

Supplement of Atmos. Chem. Phys., 16, 6721–6733, 2016
<http://www.atmos-chem-phys.net/16/6721/2016/>
doi:10.5194/acp-16-6721-2016-supplement
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Atmospheric
Chemistry
and Physics
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Supplement of

Substantial secondary organic aerosol formation in a coniferous forest: observations of both day- and nighttime chemistry

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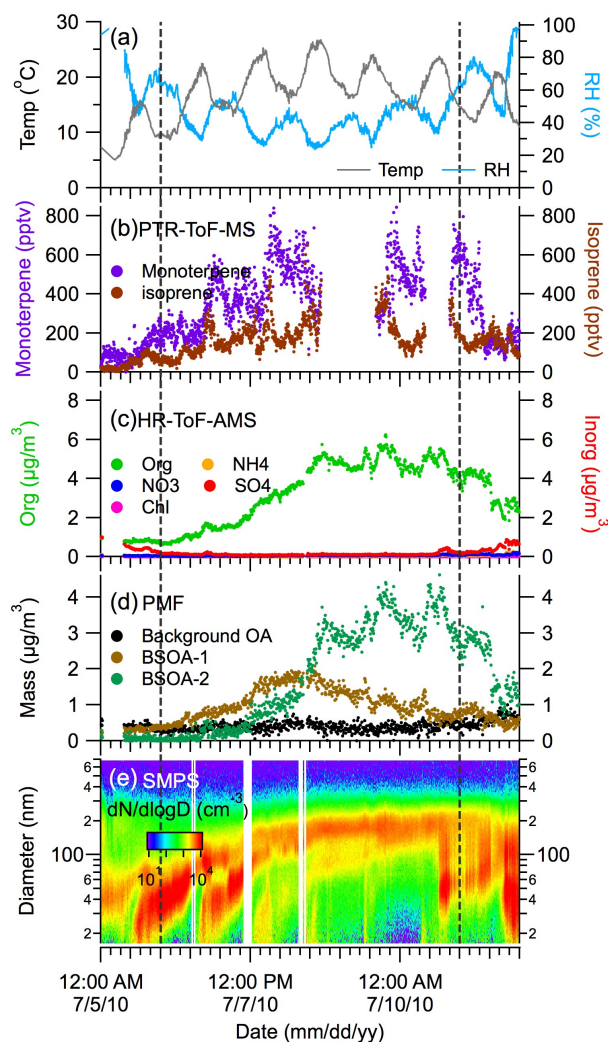


Figure S1: The location of sampling site (Raven's Nest, red marker). The sampling site located with a coniferous forest mountain area at an elevation of 1320 m-asl.

Table S1: List of VOCs observed by the PTR-ToF-MS

m/z	VOCs	Sensitivity (normalized count per ppb)	Limit of detection (LOD, pptv)
31.018	Formaldehyde	--	--
33.034	Methanol	10.4	200
42.034	Acetonitrile	22.9	4
47.014	Formic acid	17.9	110
59.049	Acetone	30.9	18
61.033	Acetic acid + glycoaldehyde	--	--
69.070	Isoprene	9.9	9
71.053	Methyl vinyl ketone (MVK) + methacrolein (MACR)	12.6	9
73.029	Methyl glyoxal	--	--
73.065	Methyl ethyl ketone (MEK)	--	--
75.044	Hydroxyacetone	--	--
79.055	Benzene	15.0	4
81.070	Σ monoterpene fragment	--	--
87.035	Propanoic acid	--	--
87.070	Methyl-3-buten-2-ol (MBO)	--	--
93.070	Toluene	17.2	4
107.097	Σ C ₈ aromatics	--	--
137.133	Σ Monoterpenes	5.6	9
139.112	Nopinone	--	--

Biogenic period (Period 1)



Period with mixed influence (Period 2)

