Supplementary Data

Table A1 Summary of recent isotope-based source apportionment studies on ambient NH_3 derived from $\delta^{15}N(NH_3)$ values

Location	Type	Year	Collection type	Mixing model	$\delta^{15}N(NH_3)$ (‰) source signature input value for stable isotope mixing model									References
					Vehicle exhaust	Ammonia Slip	Coal combustion	Volatilized Fertilizer	Livestock waste	Human Excreta	Solid Waste	Wastewater	Marine	
Beijing (China)	Urban	2014	ALPHA	IsoSource	–17.8 to –15.1 (*n* = 4, –16.5)			–52 to –47.6 (*n* = 5, –50 ± 1.8)	–31.7 to –27.1 (*n* = 7, –29.1 ± 1.7)	–39.6 to –37.3 (*n* = 8)	–37.6 to –29.9 (*n* = 8)	–41.9 to –39.2 (*n* = 8)		Chang et al. (2016)
Shanghai (China)	Urban	2015	Ogawa	SIAR	–17.8 to –9.6 (*n* = 8, –14.2 ± 2.8)	–14.6, –11.3 (*n* = 2)		–52 to –47.6 (*n* = 5, –50 ± 1.8)	–31.7 to –27.1 (*n* = 7, –29.1 ± 1.7)	–39.6 to –37.3 (*n* = 8)	–37.6 to –29.9 (*n* = 8)	–41.9 to –39.2 (*n* = 8)		Chang et al. (2019)
Shanghai (China)	Rural	2015	Ogawa	SIAR				–52 to –47.6 (*n* = 5, –50 ± 1.8)	–31.7 to –27.1 (*n* = 7, –29.1 ± 1.7)					Chang et al. (2019)
Colorado (USA)	Natural	2011	Radiello	IsoSource	–4.6, –2.2, (*n* = 2)			–26.4 (*n* = 9)	–20.9 (*n* = 16) and			–35.7 (*n* = 10)		Stratton et al. (2019)

Location	Type	Year	Collection type	Mixing model	$\delta^{15}N(NH_3)$ (‰) source signature input value for stable isotope mixing model									References
					Vehicle exhaust	Ammonia Slip	Coal combustion	Volatilized Fertilizer	Livestock waste	Human Excreta	Solid Waste	Wastewater	Marine	
									–28.2 (*n* = 15) *					
Beijing (China)	Urban	2016–2017	ALPHA	SIAR	–15.3 ± 6.4 (*n* = 30)	–14.6, –11.3 (*n* = 2)		–52 to –47.6 (*n* = 5, –50 ± 1.8)	–31.3 ± 6.0 (*n* = 86)	–32.1 ± 5.0 (*n* = 97)	–30.3 ± 3.7 (*n* = 58)	–28.6 ± 4.0 (*n* = 34)		Zhang et al. (2020a)
Texas (USA)	Urban	2016–2017	ALPHA	IsoError	–6.7 to 9.0 (*n* = 13, –2.2)			–48.0 to –36.3 (*n* = 6)	–56.1 to –22.8 (*n* = 7)					Berner and Felix (2020)
Texas (USA)	Coastal rural	2016–2017	ALPHA	SIAR	–6.7 to 9.0 (*n* = 13, –2.2)			–48.0 to –36.3 (*n* = 6)	–56.1 to –22.8 (*n* = 7)				10.2 to 2.2 (4.7 ± 2.7, n = 7)	Berner and Felix (2020)
Beijing (China)	Urban	2018	ALPHA	IsoSource	–4.6, –2.2	–14.6, –11.3	–7 to + 2	–52 to –47.6 (*n* = 5, –50 ± 1.8)	–42.5 to –27.1 (*n* = 16, –33.3 ± 5.6)	–39.6 to –37.3 (*n* = 8)	–37.6 to –29.9 (*n* = 8)	–41.9 to –39.2 (*n* = 8)		Bhattarai et al. (2020)
Beijing (China)	Urban	2017 and 2020	ALPHA	SIAR	–17.8 to –9.6 (*n* = 8,	–14.6, –11.3 (*n* = 2)		–52 to –47.6 (*n* = 5, –50 ± 1.8)	–31.7 to –27.1 (*n* = 7, –29.1 ± 1.7)	–39.6 to –37.3 (*n* = 8)	–37.6 to –29.9 (*n* = 8)	–41.9 to –39.2 (*n* = 8)		Zhang et al. (2020b)

