Supporting Information for

Opposite Effects of Aerosols on Daytime Urban Heat Island Intensity between Summer and Winter

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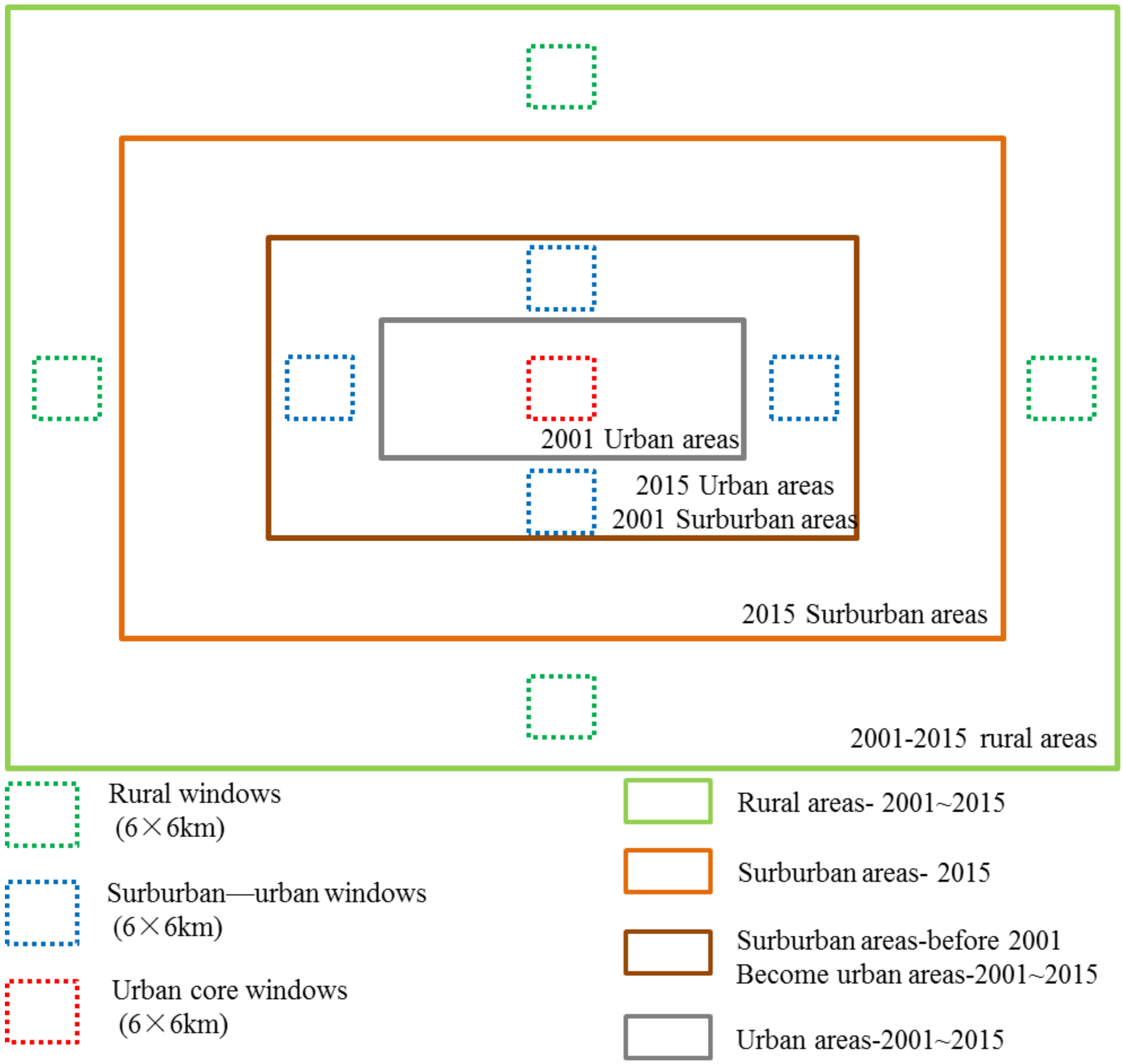

Figure S1. Schematic diagram showing the spatial distribution of the nine research windows for a given city.