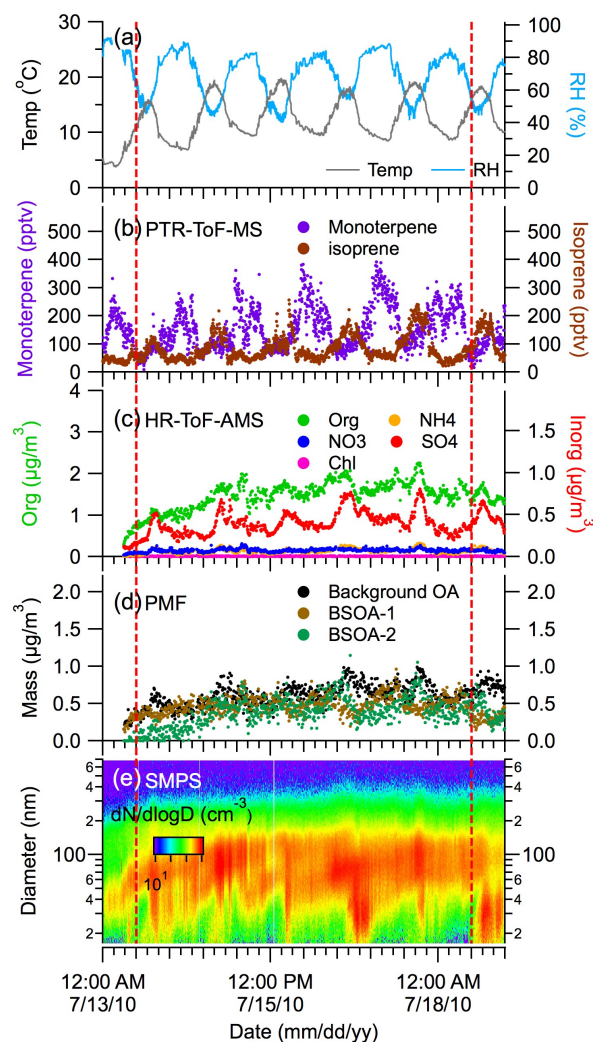


Figure S2: Left panel: biogenic episode (Period 1), right panel: period with a mix of biogenic and regional background influence (Period 2). Time series (PST) profiles of (a) Temperature and relative humidity, (b) monoterpene and isoprene measured by PTR-ToF-MS, c) Organic, nitrate, sulfate, ammonium, and chloride measured by HR-ToF-AMS, (d) background OA, BSOA-1, and BSOA-2 determined by PMF analysis, (e) particle number size distribution measured SMPS.

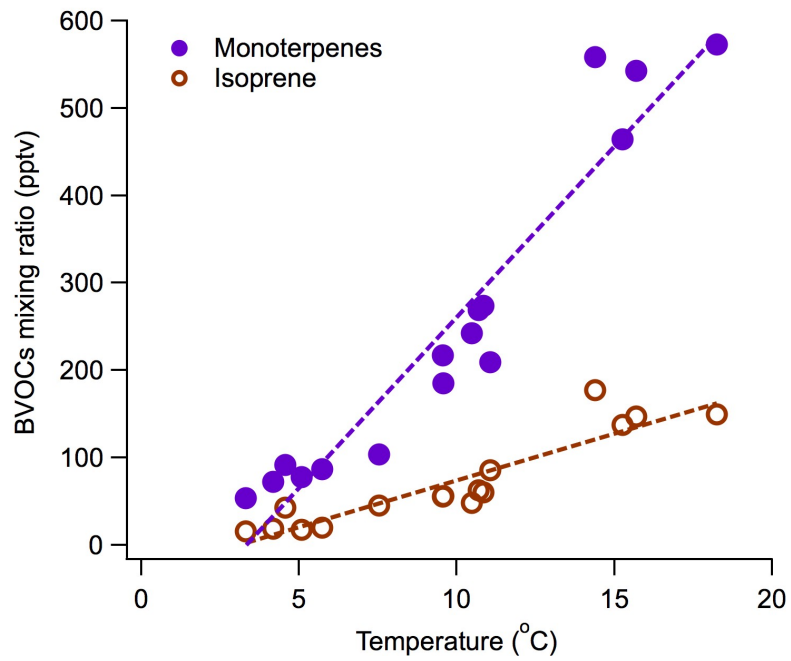


Figure S3: Correlation of BVOC mixing ratios (solid purple circle: monoterpenes, open brown circle: isoprene) and ambient temperature.

