Supplementary Materials (S1-S4)

S1. AE31 data correction

Mass loading effect: In this study, mass loading effect was corrected by following the equation S1:

$$BC_t = BC_r\,(1+k\cdot ATN) \quad \text{(S1)}$$

where BC_t is the true concentration after mass loading correction, BC_r is the Aethalometer-reported concentration, and k is an empirical parameter that, is this algorithm, is obtained from the regression of concentration on ATN.

Multiple scattering correction C: this factor is used to correct the multiple scattering within a relatively clean filter. The correction factor (C) for the multiple scattering effect highly depends on the particle property and filter matrix. We followed the methods performed in previous studies. [1,2] That is, C=2.293 for 880nm and hypothesize the value of Absorption Ångström coefficient (AAC) was equal to 1; C has 3 choices at 370nm for different AAC values. C value decreases with AAC. Earlier studies chose a reasonable range of AAC (e.g., AAC=1, 1.5 or 2) and then obtained the corresponding C values, such as 2.355 for AAC=1, 2.270 for AAC=1.5 and 2.198 for AAC=2 [2-4]. According to calculated AAC values (as shown in next section) in our study, we chose the C=2.198 value.

S2: Chemical b_{ext} calculation

[Large Nitrate] = [Total Nitrate]/20 $\mu g\cdot m^{-3}$ - [Total Nitrate], for [Total Nitrate] <20 $\mu g\cdot m^{-3}$ (S4)

[Large Nitrate] = [Total Nitrate], for [Total Nitrate] >=20 $\mu g\cdot m^{-3}$ (S5)

[Small Nitrate] = [Total Nitrate]- [Large Nitrate] (S6)

Similar equations are used to separate total sulfate and organic mass (OM) concentrations into small and large size fractions. As Xi'an is an inland city, the concentration of sea salt is low and for our purposes can be ignored. The calculation of fine soil were determined by measured non-sea salt (nss) Ca^{2+} concentrations following the equation proposed by [5]:

$$[\text{Fine soil}] = 10.96 \pm 1.00[\text{nss } Ca^{2+}] \quad \text{(S7)}$$

this equation is given in $\mu g\cdot m^{-3}$, which can be evaluated the dust mass concentration for our sampling filters. The nss Ca^{2+} was obtained from IC analysis.

S3: Fig.S1

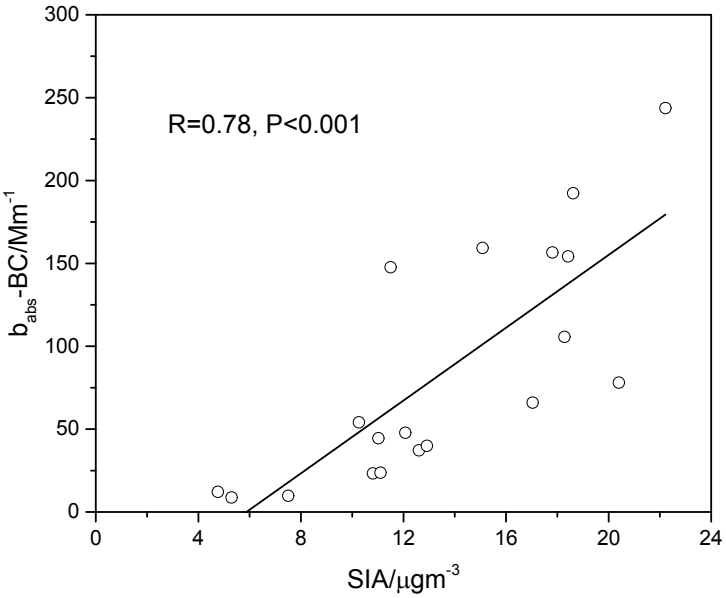

Fig. S1 Correlation of b_{abs}-BC ans SIA during WH days

S4: Table S1

Table S1 The average light absorption coefficients of total $PM_{2.5}$, BC and BrC at 370nm

Light absorption coefficient at 370nm /Mm^{-1}	WH	WNH	SH	SNH
Total $PM_{2.5}$ (b_{abs}-370nm)	305.0±92.8	189.5±53.7	53.5±13.4	40.4±10.7
BC (b_{abs}-BC-370nm)	263.8±60.9	147.9±35.9	49.0±17.8	36.3±9.8
BrC (b_{abs}-BrC)	41.2±10	41.6±13	4.5±1.7	4.1±1.6

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