

Supporting Materials

Table S1 Average values for meteorological parameters and the concentrations of PM_{2.5} and NH₄⁺.

Parameter	Unit	ground	118 m	488 m
T	°C	24.6 ± 5.1	23.1 ± 4.8	20.3 ± 4.5
WS	m/s	0.63 ± 0.20	2.2 ± 0.90	3.1 ± 1.2
RH	%	63 ± 12	65 ± 13	84 ± 16
PM _{2.5}	µg/m ³	47 ± 20	40 ± 17	39 ± 17
NH ₄ ⁺	µg/m ³	2.7 ± 1.4	3.0 ± 1.8	2.6 ± 1.7

Table S2 δ¹⁵N-NH₄⁺ values in NH₄⁺ aerosols collected in Guangzhou (South China, this study) and Beijing (North China).

Sampling height	δ ¹⁵ N-NH ₄ ⁺ value	
	Guangzhou, South China	Beijing, North China ^{a)}
ground	16‰ ± 5.2‰	
8 m		6.5‰ ± 1.5‰
118 m	12‰ ± 3.8‰	
120 m		4.5‰ ± 2.7‰
260 m		2.6‰ ± 2.6‰
488 m	7.4‰ ± 7.1‰	

Notes: a) Data in Beijing were obtained from the references of Wu et al. (2019a); Wu et al. (2024).

Table S3 $\delta^{15}\text{N-NH}_3$ (‰) endmembers of various sources obtained using active sampling techniques.

Livestock	Fertilizer	waste	Vehicle	Biomass burning	Ammonia slip	coal combustion	References
-27 ± 4.9	-24 ± 5.0	-27 ± 3.1	-1.5 ± 6.2	-12 ± 6.0	-0.2 ± 6.7	-20 ± 4.8	Li et al. (2023)
		-36 ± 2.0					Shao et al. (2020)
						-9	Bokhoven and Theeuwes (1966)
				-10 ± 6.9			Wu et al. (2024)
-12 ± 1.2						-6.1 ± 1.6	Feryer (1978)
-12 ± 4.5						-20	Heaton (1987)
			-2.1 ± 2.0				Smirnoff et al. (2012)
			-1.8 ± 5.5				Berner and David Felix (2020)
			6.6 ± 2.1				Walters et al. (2020)
			3.7 ± 1.8				Song et al. (2021)
			1.7 ± 6.3				Chang et al. (2022)
					-13 ± 2.3		David Felix et al. (2013)
					-11 ± 5.3		Bhattarai et al. (2020)
-25 ± 6.4 ^{a)}	-26 ± 5.2	-33 ± 5.0	3.4 ± 5.0	-11 ± 6.4	-2.8 ± 7.8	-18 ± 6.5	
46 ^{b)}	35	22	176	42	27	26	

Notes: a) Values represent the mean ± standard deviation of the $\delta^{15}\text{N-NH}_3$ (‰) endmembers corresponding to each source from all references in this table. b) The total number of samples in the corresponding column.

Table S4 $\delta^{15}\text{N-NH}_3$ (‰) endmembers of various sources employed in this study.

First-level	Second-level	Average \pm SD	n
Agriculture	Livestock	-25 ± 6.1	81
	Fertilizer application		
Waste	Sewage	-33 ± 5.0	22
	Human excreta		
Ammonia slip	Power plant	-2.8 ± 7.8	27
	Industrial		
Vehicle	Heavy-duty vehicle	3.4 ± 5.0	176
	Tunnel		
	Roadside		
Biomass burning	Maize straw	-11 ± 6.4	42
	Wheat straw		
	Cypress firewood		
	Pine firewood		
	Domestic waste		
	Chili and pork (Cooking)		
Coal combustion	Mutton (Barbecue)	-18 ± 6.5	26
	Coking coal gas		
	Coal combustion		

Table S5 The f values reported in China.

City	f					Sampling time	References
	Autumn	Winter	Spring	Summer	Annual		
PRD	0.48	0.55	0.34	0.17	0.38	2013/8/5–2014/3/26	Yue et al. (2015)
Tianjin	0.4	0.4	0.20	0.20	0.30	2017/10–2018/7	Xiao et al. (2024)
Beijing and Zhengzhou	0.39	0.53	0.26	0.17	0.34	2020/3–2021/4	Zhang et al. (2023)
Xiamen					0.29	2016/12–2017/11	Wu et al. (2019b)
Beijing					0.39	2021/1–2022/6	Feng et al. (2024)
Nanjing	0.42					2018/10/1–2018/11/30	Shao et al. (2019)
Xi'an		0.48				2017/1/1–2017/1/22	Wu et al. (2020)
Beijing		0.41				2017/12/26–2017/12/31	Xiang et al. (2022)
Baoding		0.44				2017/12/26–2017/12/31	Xiang et al. (2022)
Tianjin		0.43				2017/12/26–2017/12/31	Xiang et al. (2022)
Tangshan		0.43				2017/12/26–2017/12/31	Xiang et al. (2022)
Taiyuan		0.45				2017/12/26–2017/12/31	Xiang et al. (2022)
Shijiazhuang		0.44				2017/12/26–2017/12/31	Xiang et al. (2022)
Xingtai		0.42				2017/12/26–2017/12/31	Xiang et al. (2022)
Jinan		0.44				2017/12/26–2017/12/31	Xiang et al. (2022)

