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Influence of biomass burning from South Asia at a high-altitude mountain receptor site in China

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S.1 Instruments

Table S1. Overview of main instruments used during the campaign.

Parameter	Phase	Instrument	Manufacturer
NR-PM_1 composition	Particle	HR-ToF AMS	Aerodyne Research Inc, Billerica, MA, USA
BC	Particle	Aethalometer, type AE31	Magee Scientific, Berkeley, CA, USA
Aerosol number size distribution	Particle	SMPS (3081-DMA and 3022-CPC)	TSI Inc., Shoreview, MN, USA
VOCs concentration	Gas	GC-MS/FID	Self-made instrument

S.2 Comparisons between AMS and other instruments

The sum of mass concentrations measured by the AMS (sulfate + nitrate + ammonium + OA) and BC were compared to mass concentrations converted from volume concentrations measured by the SMPS by multiplying an estimated composition-dependent density. The aerosol density used was 1.4 g cm^{-3} for organics (Gysel et al., 2007), 1.75 g cm^{-3} for sulfate, nitrate and ammonium, and 1.80 g cm^{-3} for black carbon as suggested by Middlebrook et al. (2012). Given the decrease of the transmission efficiency of AMS at large size, the size range of the SMPS for integration was taken from 15 to 600 nm when doing the inter-comparison (Hu et al., 2013). The scatter plot of AMS plus BC vs. PM_1 concentrations from SMPS showed a strong correlation (R^2 = 0.96) with a slope of 1.1 (Fig. S1）.

S.3 PMF diagnostics and evaluation

PMF analysis was performed on the high resolution spectral matrix of organics provided by AMS. The data was analyzed according to the method recommend by Ulbrich et al. (2009). Factor numbers from 1 to 12 were tested to see if the solutions could successfully explain the variations of organic time series by several meaningful factors.

One factor or two factors would result in large residuals in both time series and key m/z values, with high Q/Qexp values. A 3-factor solution has a low Q/Qexp values of 1.1, and further increasing the factor number only resulted in minor decreases in Q/Qexp values. The 3-factor solution has two similar OOA factors. The time series of one OOA factor presented noisy background, shown as fac1 in grey color in Fig. S2(b). The 4-factor solution could clearly identify two factors, and can be

assigned as BBOA and OOA-BB. However the time series of the first factor was noisy as Fig. S3(b). The similarity in the spectra of factor 1 and factor 2 indicates that these two factors were essentially a split of one factor. When factor number went beyond 4, splits of factors also happened, as shown in the example of 5-factor solution in Fig. S4(a).

Based on the analysis above, the 4-factor solution was chosen, with factor 3 identified as OOA-BB, and factor 4 identified as BBOA. Factor 1 and factor 2 were combined together to form a new factor by a mass-weighted averaging of their profiles, and was identified as OOA. The concentration of the combined factor equals to the sum of the concentrations of factor 1 and factor 2.

The stability of the solution was further investigated by FPEAK rotational analysis and SEED method. Results showed very little variability at different FPEAK values, with FPEAK = 0 being the lowest point in Fig.S5 (b). Thus FPEAK= 0 was chosen. Seeds were chosen from 0 to 100, and with an interval of 10. Nearly identical results were seen for different seed values, as shown in Fig.S5 (d), proving that the solution of PMF was stable.

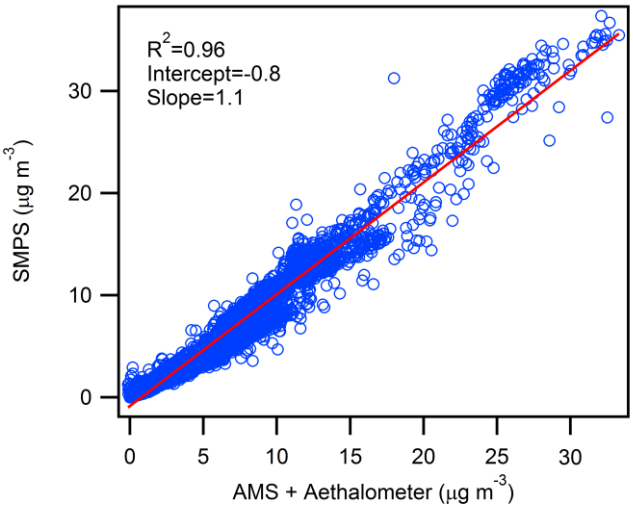


Figure S1. Comparison of the mass concentration of PM_1 measured by SMPS and that by AMS plus Aethalometer.

