Supplement for

Amplification of black carbon light absorption induced by atmospheric aging: temporal variation at seasonal and diel scales in urban Guangzhou

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This supplement contains 3 tables and 16 figures.

Table S1. Grouping criteria of EC-containing particles data from SPAMS used in this study. EC-containing particles were defined by the criteria shown below. Then EC-containing particles were further grouped into two categories, EC-fresh and EC-aged. EC-aged particles were extracted from EC-containing particles using the ion markers with the RPA thresholds listed below. The remaining EC-containing particles were defined as EC-fresh particles.

Species	m/z	Marker Ion	Peak Area	Relative Peak Area	Function
EC-containing	12	$[C]^+$	>50	>0.005	or
	24	$[C_2]^+$	>50	>0.005	or
	36	$[C_3]^+$	>50	>0.005	or
	48	$[C_4]^+$	>50	>0.005	or
	60	$[C_5]^+$	>50	>0.005	or
	-12	$[C]^-$	>50	>0.005	or
	-24	$[C_2]^-$	>50	>0.005	or
	-36	$[C_3]^-$	>50	>0.005	or
	-48	$[C_4]^-$	>50	>0.005	or
	-60	$[C_5]^-$	>50	>0.005	or
EC-aged	27	$[C_2H_3]^+$	>50	>0.005	or
	37	$[C_3H]^+$	>50	>0.005	or
	43	$[C_2H_3O]^+$	>50	>0.005	or
	-46	$[NO_2]^-$	>100	>0.05	or
	-62	$[NO_3]^-$	>100	>0.05	or
	-97	$[HSO_4]^-$	>100	>0.05	or

Table S2. SPAMS measurement statistics in this study.

Season	Single particle classes	number count	number fraction
Wet season	mass particles	327453	100%
	EC-containing	120351	36.75%
	EC-fresh	10919	3.33%
	EC-aged	109432	33.42%
Dry season	mass particles	2212688	100%
	EC-containing	595180	26.90%
	EC-fresh	55940	2.53%
	EC-aged	539240	24.37%

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Table S3. Spectral optical properties of BC between wet and dry seasons.

wavelength (nm)		370	470	520	590	660	880	950
MAE_p ($m^2\ g^{-1}$)	wet season	14.2	10.2	8.6	7.46	6.36	4.51	4.3
	dry season	28.7	20.1	16.8	14.4	12.3	8.61	8.18
E_{abs}	wet season mean	1.55	1.51	1.51	1.51	1.51	1.51	1.50
	wet season S.D.	0.53	0.51	0.50	0.50	0.50	0.49	0.49
	dry season mean	1.35	1.29	1.29	1.24	1.29	1.29	1.29
	dry season S.D.	0.34	0.29	0.28	0.19	0.27	0.27	0.27
σ_{abs} (Mm^{-1})	wet season mean	39.18	27.90	23.62	20.44	17.39	12.25	11.64
	wet season S.D.	18.98	13.42	11.27	9.74	8.28	5.87	5.59
	dry season mean	95.38	65.35	54.56	37.61	39.67	27.55	26.14
	dry season S.D.	62.02	42.74	35.71	33.05	26.08	18.26	17.36
k	wet season mean	0.0072	0.0076	0.0078	0.0081	0.0081	0.0075	0.0074
	wet season S.D.	0.0004	0.0005	0.0006	0.0007	0.0009	0.0016	0.0018
	dry season mean	0.0066	0.0072	0.0072	0.0075	0.0072	0.0072	0.0072
	dry season S.D.	0.0013	0.0018	0.0018	0.0020	0.0037	0.0037	0.0039

Figure S1. Location of the sampling site. (a) Map of PRD region. (b) City map around JNU. The dash line in red indicates the area of JNU campus in the downtown of Guangzhou. (c) The JNU library building. (d) JNU super site

