S1 Methods

S1.1 Sampling sites

Beijing: samples were collected on the roof of a three-story building (10m above the ground level) in the campus of Chinese Research Academy of Environmental Science (CRAES) (116.40°E, 40.03°N), which is located in the urban downtown area of northern Beijing, China, at a flow rate of 16.7 L min^{-1} from December 28, 2022 to January 18, 2023, and from November 16 to 27, 2023. The sampling duration was 23 h (from 9:00 to 8:00 of the following day in local time, UTC+8).

Wangdu: the sampling site was on the platform (around 5m above ground) at the Station of Rural Environment, Research Center for Eco-Environmental Sciences (SRE-RCEES, 115.25°E, 38.67°N) situated in an open agricultural field of Wangdu county, Hebei Province of China. The station is 35 km southwest of Baoding city and 120 km away from Shijiazhuang city. Samples were collected at a flow rate of 16.7 L min^{-1} from December 28, 2022 to January 18, 2023, and from November 20, 2023 to December 11, 2023.

Changji: samples were collected on the roof of a six-story building (18m above the ground level) at Fukang City ecological environment Bureau (87.98°E, 44.15°N) in Changji Autonomous Prefecture in Xinjiang, China, at a flow rate of 100 L min^{-1} from November 3 to 19, 2019. The sampling duration was 23 h (from 9:00 to 8:00 of the following day in local time, UTC+8).

Xinxiang: the sampling site was located on the campus of Henan Normal University (113.91°E, 35.33°N, 25m above the ground level) in Xinxiang city, Henan Province of China. Samples were collected at a flow rate of 1050 L min^{-1} from November 20, 2023 to December 10, 2023. The sampling duration was 23 h (from 9:00 to 8:00 of the following day in local time, UTC+8).

Guangzhou: samples were collected on the roof of a three-story building (10m above the ground level) at Guangdong Ecological Engineering Polytechnic College (113.38°E, 23.19°N) in Guangzhou city, GuangDong Province of China, at a flow rate of 100 L min^{-1} from November 20, 2023 to December 10, 2023. The sampling duration was 23 h (from 9:00 to 8:00 of the following day in local time, UTC+8).

S1.2 Extended Aerosol Inorganic Model (E-AIM model)

E-AIM model (http://www.aim.env.uea.ac.uk/aim) is applied for calculating the partitioning of gases, liquids, and solids in aerosol systems that include inorganic and organic components as well as water. This model has been widely utilized in numerous studies to explore aerosol formation, aging, and the impact of diverse atmospheric conditions on aerosol composition (Shi et al., 2021; Wexler and Clegg, 2002; Clegg et al., 1998). In this work, the Model IV, which is an equilibrium thermodynamic model of the system H^+ - NH_4^+ - Na^+ - SO_4^{2-} - NO_3^- - Cl^- - H_2O, was applied to calculate aerosol pH. Aerosol pH was calculated based on H^+_{air} and liquid water content (LWC) from E-AIM IV output:

$$pH = -\log_{10}\gamma_{H^+}H^+_{aq} = -\log_{10}\gamma_{H^+}\frac{H^+_{air}}{LWC} \quad (1)$$

where, γ_{H^+} is the activity coefficient of H^+ (dimensionless, assumed to be 1), H^+_{aq} (mol kg $^{-1}$) is the concentration of H^+ in aerosol liquid water, H^+_{air} (mol m^{-3}) is the concentration of H^+ per unit volume of air, LWC is the amount of liquid water in unit volume of air (kg m^{-3}).

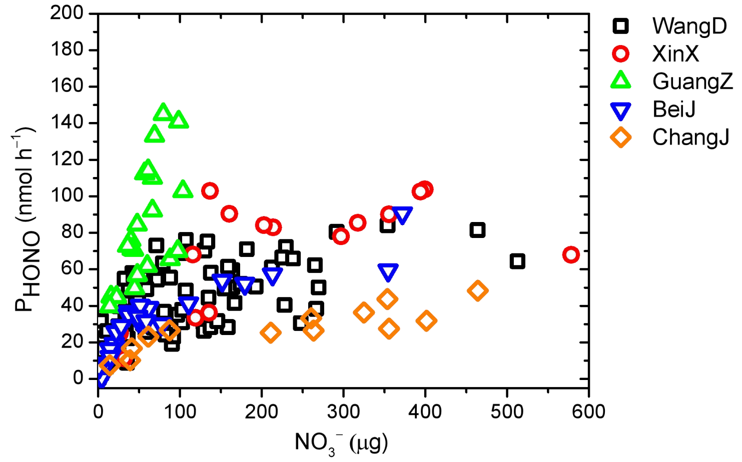

Figure S1 The relationships between P_{HONO} and particulate nitrate loadings in different sampling locations.

