5.70(0.21)	0.57(0.14)	0.45(0.09)
Winter	22.63(10.60)	10.49(5.65)	34.42(18.39)	17.83(8.02)	1.85(0.48)	1.50(0.29)	5.18(0.23)	5.32(0.18)	0.45(0.10)	0.54(0.08)

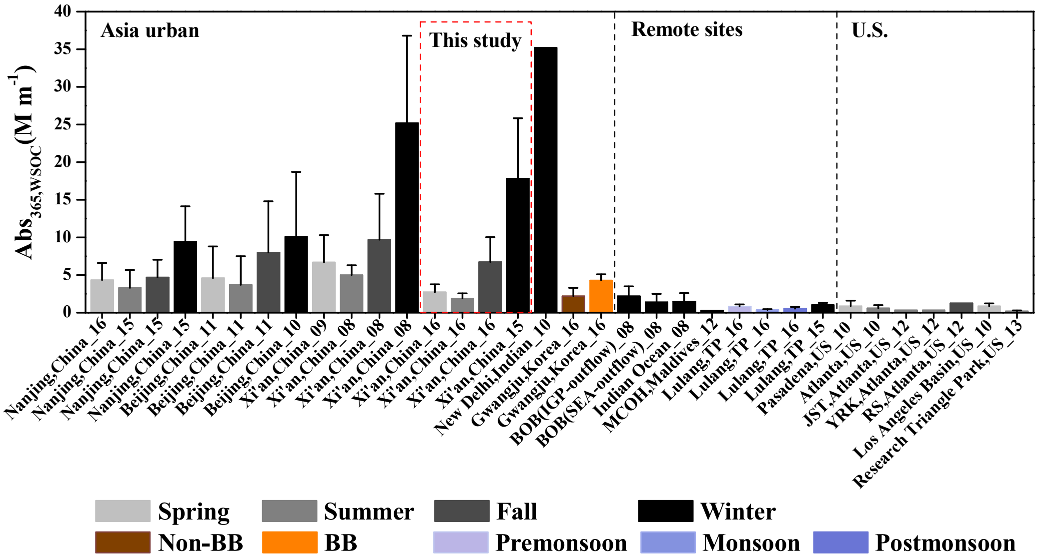

Figure S1. Comparison of $Abs_{365,WSOC}$ in Asia urban (Du et al., 2014; Kirillova et al., 2014; Chen et al., 2018; Huang et al., 2018; Park et al., 2018) , remote sites (Srinivas and Sarin, 2013; Bosch et al., 2014; Zhu et al., 2018) and the United States (Zhang et al., 2011; Liu et al., 2013; Zhang et al., 2013; Xie et al., 2019).

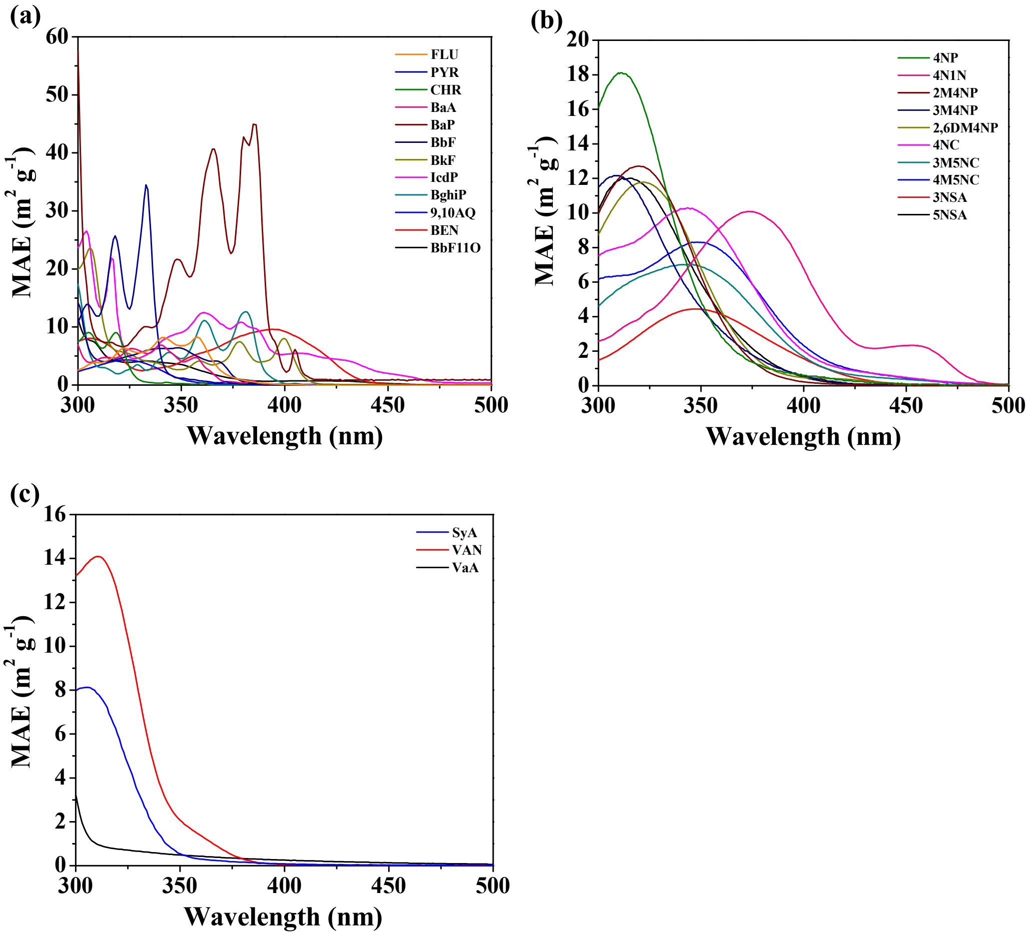

Figure S2. MAE spectra of measured (a) PAHs, (b) NACs, and (c) MOPs at wavelength of 300-500 nm.

