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*Supplement of*

# Volatile organic compounds at a rural site in Beijing: influence of temporary emission control and wintertime heating

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## 1. Calculation of ozone formation potentials (OFPs) and secondary organic aerosol formation potentials (SOAFPs)

The OFP of individual VOC species *i*, OFP (*i*), is calculated by the following equation:

$$OFP(i) = conc(i) \times MIR(i)$$

where conc (*i*) is the concentration of VOC species *i*, and MIR (*i*) is the maximum incremental reactivity coefficient of VOC species *i*, which is defined by Carter (2009). MIR defined as the maximum amount of ozone formed per unit of VOCs added or subtracted from the whole gaseous mixture in the given air mass.

SOAFPs is estimated using the following formula:

$$SOAFPs = \sum_{i} X_i \times Y_i$$

where $X_i$ is the mass concentration of precursor *i* (μg $m^{-3}$), and $Y_i$ (%) is the SOA yield of precursor *i*. SOA yield is defined as mass of SOA formed divided by mass of VOCs reacted (Loza et al., 2014). SOA yield data have been obtained in controlled smog chamber studies. In this study, the SOA yields are taken from Ng et al (2007), Lim and Ziemann (2009) and Loza et al (2014). As SOA formation depend on nitrogen oxide (NOx) (Ng et al., 2007), and we calculated SOAFPs under low-NOx and high-NOx conditions, approximating the higher and lower limits.

**Table S1. Comparison of mixing ratios (ppbv) of VOCs in present study with those from other studies at metropolitan areas in the world.**

