# Exploring the amplied role of HCHO during the wintertime ozone and $PM_{2.5}$ pollution in a coastal city of southeast China

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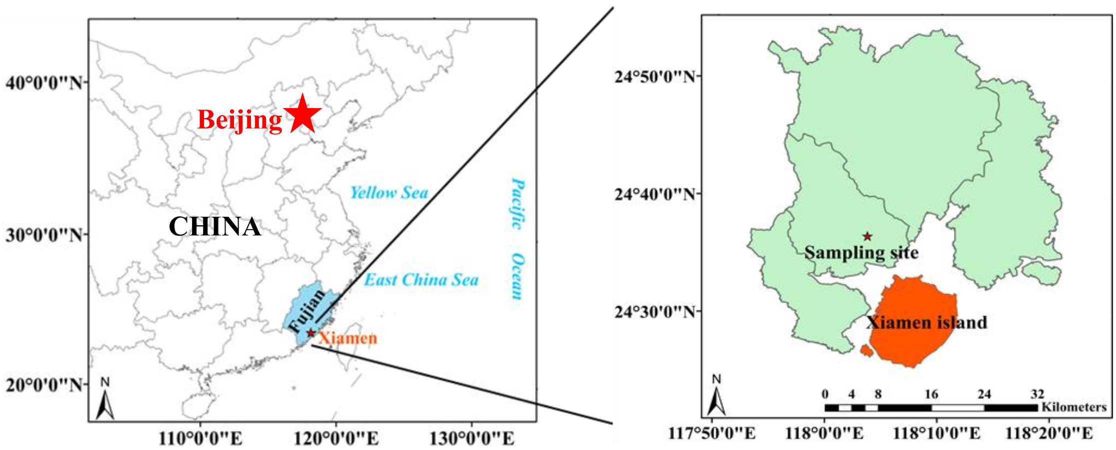


