



## Supplement of

## Sources and physicochemical characteristics of black carbon aerosol from the southeastern Tibetan Plateau: internal mixing enhances light absorption

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Location	Latitude	Longitude	Altitude (m a.s.l.)	Observation period	Method <sup>a</sup>	rBC/BC <sup>b</sup> (µg m <sup>-3</sup> )	Reference
Lulang	29.46	94.44	3300	SepOct. 2015	SP2	0.31	This study
Muztagh Ata	38.28	75.023	4500	Sep. 2009	Aeth.	0.16	Zhu et al., 2016
Qilian Shan	39.5	96.51	4214	May 2009–Mar. 2011	Aeth.	0.05	Zhao et al., 2012
Qinghai Lake	36.98	99.88	3200	Nov. 2012	SP2	0.16	Wang et al., 2015a
Waliguan	36.28	100.9	3816	OctNov. 1997/Jan. 1998	Aeth.	0.27	Ma et al., 2003
Beiluhe	34.85	92.94	4600	Nov. 2012–Feb. 2013	Aeth.	0.2	Wang M. et al., 2016
Hanle valley	32.78	78.96	4250	Aug. 2009–Jul. 2010	Aeth.	0.08	Babu et al., 2011
Nam Co	30.77	90.99	4730	SepDec. 2012	TOR	0.09	Wan et al., 2015
Everest	28.36	86.95	4276	2014–2016	TOR	0.15	Li et al., 2017
NCO-P	27.95	86.82	5079	Post-monsoon, 2006/2007	MAAP	0.14	Marinoni et al., 2010
Tengchong	25.01	98.3	1960	Apr.–May 2004	Aeth.	0.42	Engling et al., 2010
Ranwu	29.32	96.96	4600	Nov. 2012–Feb. 2013	Aeth.	0.41	Wang M. et al., 2016
Godavari	27.59	85.31	1600	JanDec. 2006	TOT	1.0	Stone et al., 2010
Manora Peak	29.4	79.5	1950	Dec. 2004	Aeth.	1.36	Pant et al., 2006
Mukteshwar	29.47	79.65	218	FebMar. 2014	SP2	1.0	Raatikainen et al., 2017

Table S1. Concentrations of black carbon (BC) at Lulang compared with other high-altitude stations on the Tibetan Plateau and Himalayas.

<sup>a</sup>SP2, Aeth., TOR, MAAP, and TOT represent single particle soot photometer, aethalometer, thermal-optical reflectance method, multi-angle absorption photometer, thermal-optical transmittance method, respectively.

<sup>b</sup>The term rBC is used exclusively in reference to SP2 measurements while BC more generally refers to measurements made with other techniques.



**Figure S1.** Mass and number size distributions of rBC for the campaign. The black line is the mono-modal lognormal fit to the data. In the vertical axes labels "M", "N", and "D" denote rBC mass, number, and void-free equivalent diameters (assuming 1.8 g cm<sup>-3</sup> density), respectively, and "arb.u." stands for arbitrary units.



**Figure S2.** Frequency distribution of the incandescence lag-times for  $\sim$ 10000 arbitraryselected ambient rBC particles. The vertical dashed line shows a lag-time of 2 µs, which can be used to distinguish thickly-coated rBC particles from uncoated or thinly-coated rBC.



**Figure S3.** Scattering and absorption calibration of the photoacoustic extinctiometer  $(PAX_{870})$ .



**Figure S4.** Scatter plot of light absorption coefficient measured with (b<sub>abs\_nafion</sub>) and without (b<sub>abs\_without nafion</sub>) Nafion dryer (MD-110-48S).



**Figure S5.** Frequency distribution of refractory black carbon (rBC) mass concentrations during the campaign.



**Figure S6.** Correlation between the mass concentrations of refractory black carbon (rBC) and total suspended particles (TSP) on 21 October and other sampling days.



**Figure S7.** (left panels) Terra MODIS true color images of haze clouds and (right panels) horizontal wind distributions 200 m above the ground at 08:00 local time (LT) during 20–23 October 2015. The Terra satellite passed over this region at ~10:30 LT. The red crosses mark the Lulang site.



**Figure S8.** Diurnal variations of refractory black carbon (rBC) on 21 October and with and without data from October 21.



**Figure S9.** Three-day air-mass trajectories calculated backwards in time for 08:00–10:00 (local time) on 21 October 2015.



Figure S10. Daily averaged refractory black carbon (rBC) mass concentrations versus precipitation amount.



**Figure S11.** Frequency distribution of refractory black carbon aerosol absorption enhancement at  $\lambda = 870$  nm. The black line is the mono-modal lognormal fit to the data



**Figure S12.** Mass median diameters (MMDs) versus number fraction of thickly-coated refractory black carbon particles ( $F_{rBC}$ ) and mass absorption cross section of uncoated rBC (MAC<sub>rBC,uncoated</sub>).