| | This study | | | Li et al., 2015 | | | Liu et al., 2017 | | | Wang et al.,2010 | Cai et al., 2010 | Zou et al., 2015 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Beijing, China | | | Beijing, China | | | Beijing, China | | | Beijing, China | Shanghai, China | Guangzhou, China |
| Sampling sites type | Ruran | | | Urban | | | Urban | | | Urban | Urban | Suburban |
| Sampling periods | 2014.10.25-2014.12.31 | | | 2014.10.18-2014.11.22 | | | 2015.12.15-2016.1.14 | | | 2008.6 | 2007.1-2010.3 | 2011.6-2012.5 |
| Types | Period I | Period II | Period III | Before APEC | During APEC | After APEC | Clear days | Light haze days | Heavy haze days | | | |
| Ethane | 3.25 | 2.44 | 3.67 | 10.80 | 7.71 | 11.31 | 3.71 | 8.03 | 17.63 | 3.53 | - | 3.66 |
| Propane | 2.88 | 1.30 | 2.48 | 6.38 | 4.44 | 5.40 | 2.12 | 5.18 | 12.52 | 2.85 | 4.81 | 4.34 |
| i-Butane | 1.12 | 0.47 | 0.75 | 2.32 | 1.57 | 1.75 | 0.44 | 0.91 | 2.05 | 1.47 | 1.43 | 2.67 |
| n-Butane | 1.28 | 0.56 | 0.84 | 3.27 | 1.89 | 2.25 | 0.73 | 1.76 | 3.71 | 1.87 | 2.03 | 3.07 |
| i-Pentane | 1.43 | 0.56 | 1.02 | 2.16 | 1.14 | 1.41 | 0.39 | 0.83 | 1.76 | 2.03 | 2.29 | 1.72 |
| n-Pentane | 0.62 | 0.25 | 0.46 | 1.61 | 0.74 | 0.99 | 0.26 | 0.54 | 1.31 | 0.91 | - | 1.37 |
| 2,2-Dimethylbutane | 0.03 | 0.02 | 0.03 | 0.07 | 0.02 | 0.03 | 0.06 | 0.08 | 0.13 | 0.05 | - | 0.37 |
| Cyclopentane | 0.06 | 0.04 | 0.05 | 0.35 | 0.09 | 0.14 | 0.07 | 0.16 | 0.29 | 0.10 | - | 0.15 |
| 2,3-Dimethylbutane | 0.05 | 0.03 | 0.04 | 0.25 | 0.14 | 0.18 | 0.03 | 0.07 | 0.09 | 0.09 | - | 0.13 |
| 2-Methylpentane | 0.17 | 0.08 | 0.12 | 0.73 | 0.44 | 0.54 | 0.16 | 0.36 | 0.59 | 0.52 | 0.67 | 0.88 |
| 3-Methylpentane | 0.15 | 0.07 | 0.10 | 0.49 | 0.25 | 0.27 | 0.18 | 0.24 | 0.42 | 0.34 | 0.48 | 0.75 |
| n-Hexane | 0.51 | 0.32 | 1.40 | 0.93 | 0.66 | 0.62 | 0.93 | 0.81 | 1.04 | 0.56 | 0.84 | 1.43 |
| Methylcyclopentane | 0.10 | 0.06 | 0.09 | 0.44 | 0.23 | 0.27 | 0.21 | 0.32 | 0.65 | 0.25 | 0.27 | 0.32 |
| 2,4-Dimethylpentane | 0.02 | 0.01 | 0.02 | 0.06 | 0.03 | 0.03 | 0.03 | 0.04 | 0.05 | 0.04 | 0.21 | 0.37 |
| Cyclohexane | 0.17 | 0.04 | 0.08 | 0.41 | 0.13 | 0.18 | 0.07 | 0.13 | 0.24 | 0.09 | - | 1.65 |
| 2-Methylhexane | 0.07 | 0.02 | 0.05 | 0.20 | 0.09 | 0.12 | 0.05 | 0.09 | 0.18 | 0.18 | 0.18 | 0.58 |
| 2,3-Dimethylpentane | 0.03 | 0.02 | 0.03 | 0.12 | 0.05 | 0.07 | - | - | - | 0.08 | - | 0.26 |
| 3-Methylhexane | 0.09 | 0.04 | 0.07 | 0.21 | 0.10 | 0.14 | 0.07 | 0.14 | 0.36 | 0.21 | 0.21 | 0.52 |
| 2,2,4-Trimethylpentane | 0.04 | 0.03 | 0.04 | 0.18 | 0.09 | 0.11 | 0.06 | 0.14 | 0.22 | 0.03 | - | 0.22 |
| n-Heptane | 0.09 | 0.03 | 0.08 | 0.26 | 0.12 | 0.18 | 0.07 | 0.15 | 0.35 | 0.19 | 0.23 | 0.32 |
| Methylcyclohexane | 0.05 | 0.02 | 0.04 | 0.23 | 0.08 | 0.12 | 0.05 | 0.11 | 0.26 | 0.09 | - | 0.26 |
| 2,3,4-Trimethylpentane | 0.01 | 0.01 | 0.02 | 0.09 | 0.04 | 0.05 | 0.02 | 0.05 | 0.07 | 0.03 | - | 0.12 |
| 2-Methylheptane | 0.03 | 0.01 | 0.02 | 0.08 | 0.04 | 0.06 | 0.03 | 0.05 | 0.08 | 0.05 | - | 0.08 |
| 3-Methylheptane | 0.03 | 0.01 | 0.02 | 0.05 | 0.02 | 0.03 | 0.02 | 0.03 | 0.05 | 0.05 | - | 0.08 |
| n-Octane | 0.04 | 0.02 | 0.04 | 0.13 | 0.07 | 0.10 | 0.03 | 0.05 | 0.09 | 0.11 | - | 0.19 |