Location	Type	Year	Collection type	Mixing model	$\delta^{15}N(NH_3)$ (‰) source signature input value for stable isotope mixing model									References
					Vehicle exhaust	Ammonia Slip	Coal combustion	Volatilized Fertilizer	Livestock waste	Human Excreta	Solid Waste	Wastewater	Marine	
					−14.2 ± 2.8)									

Notes: In column 4, SIAR means Stable Isotope Analysis in R. Two or three $\delta^{15}N(NH_3)$ source signature columns with the similar color (filled) means that the sources are combined as an input in the mixing model. Blank space means the heading is not applicable to the corresponding reference. An asterisk " * " symbol on column 10 mark that dairy cattle and beef cattle were considered as two different sources in Stratton et al. (2019)

Table A2 Summary of recent isotope-based source apportionment studies on particulate NH_4^+ derived from $\delta^{15}N(NH_4^+)$ values

Location	Type	Year	Air quality	Mixing model	$\delta^{15}N(NH_3)$ (‰) source signature input value for stable isotope mixing model									References
					Vehicle exhaust	Coal combustion	Ammonia Slip	Volatilized Fertilizer	Livestock waste	Human Excreta	Solid Waste	Wastewater	Biomass burning	
Beijing (China)	Urban	2013	Clean/Hazy	IsoSource	−4.6, −2.2	−7 to + 2	−14.6, −11.3 (*n* = 2, −12.95)	−48.0 to −36.3 (*n* = 6)	−56.1 to −23.1 (*n* = 5, −39.6)					Pan et al. (2016)
Beijing (China)	Urban	2013-2014	–	IsoSource	−4.6, −2.2	−7 to + 2	−14.6, −11.3 (*n* = 2, −12.95)	−48.0 to −36.3 (*n* = 6)	−56.1 to −23.1 (*n* = 5, −39.6)					Pan et al. (2018a)

Location	Type	Year	Air quality	Mixing model	$\delta^{15}N(NH_3)$ (‰) source signature input value for stable isotope mixing model									References
					Vehicle exhaust	Coal combustion	Ammonia Slip	Volatilized Fertilizer	Livestock waste	Human Excreta	Solid Waste	Wastewater	Biomass burning	
Guangzhou (China)	Urban	2013	Hazy	IsoSource	–4.6, –2.2	–7 to + 2		–52 to –47.6 (–50)	–31.7 to –27.1 (*n* = 7, –29.1)	–39.6 to –37.3 (*n* = 8)	–37.6 to –29.9 (*n* = 8)	–41.9 to –39.2 (*n* = 8)	–20	Liu et al. (2018)
Beijing (China)	Urban	2013	Clean/Hazy	IsoSource	–4.6, –2.2	–7 to + 2	–14.6, –11.3 (*n* = 2, –12.95)*	–48.0 to –36.3 (*n* = 6)	–56.1 to –23.1 (*n* = 5, –39.6)					Pan et al. (2018b)
Beijing (China)	Urban	2015	Before/During/After*	MixSIAR	–4.6, –2.2	–7 to + 2	–14.6, –11.3 (*n* = 2)	–48.0 to –36.3 (*n* = 6)	–56.1 to –23.1 (*n* = 5, –39.6)				12	Wu et al. (2019a)
Xiamen (China)	Coastal urban	2016 – 2017	_	IsoSource	–4.6, –2.2	–7 to + 2	–14.6, –11.3 (–12.95)	–22.73 to –20.28 (–21.34) **		–26.96 to –23.88 (–25.42 ± 2.18)				Wu et al. (2019b)