**Fig S1. Location of the observation site in a coastal city of Southeast China**

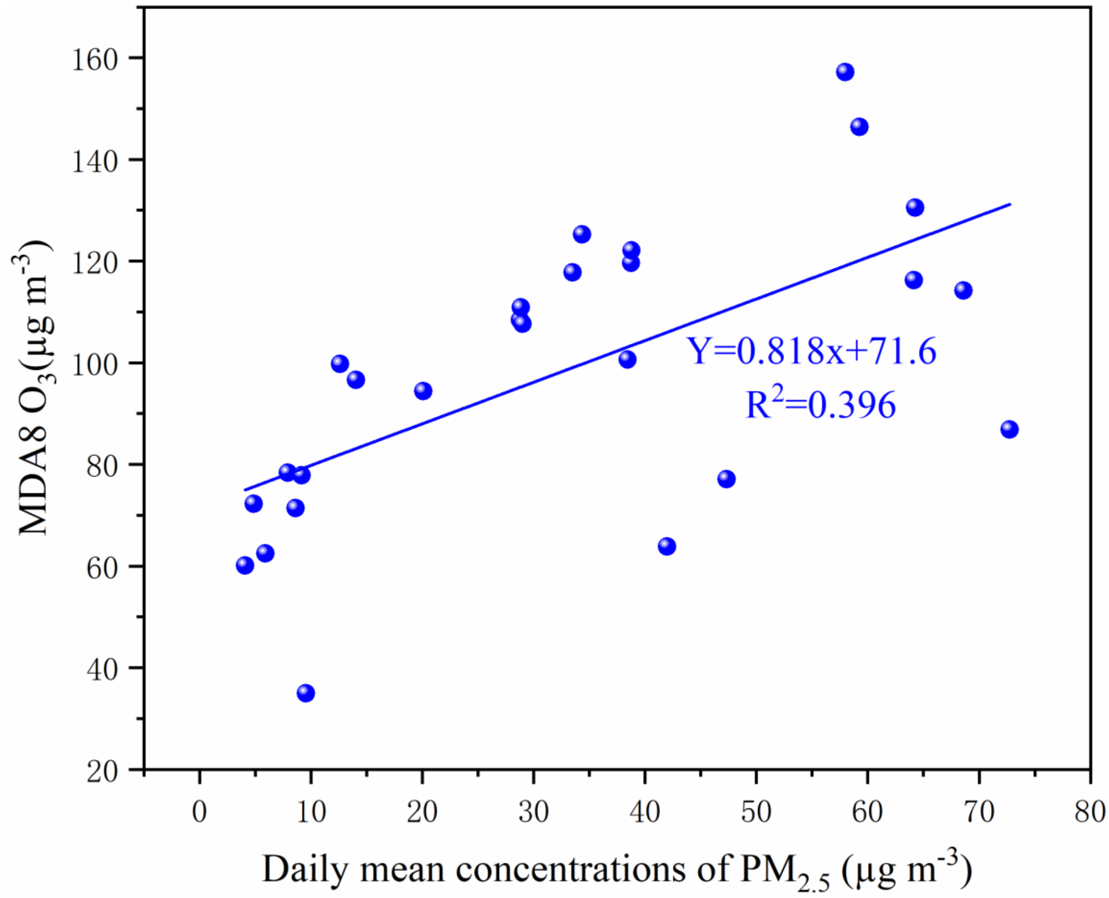


**Fig S2. The correlation of $PM_{2.5}$ and MDA8 O3 concentrations during the whole periods**

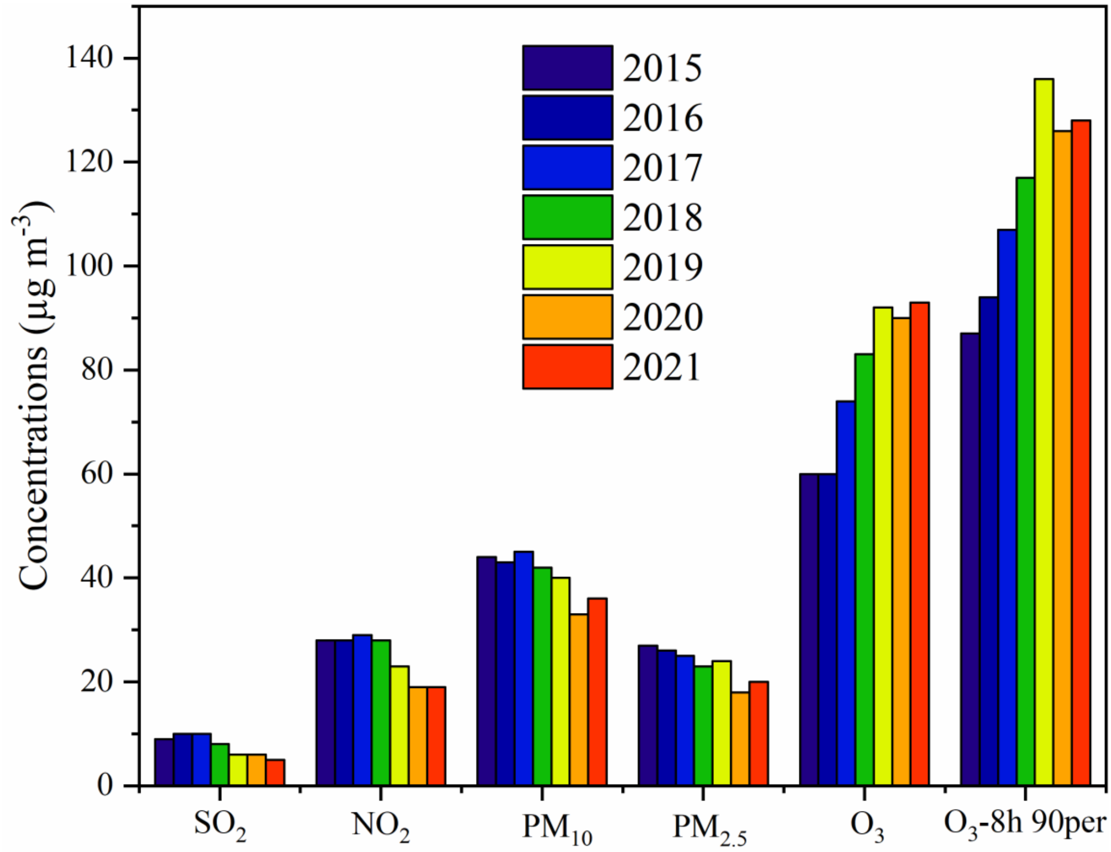