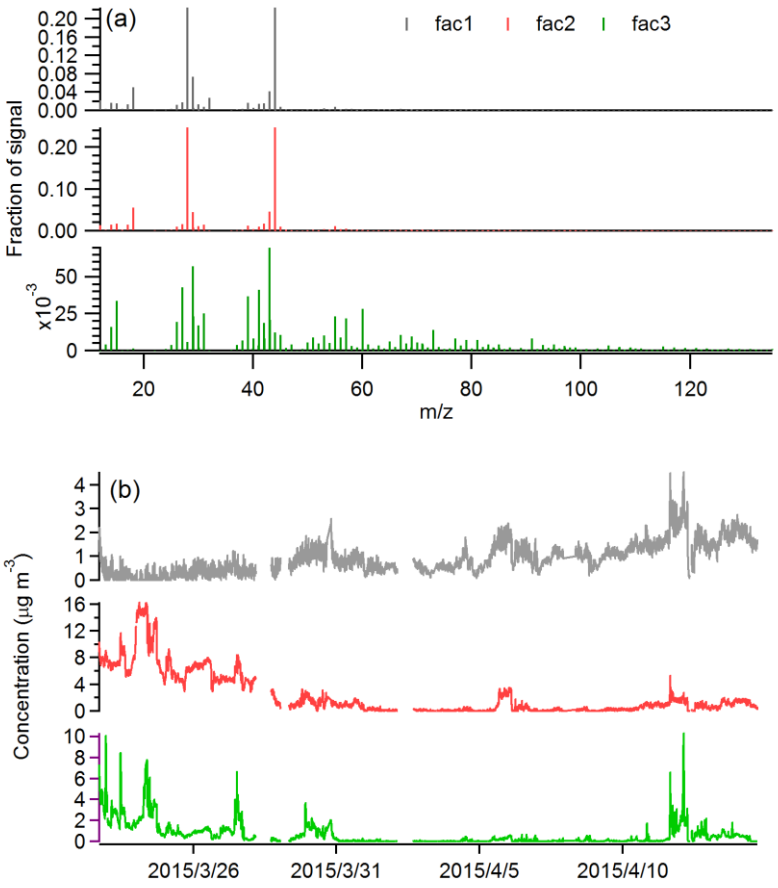


Figure S2. (a) mass spectra and (b) time series of the 3-factor solution.

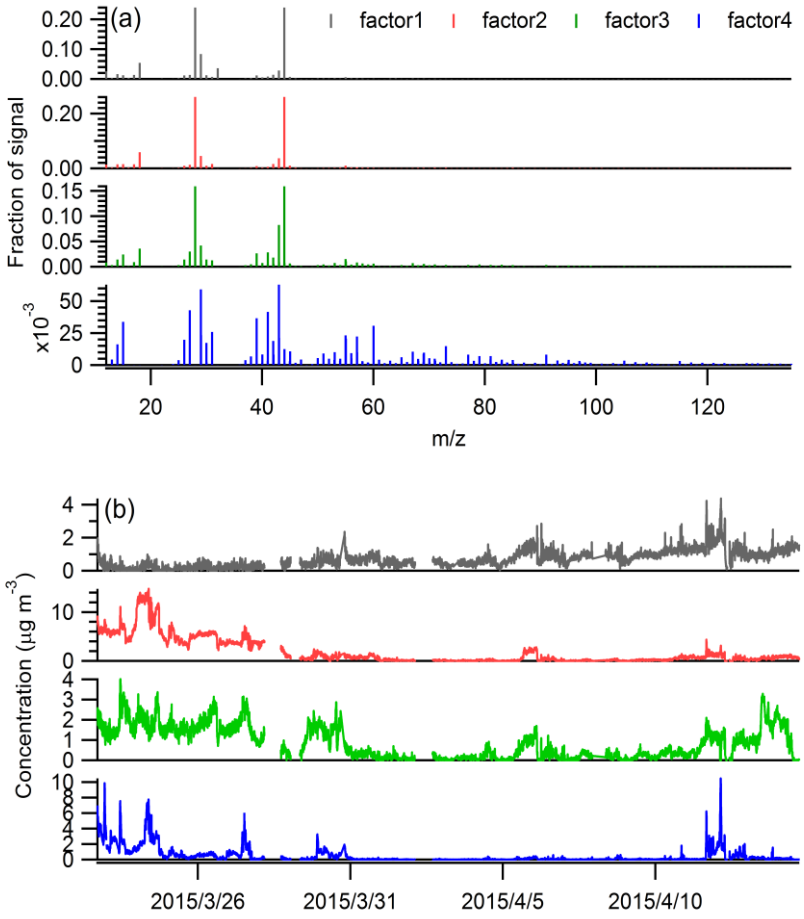
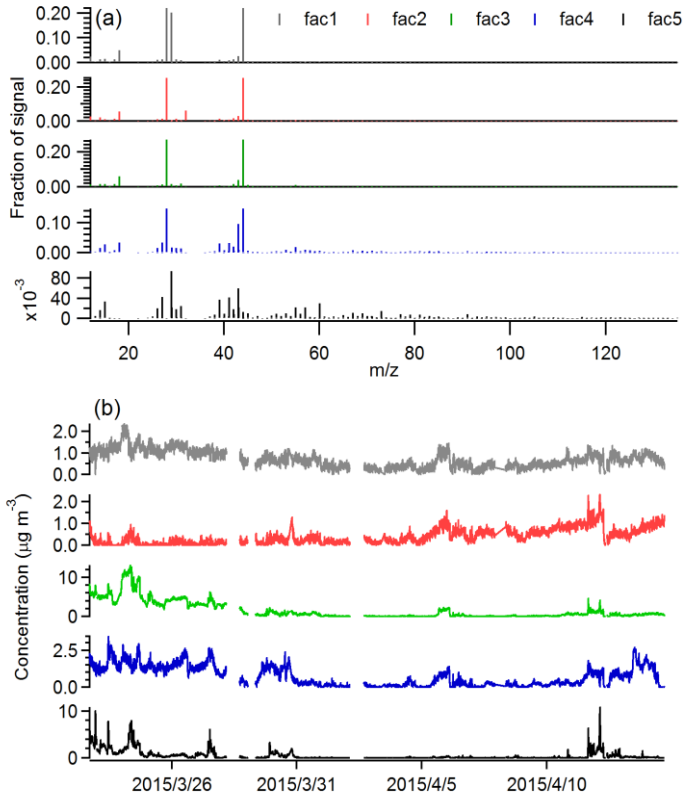


