

## S1 Correction procedure for Aethalometer data

The Aethalometer data was corrected against MAAP data (Multi–Angle Absorption Photometer) to account for multiple scattering effects on the filter matrix. The time resolution of MAAP and Aethalometer was set to 1 s. First, the particulate light absorption coefficient  $b_{\text{abs}}$  was calculated for the MAAP using the following equation:

$$b_{\text{abs,MAAP}} [Mm^{-1}] = [BC_{\text{MAAP}}] \cdot 6.6 \frac{m^2}{g} \cdot 1.05 \quad (\text{S1})$$

Where  $[BC_{\text{MAAP}}]$  is the mass concentration of black carbon (BC) derived from the instrument,  $6.6 \text{ m}^2 \text{ g}^{-1}$  is the mass absorption cross-section (MAC) for ambient aerosol particles determined for the wavelength 670 nm. The factor 1.05 accounts for an adjustment to the correct instruments operating wavelength of 637 nm (Müller et al., 2011).

Accordingly, the particulate light absorption coefficient was calculated for the Aethalometer:

$$b_{\text{abs,Aetha}} = [BC_{\text{Aetha}}] \cdot \frac{MAC_{\lambda}}{C} \quad (\text{S2})$$

Where  $[BC_{\text{Aetha}}]$  is the mass concentration of BC derived from the instrument and  $C$  is a normalization factor. MAC values used for the Aethalometer are given in Table S2.

Since the MAAP operates at 637 nm  $b_{\text{abs, Aetha}}$  was interpolated to 637 nm using Eq. (S4). The AAE was calculated using the wavelength pair of 590 and 660 nm according to the following equation:

$$AAE = - \frac{\ln\left(\frac{b_{\text{abs,590}}}{b_{\text{abs,660}}}\right)}{\ln\left(\frac{590}{660}\right)} \quad (\text{S3})$$

Now  $b_{\text{abs,637}}$  can be calculated as follows:

$$b_{\text{abs,637}} = b_{\text{abs,590}} \cdot \left(\frac{637}{590}\right)^{-AAE} \quad (\text{S4})$$

When  $b_{\text{abs,637, Aetha}}$  is plotted against  $b_{\text{abs,MAAP}}$  the slope of the regression line corresponds to the correction factor  $C$ , that is 1.69 for the TROPOS (winter) campaign and 2.06 for the Waldstein (summer) campaign (see Fig. S1 and Fig. S2).

## S2 Figures and Tables

**Table S1.** Sampling times at the different measurement campaigns.

Measurement campaign	Sampling time given as local time	
Melpitz (summer + winter)	00:00–24:00	
	Day	Night
TROPOS (winter)	06:00–18:00	18:00–06:00
Waldstein (summer)	07:00–18:00	19:00–06:00
Xianghe (summer)	06:00–18:00	18:00–06:00
Wangdu (summer)	06:00–18:00	18:00–06:00

**Table S2.** Mass absorption cross–sections (MAC) for ambient aerosol at a given wavelength  $\lambda$  used to calculate the particulate light absorption coefficient  $b_{\text{abs}}$  from Aethalometer data (Drinovec et al., 2015).

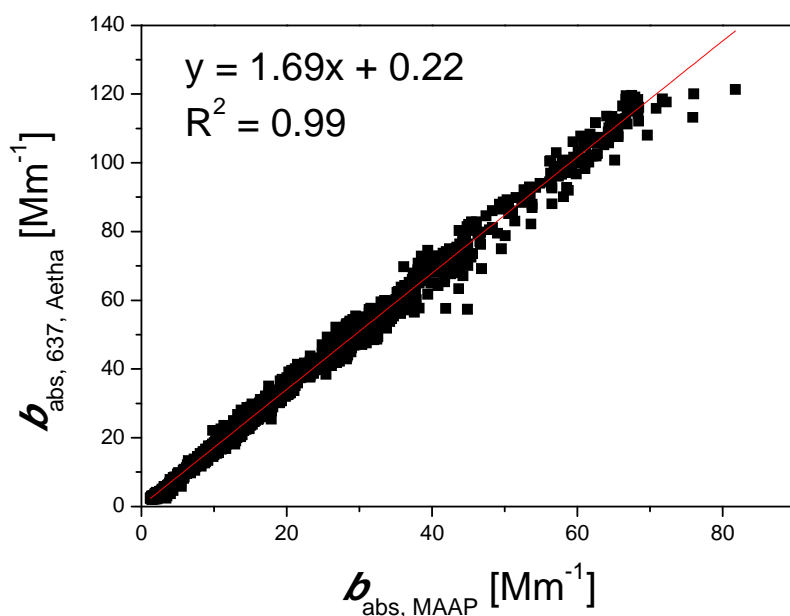
$\lambda$ [nm]	370	470	525	590	660	880	940
MAC [ $\text{m}^2 \text{ g}^{-1}$ ]	18.47	14.54	13.14	11.58	9.89	7.77	7.19

