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Supplementary Material

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Table S1. Air quality standard codes between 1998 and 2007.

Year	Bioler	Power plant	Automobile and gas stations	Cement industry	Petrochemicals industry	Oil storage
1998	DB11/109-1998					
1999		DHJB1-1999				
2000		DHJB4-2000	DB11/120-2000			
			DB11/123-2000			
			DB11/045-2000			
2001	GB13271-2001		GB18352.1-2001			
			GB18352.2-2001			
2002	DB11/139-2002					
2003		GB13223-2003	DB11/208-2003			
2004			DB11/238-2004	GB4915-2004		
2005			GB18352.3-2005			
2006			GB17930-2006			
2007	DB11/139-2007		GB20952-2007		DB11/447-2007	GB20950-2007

Table S2. China's national air quality standards.

Species	Time range	Thresholds[a]		
		Grade I[b]	Grade II[c]	Grade III[d]
SO_2	Annual	0.02	0.06	0.10
	Daily	0.05	0.15	0.25
	Hourly	0.15	0.50	0.70
TSP[e]	Annual	0.08	0.20	0.30
	Daily	0.12	0.30	0.50
PM_{10}	Annual	0.04	0.10	0.15
	Daily	0.05	0.15	0.25
NO_2	Annual	0.04	0.08	0.08
	Daily	0.08	0.12	0.12
	Hourly	0.12	0.24	0.24
CO	Daily	4.0	4.0	6.0
	Hourly	10.0	10.0	20.0
O_3	Hourly	0.16	0.20	0.20

[a] Units:μg/m^3

[b] For natural scenic spots.

[c] For residential community.

[d] For industrial areas.

[e] Total suspended particulate.

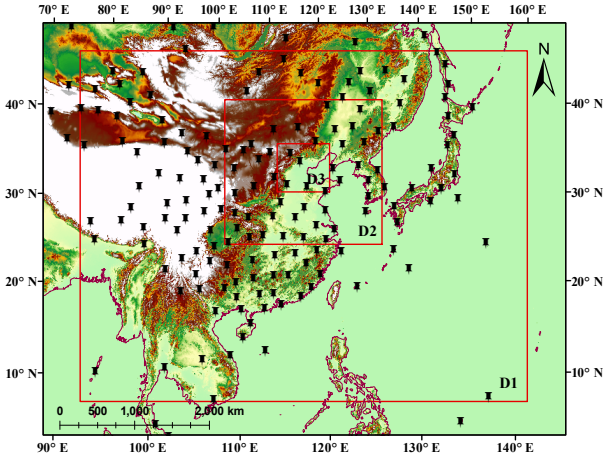

Fig. S1. Topography, domain settings and upper sites used to correct the first guess fields in WRF.