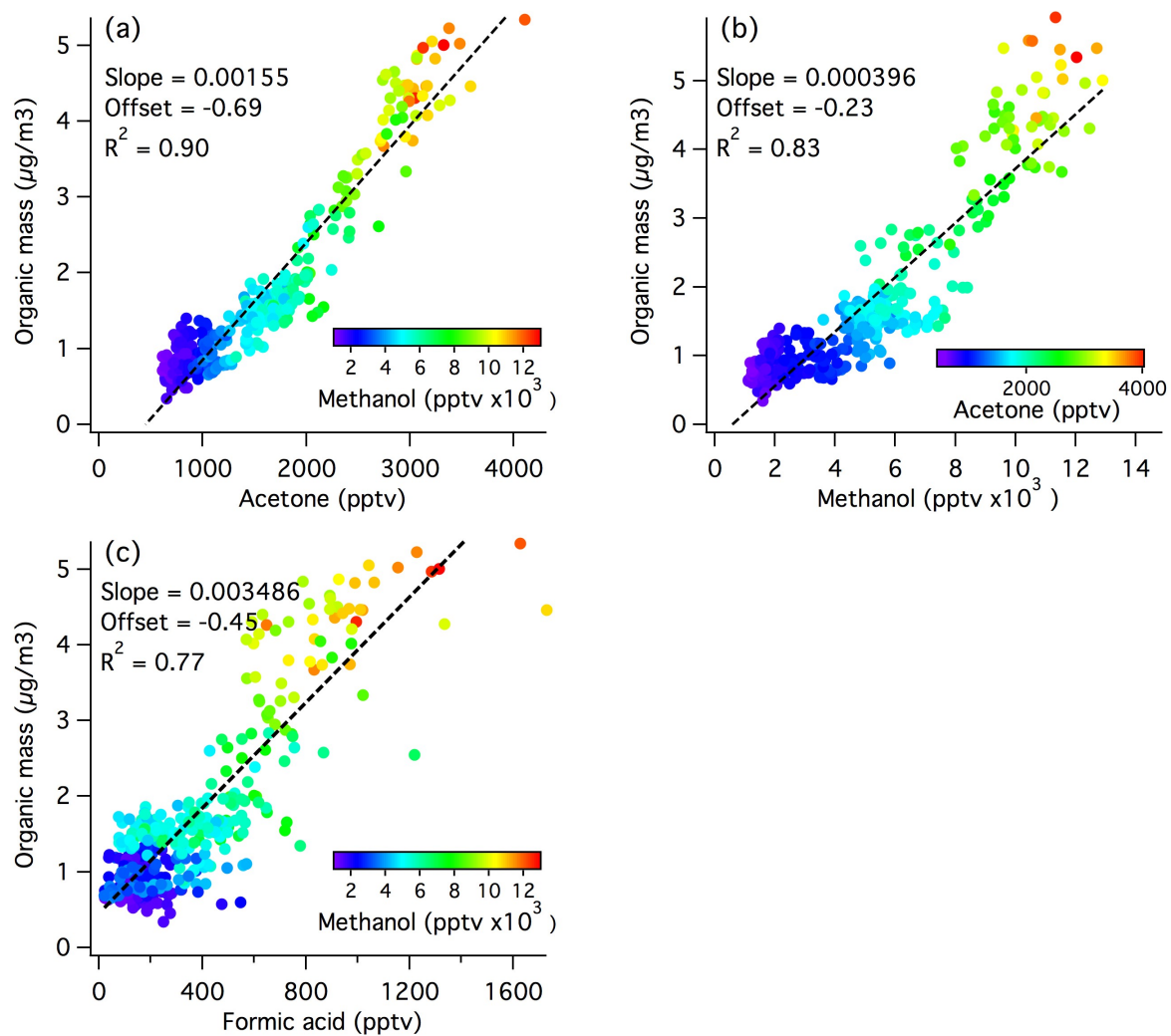


Figure S4: (a) Correlation of organic mass and acetone. The color scale represents the mixing ratio of methanol. (b) Correlation of organic mass and methanol. The color scale represents the mixing ratio of acetone. (c) Correlation of organic mass and formic acid. The color scale represents the mixing ratio of methanol.