**Fig S3. Inter-annual mean concentrations of criteria air pollutants in Xiamen, a coastal city of Southeast China**

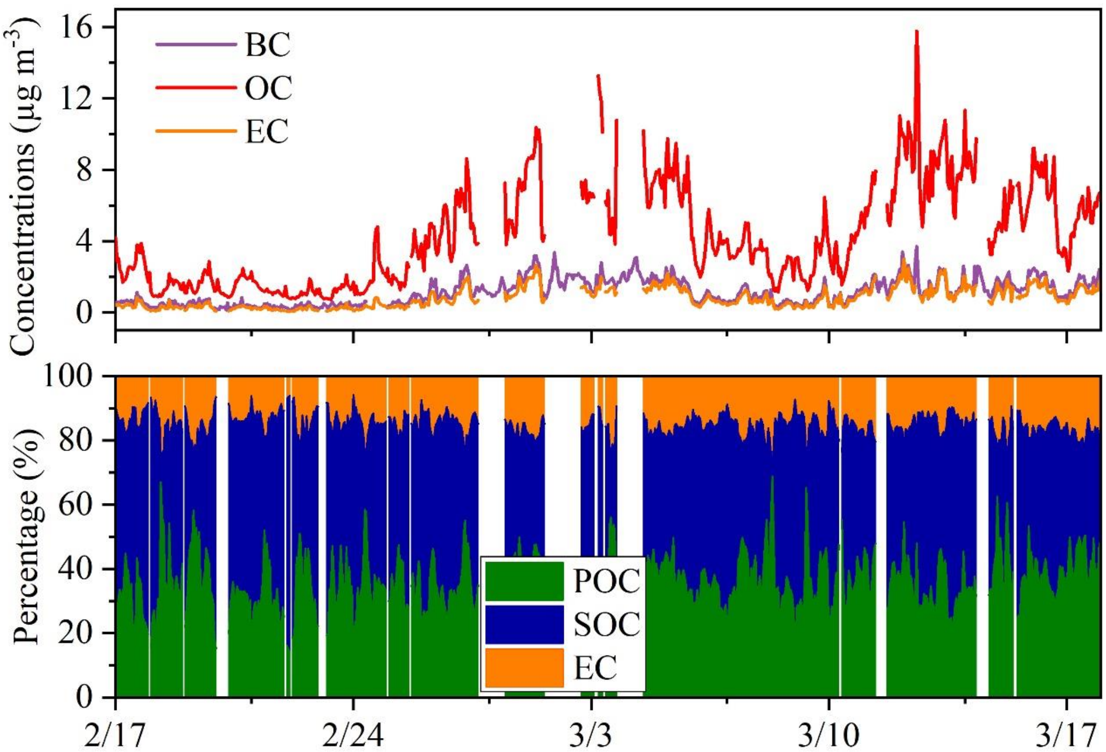


**Fig S4. The concentrations and percentages of OC, EC, and BC during the whole periods**

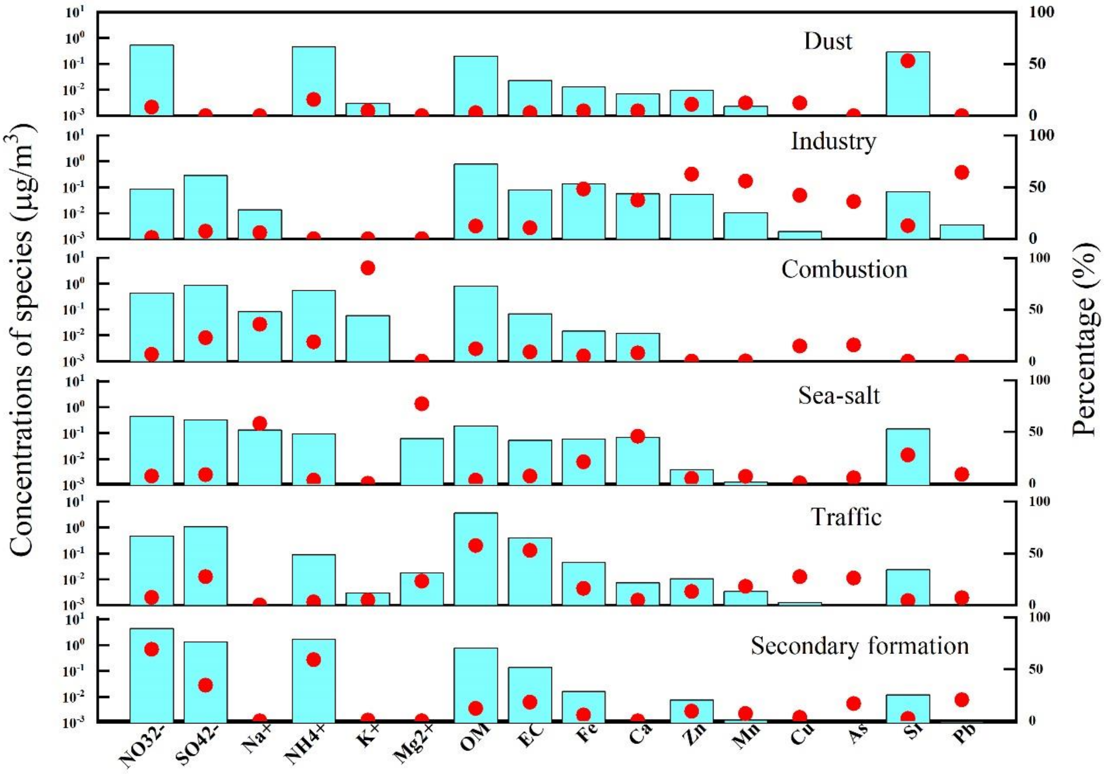


**Fig S5. The factor profiles and the contribution of various sources to $PM_{2.5}$ by the positive matrix factorization (PMF) model analysis. The bars represent the concentrations of various species and the dots represent the contributions of species to the factors.**

