

Supplementary Materials: Spatial-Temporal Variation in Health Impact Attributable to PM_{2.5} and Ozone Pollution in the Beijing Metropolitan Region of China

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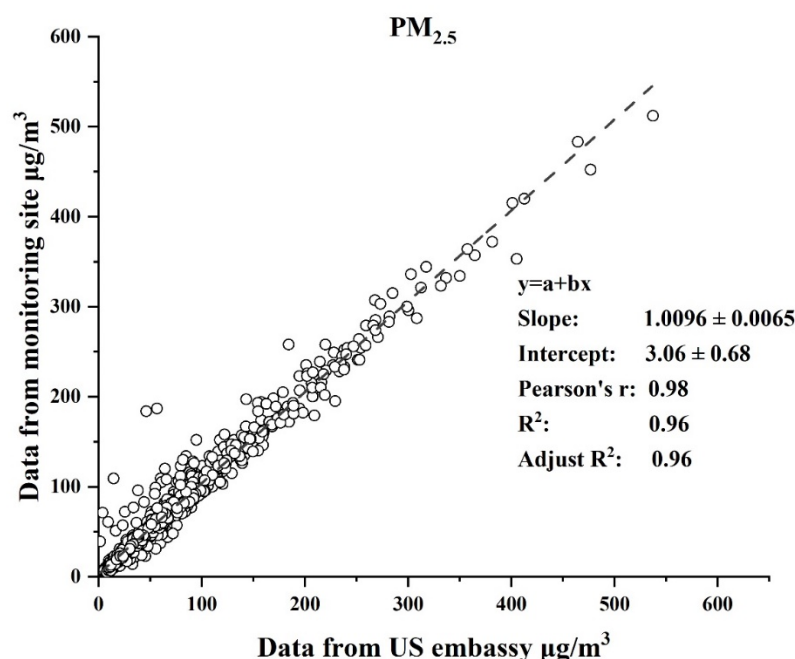


Figure S1. The correlation analysis between daily PM_{2.5} concentration observed from US embassy and the nearest monitoring site (Nongzhanguan site) in Beijing from 2015 to 2017.

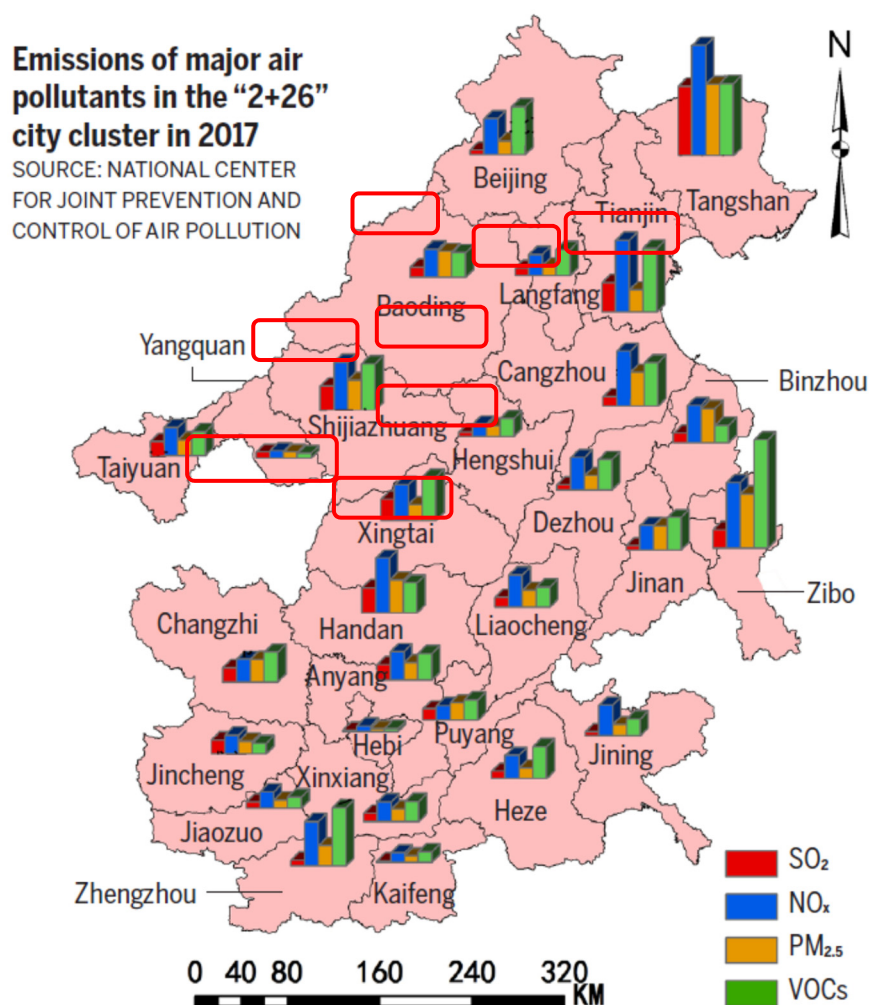


Figure S2. Emissions of major air pollutants in the study area. Source: National Center for Joint Prevention and Control of Air Pollution, China. Note: The city in the red box is included the Beijing-Tianjin-Hebei region.