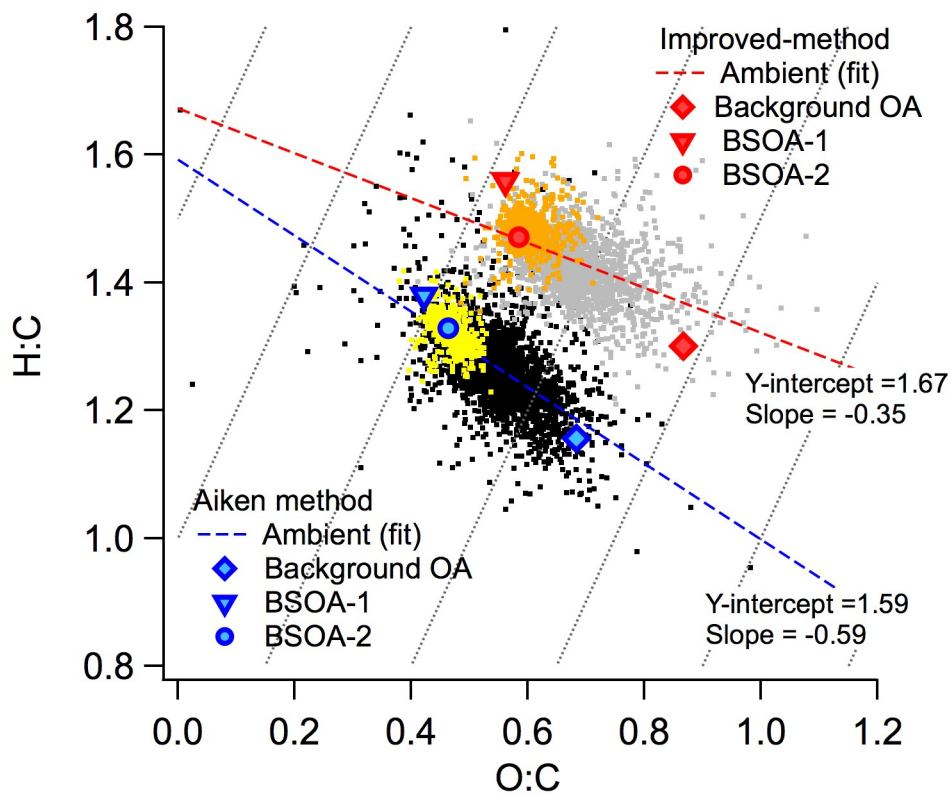


Figure S5: Van-Krevelen diagram: Improved method: orange and gray dots represent observations from the regional biogenic period (July 6-10) and the whole study period, respectively. Red symbols represent PMF factors. Aiken's method: yellow and black dots represent observations from the regional biogenic period and the whole study period, respectively. Blue symbols represent PMF factors.

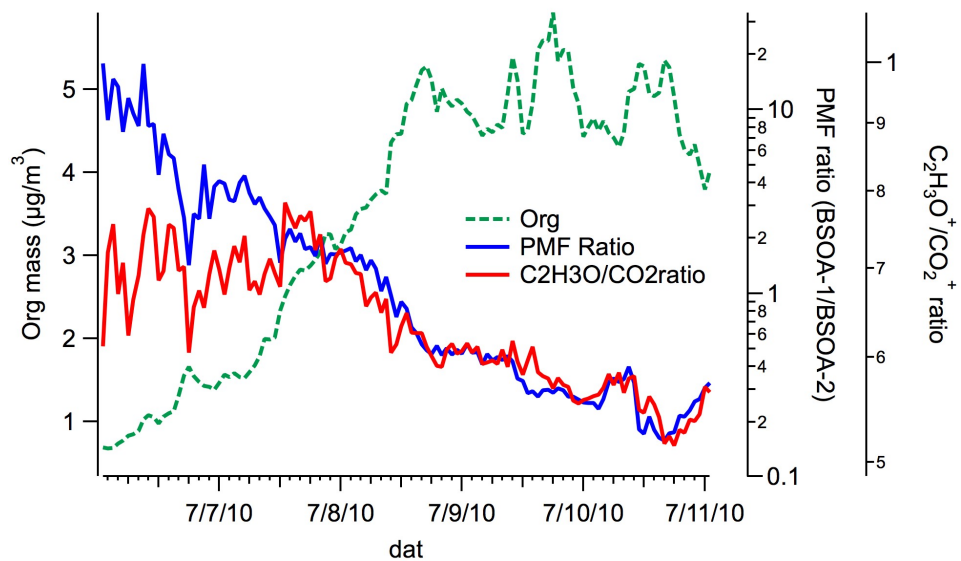


Figure S6: Time series (PST) profiles of total organic mass, BSOA-1/BSOA-2 ratio, and $C_2H_3O^+$ / CO_2^+ ratio during the biogenic period.