| n-Nonane | 0.04 | 0.02 | 0.04 | 0.10 | 0.05 | 0.08 | 0.03 | 0.05 | 0.09 | 0.09 | 0.09 | 0.35 |
| n-Decane | 0.13 | 0.04 | 0.07 | 0.10 | 0.06 | 0.07 | 0.02 | 0.03 | 0.06 | 0.10 | 0.09 | 0.03 |
| n-Undecane | 0.15 | 0.07 | 0.09 | 0.06 | 0.04 | 0.05 | 0.03 | 0.03 | 0.04 | 0.06 | - | 0.17 |
| n-Dodecane | 0.13 | 0.08 | 0.06 | 0.05 | 0.05 | 0.04 | 0.05 | 0.05 | 0.05 | - | - | 0.14 |
| Ethylene | 1.79 | 1.25 | 2.31 | 7.18 | 5.51 | 11.23 | 2.43 | 6.54 | 15.14 | 4.18 | - | 2.99 |
| Propene | 0.43 | 0.37 | 0.82 | 1.33 | 1.16 | 2.42 | 0.89 | 2.35 | 4.51 | 0.88 | 0.84 | 1.32 |
| 1-Butene | 0.11 | 0.06 | 0.14 | 0.35 | 0.22 | 0.42 | 0.19 | 0.44 | 0.78 | 1.17 | 0.26 | 0.44 |
| 1,3-Butadiene | 0.15 | 0.08 | 0.25 | - | - | - | - | - | - | - | - | - |
| trans-2-Butene | 0.02 | 0.01 | 0.04 | 0.12 | 0.10 | 0.15 | 0.11 | 0.12 | 0.15 | 0.14 | 0.24 | 0.28 |
| cis-2-Butene | 0.02 | 0.01 | 0.04 | 0.16 | 0.09 | 0.17 | 0.12 | 0.12 | 0.17 | 0.12 | 0.22 | 0.22 |
| 1-Pentene | 0.03 | 0.02 | 0.05 | - | - | - | 0.07 | 0.11 | 0.19 | 0.06 | 0.13 | 0.05 |
| Isoprene | 0.16 | 0.06 | 0.20 | 0.11 | 0.06 | 0.07 | 0.07 | 0.12 | 0.16 | 0.25 | 0.12 | 1.14 |
| trans-2-Pentene | 0.02 | 0.02 | 0.02 | 0.06 | 0.03 | 0.05 | 0.06 | 0.07 | 0.09 | 0.05 | - | 0.03 |
| cis-2-Pentene | 0.01 | 0.01 | 0.02 | 0.03 | 0.01 | 0.02 | 0.16 | 0.22 | 0.51 | 0.05 | - | 0.19 |
| 2-Methyl-2-butene | 0.02 | 0.02 | 0.02 | - | - | - | - | - | - | - | - | - |
| Benzene | 0.87 | 0.41 | 0.80 | 1.98 | 1.02 | 1.87 | 0.59 | 1.33 | 3.54 | 1.23 | 1.81 | 0.62 |
| Toluene | 1.27 | 0.34 | 0.84 | 3.31 | 1.57 | 2.37 | 0.55 | 1.34 | 3.18 | 2.53 | 4.70 | 4.59 |
| Ethylbenzene | 0.68 | 0.15 | 0.32 | 1.13 | 0.49 | 0.74 | 0.1 | 0.27 | 0.68 | 0.83 | 1.23 | 1.48 |
| m/p-Xylene | 0.77 | 0.15 | 0.42 | 1.01 | 0.48 | 0.71 | 0.24 | 0.66 | 1.56 | 1.13 | 1.40 | 1.41 |
| Styrene | 0.17 | 0.03 | 0.15 | 0.24 | 0.11 | 0.21 | 0.06 | 0.13 | 0.25 | 0.14 | 0.14 | 0.41 |
| o-Xylene | 0.33 | 0.07 | 0.18 | 0.71 | 0.32 | 0.49 | 0.09 | 0.24 | 0.57 | 0.32 | 0.49 | 0.66 |
| Isopropylbenzene | 0.02 | 0.01 | 0.02 | 0.05 | 0.02 | 0.03 | 0.01 | 0.02 | 0.02 | 0.04 | - | 0.10 |
| n-Propylbenzene | 0.07 | 0.02 | 0.04 | 0.09 | 0.04 | 0.06 | 0.02 | 0.02 | 0.04 | 0.08 | - | 0.23 |
| m-Ethyltoluene | 0.14 | 0.03 | 0.09 | 0.25 | 0.10 | 0.16 | 0.04 | 0.08 | 0.14 | 0.12 | - | 0.25 |
| p-Ethyltoluene | 0.06 | 0.02 | 0.04 | 0.13 | 0.05 | 0.08 | - | - | - | 0.10 | - | 0.21 |
| 1,3,5-Trimethylbenzene | 0.05 | 0.01 | 0.04 | 0.09 | 0.04 | 0.06 | 0.02 | 0.04 | 0.06 | 0.08 | - | 0.21 |
| o-Ethyltoluene | 0.06 | 0.02 | 0.04 | 0.10 | 0.04 | 0.07 | 0.02 | 0.03 | 0.06 | 0.08 | - | 0.27 |
| 1,2,4-Trimethylbenzene | 0.22 | 0.06 | 0.13 | 0.29 | 0.13 | 0.19 | 0.04 | 0.11 | 0.19 | 0.16 | - | 0.21 |
| 1,2,3-Trimethylbenzene | 0.08 | 0.02 | 0.06 | 0.08 | 0.04 | 0.06 | 0.02 | 0.03 | 0.06 | 0.08 | - | 0.15 |
| 1,3-Diethylbenzene | 0.04 | 0.02 | 0.03 | 0.02 | 0.01 | 0.01 | 0.02 | 0.03 | 0.03 | 0.12 | - | 0.12 |
| 1,4-Diethylbenzene | 0.08 | 0.02 | 0.05 | 0.06 | 0.04 | 0.04 | 0.02 | 0.02 | 0.03 | 0.10 | - | 0.11 |
| 1,2-Diethylbenzene | 0.02 | 0.01 | 0.02 | - | - | - | - | - | - | - | - | - |
| Ethyne | 3.13 | 1.63 | 3.01 | 6.41 | 4.04 | 8.27 | 2.51 | 6.72 | 13.69 | 4.40 | - | - |