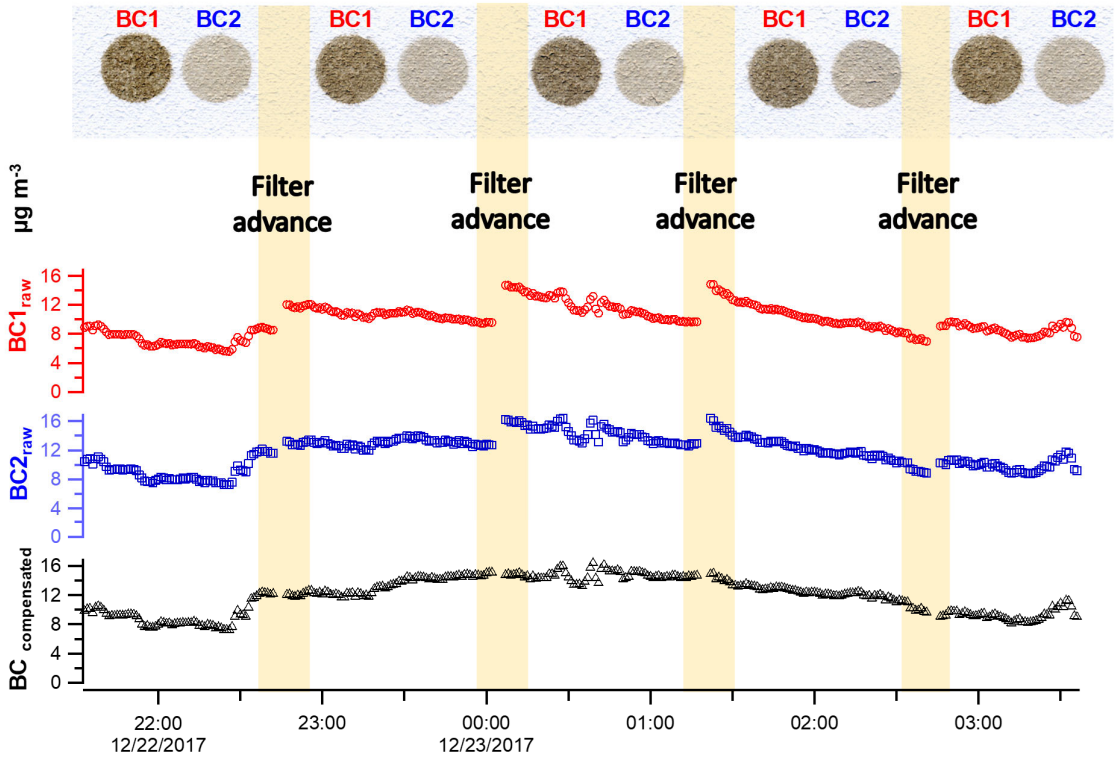

Figure S2. Example of dual-spot data correction. The photo in the upper panel shows the actual appearance of aerosol-laden filter tape used by the AE33 aethalometer. Two spots were used for sample collection during each sampling cycle. The BC1 spot was sampled with a higher flow rate, thus leads to more BC particles deposition, with a darker appearance than the BC2 spot. The panel below shows the raw data from BC1 spot (in red) and from BC2 spot (in blue). The corrected BC is shown in black.

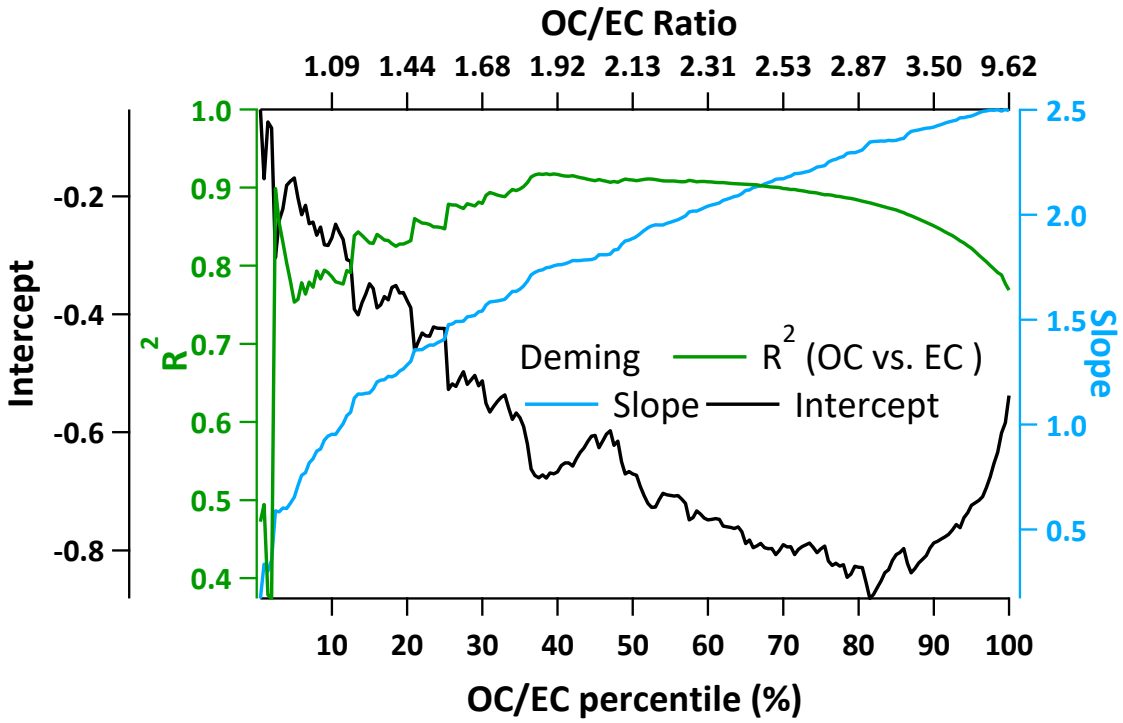

Figure S3. Slope and intercept by orthogonal distance regressions (WODR) as a function of OC/EC percentile from 1 to 100%. The blue curve represents the WODR slope of the corresponding percentile subset. The green curve represents R^2(OC, EC) of the corresponding percentile subset. The black line represents the intercept of the WODR from the corresponding percentile subset (1-100%). The error bars on each curve represents the uncertainty (±1sd) of slope or intercept.