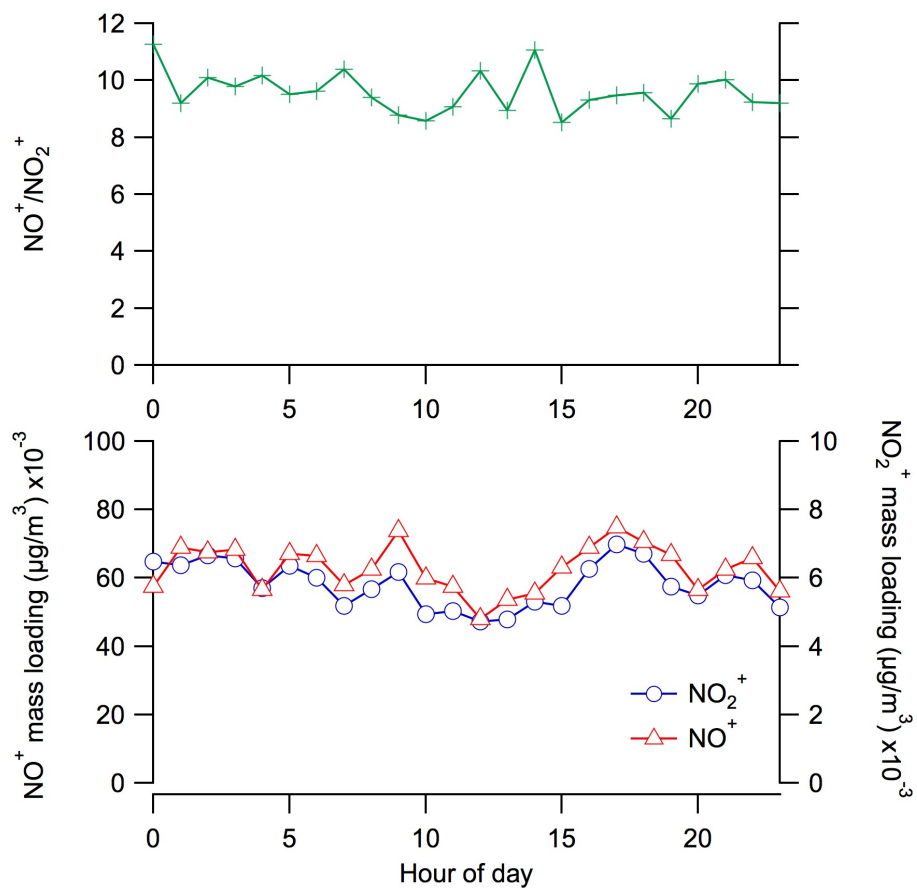


Figure S7: Diurnal patterns of the AMS signals of NO^+ , NO_2^+ and $\text{NO}^+/\text{NO}_2^+$ during the period with a mix of biogenic and anthropogenic influence.

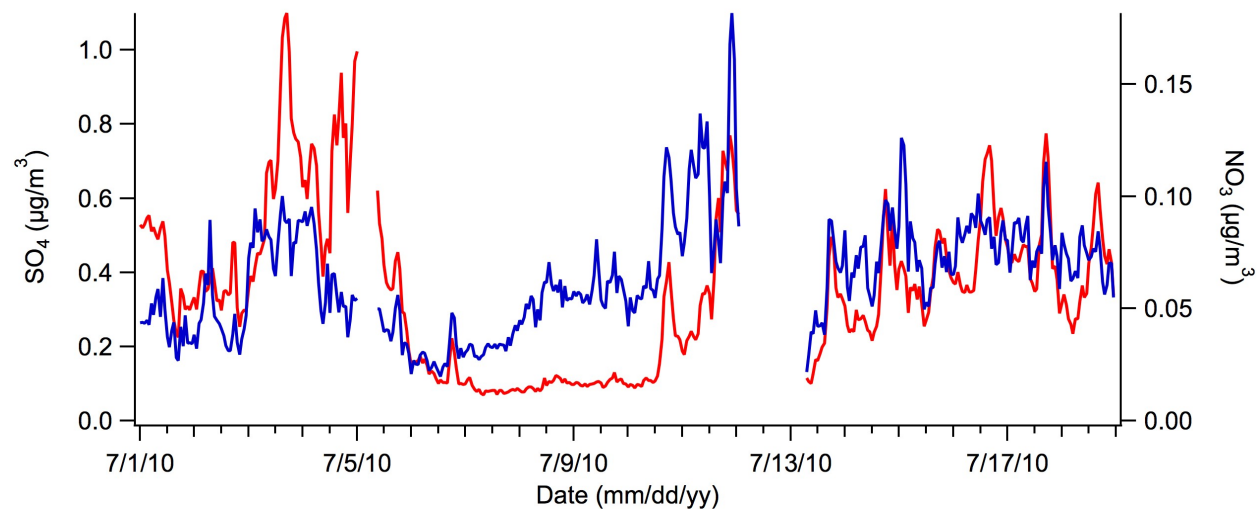


Figure S8: Time series (PST) profiles of nitrate and sulfate during the whole sampling period.

