Supporting Information for

Modified Thermal-Optical Analysis Using Spectral Absorption Selectivity to Distinguish Black Carbon from Pyrolized Organic Carbon

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Carbon mass is derived from the measured CO_2 as it is evolved from the filter. Equation S.1 converts the partial pressure of CO_2 into carbon mass. Oxygen is the carrier gas for the CO_2 and moles of O_2 are calculated from the concentration and flow rate. Finally the mass is divided by the temperature ramp rate, to obtain a carbon mass for each degree increase in temperature. The total amount of carbon on the filter is the sum of all carbon evolved between 50°C and 700°C.

$$C_{mass}(T_s) = \frac{\left(\frac{\mu moles}{mol O_2 s}\right)\left(\frac{12 \mu gC}{\mu mol C}\right) * \left(\frac{0.0409 mol O_2}{L O_2}\right) * \left(\frac{0.2 L O_2}{min}\right)}{\left(\frac{4 °C}{min}\right)} \qquad S.1$$

Equations S.2 and S.3 are the solutions obtained for t[...] char) and the coefficient (c_2) (c_1). Equation S.3 is obtained from rewriting equation S.2 in terms of c_2 (equation 3) to s[...]

$$c_1(T)\lambda^{-k_{BC}} + c_2(T)\lambda^{-k_{char}} \approx c(T)\lambda^{-k_m}, \text{ for } 350 \text{ nm} \leq \lambda \leq 600 \text{ nm} \qquad S.2$$

$$c_2 = \frac{c\lambda^{-k_m} - c_1\lambda^{-k_{BC}}}{\lambda^{-k_{char}}} \qquad S.3$$

After substituting S.3 into S.2 for m equations w[...] lamda, the c_1 is solved as follow.

$$c_1 = \frac{c\left(\lambda_2^{-k_m} - \lambda_1^{(-k_m+k_{char})}\lambda_2^{-k_{char}}\right)}{\left(\lambda_2^{-k_{BC}} - \lambda_1^{(-k_{BC}+k_{char})}\lambda_2^{-k_{char}}\right)}, \quad \begin{matrix}\lambda_1 = 530nm \\ \lambda_2 = 570nm\end{matrix} \qquad \text{S.4}$$

The following table shows: the BC loading on the filter in micrograms retrieved using traditional thermo-optical analysis (TOA), the BC retrieved using the modified spectral analysis, the uncertainty for the modified version, and the difference between the two methods. For small loading, the two methods agree somewhat, but for a heavily laden filter, the positive bias due to the char is increasingly significant, nearly doubling the amount of apparent BC in some cases.

Notation

k	absorption angstrom exponent (AAE)
A	area of the sample spot on a filter
ATN	attenuation
c	coefficient of attenuation
c_1	coefficient of attenuation for BC
c_2	coefficient of attenuation for char
a	fraction of attenuation from black carbon
I	intensity of light
MAE	mass attenuation efficiency

BC	mass of black carbon
TC	mass of carbon
EC	mass of elemental graphitic carbon
LAC	mass of light absorbing carbon (black carbon and char)
OC	mass of organic carbon
T	temperature
TOA	thermal-optical analysis
λ	wavelength of light
σ	uncertainty