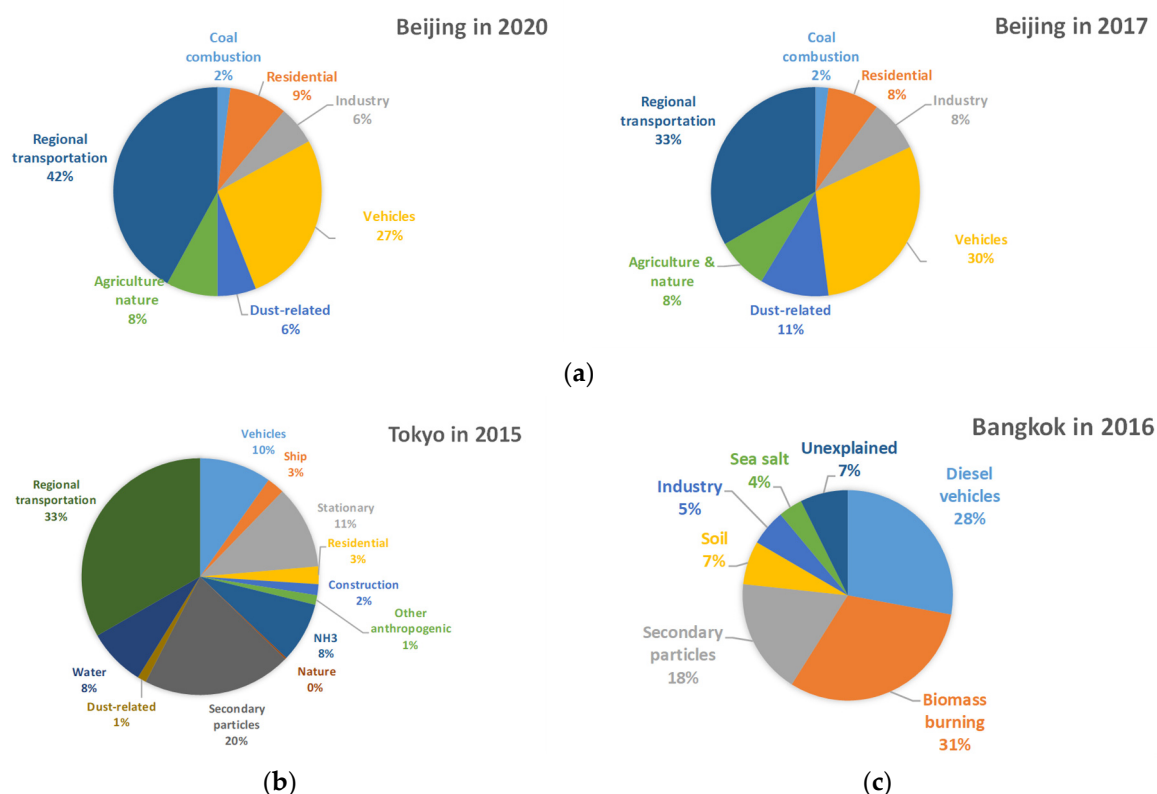


Figure S3. The source apportionment results from the cities in East Asia. Source: (a) Report of PM_{2.5} source apportionment project by Beijing Municipal Ecology and Environment Bureau; (b) Report of results of PM_{2.5} source apportionments in Tokyo by Ministry of Environment Japan; (c) Final report on “A Study in Urban Air Pollution Improvement in Asia” by the Japan International Cooperation Agency (JICA).