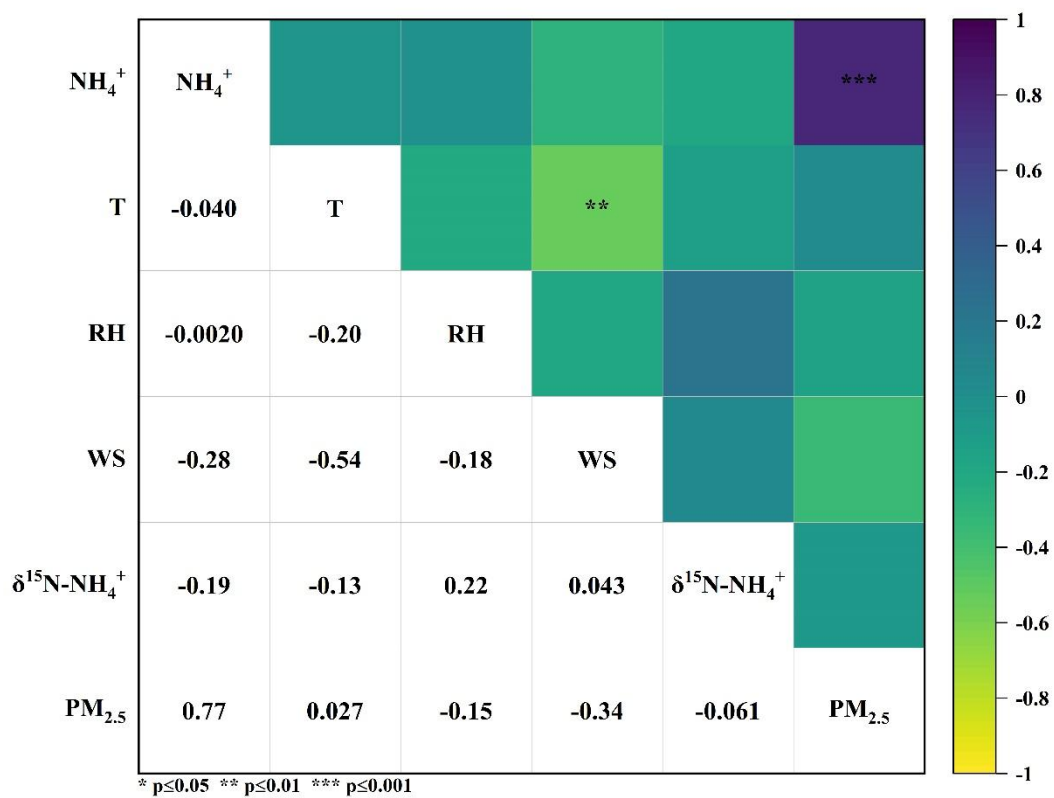


Fig. S1 Correlations between NH_4^+ , $\delta^{15}\text{N-NH}_4^+$, $\text{PM}_{2.5}$, and meteorological conditions at the ground site during the sampling period.