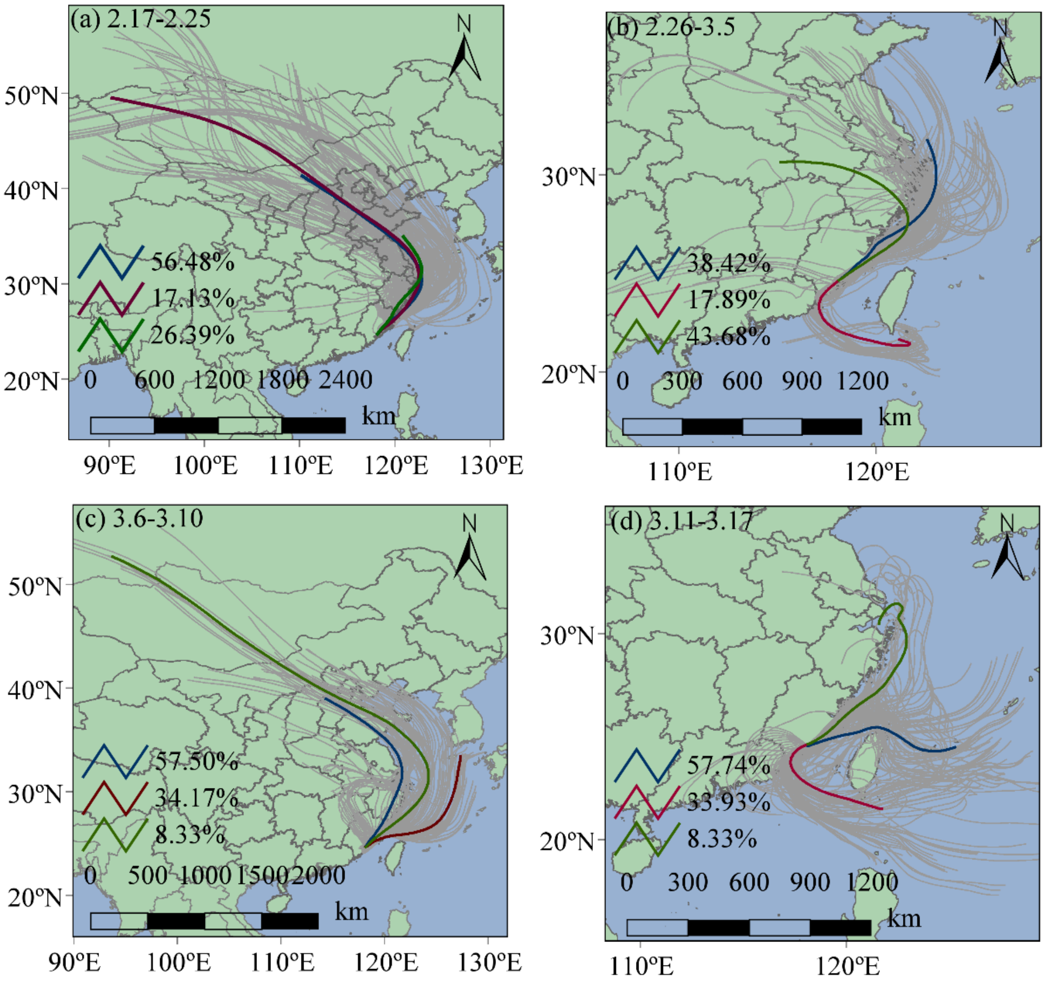


**Fig.S6 Backward trajectory clusters at the monitoring site under different periods**

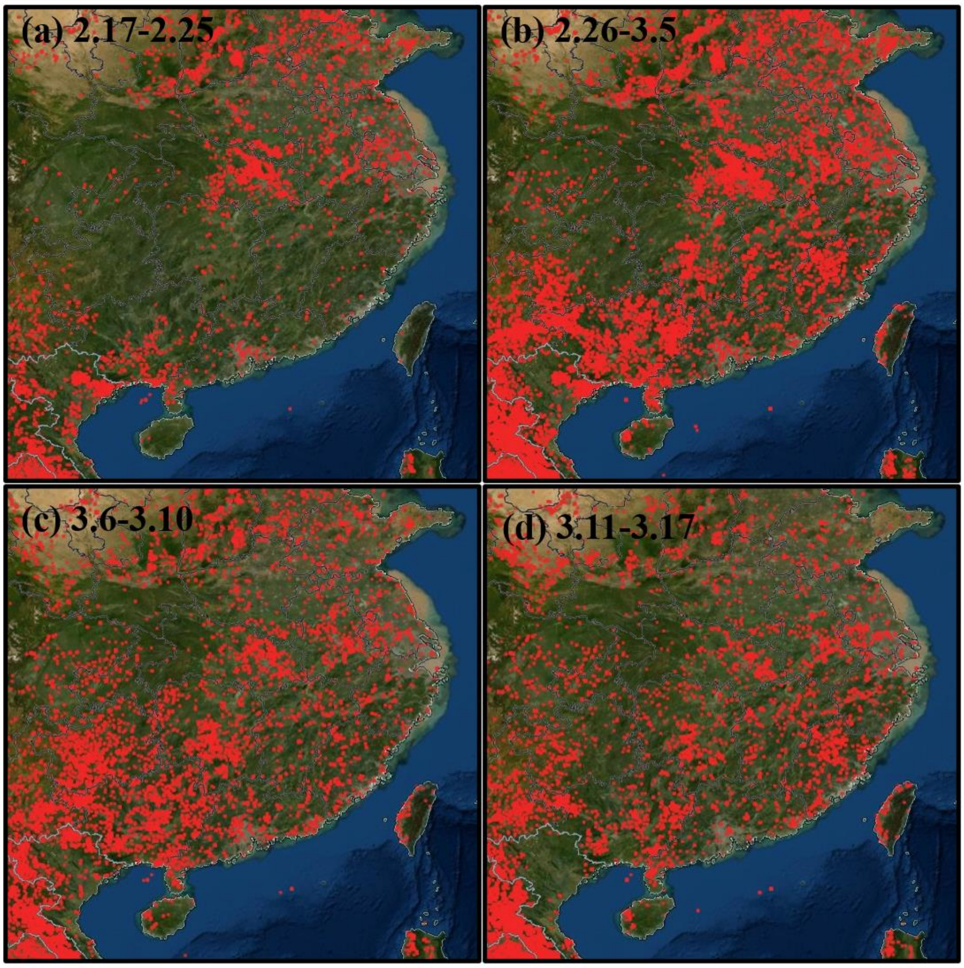


**Fig.S7 The distribution of fire spots around the monitoring site under different periods (From the Fire Information for Resource Management System, https://firms.modaps.eosdis.nasa.gov/firemap/)**