Location	Type	Year	Air quality	Mixing model	$\delta^{15}N(NH_3)$ (‰) source signature input value for stable isotope mixing model									References
					Vehicle exhaust	Coal combustion	Ammonia Slip	Volatilized Fertilizer	Livestock waste	Human Excreta	Solid Waste	Wastewater	Biomass burning	
Xiamen (China)	Coastal suburban	2016–2017	_	IsoSource	–4.6, –2.2	–7 to + 2	–14.6, –11.3 (–12.95)	–22.73 to –20.28 (–21.34) **		–26.96 to –23.88 (–25.42 ± 2.18)				Wu et al. (2019b)
Beijing, Tianjin, Shijiazhuang (China)	Urban	2017	Hazy	_	–4.6, –2.2	–7 to + 2	–14.6, –11.3 (–12.95)			–39.6 to –37.3	–37.6 to –29.9	–41.9 to –39.2		Zhang et al. (2020c)
Beijing, Tianjin, Shijiazhuang (China)	Urban	2017	Clean	_	–4.6, –2.2	–7 to + 2	–14.6, –11.3	–46.5 ± 6.6	–32.3 ± 6.7	–39.6 to –37.3	–37.6 to –29.9	–41.9 to –39.2		Zhang et al. (2020c)
Xi'an (China)	Urban	2017	Clean/Hazy	IsoSource	–4.6, –2.2	–7 to + 2	–14.6, –11.3 (–12.95)	–50.0 to –36.3 (–46.0)	–56.1 to –22.8 (–29.1)					Wu et al. (2020)

Location	Type	Year	Air quality	Mixing model	$\delta^{15}N(NH_3)$ (‰) source signature input value for stable isotope mixing model									Reference s
					Vehicle exhaust	Coal combustion	Ammonia Slip	Volatilized Fertilizer	Livestock waste	Human Excreta	Solid Waste	Wastewater	Biomass burning	
Beijing (China)	Urban	2018	Clean/Slightly polluted	IsoSource	−4.6, −2.2	−7 to + 2	−14.6, −11.3	−52 to −47.6 (−50)	−42.5 to −27.1 (−33.3)	−39.6 to −37.3	−37.6 to −29.9	−41.9 to −39.2		Bhattarai et al. (2020)
Nanchang (China)	Urban	2017	Hazy	MixSIAR	−17.8 to −2.2 (*n* = 10, −12.1)	−7.2 to −4.3 (*n* = 3, −6.1)	−14.6, −11.3	−52.0 to −36.3 (*n* = 11, −45.9)	−56.1 to −22.1 (*n* = 14, −31.1)	−39.6 to −37.3	−37.6 to −29.9	−41.9 to −39.2	23	Xiao et al. (2020)
Wuhan (China)	Urban	2017	Hazy	MixSIAR	−17.8 to −2.2 (*n* = 10, −12.1)	−7.2 to −4.3 (*n* = 3, −6.1)	−14.6, −11.3	−52.0 to −36.3 (*n* = 11, −45.9)	−56.1 to −22.1 (*n* = 14, −31.1)	−39.6 to −37.3	−37.6 to −29.9	−41.9 to −39.2	23	Xiao et al. (2020)
Changsha (China)	Urban	2017	Hazy	MixSIAR	−17.8 to −2.2 (*n* = 10, −12.1)	−7.2 to −4.3 (*n* = 3, −6.1)	−14.6, −11.3	−52.0 to −36.3 (*n* = 11, −45.9)	−56.1 to −22.1 (*n* = 14, −31.1)	−39.6 to −37.3	−37.6 to −29.9	−41.9 to −39.2	23	Xiao et al. (2020)

Notes: An em dash " – " symbol mark no information is available in the cell. A double asterisk " ** " symbol on column 9 mark volatilized fertilizer (organic) with mean $\delta^{15}N(NH_3)$ values of −21.34‰ (range: −22.73‰ to −20.28‰), assumed as an additional source in Wu et al. (2019b) that were higher than the inorganic fertilizer source signature value observed in previous studies (Felix et al., 2013; Chang et al., 2019; Bhattarai et al., 2020)

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