(Tab S1 Continued)

| | Guo et al., 2007 | Borbon et al., 2002 | Leuchner and Rappengluck., 2010 | Baudic et al., 2016 | Garzon et al., 2015 | | Liakakou et al., 2009 | Saito et al., 2009 |
|---|---|---|---|---|---|---|---|---|
| Location | HongKong, China | Lille, French | Houston, USA | Paris, French | Mexico city, Mexico | | Finokalia, Greece | Nagoya, Japan |
| Sampling sites type | Urban | Urban | Urban | Urban | Urban | | Marine | urban |
| Sampling periods | 2002.9-2003.8 | 1997.5-1999.4 | 2006.8-9 | 2010.1-2 | 2005.11-12 | 2011.11-12 | Fall, 2004-2006 | 2003.12-2004.11 |
| Types | | | | | | | | |
| Ethane | 1.83 | 4.86 | 6.21 | 5.70 | 7.01 | 1.57 | 1.95 | 3.86 |
| Propane | 1.60 | 2.48 | 5.39 | 5.09 | 45.82 | 10.12 | 0.47 | 3.34 |
| i-Butane | 0.90 | 1.64 | 3.33 | 4.74 | 11.49 | 5.04 | 0.17 | 1.40 |
| n-Butane | 1.46 | 3.07 | 2.31 | 8.11 | 4.44 | 13.58 | 0.24 | 2.66 |
| i-Pentane | 0.52 | 5.23 | 1.74 | 6.72 | 3.76 | 5.92 | 0.23 | 1.33 |
| n-Pentane | 0.25 | 1.51 | 0.92 | 3.12 | 0.22 | 3.55 | 0.20 | 0.70 |
| 2,2-Dimethylbutane | - | - | 0.06 | - | 0.73 | 0.28 | 0.08 | 0.08 |
| Cyclopentane | - | - | 0.14 | - | 1.31 | 1.42 | 0.04 | 0.08 |
| 2,3-Dimethylbutane | - | - | 0.11 | - | - | - | 0.03 | 0.11 |
| 2-Methylpentane | - | - | 0.39 | - | 0.05 | 1.08 | 0.14 | 0.37 |
| 3-Methylpentane | - | - | 0.28 | - | - | - | 0.05 | 0.29 |
| n-Hexane | - | 0.50 | 0.47 | 1.75 | 4.50 | 4.88 | 0.10 | 0.56 |
| Methylcyclopentane | - | - | 0.22 | - | 0.31 | 0.17 | - | 0.13 |
| 2,4-Dimethylpentane | - | - | 0.05 | - | - | - | - | 0.06 |
| Cyclohexane | - | - | 0.12 | - | 0.54 | 0.73 | 0.02 | 0.18 |
| 2-Methylhexane | - | - | 0.23 | - | 0.61 | 0.11 | - | 0.12 |
| 2,3-Dimethylpentane | - | - | 0.03 | - | 0.71 | 0.43 | - | 0.07 |
| 3-Methylhexane | - | - | 0.22 | - | - | - | - | 0.14 |
| 2,2,4-Trimethylpentane | - | - | 0.31 | - | - | - | - | 0.13 |
| n-Heptane | - | 0.40 | 0.18 | - | 1.11 | 1.23 | 0.05 | 0.16 |
| Methylcyclohexane | - | - | 0.22 | - | 2.36 | 0.28 | - | 0.21 |
| 2,3,4-Trimethylpentane | - | - | 0.08 | - | 2.43 | 0.39 | - | - |
| 2-Methylheptane | - | - | 0.04 | - | 2.18 | 0.22 | - | - |
| 3-Methylheptane | - | - | 0.05 | - | - | - | - | - |
| n-Octane | 0.18 | 0.13 | 0.06 | - | 2.20 | 0.28 | 0.07 | 0.10 |
| n-Nonane | - | - | 0.10 | - | 2.32 | 0.50 | - | 0.13 |
| n-Decane | - | - | - | - | - | - | - | 0.19 |
| n-Undecane | - | - | - | - | - | - | - | 0.13 |
| n-Dodecane | - | - | - | - | - | - | - | - |
| Ethylene | 1.47 | 7.83 | 2.10 | 1.81 | 8.49 | 4.75 | 0.08 | 2.89 |
| Propene | 0.32 | 2.01 | 1.12 | 1.12 | 22.29 | 2.30 | 0.24 | 0.71 |
| 1-Butene | 0.09 | 0.61 | 0.15 | - | 0.26 | 0.47 | 0.05 | 0.21 |
| 1,3-Butadiene | 0.05 | 0.40 | 0.17 | - | - | - | - | - |
| trans-2-Butene | - | 0.59 | 0.06 | - | 0.39 | 0.27 | 0.02 | 0.14 |
| cis-2-Butene | - | 0.43 | 0.04 | - | 7.25 | 0.15 | 0.02 | 0.14 |
| 1-Pentene | - | 0.15 | 0.06 | - | 4.57 | 0.15 | - | 0.15 |
| Isoprene | - | 0.19 | 0.54 | 0.74 | - | - | - | 0.66 |
| trans-2-Pentene | - | 0.32 | 0.06 | - | 0.22 | 0.50 | - | 0.15 |
| cis-2-Pentene | - | 0.16 | 0.03 | - | 1.03 | 0.53 | - | 0.10 |
| 2-Methyl-2-butene | - | - | 0.03 | - | - | - | - | - |
| Benzene | 0.42 | 2.43 | 0.34 | 3.41 | 3.93 | 2.30 | 0.23 | 0.52 |
| Toluene | 2.77 | 5.12 | 0.80 | 12.60 | 30.93 | 12.73 | 0.17 | 2.54 |
| Ethylbenzene | 0.40 | 0.81 | 0.16 | - | 3.20 | 1.48 | - | 0.52 |
| m/p-Xylene | 0.70 | 2.56 | 0.53 | 12.20 | 6.20 | 2.50 | - | 0.68 |
| Styrene | - | - | 0.30 | - | 3.48 | 0.55 | - | 0.13 |
| o-Xylene | - | 0.99 | 0.20 | - | 2.29 | 1.95 | - | 0.25 |
| Isopropylbenzene | - | - | 0.02 | - | 2.13 | 0.87 | - | - |
| n-Propylbenzene | - | - | 0.03 | - | - | - | - | - |
| m-Ethyltoluene | - | - | 0.08 | - | - | - | - | 0.20 |
| p-Ethyltoluene | - | - | - | - | - | - | - | 0.11 |
| 1,3,5-Trimethylbenzene | - | 0.27 | 0.08 | - | - | - | - | 0.16 |
| o-Ethyltoluene | - | - | - | - | - | - | - | 0.11 |
| 1,2,4-Trimethylbenzene | - | 0.78 | 0.20 | - | - | - | - | - |
| 1,2,3-Trimethylbenzene | - | 0.24 | - | - | - | - | - | 0.14 |
| 1,3-Diethylbenzene | - | - | 0.04 | - | - | - | - | 0.08 |
| 1,4-Diethylbenzene | - | - | 0.06 | - | - | - | - | 0.13 |
| 1,2-Diethylbenzene | - | - | - | - | - | - | - | - |
| Ethyne | 1.95 | 5.13 | 0.67 | 0.73 | 11.35 | 4.92 | 0.23 | 1.99 |

**Table S2. Ozone formation potentials (OFPs) of VOCs in the southerly and northerly air masses during period I, II and III.**

| | | Ozone formation potentials, ppbv | | | | |
|---|---|---|---|---|---|---|
| | | Alkanes | Alkenes | Aromatics | Ethyne | Sum |
| Period I | | 10.02 | 25.90 | 21.81 | 2.91 | 60.64 |
| Period II | | 4.51 | 17.42 | 5.07 | 1.51 | 28.51 |
| Period III | | 8.78 | 36.73 | 13.17 | 2.80 | 61.47 |
| Period I | South [a] | 12.04 | 30.03 | 23.57 | 3.58 | 69.21 |
| | North [b] | 3.97 | 13.53 | 16.53 | 0.90 | 34.92 |
| Period II | South [a] | 6.07 | 20.46 | 7.29 | 2.08 | 35.89 |
| | North [b] | 2.27 | 13.04 | 1.85 | 0.69 | 17.86 |
| Period III | South [a] | 14.15 | 67.64 | 25.40 | 5.51 | 112.70 |
| | North [b] | 5.93 | 20.38 | 6.70 | 1.36 | 34.39 |

[a] For the datasets in the southerly air masses; [b] For the datasets in the northerly air masses.