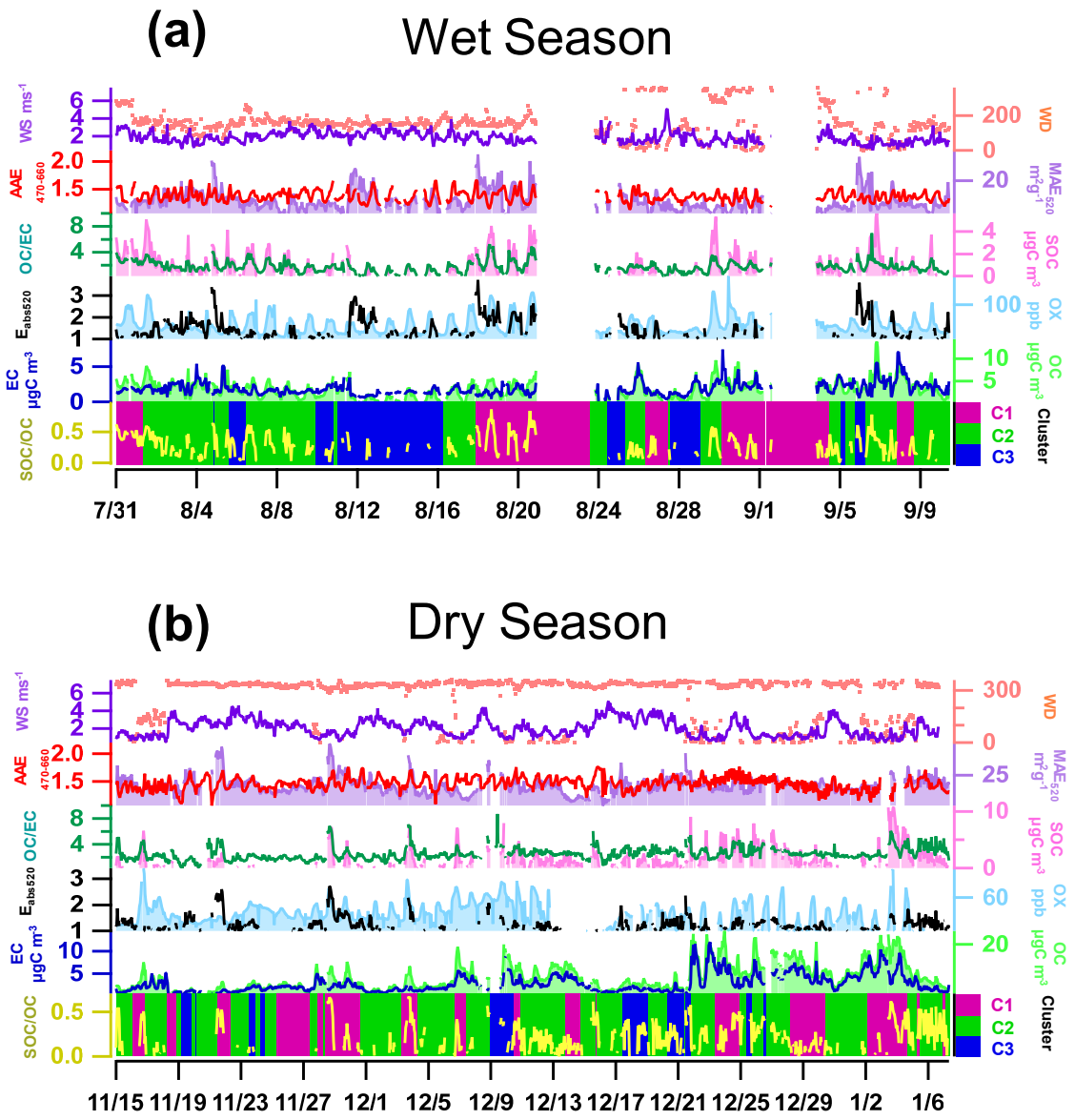

Figure S4. Time series of optical properties and meteorological factors during the two sampling periods. (a) Wet season. (b) Dry season.

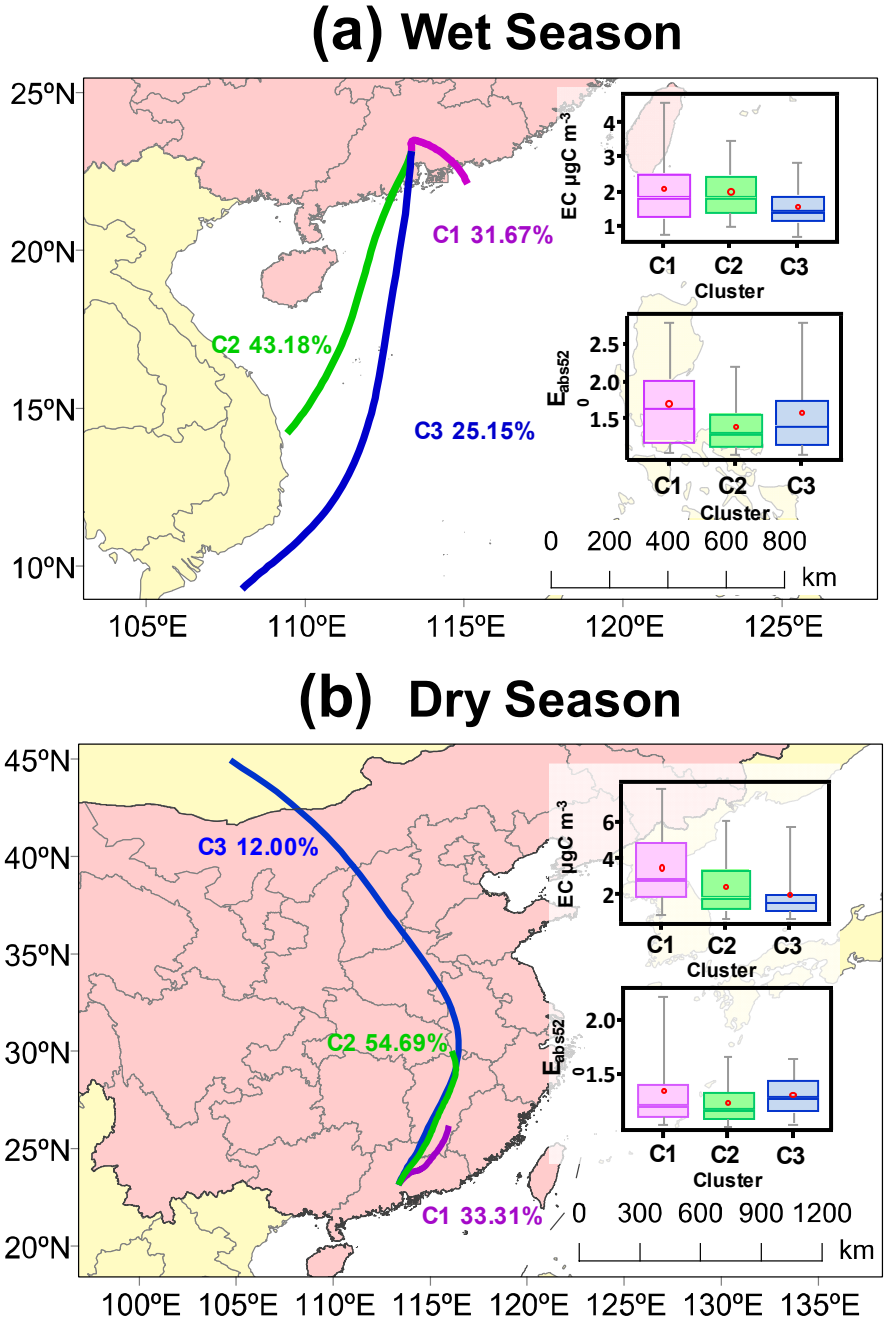

Figure S5. Cluster analysis of back trajectories with EC and E_{abs}. (a) wet season. (b) dry season.