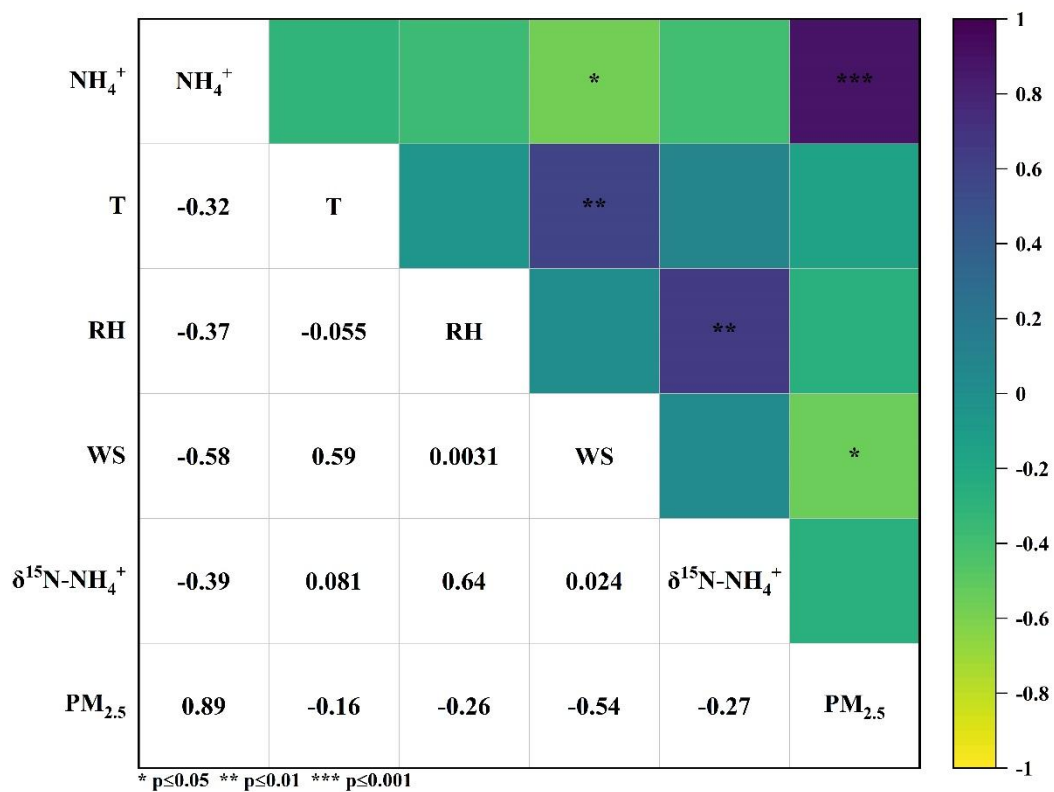


Fig. S2 Correlations between NH_4^+ , $\delta^{15}\text{N-NH}_4^+$, $\text{PM}_{2.5}$, and meteorological conditions at 118 m during the sampling period.

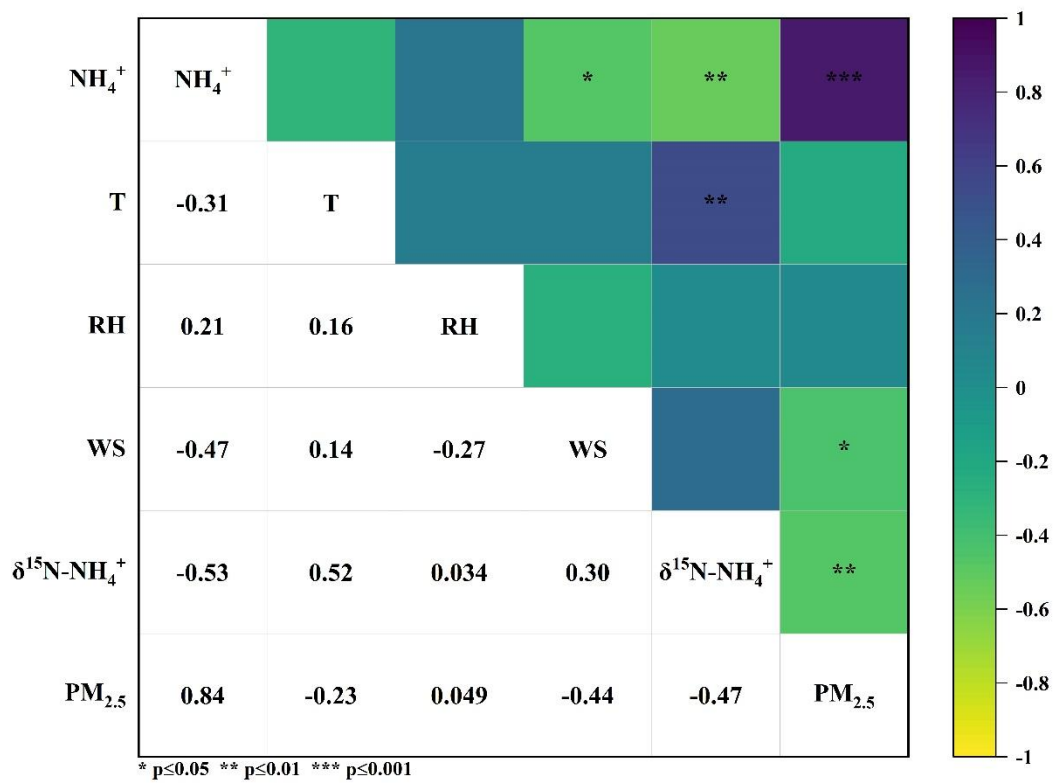


Fig. S3 Correlations between NH_4^+ , $\delta^{15}\text{N-NH}_4^+$, $\text{PM}_{2.5}$, and meteorological conditions at 488 m during the sampling period.

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