**Table S3. Secondary organic aerosol formation potentials (SOAFPs) of VOCs in the southerly and northerly air masses during period I, II and III.**

| | | Secondary organic aerosol formation potentials, μg $m^{-3}$ | | | | | |
|---|---|---|---|---|---|---|---|
| | | Low-NOx | | | High-NOx | | |
| | | Alkanes | Aromatics | Sum | Alkanes | Aromatics | Sum |
| Period I | | 1.47 | 7.30 | 8.77 | 1.63 | 2.39 | 4.02 |
| Period II | | 0.61 | 1.93 | 2.54 | 0.68 | 0.75 | 1.43 |
| Period III | | 0.68 | 4.62 | 5.30 | 0.75 | 1.68 | 2.43 |
| Period I | South [a] | 1.66 | 8.08 | 9.74 | 1.83 | 2.71 | 4.54 |
| | North [b] | 0.91 | 4.96 | 5.86 | 1.01 | 1.44 | 2.45 |
| Period II | South [a] | 0.75 | 2.80 | 3.55 | 0.84 | 1.09 | 1.92 |
| | North [b] | 0.40 | 0.68 | 1.09 | 0.45 | 0.27 | 0.72 |
| Period III | South [a] | 1.08 | 9.11 | 10.19 | 1.17 | 3.37 | 4.54 |
| | North [b] | 0.47 | 2.25 | 2.72 | 0.52 | 0.79 | 1.31 |

[a] For the datasets in the southerly air masses; [b] For the datasets in the northerly air masses.

**Table S4. Average reductions of VOCs (ppbv) contributed by the control of different sources as derived from the PMF source apportioning results.**

| Sources | Average sources reduction contribution, ppbv | | |
|---|---|---|---|
| | All [a] | South [b] | North [c] |
| Gasoline exhaust | 3.18 | 4.00 | 0.57 |
| Industrial emission | 1.35 | 1.77 | 0.27 |
| Solvent use | 4.29 | 4.90 | 2.22 |
| Diesel exhaust | 2.28 | 2.03 | 1.71 |
| Coal/biomass burning | 0.31 | 0.16 | 0 |
| Total | 11.41 | 12.86 | 4.77 |

[a] For all the data; [b] For the datasets in the southerly air masses; [c] For the datasets in the northerly air masses.

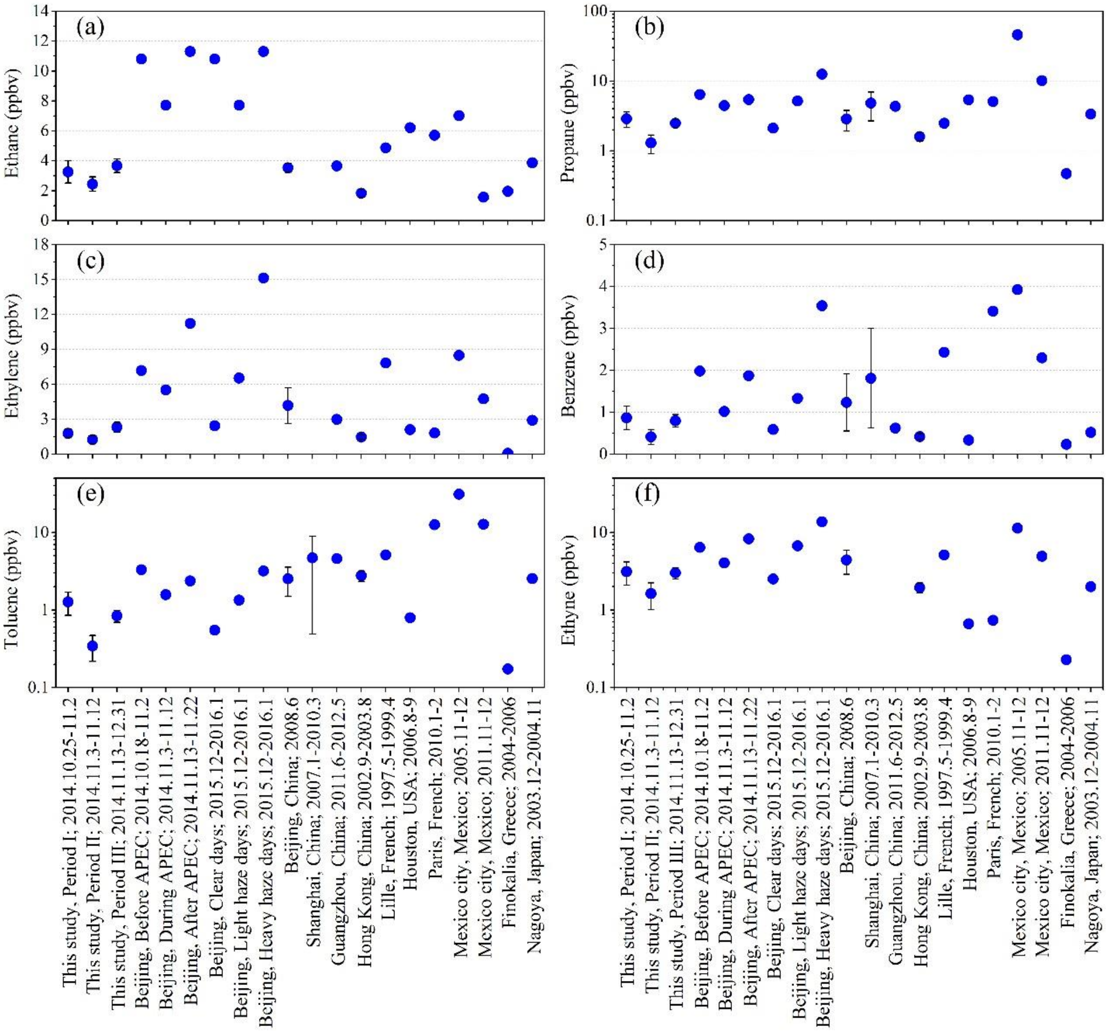


Figure S1. Comparison of (a) ethane, (b) propane, (c) ethylene, (d) benzene, (e) toluene and (f) ethyne observed at UCAS with those from other studies at metropolitan areas in the world.