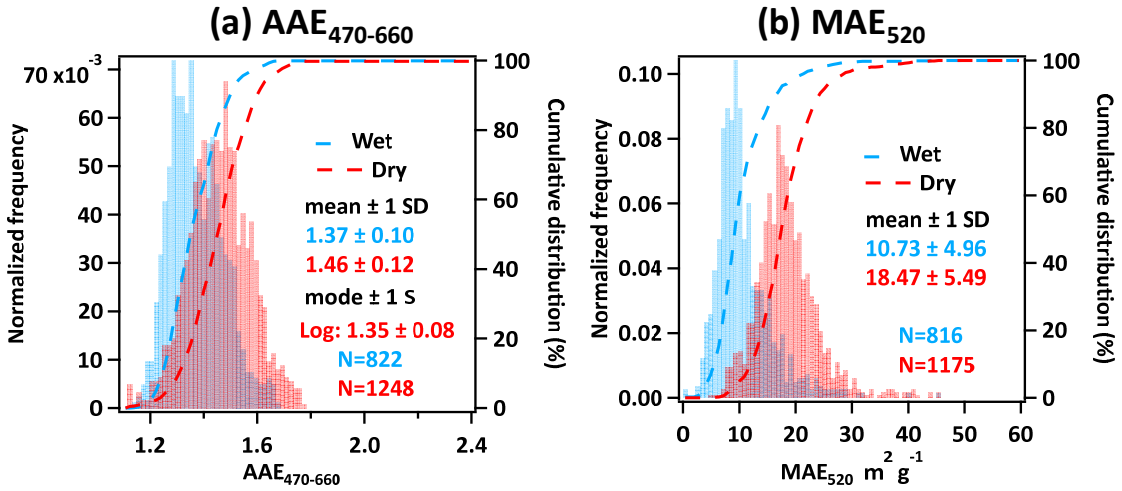

Figure S6. Distribution of $AAE_{470\text{-}660}$ and MAE_{520} in wet and dry seasons.

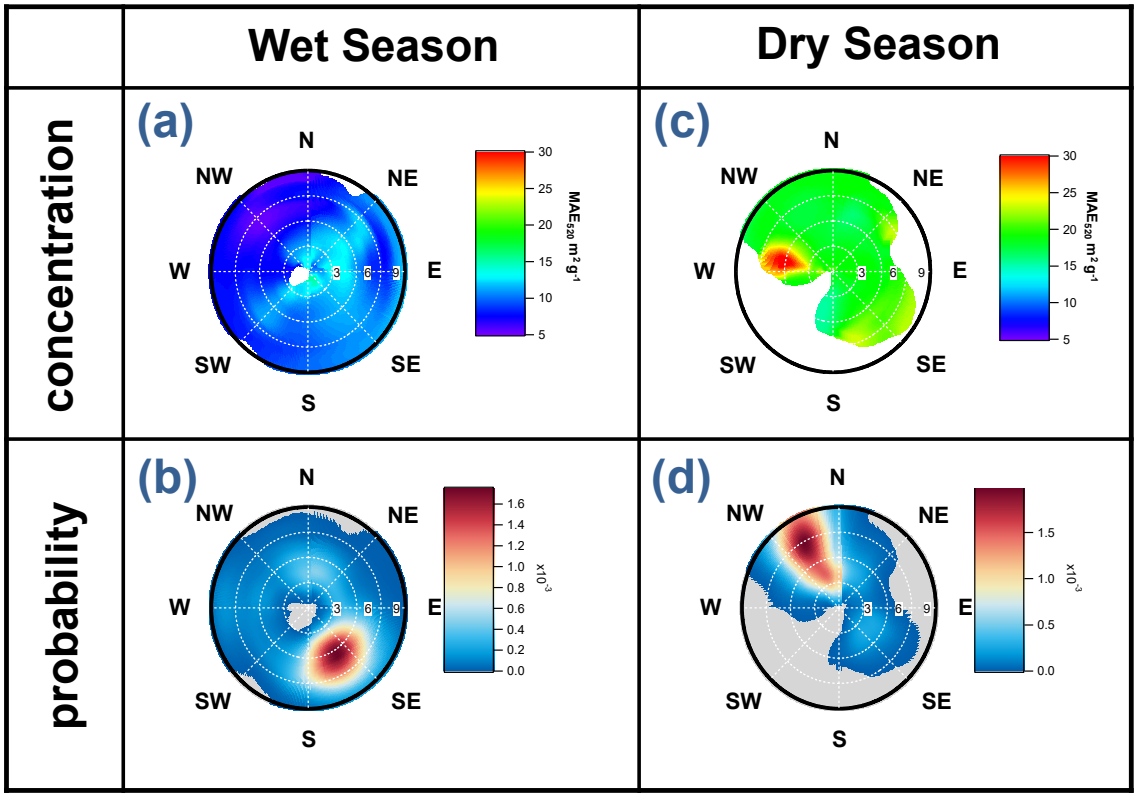

Figure S7. Wind-rose plots that were generated using ZeFir (Petit et al., 2017). The left column shows the distributions of MAE_{520} as a function of wind speed and wind direction, where the color represents the value of MAE_{520} at the corresponding wind speed and wind direction. The right column shows the probability of wind arising from the given wind direction, where the color represents probability.