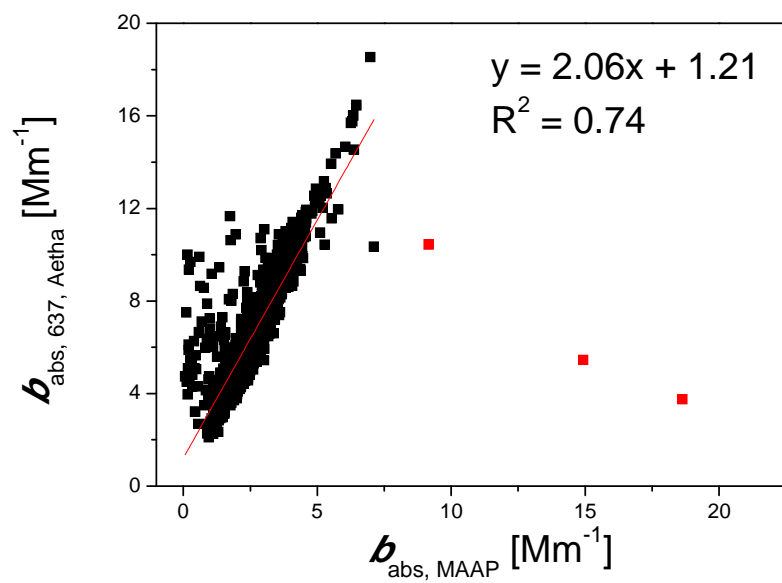
**Table S3.** Molar extinction coefficients determined under acidic and alkaline conditions (in  $M^{-1} cm^{-1}$ ).

Compound	$\epsilon_{370}$ pH $\approx$ 2	$\epsilon_{370}$ pH $\approx$ 10
3NSA	2509	2948
5NSA	1349	2271
4NP	1653	12243
2M4NP	3061	7673
3M4NP	2105	11408
2,6DM4NP	1575	1916
2,4DNP	1239	14075
3,4DNP	1650	8521

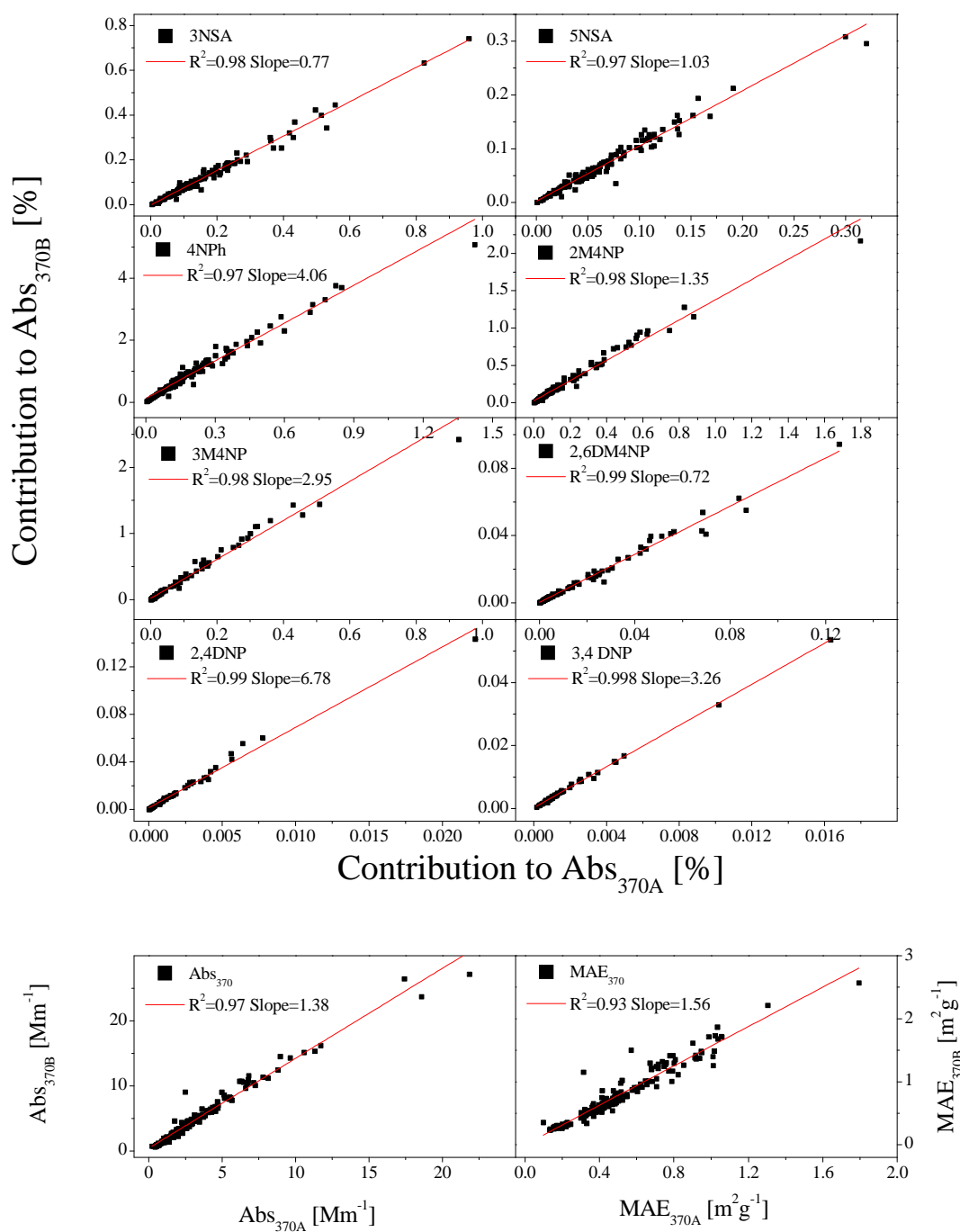
**Table S4.** Chemical parameters for each campaign. The concentrations are given as: minimum-maximum (mean $\pm$ standard deviation)