PMF analysis

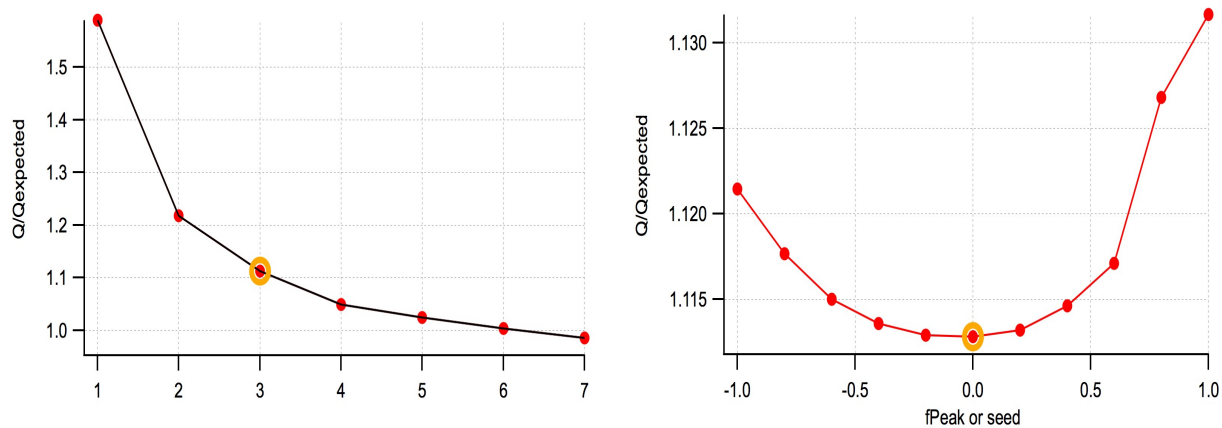


Figure S9: The PMF quality of fit parameter (Q/Q_{expected}) as a function of the number of factors (left) and f_{Peak} (right)

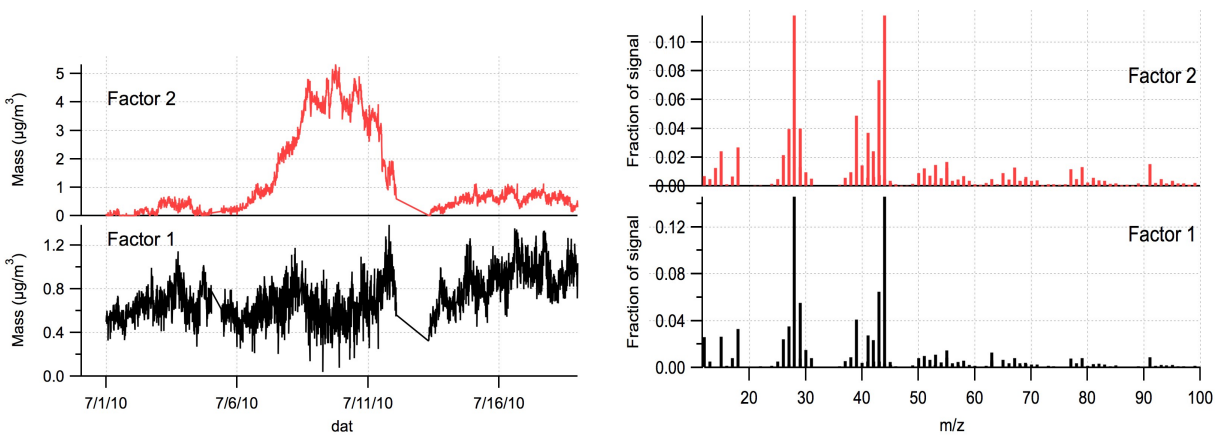


Figure S10: Time series and mass spectra corresponding to the two - factor PMF solution. Organic mass loadings are represented here as nitrate equivalent mass.

