Supplement of

Coarse particulate matter air quality in East Asia: implications for fine particulate nitrate

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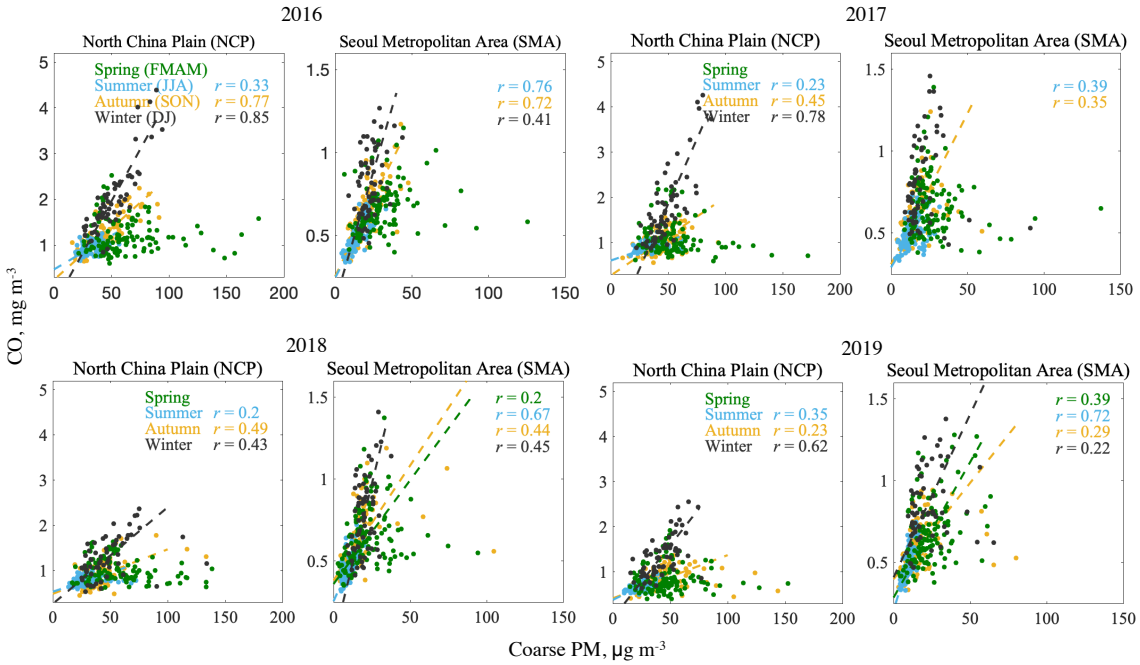

Figure S1. Daily correlations of coarse PM and CO over the North China Plain (NCP) and Seoul Metropolitan Area (SMA). Same as Fig. 3 in the main text but for the years 2016, 2017, 2018, and 2019.

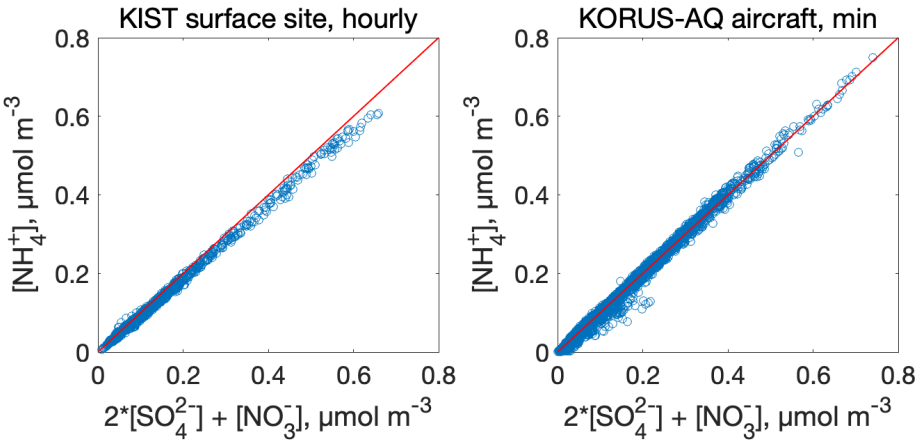

Figure S2. Ionic charge balance of AMS PM_1 during KORUS-AQ over SMA. Here the ionic charge balance is represented by scatterplots of $2*[SO_4^{2-}] + [NO_3^-]$ and $[NH_4^+]$ molar concentrations at the surface KIST site (left) and on the DC-8 aircraft (right). $2*[SO_4^{2-}] + [NO_3^-]$ and $[NH_4^+]$ are in charge balance, suggesting that AMS measured nitrate is mainly inorganic nitrate that is associated with ammonium.