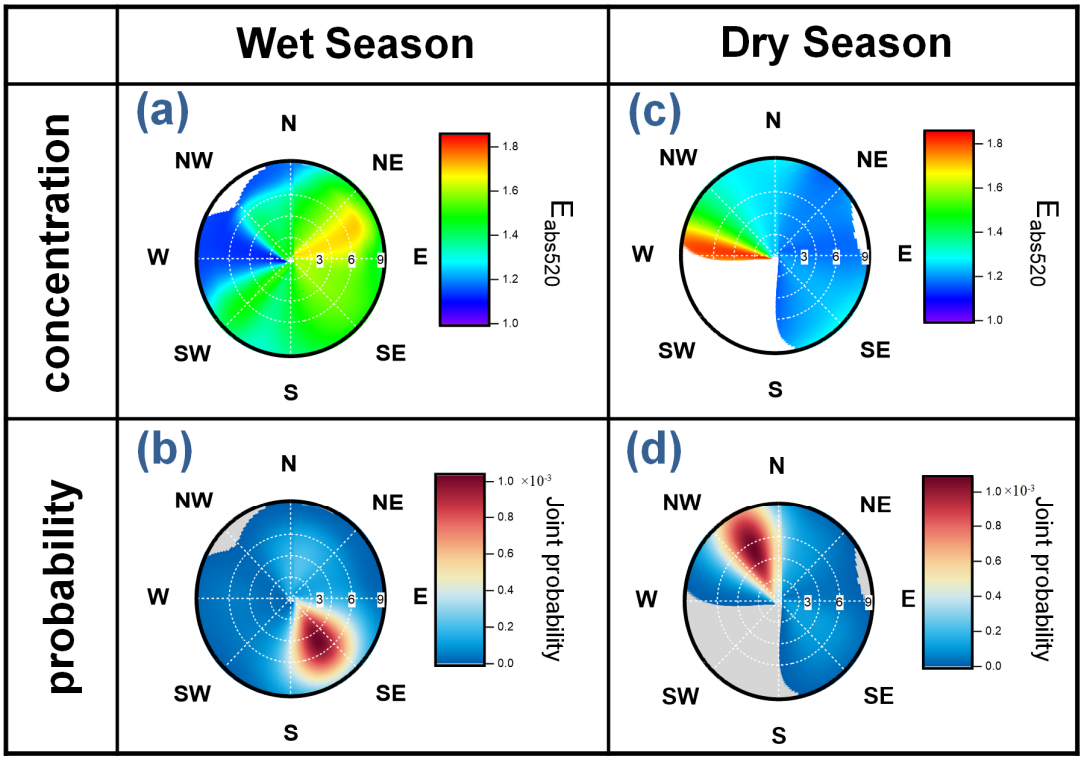

Figure S8. Wind rose plot of $Eabs_{520}$ in wet and dry seasons.

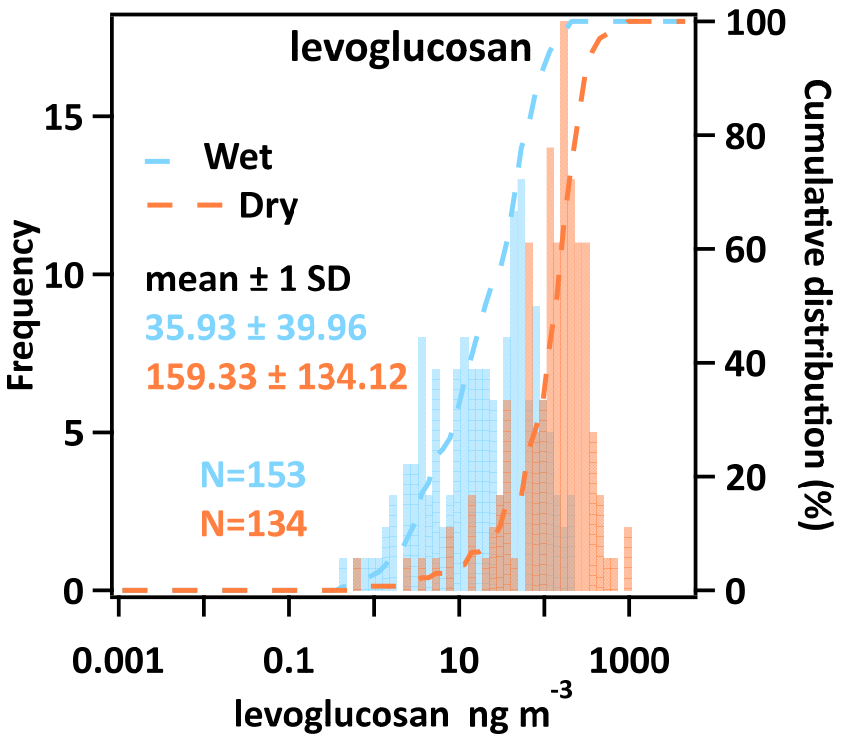

Figure S9. Levoglucosan concentrations measured in Guangzhou during wet and dry season during 2009-2012.