Figure S3. (a) mass spectra and (b) time series of the 4-factor solution.



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42 **Figure S4.** (a) mass spectra and (b) time series of the 5-factor solution.

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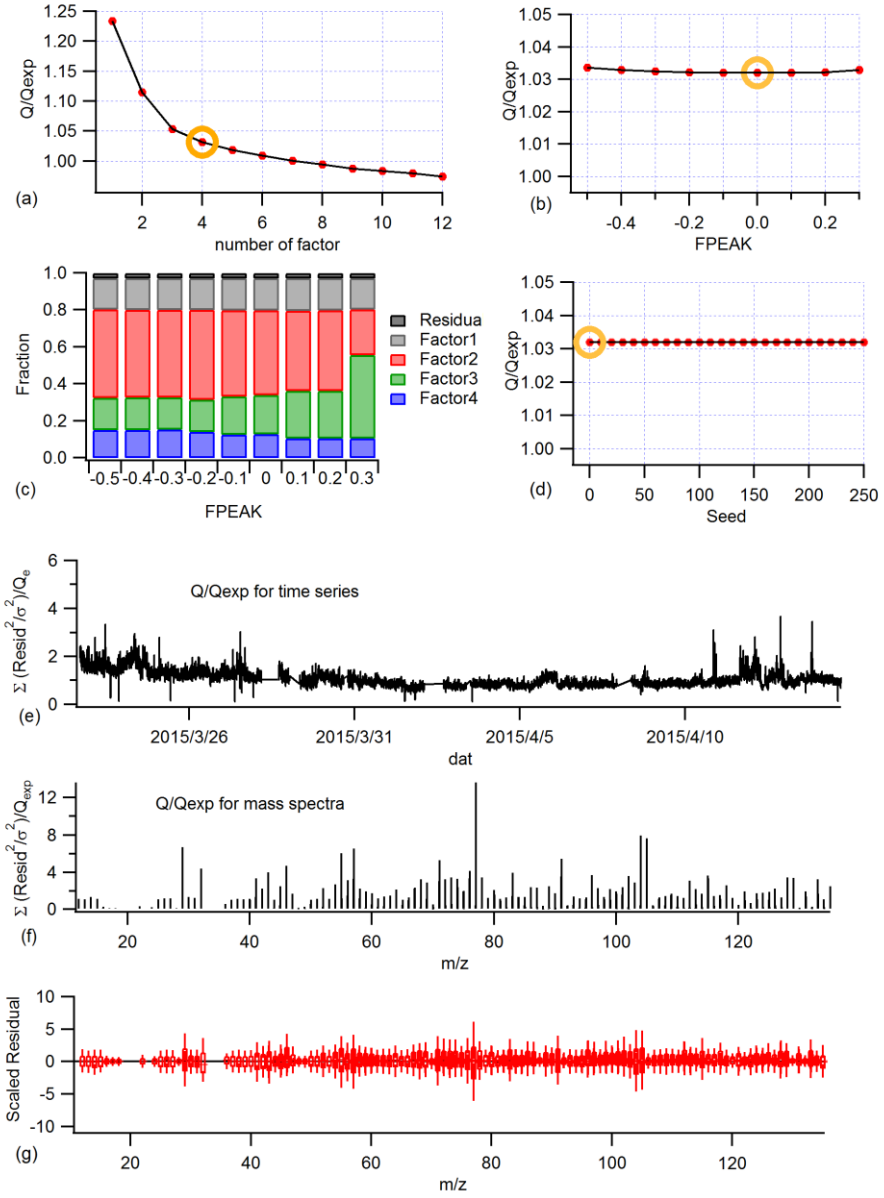

Figure S5. Diagnostic plot of PMS solution. Panel (a) the Q/Qexp values as a function of factor number; (b) the Q/Qexp values as a function of FPEAK values of 4 factor solution; (c) relative contribution of four OA factors of different FPEAK values; (d) the Q/Qexp values as a function of seed values of 4 factor solution; (e) time series of the Q/Qexp values; (f) the Q/Qexp values of different m/z; (g) the box-whisker plot for the scaled residual for the mass spectra.

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