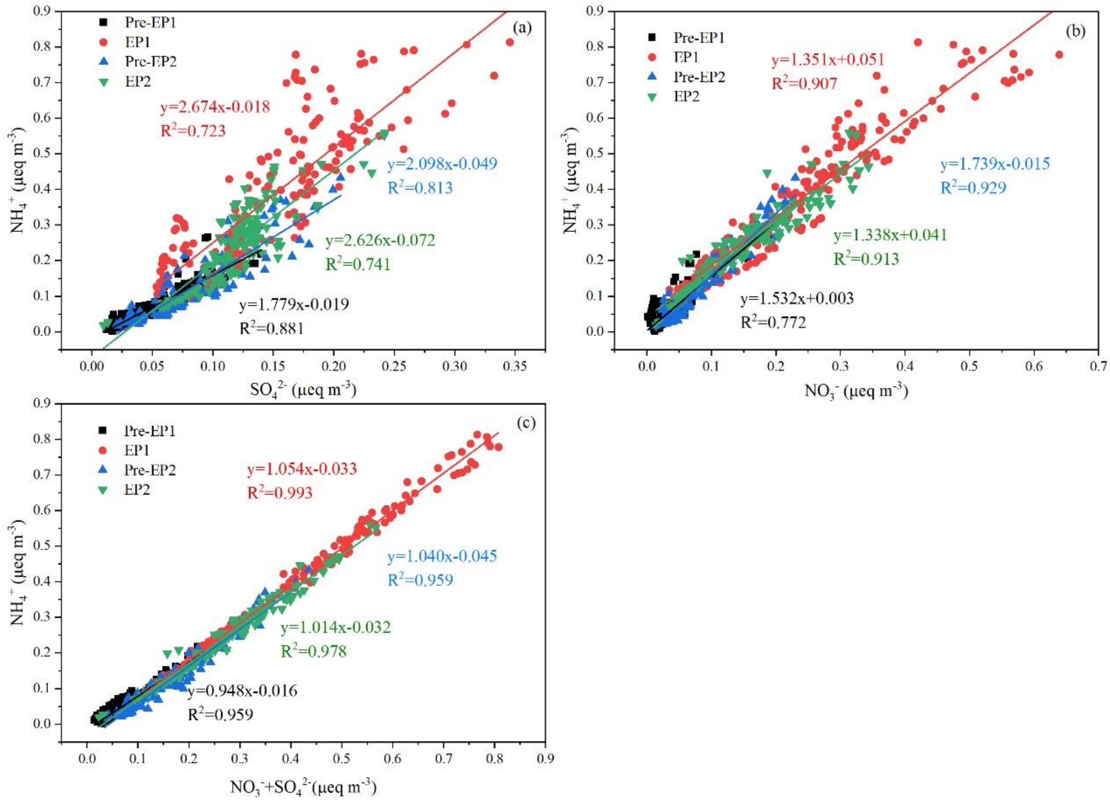


**Fig S8.The correlations between (a) $NH_4^+$ and $SO_4^{2-}$, (b) $NH_4^+$ and $NO_3^-$, and (c) $NH_4^+$ and $NO_3^-+SO_4^{2-}$**

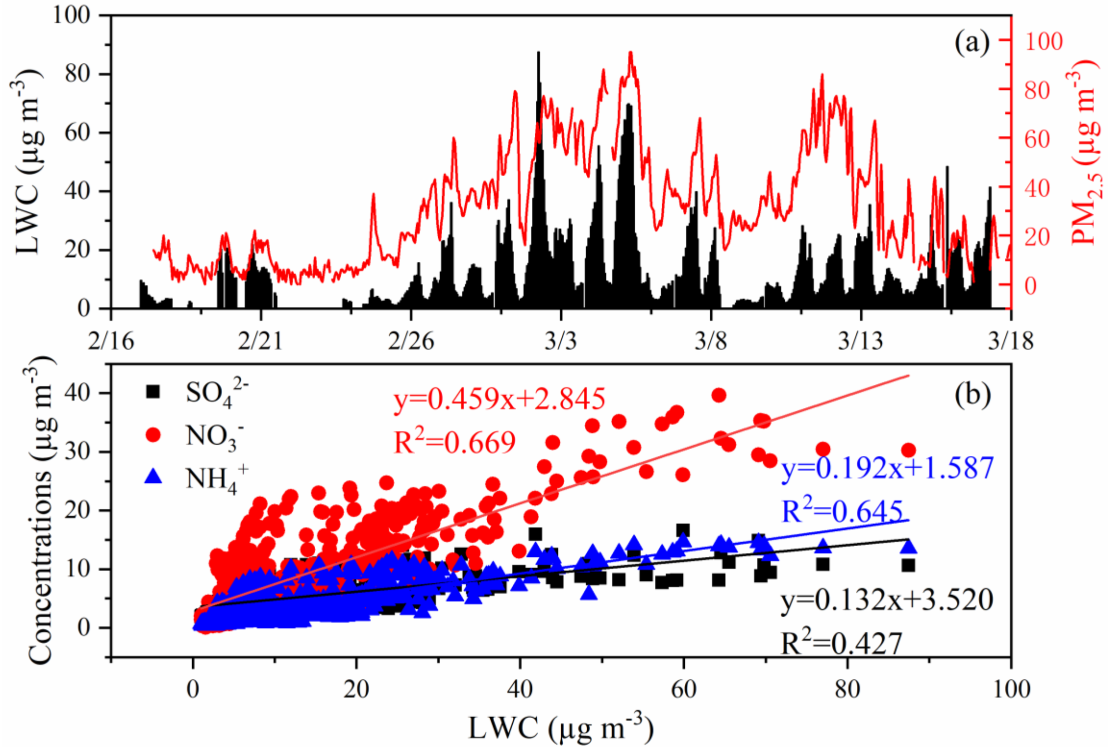


**Fig S9. The correlations between liquid water content (LWC) of aerosols and concentrations of secondary inorganic aerosol (SIA, including $SO_4^{2-}$, $NO_3^-$ and $NH_4^+$)**