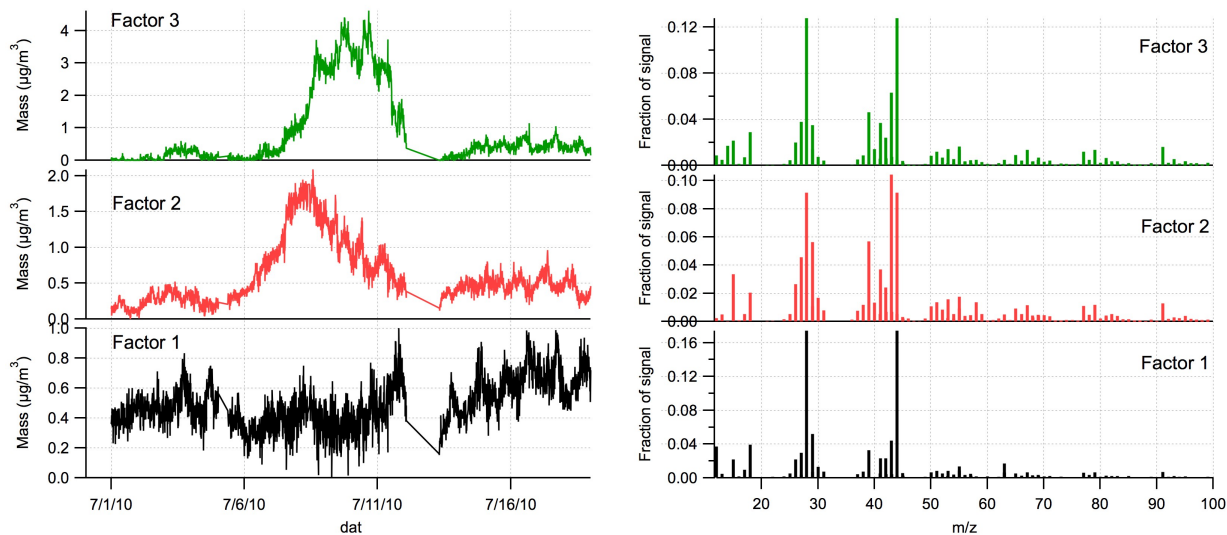


Figure S11: Time series and mass spectra corresponding to the three - factor PMF solution. Organic mass loadings are represented here as nitrate equivalent mass.