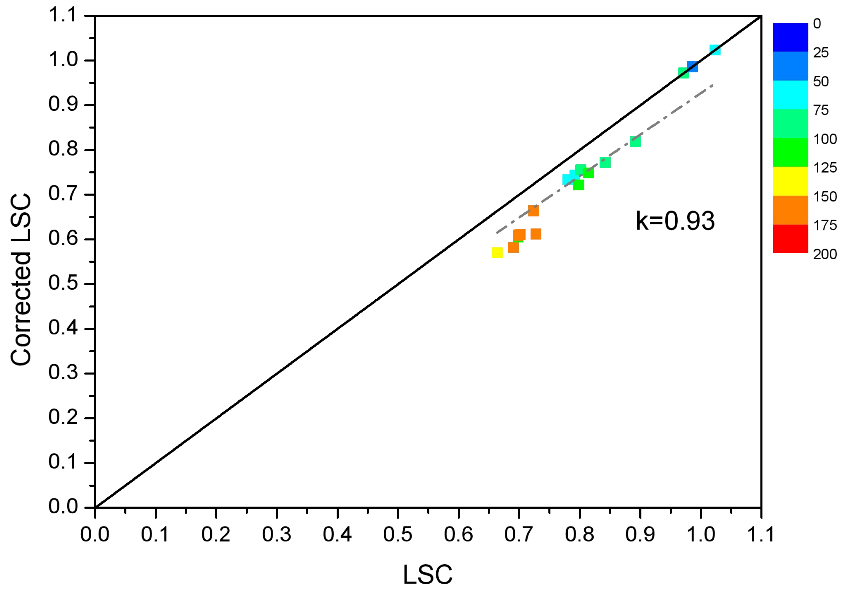

Figure S2 Scatter plot of the LSC and the corrected LSC for the aerosol samples collected in Wangdu. The dot colors represent the $PM_{2.5}$ surface concentrations. The solid-black line represented the 1:1 ratio, and the gray-dashed line reflected the linear fitted relationship between LSC and the corrected one.

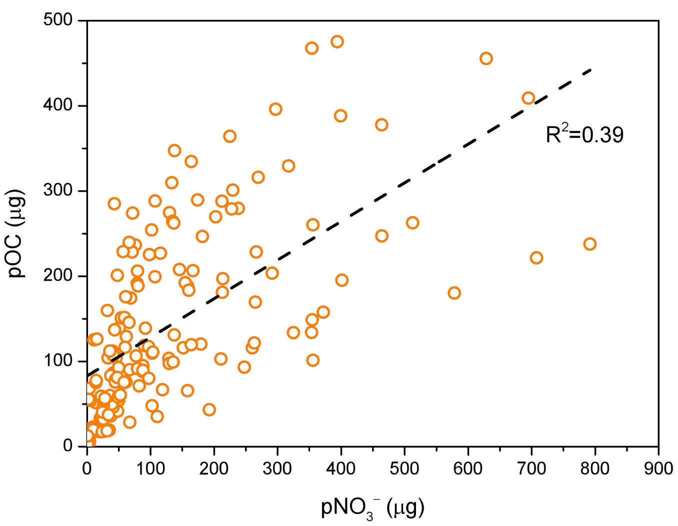

Figure S3 Relationship between pNO_3 and pOC.

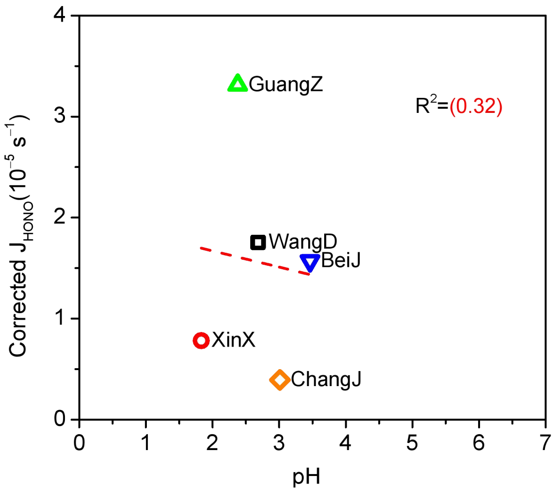

Figure S4. Relationships between the average corrected J_{HONO} and pH under different sampling locations.

References

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