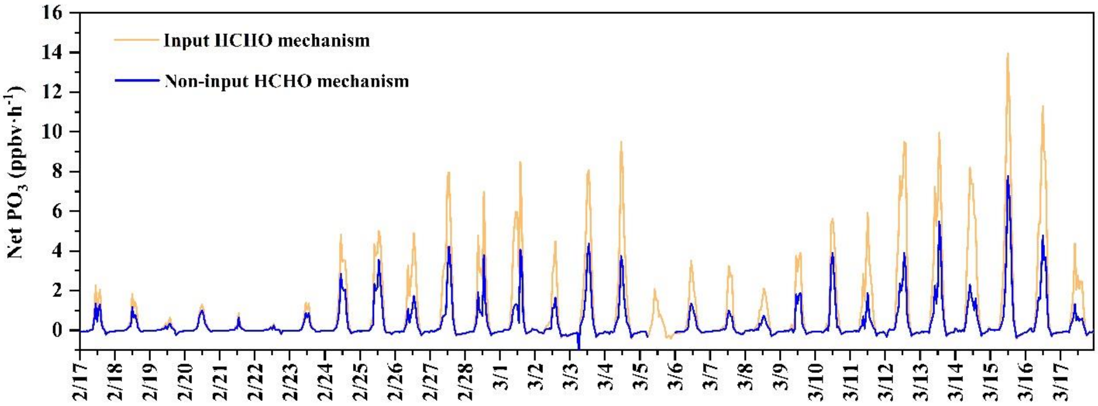


**Fig S10. The net $O_3$ production rates modeled by the OBM with or without HCHO mechanism**

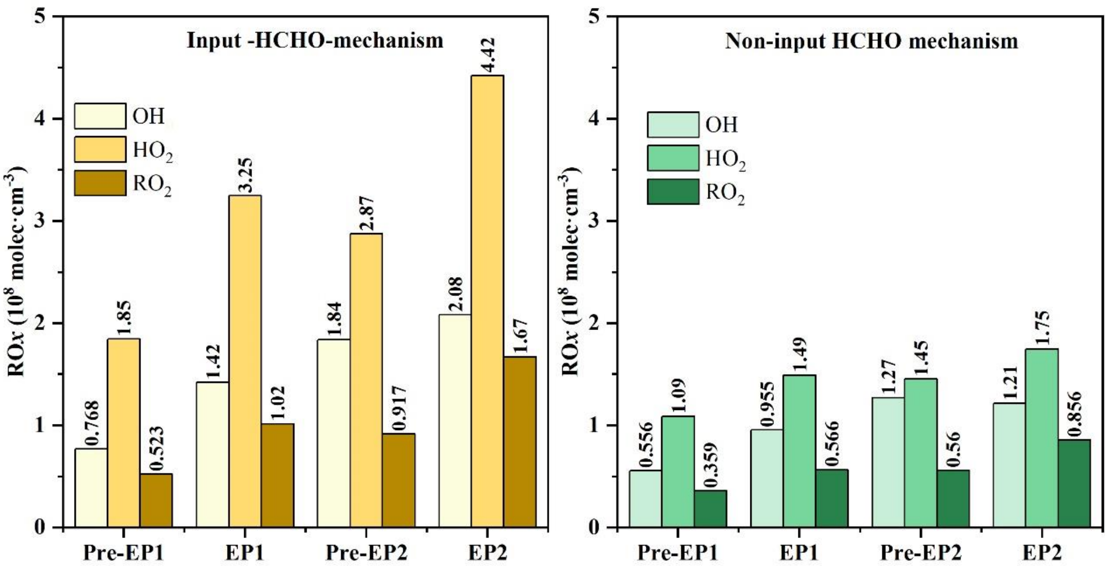


**Fig S11. The ROx concentrations modeled by the OBM with or without HCHO mechanism**

Table S1 Mean concentrations of air pollutants, chemical compositions and meteorological parameters under different pollution stages