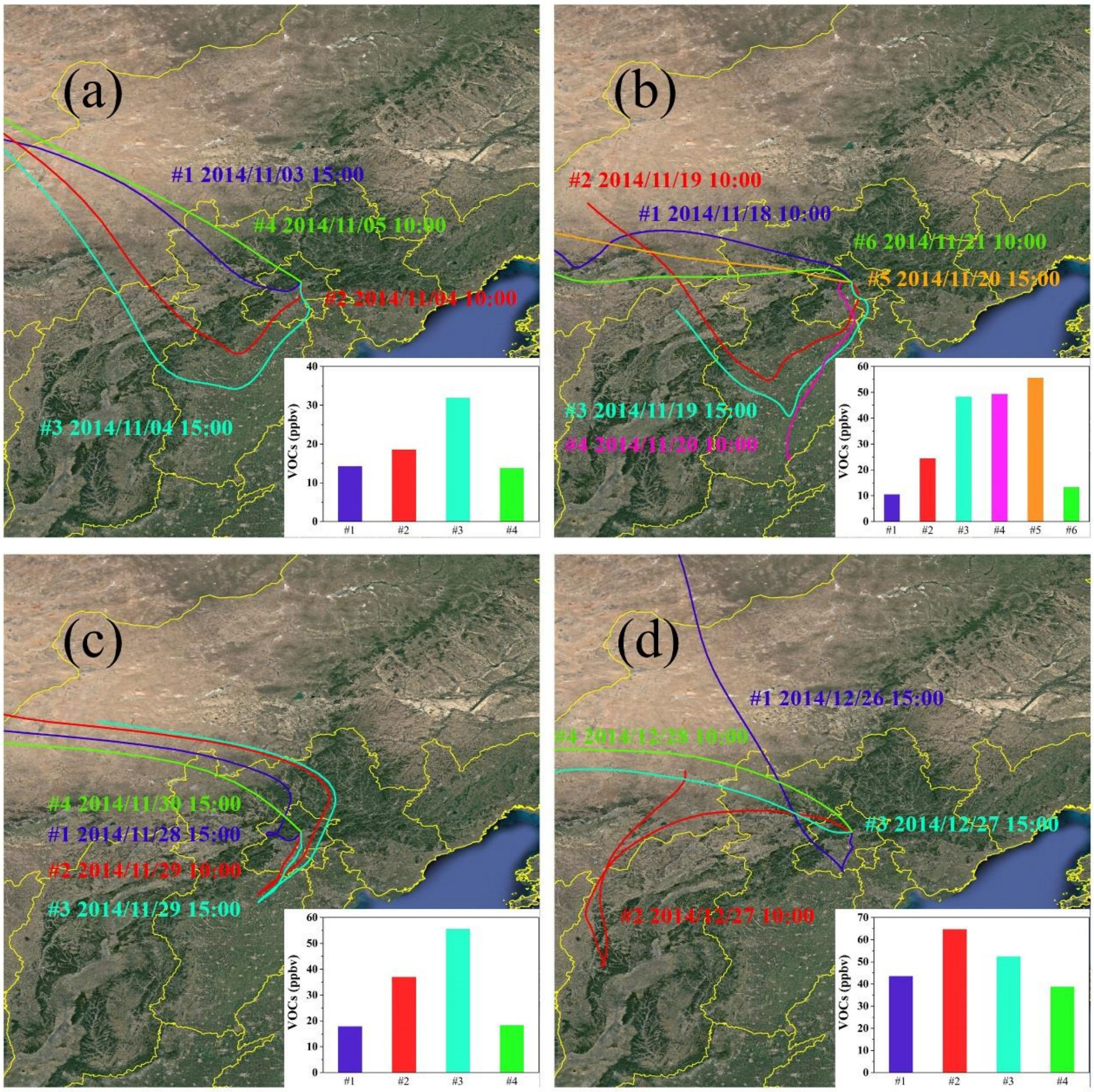


Figure S2. Mixing ratios of VOCs and corresponding back trajectories of air masses arriving at 100 m above the ground level during (a) 3-5 November, (b) 18-21 November, (c) 28-30 November, and (d) 26-28 December, respectively.