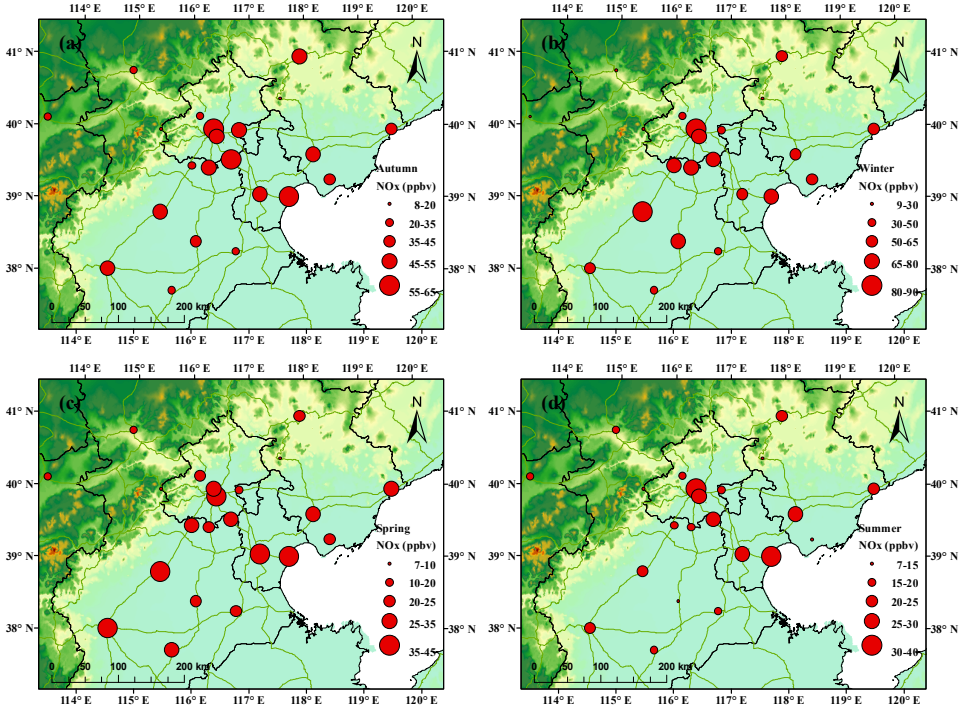

Fig. S2. Spatial distribution of average NO_x over Northern China for autumn **(a)**, winter **(b)**, spring **(c)**, and summer **(d)**.

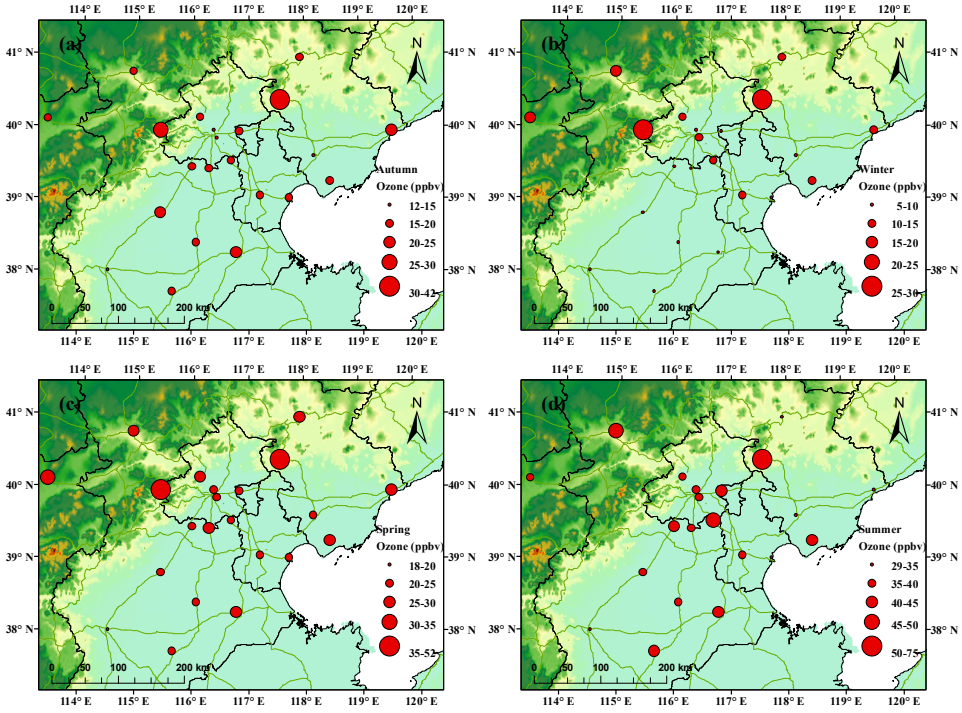

Fig. S3. Spatial distribution of average O_3 over Northern China for autumn (**a**), winter (**b**), spring (**c**), and summer (**d**).

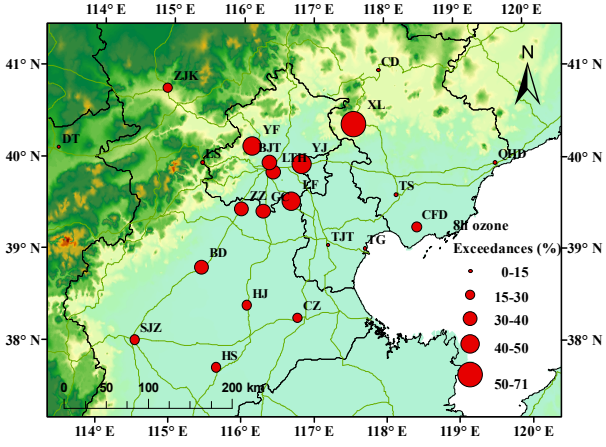

Fig. S4. Spatial distribution of exceedances for average daily 8-h maximum O_3 for summer.