| | Pre-EP1 | EP1 | Pre-EP2 | EP2 |
|---|---|---|---|---|
| $PM_{2.5}$(μg $m^{-3}$) | 9.03±6.28 | 51.94±19.02 | 33.53±10.41 | 35.34±23.51 |
| $PM_{10}$(μg $m^{-3}$) | 13.68±10.51 | 74.43±24.40 | 57.46±21.11 | 58.21±28.98 |
| $O_3$(μg $m^{-3}$) | 60.82±18.57 | 67.12±44.73 | 76.58±31.83 | 58.98±47.97 |
| CO(μg $m^{-3}$) | 531.02±63.18 | 742.86±121.34 | 379.17±95.65 | 577.98±97.24 |
| $SO_2$(μg $m^{-3}$) | 9.16±3.47 | 13.74±7.61 | 16.26±2.68 | 18.20±6.58 |
| $NO_2$(μg $m^{-3}$) | 12.40±7.00 | 31.38±14.20 | 22.01±10.82 | 32.56±11.08 |
| NO(μg $m^{-3}$) | 1.5±1.31 | 5.56±9.51 | 2.04±14.29 | 6.13±8.02 |
| Ox(μg $m^{-3}$) | 73.22±12.78 | 98.50±29.45 | 88.59±21.32 | 91.54±29.57 |
| BC(μg $m^{-3}$) | 0.45±0.19 | 1.69±0.56 | 0.78±0.32 | 1.61±0.54 |
| OC(μg $m^{-3}$) | 1.69±0.81 | 6.36±2.16 | 3.20±1.52 | 7.48±5.03 |
| EC(μg $m^{-3}$) | 0.27±0.17 | 1.23±0.50 | 0.59±1.51 | 1.29±0.51 |
| $SO_4^{2-}$(μg $m^{-3}$) | 1.96±1.26 | 7.07±2.91 | 3.87±2.24 | 5.87±1.70 |
| $NO_3^-$(μg $m^{-3}$) | 2.02±1.81 | 14.95±8.34 | 4.83±2.83 | 9.69±4.89 |
| $NH_4^+$(μg $m^{-3}$) | 0.96±0.90 | 6.77±3.43 | 2.16±1.63 | 4.46±1.88 |
| NOR | 0.16±0.07 | 0.32±0.08 | 0.18±0.06 | 0.24±0.05 |
| SOR | 0.19±0.07 | 0.38±0.18 | 0.19±0.06 | 0.26±0.08 |
| T(℃) | 12.38±3.89 | 20.56±3.90 | 18.65±4.17 | 23.93±4.30 |
| RH(%) | 69.41±12.45 | 63.17±10.32 | 54.30±15.52 | 62.17±11.05 |
| P(kPa) | 101.14±0.36 | 100.71±0.30 | 100.68±0.15 | 100.17±0.21 |
| WS(m/s) | 1.64±0.70 | 1.02±0.51 | 1.37±0.59 | 0.93±0.54 |
| UV(W/$m^2$) | 5.88±9.58 | 9.31±13.94 | 11.08±16.09 | 11.10±15.05 |
| $JNO_2$(×$10^{-3}$ $s^{-1}$) | 1.50±2.45 | 2.49±3.57 | 2.91±3.94 | 2.95±3.79 |
| HONO(μg $m^{-3}$) | 0.75±0.36 | 3.10±2.25 | 1.19±0.58 | 4.19±2.68 |
| HCHO(ppb) | 0.68±0.71 | 2.94±1.01 | 1.59±0.71 | 3.59±1.36 |
| TVOCs(ppb) | 14.47±7.14 | 29.39±11.65 | 14.28±6.18 | 29.91±12.05 |

| | | | | |
|---|---|---|---|---|
| Aromatics(ppb) | 1.29±1.36 | 3.21±1.92 | 1.54±1.29 | 3.06±1.87 |
| Alkynes(ppb) | 0.78±0.41 | 1.04±1.00 | 0.12±0.06 | 0.77±0.72 |
| Alkanes(ppb) | 6.48±2.06 | 10.27±5.07 | 4.46±1.92 | 9.73±4.46 |
| Alkenes(ppb) | 0.75±0.52 | 1.28±0.84 | 0.49±0.42 | 1.37±1.09 |
| OVOCs(ppb) | 0.87±0.35 | 1.21±0.23 | 1.01±0.41 | 1.22±0.25 |
| Halohydrocarbon(ppb) | 4.30±3.69 | 12.40±4.77 | 6.65±3.03 | 13.76±5.76 |