	Waldstein (summer)	Melpitz (summer)	TROPOS (winter)	Melpitz (winter)	Xianghe (summer)	Wangdu (summer)
PM 10 [ $\mu g m^{-3}$ ]	11.1-24.4 (17.3 $\pm$ 3.92)	18.7-41.0 (26.3 $\pm$ 6.57)	6.35-85.8 (40.9 $\pm$ 21.2)	23.8-67.6 (40.6 $\pm$ 13.5)	19.7-297 (118 $\pm$ 59.7)	18.8-143 (63.4 $\pm$ 27.8)
OC [ $\mu g m^{-3}$ ]	2.68-6.57 (4.63 $\pm$ 0.95)	4.45-9.71 (6.38 $\pm$ 1.58)	1.56-25.3 (10.6 $\pm$ 6.32)	4.97-23.0 (12.6 $\pm$ 6.15)	5.51-29.6 (13.9 $\pm$ 5.39)	7.09-48.9 (17.8 $\pm$ 8.91)
EC [ $\mu g m^{-3}$ ]	0.15-0.42 (0.24 $\pm$ 0.07)	0.24-0.46 (0.35 $\pm$ 0.08)	0.29-3.31 (1.53 $\pm$ 0.69)	0.60-2.02 (1.30 $\pm$ 0.54)	0.86-7.01 (3.07 $\pm$ 1.44)	1.06-9.37 (3.55 $\pm$ 1.73)
WSOC [ $\mu g m^{-3}$ ]	2.06-4.53 (3.05 $\pm$ 0.63)	2.20-6.09 (3.92 $\pm$ 1.26)	0.80-8.64 (4.39 $\pm$ 2.26)	2.64-7.02 (4.65 $\pm$ 1.56)	2.08-10.03 (5.21 $\pm$ 1.84)	2.53-23.6 (7.80 $\pm$ 4.67)
Levogluconan [ $\mu g m^{-3}$ ]			0.05-1.02 (0.46 $\pm$ 0.24)		0.01-0.38 (0.12 $\pm$ 0.08)	0.03-2.01 (0.29 $\pm$ 0.41)