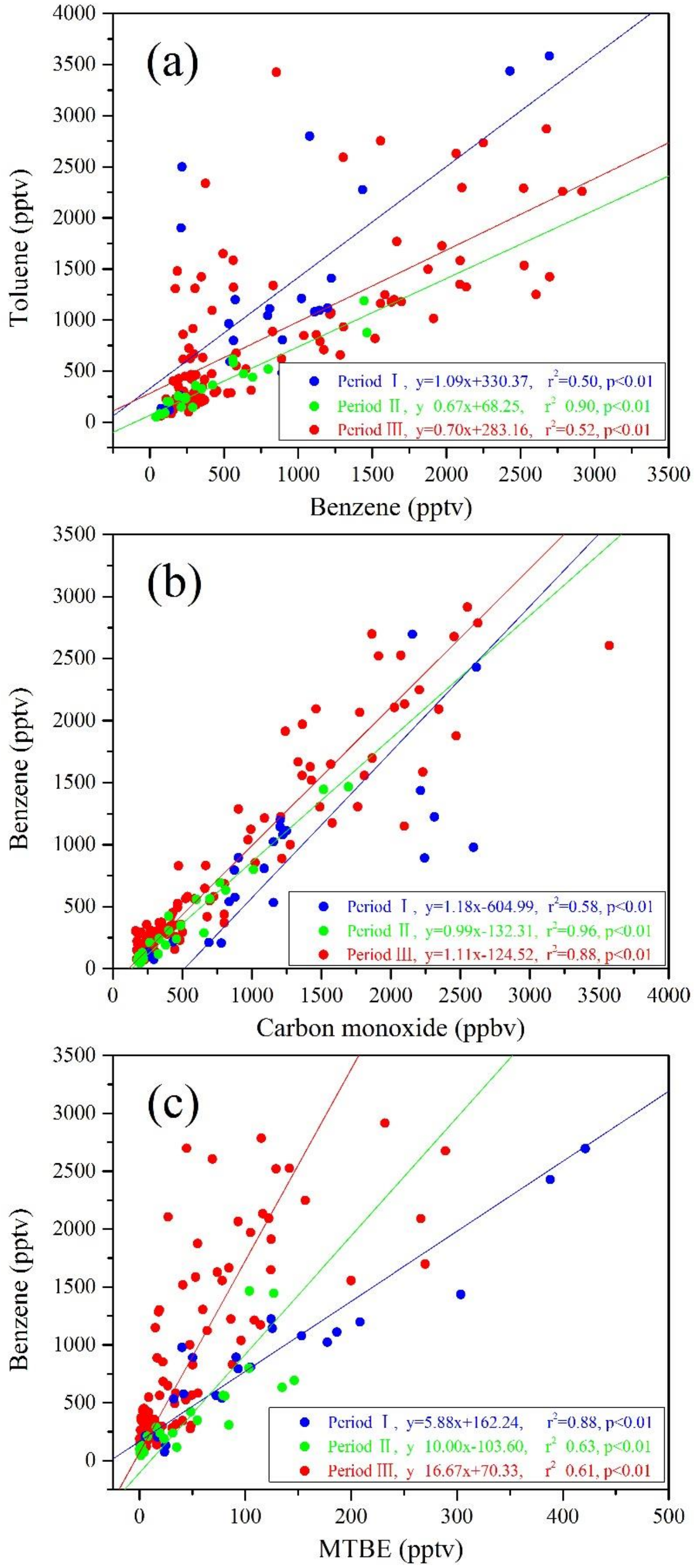


Figure S3. Scatter plots of (a) toluene versus benzene, (b) benzene versus carbon monoxide, and (c) benzene versus methyl tert-butyl ether (MTBE), during period I (in blue), II (in green) and III (in red).

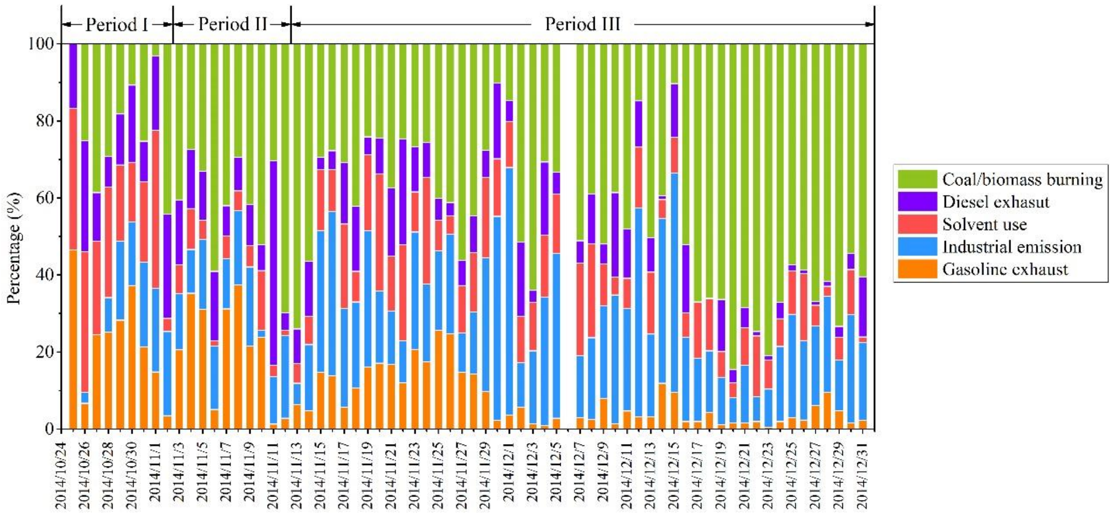


Figure S4. Time series of source contributions based on PMF results (No data on 2014/12/6 due to unexpected power failure).