Calculation of light absorption contribution

Light absorption contribution of individual chromophore to methanol-soluble BrC at wavelength of λ ($Cont_{chr/BrC,\lambda}$) is calculation as following equation:

$$Cont_{chr/BrC,\lambda} = \frac{Conc_{chr} \times MAE_{chr,\lambda}}{Abs_{BrC,\lambda}} \quad (S1)$$

where $Conc_{chr}$ is the concentration of individual chromophore, $MAE_{chr,\lambda}$ represents the mass absorption efficiency (MAE) of individual chromophore at wavelength of λ nm and $Abs_{BrC,\lambda}$ is the light absorption coefficient of BrC at wavelength of λ nm.

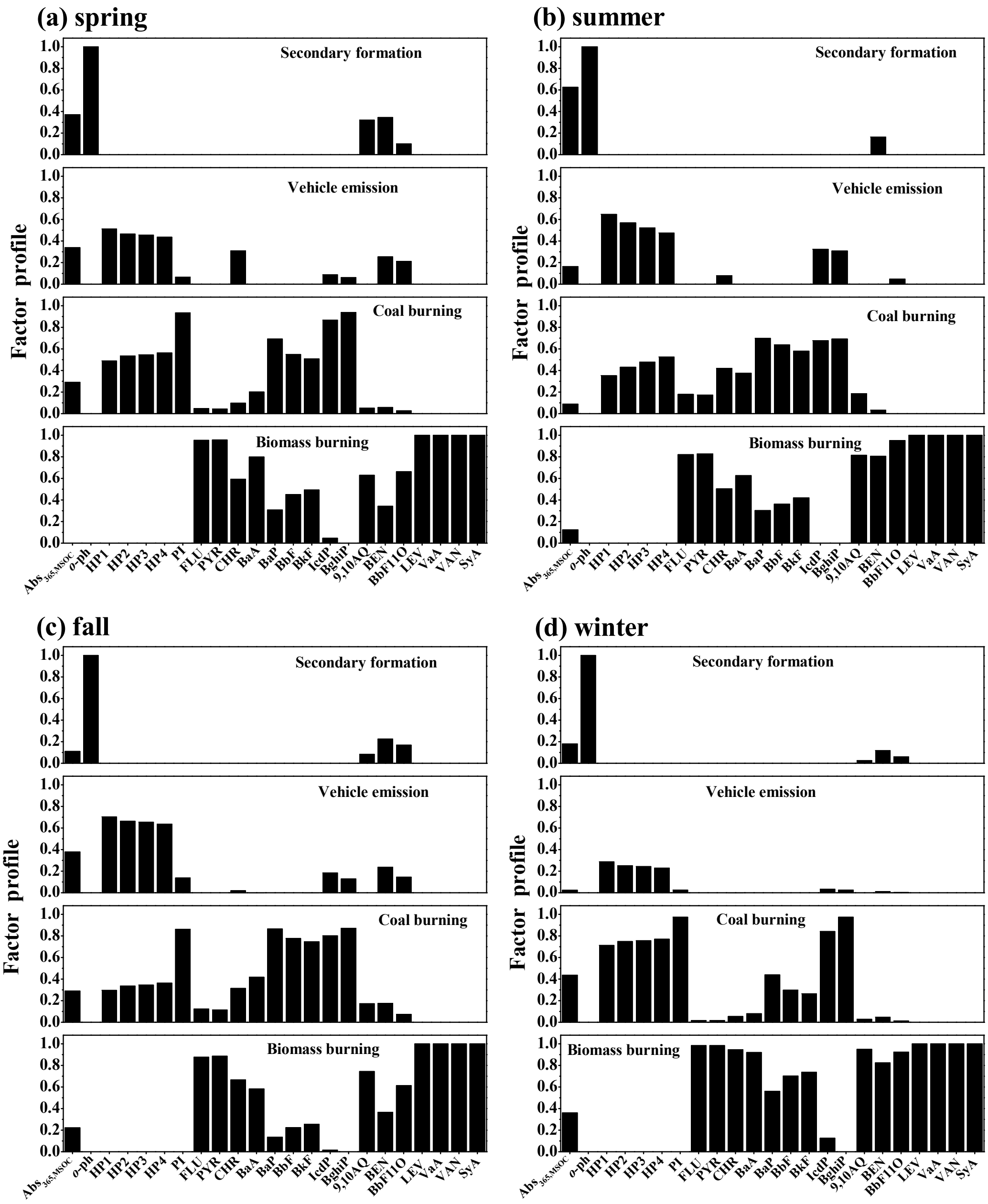

Figure S3. Factor profiles for the 4-factor solution in (a) spring, (b) summer, (c) fall, and (d) winter.

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