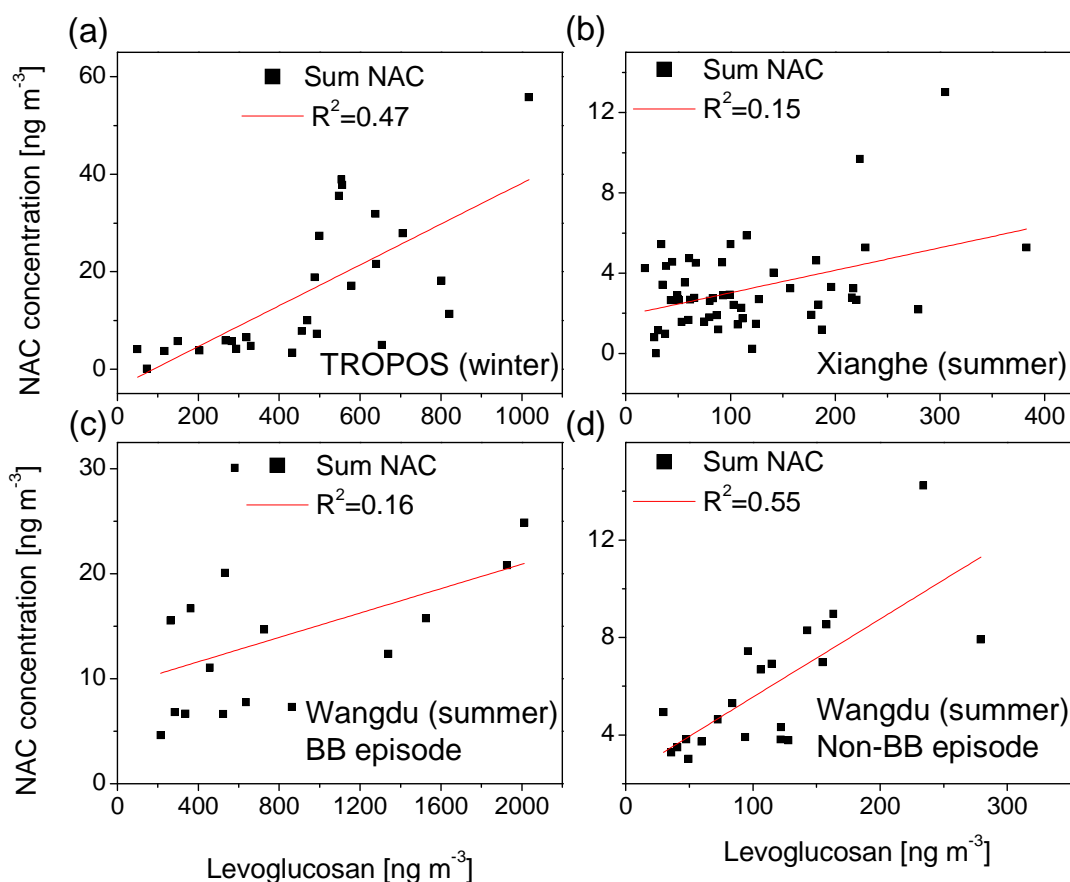
**Figure S1.** Correlation plot of the particulate light absorption coefficient derived from the Aethalometer at 637 nm ( $b_{abs,637,Aetha}$ ) and the particulate light absorption coefficient derived from the MAAP at 637 nm ( $b_{abs,MAAP}$ ) at the TROPOS (winter) campaign.



**Figure S2.** Correlation plot of the particulate light absorption coefficient derived from the Aethalometer at 637 nm ( $b_{\text{abs,637,Aetha}}$ ) and the particulate light absorption coefficient derived from the MAAP at 637 nm ( $b_{\text{abs,MAAP}}$ ) at the Waldstein (summer) campaign. Red data points are excluded from the regression fit.



**Figure S3.** (Top) Correlation plot of the contribution to the aqueous light absorption coefficient  $Abs_{370}$  for each target compound under alkaline (indicated by the subscript “A”) and acidic (indicated by the subscript “B”) conditions. (Bottom) Correlation plot of the aqueous light absorption coefficient and mass absorption efficiency (MAE) under alkaline conditions with acidic conditions. All data points were measured at 370 nm.



**Figure S4.** Correlation plot of nitrated aromatic compound (NAC) concentration with levoglucosan concentration for the campaigns (a) TROPOS (winter), (b) Xianghe (summer), (c) Wangdu (summer, BB episode) and (d) Wangdu (summer, non-BB episode). Abs370 is given for acidic conditions (indicated by the subscript “A”, black squares) and for alkaline conditions (indicated by the subscript “B”, red dots).

## References

- Drinovec, L., Mocnik, G., Zotter, P., Prevot, A.S.H., Ruckstuhl, C., Coz, E., Rupakheti, M., Sciare, J., Müller, T., Wiedensohler, A., Hansen, A.D.A., The "dual-spot" Aethalometer: an improved measurement of aerosol black carbon with real-time loading compensation, in: *Atmos. Meas. Tech.*, 8, 1965-1979, 2015
- Müller, T., Henzing, J.S., de Leeuw, G., Wiedensohler, A., Alastuey, A., Angelov, H., Bizjak, M., Coen, M.C., Engstrom, J.E., Gruening, C., Hillamo, R., Hoffer, A., Imre, K., Ivanow, P., Jennings, G., Sun, J.Y., Kalivitis, N., Karlsson, H., Komppula, M., Laj, P., Li, S.M., Lunder, C., Marinoni, A., dos Santos, S.M., Moerman, M., Nowak, A., Ogren, J.A., Petzold, A., Pichon, J.M., Rodriguez, S., Sharma, S., Sheridan, P.J., Teinila, K., Tuch, T., Viana, M., Virkkula, A., Weingartner, E., Wilhelm, R., Wang, Y.Q., Characterization and intercomparison of aerosol absorption photometers: result of two intercomparison workshops, in: *Atmos. Meas. Tech.*, 4, 245-268, 2011.