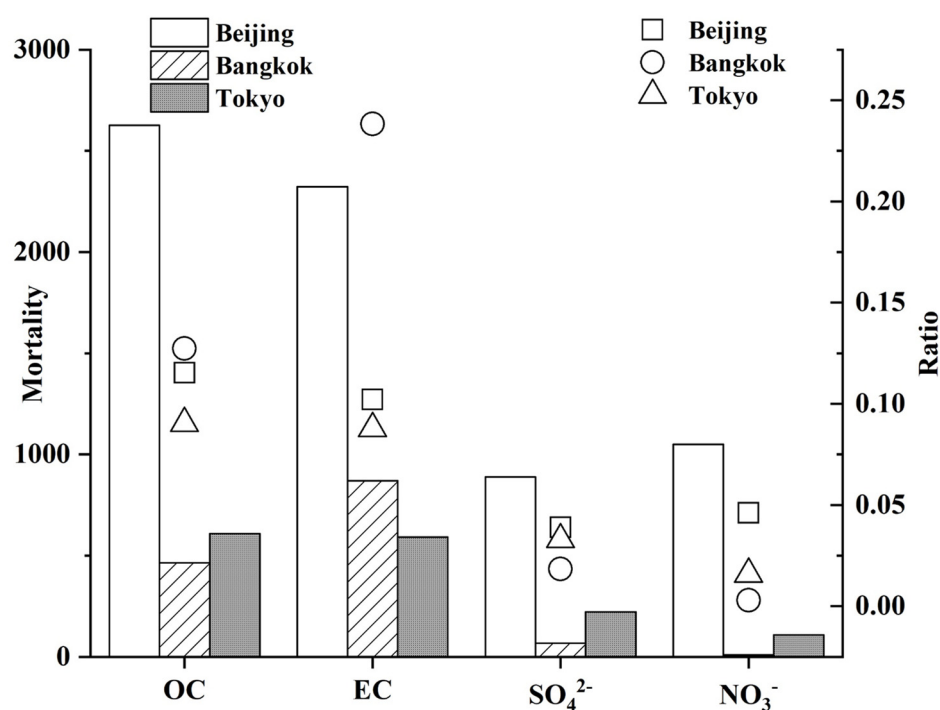


Figure S4. Mortality attributable to PM_{2.5} compositions (left axis) and the ratio of mortality attributable to PM_{2.5} compositions to the mortality attributable to PM_{2.5} (right axis) among Beijing, Tokyo and Bangkok.

Table S1. Population (10⁴) and Death rate (‰) at Beijing City, Tianjin City, and Hebei Province.

Beijing			Tianjin		Hebei		Tokyo		Bangkok	
population	death rate		population	death rate	population	death rate	population	death rate	population	death rate
2013	2125	4.50	1410	6.00	7288	6.87				
2014	2171	4.89	1429	6.05	7323	6.23				
2015	2188	4.91	1439	5.61	7345	5.79	1352	8.5		
2016	2195	5.16	1443	5.54	7375	6.36			569	7.8
2017	2194	5.24	1410	5.05	7409	6.60				
2018	2192	5.50	1383	5.42	7426	6.38				
2019	2190	5.40	1385	5.30	7447	6.12				
2020	2189	4.59	1387	5.92	7464	5.65				

Table S2. Data sources of PM_{2.5} compositions (particulate OC, EC, SO₄²⁻ and NO₃⁻) at Beijing since 2013 to 2020.

City	Year	Parameters	Reference
Beijing, China	2013	OC, EC, SO ₄ ²⁻ and NO ₃ ⁻	Ji et al., 2019 [20]
			Want et al., 2019 [21]
	2014	OC, EC, SO ₄ ²⁻ and NO ₃ ⁻	Ding et al., 2017 [23]
	2015	SO ₄ ²⁻ and NO ₃ ⁻	Ding et al., 2017 [23]
	2016	SO ₄ ²⁻ and NO ₃ ⁻	Jia et al., 2018 [22]
	2017	OC, EC, SO ₄ ²⁻ and NO ₃ ⁻	Want et al., 2019 [21]
	2018	OC and EC	Huang et al., 2021 [18]
	2019	OC, EC, SO ₄ ²⁻ and NO ₃ ⁻	Luo et al., 2021 [19]
Tokyo, Japan	2015	OC, EC, SO ₄ ²⁻ and NO ₃ ⁻	Website of MOEJ
Bangkok, Thailand	2016	OC, EC, SO ₄ ²⁻ and NO ₃ ⁻	JICA report [24]
			Narita et al., 2019 [25]

MOEJ: Ministry of Environment, Japan (<https://www.env.go.jp/air/osen/pm/monitoring.html> accessed on 1 June 2022).

Table S3. Estimates for extra risk values (ER) and 95% confidence intervals (95% CI) of all-cause mortality attribute to PM_{2.5} and ozone.

Air pollutant	ER and (95% CI)	References
PM _{2.5}	3.8×10^{-3} (3.10×10^{-3} , 4.50×10^{-3})	Shang et al., 2013 [29]
OC in PM _{2.5}	2.1×10^{-3} (0.73×10^{-3} , 3.47×10^{-3})	Achilleos et al., 2018 [30]
EC in PM _{2.5}	6.0×10^{-3} (2.28×10^{-3} , 9.72×10^{-3})	Achilleos et al., 2018 [30]
SO ₄ ²⁻ in PM _{2.5}	8.0×10^{-4} (4.08×10^{-4} , 1.19×10^{-3})	Achilleos et al., 2018 [30]
NO ₃ ⁻ in PM _{2.5}	7.0×10^{-4} (-8.40×10^{-5} , 1.48×10^{-3})	Achilleos et al., 2018 [30]
Ozone	3.0×10^{-3} (1.00×10^{-3} , 4.00×10^{-3})	WHO 2008 [31]