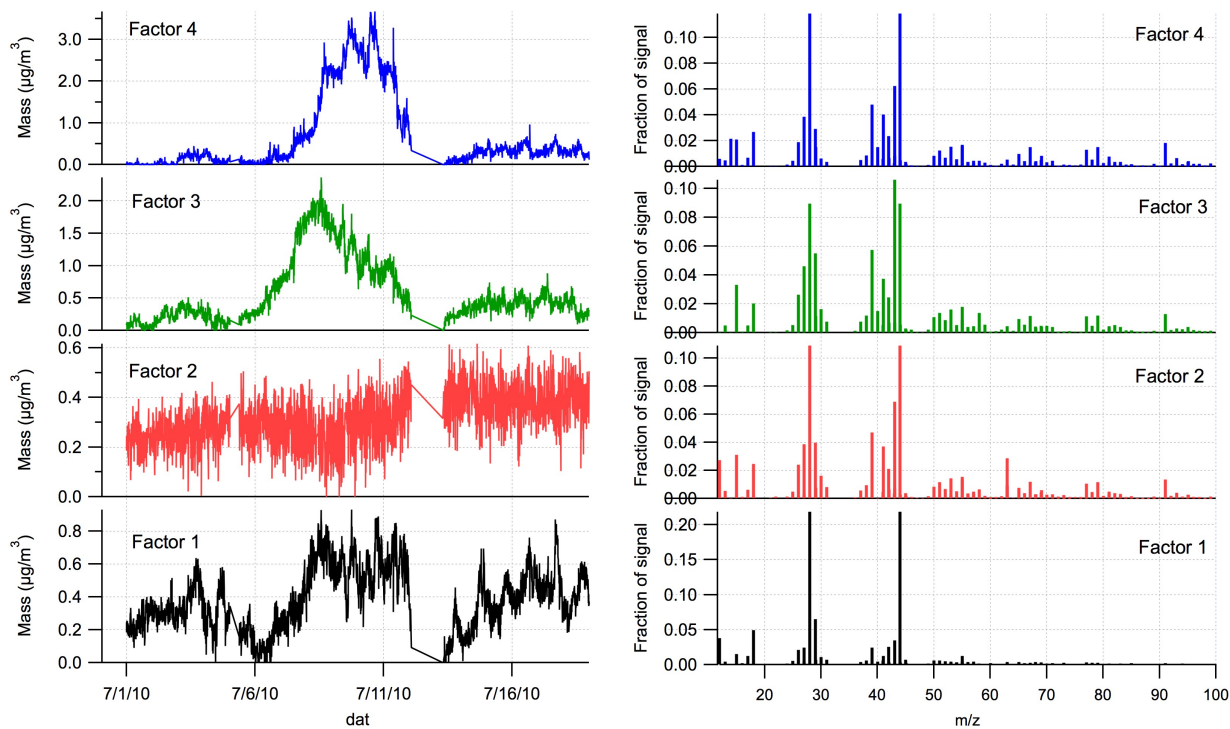


Figure S12: Time series and mass spectra corresponding to the four - factor PMF solution. Organic mass loadings are represented here as nitrate equivalent mass.

Calculation of organic nitrate mass

The mass concentration of the nitrate functional groups (-ONO₂) in organic compounds is estimated using the AMS mass concentrations of NO⁺ and NO₂⁺ followed by the calculation suggested by Xu et al. (2015).

$$[-\text{ONO}_2] = [\text{NO}^+] + [\text{NO}_2^+]$$

where [NO⁺] and [NO₂⁺] are nitrate-equivalent mass concentration of fragment NO⁺ and NO₂⁺

The mass concentration of nitrate functional groups in organic compounds is used to estimate the mass concentration of organic nitrates (ON) by the following equation.

$$[\text{ON}] = ([-\text{ONO}_2]/62) \times \text{MW}_{\text{ON}}$$

where MW_{ON} is the average molecular weight of organic nitrates, which is assumed to range from 200 to 300 g/mol.

Reference:

Xu, L., Guo, H., Boyd, C. M., Klein, M., Bougiatioti, A., Cerully, K. M., Hite, J. R., Isaacman-VanWertz, G., Kreisberg, N. M., Knote, C., Olson, K., Koss, A., Goldstein, A. H., Hering, S. V., de Gouw, J., Baumann, K., Lee, S., Nenes, A., Weber, R. J. and Ng, N. L.: Effects of anthropogenic emissions on aerosol formation from isoprene and monoterpenes in the southeastern United States, Proc. Natl. Acad. Sci. U. S. A., 112, 37-42, 2015.

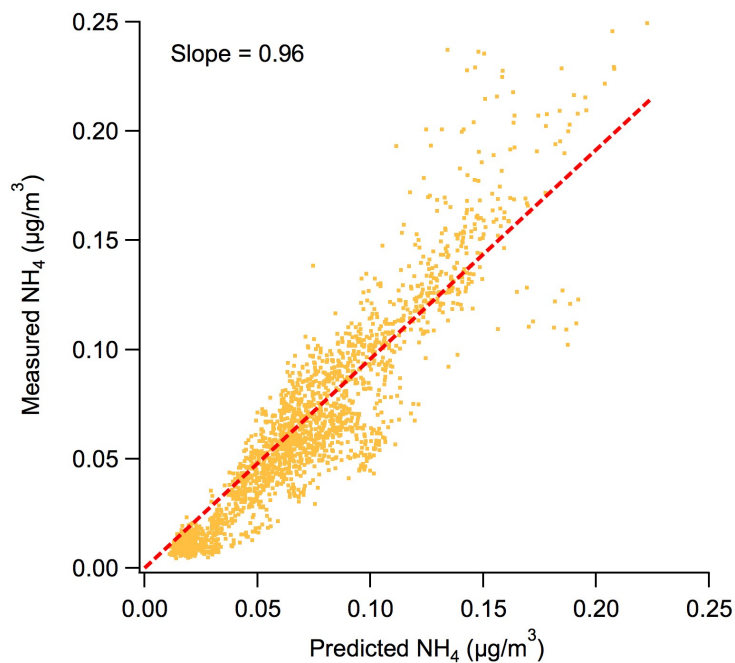


Figure S13: Correlation between mass loadings of ammonium measured by the HR-ToF-AMS and predicted by sulfate mass ($R^2 = 0.69$, slope = 0.96) for the whole period. Note that organic nitrate dominated the measured nitrate mass as demonstrated in Section 3.4 of the main text, and thus the measured nitrate mass is not included in the prediction.