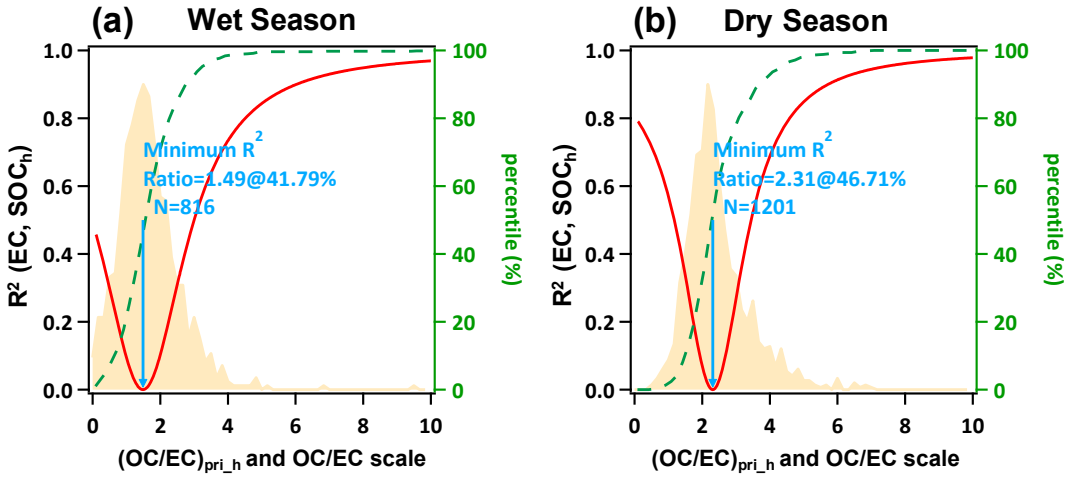

Figure S10. $(OC/EC)_{pri}$ determined by MRS in dry and wet seasons.

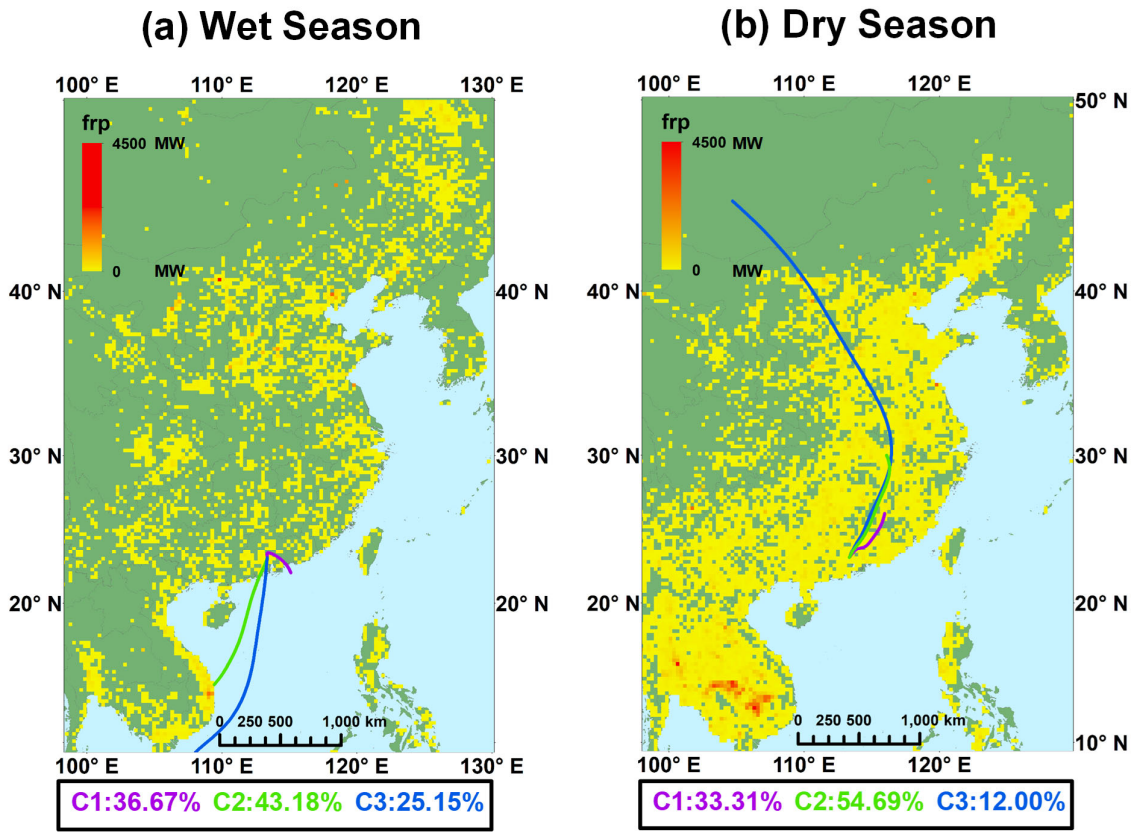

Figure S11. Gridded accumulated fire radiative power (FRP) in MW (megawatts) determined by Visible Infrared Imaging Radiometer Suite (VIIRS) from NASA FIRMS application (https://firms.modaps.eosdis.nasa.gov/). Back trajectories clusters analysis results were also plotted overplayed. (a) wet season. (b) dry season.

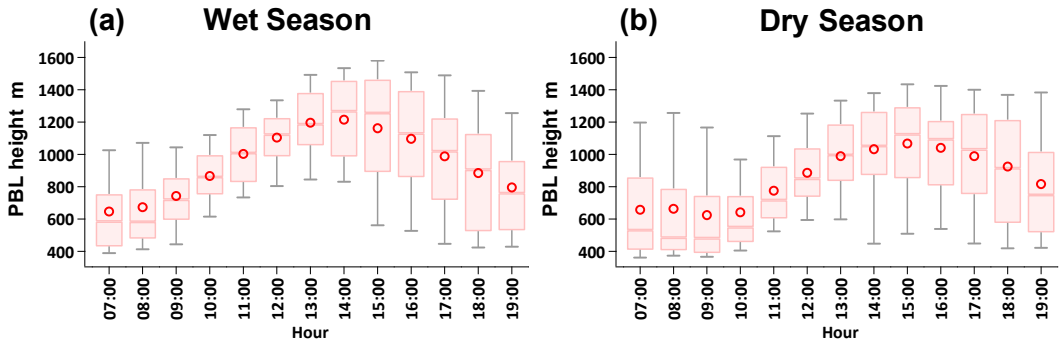

Figure S12. Diurnal patterns of planetary boundary layer height (PBLH) were determined by lidar at the Guangzhou Meteorological Bureau (GMB, 23.00° N, 113.32° E, elevation: 43 m) during September 2013 to November 2014. Red circles represent the hourly averages. The line inside the box indicates the hourly median. Upper and lower boundaries of the box represent the 75th and the 25th percentiles; the whiskers above and below each box represent the 95th and 5th percentiles.