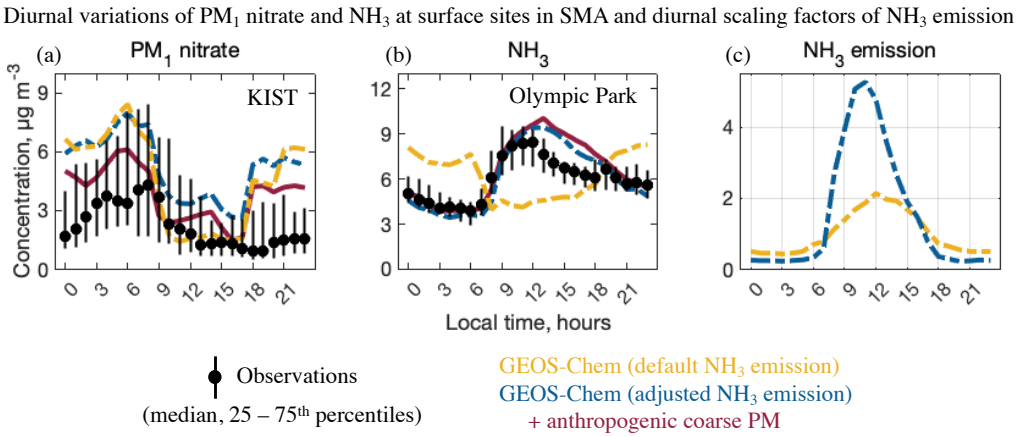

Figure S3. Effects of anthropogenic coarse PM and diurnal variations of NH_3 emission on PM_1 nitrate and NH_3 over Seoul Metropolitan Area (SMA) during KORUS-AQ. Same as Fig. 4a in the main text but with the diurnal profiles of NH_3 at the Olympic Park site in SMA, diurnal scaling factors of NH_3 emission, and GEOS-Chem model results with default and adjusted NH_3 emissions added. NH_3 was measured by ion chromatography at the Olympic Park site in SMA, ~7 km to the southeast of KIST. The default diurnal scaling factors of NH_3 emission is provided by the Multi-resolution Emission Inventory for China (MEIC) agriculture emission sector.

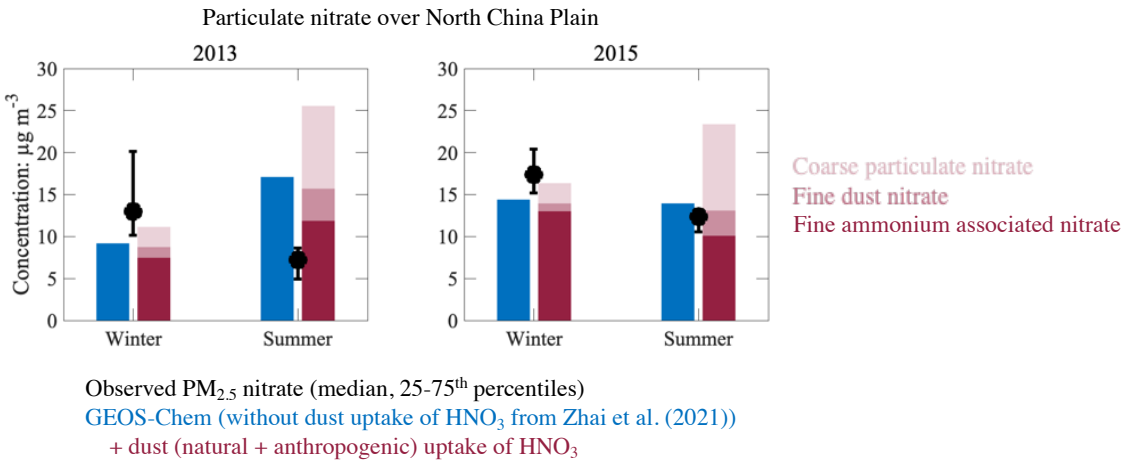

Figure S4. Effects of dust uptake of HNO_3 on winter and summer mean particulate nitrate over the North China Plain. Observed $PM_{2.5}$ nitrate at sites in NCP and the GEOS-Chem model results without considering dust uptake of HNO_3 are from our previous study (Zhai et al., 2021). GEOS-Chem model results are sampled at NCP observation sites.

Table S1 Concentrations of multi-year winter and summer mean[a] fine particulate nitrate observed in Beijing and Seoul, Unit: μg m^{-3}. Data is visualized in Fig. 5 in the main text.

	Winter					Summer				
	IAP[b]	Tsinghua[c]	PKU[d]	NIER[e]	KIST[f]	IAP	Tsinghua	PKU	NIER	KIST
2015	14.6		14.6	9.2		5.0	8.4	12.4	0.4	
2016				7.9	6.6				1.3	1.4
2017		16.5		9.4	8.9		7.7		0.8	
2018	14.7	11.5		6.7	5.2	8.6	9.0		0.7	0.5
2019	11.4	12.8		10.3	10.5	6.1	7.6		0.7	
2020	13.8	15.8				7.2	8.5			0.3
2021		19.2				3.0	6.8			

[a] Winter mean are December-January-February averages and summer mean are June-July-August averages unless otherwise noted.

[b] Winter mean fine particulate nitrate at the Institute of Atmospheric Physics (IAP) site are January-February-March averages (Lei et al., 2021). Winter data for year 2015 and year 2018 are Q-ACSM NR-PM_1. Winter data for year 2019 and 2020 are ToF-ACSM NR-$PM_{2.5}$. Summer data for year 2015 (1 June - 3 July and 15 August - 31 August) are AMS NR-PM_1. Summer data for years 2018, 2019, 2020, and 2021 are ACSM NR-$PM_{2.5}$.

[c] $PM_{2.5}$ nitrate at Tsinghua campus from 2017 to 2021 are measured by Monitor for AeRosols and Gases (MARGA, Metrohm Ltd., Switzerland) (Xu et al., 2019). Winter mean are January-February-March averages. PM_1 nitrate in summer 2015 is from Li et al. (2018).

[d] Data is from ref Liu et al. (2019).

[e] Data is measured by an ambient ion monitor (AIM, URG-9000D/USA)(Jo et al., 2020; Jeong et al., 2022).

[f] PM_1 nitrate at the Korea Institute of Science and Technology (KIST) site is HR-ToF-AMS NR-PM_1 (Kim et al., 2017). Winter mean concentration are averaged from 5 December 2015 to 21 January 2016 for year 2016 (Kim et al., 2017), from 1 January 2017 to 10 February 2017 for year 2017, from 17 January 2018 to 22 February 2018 for year 2018, and from 22 February 2019 to 2 April 2019 for year 2019 (Kim et al., 2020). Summer mean concentration are averaged from 27 July to 31 August for year 2016, from 6 August to 31 August for year 2018, from 13 August to 31 August for year 2020.

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