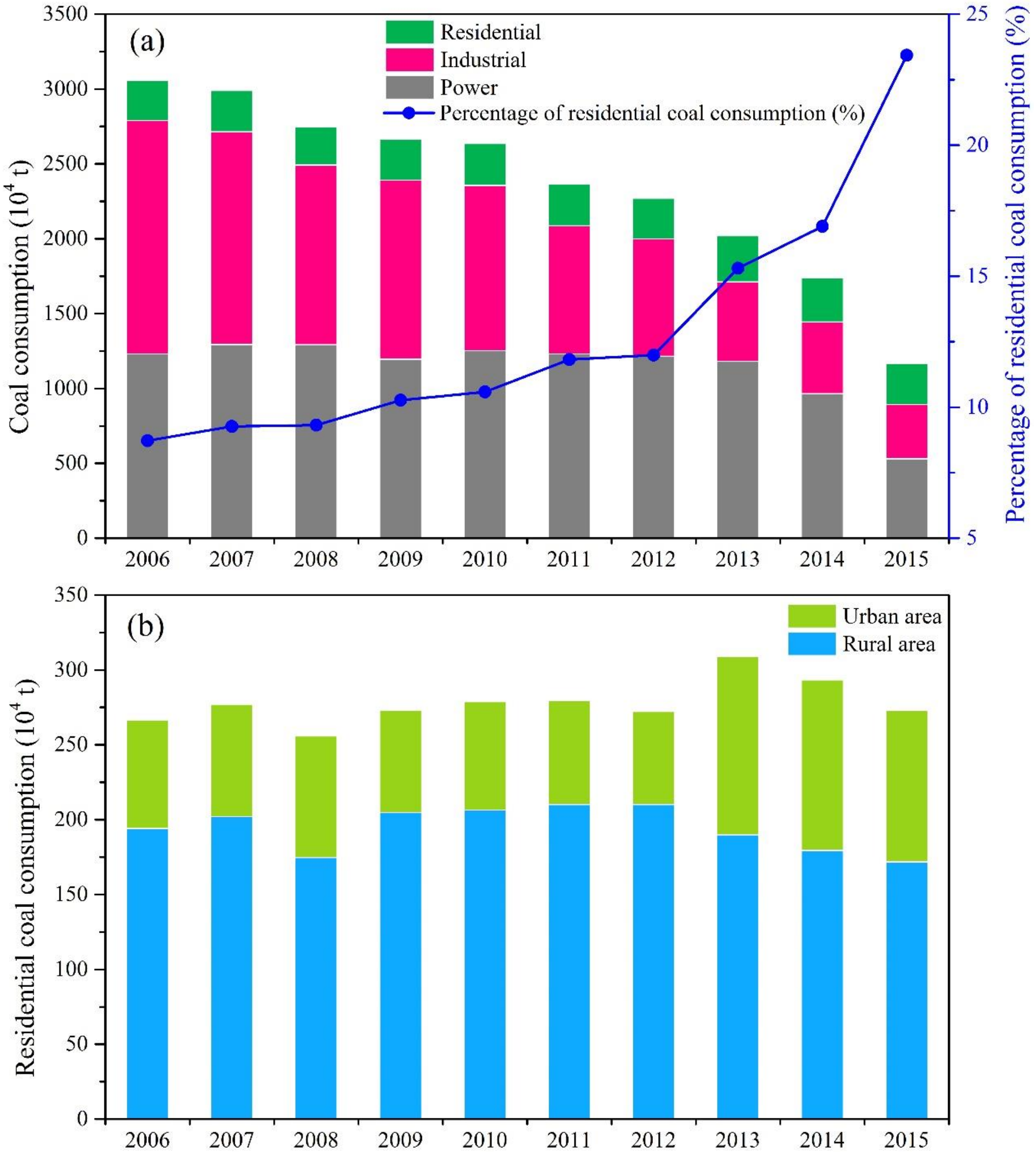


Figure S5. (a) The total coal consumption in residential, industrial and power generation sectors and the percentage of residential coal consumption in total coal consumption in Beijing during 2006-2015; (b) Residential coal consumption in urban and rural areas of Beijing during 2006-2015.

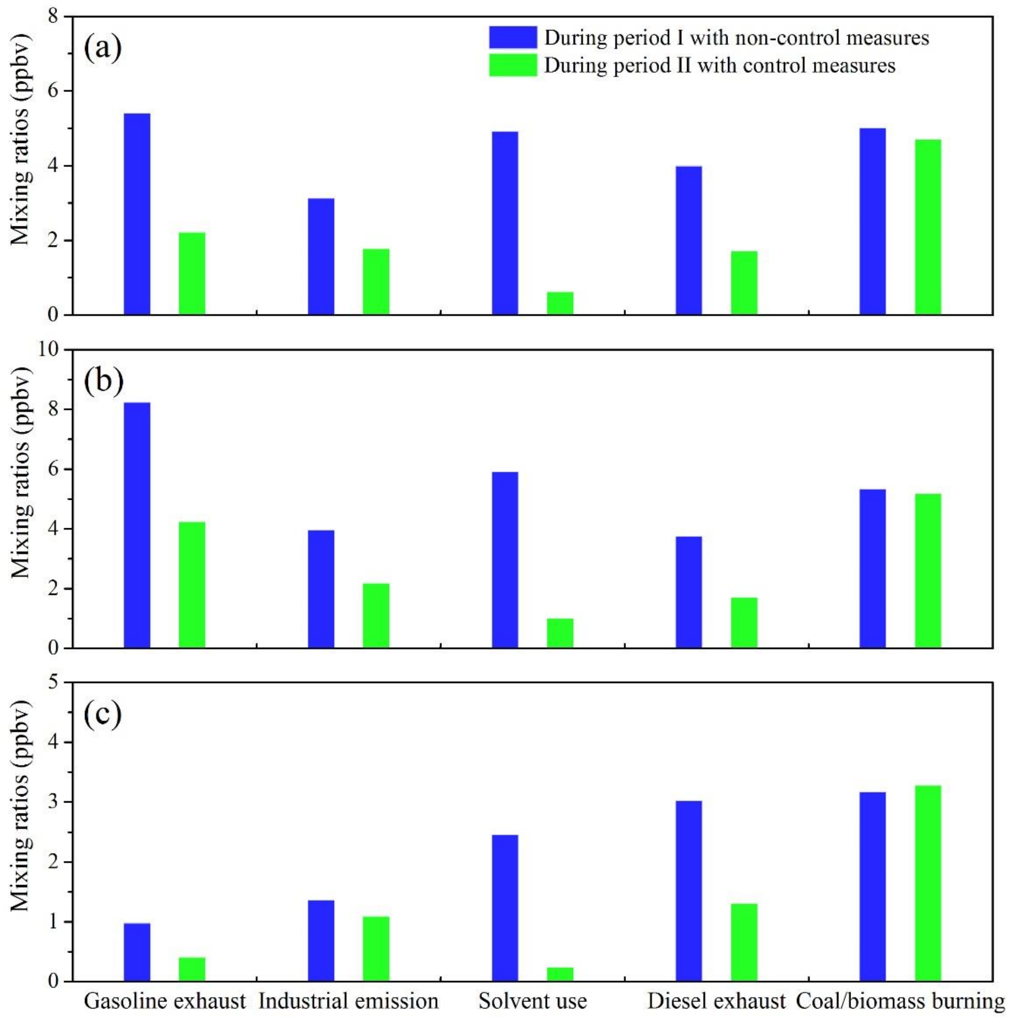


Figure S6. Sources contributions (a) in all samples, (b) in the air masses from the south, and (c) in the air masses from north during period I and II, as resolved from the PMF model.

## References

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