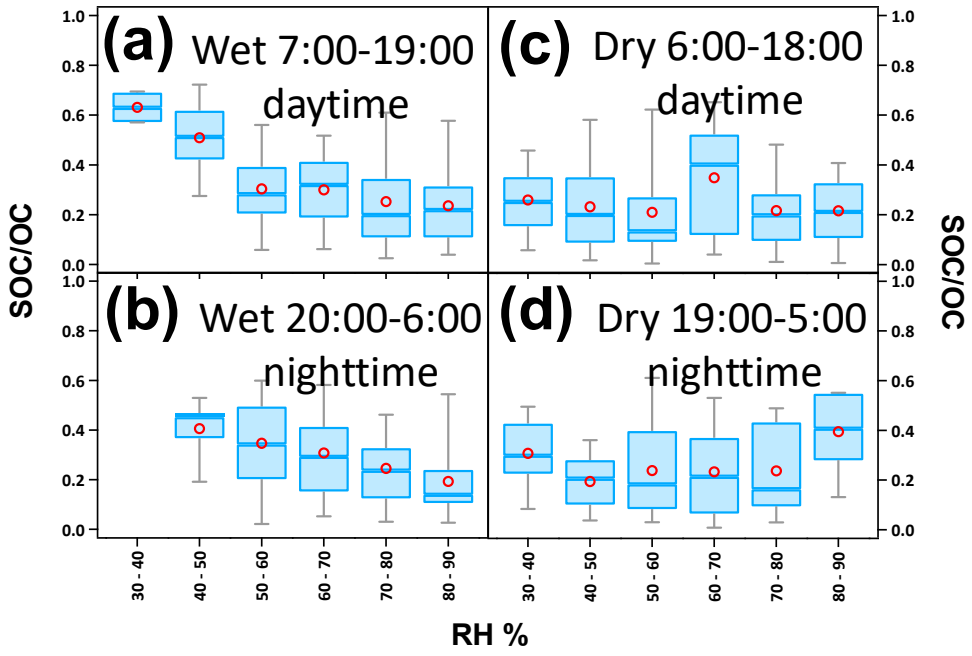

Figure S13. SOC/OC dependency on RH in wet and dry seasons. Red circles represent the average values. The line inside the box indicates the hourly median. Upper and lower boundaries of the box represent the 75th and the 25th percentiles; the whiskers above and below each box represent the 95th and 5th percentiles. (a) SOC/OC dependency on RH in wet season during daytime (7:00 - 19:00). (b) SOC/OC dependency on RH in wet season during nighttime (20:00 - 7:00). (c) same as (a) but for dry season. (d) same as (b) but for dry season.

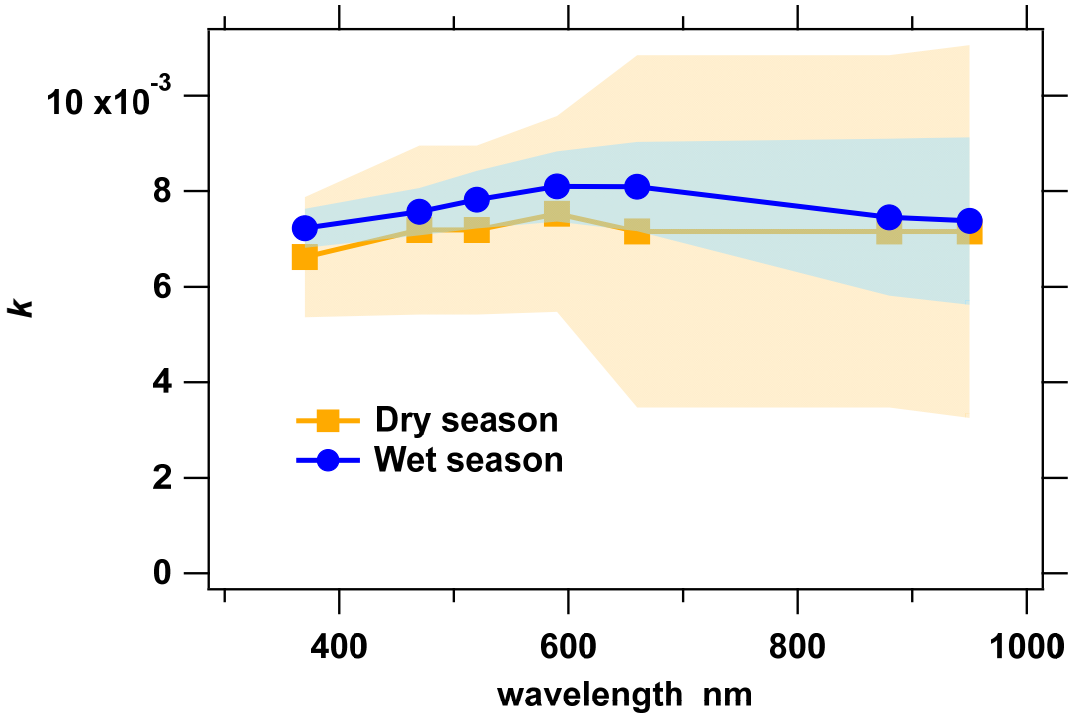

Figure S14. The spectral fingerprints of *k* between wet and dry season.

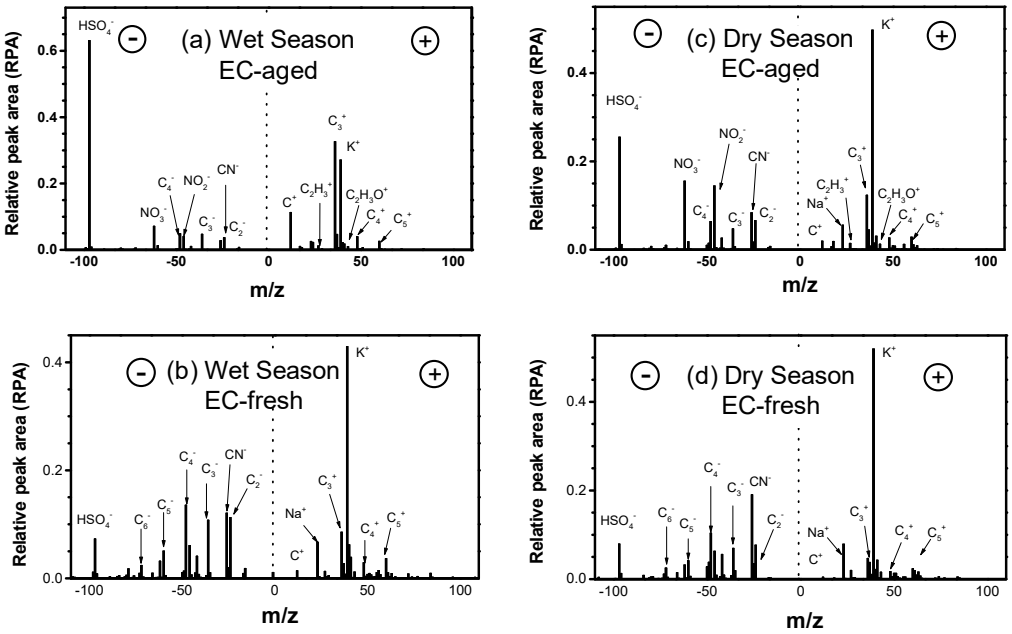

Figure S15. EC-containing particles measured by SPAMS in wet and dry season. Positive and negative mass spectra were shown in the relative peak area (RPA) scale. (a) Average mass spectra of EC-aged particles in wet season. (b) Average mass spectra of EC-fresh particles in wet season. (c) Average mass spectra of EC-aged particles in dry season. (d) Average mass spectra of EC-fresh particles in dry season.

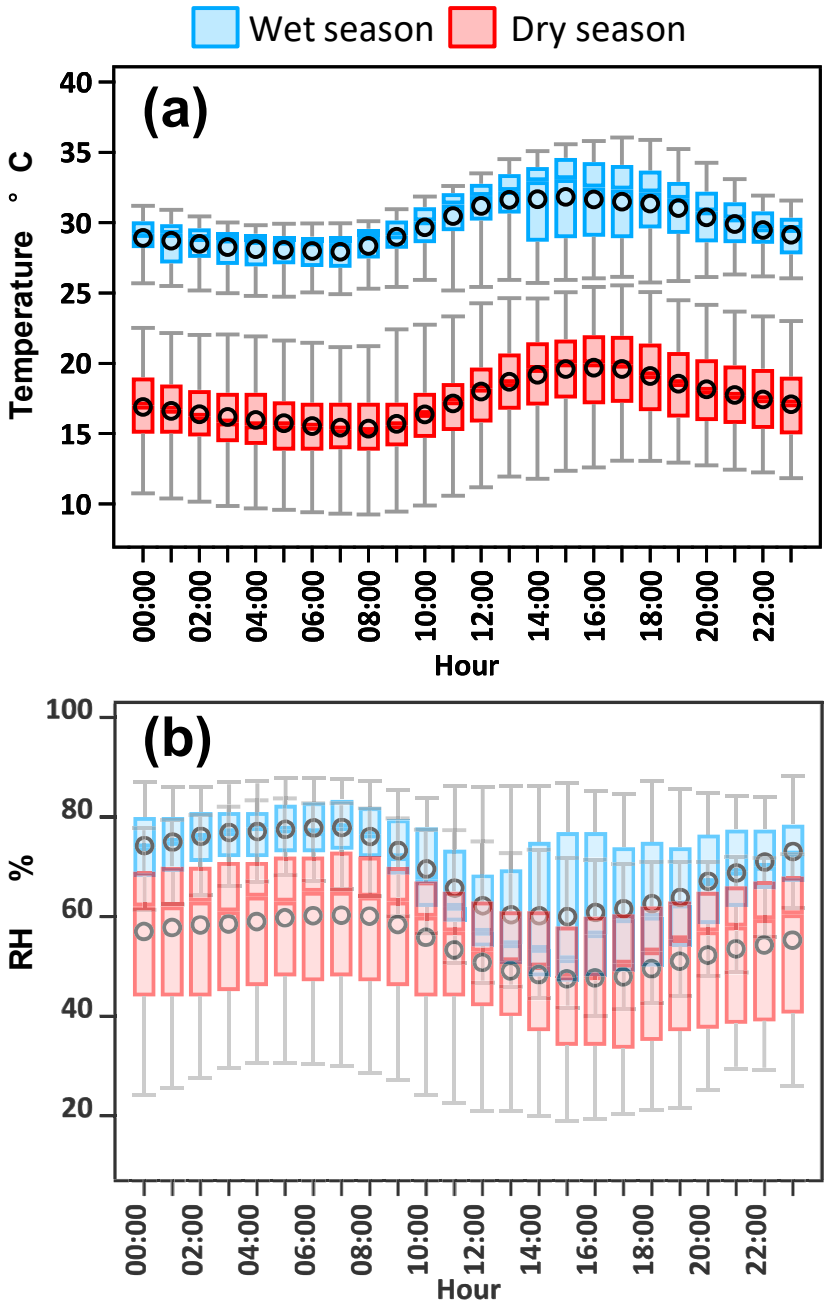

Figure S16. Diurnal variations of temperature and RH during wet and dry season.