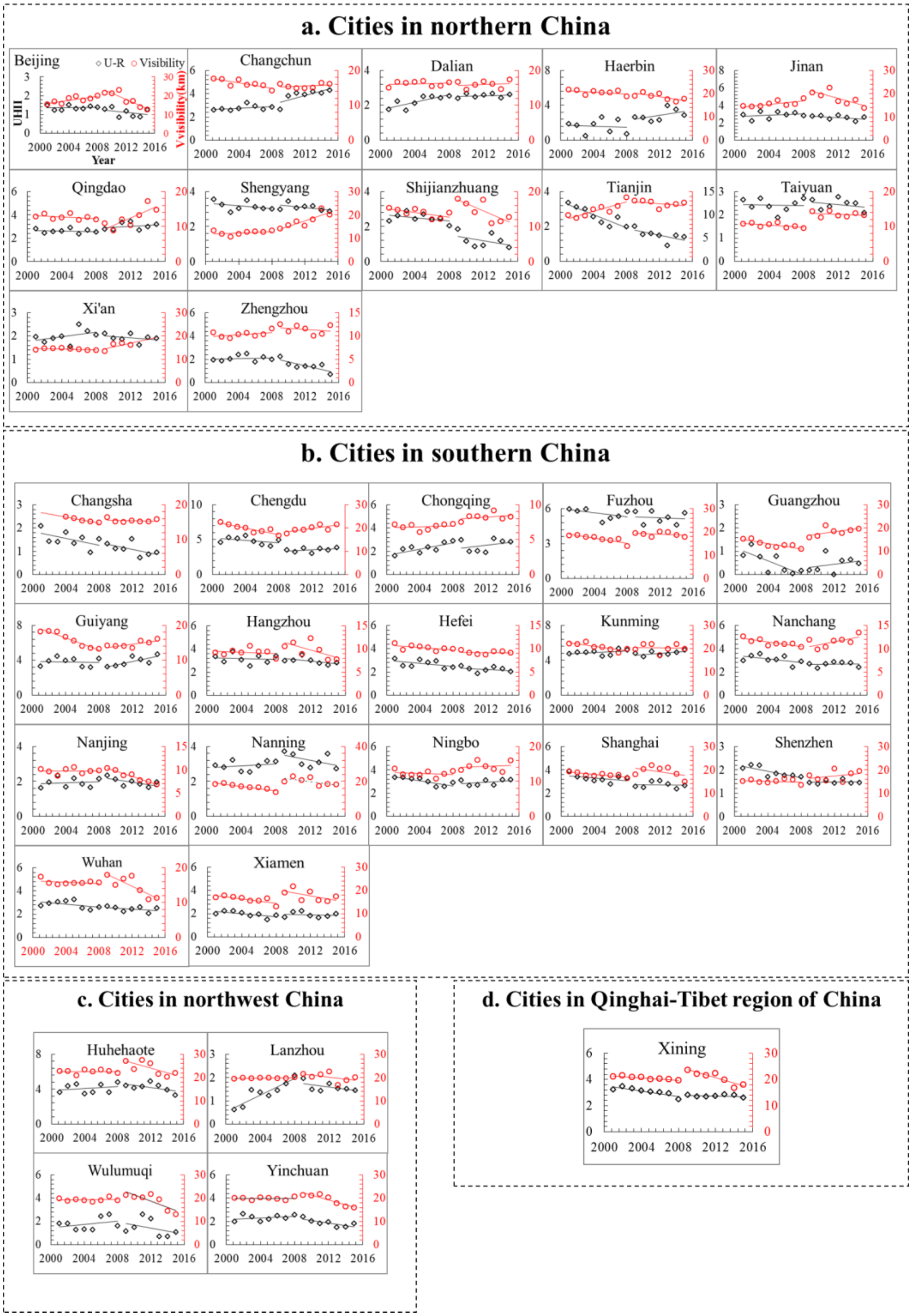

Figure S2. UHII (black lines, unit: K) and visibility (red lines, unit: km) trends at the 35 cities grouped in different regions of China: northern China (a), southern China (b), northwest China (c), Qinghai-Tibet region (d) for the period from 2001 to 2015.

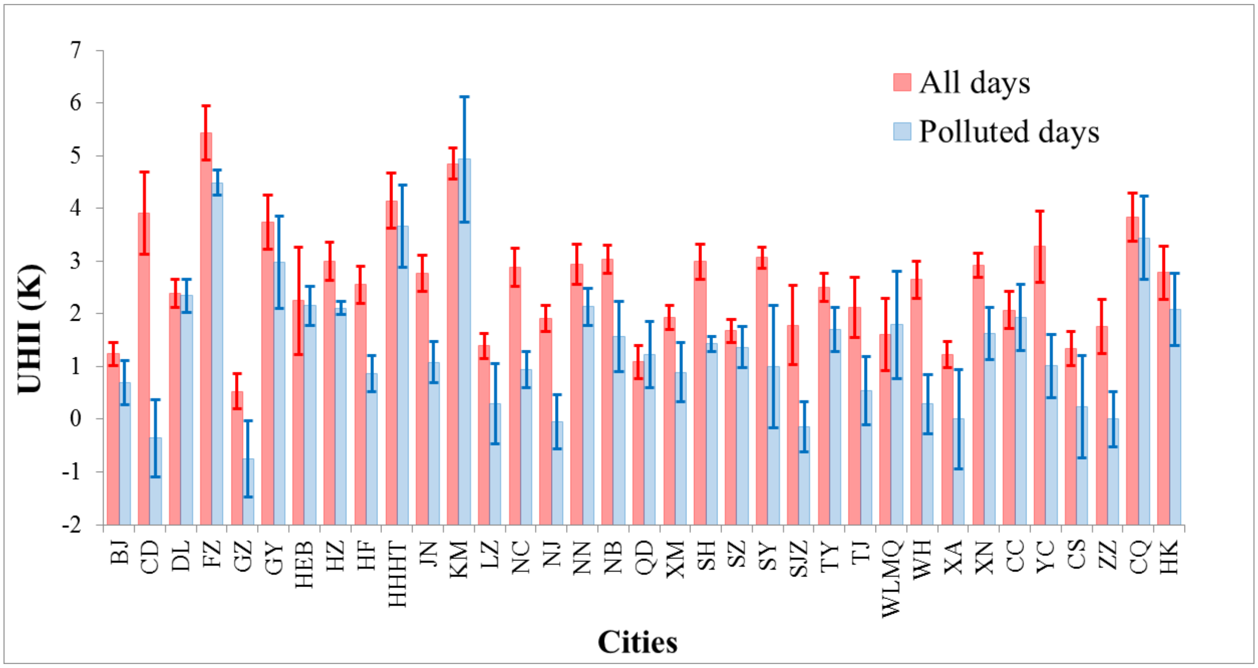

Figure S3. $MUHII$ (unit: K) at each city under polluted conditions (blue bars) and for all days (red bars).

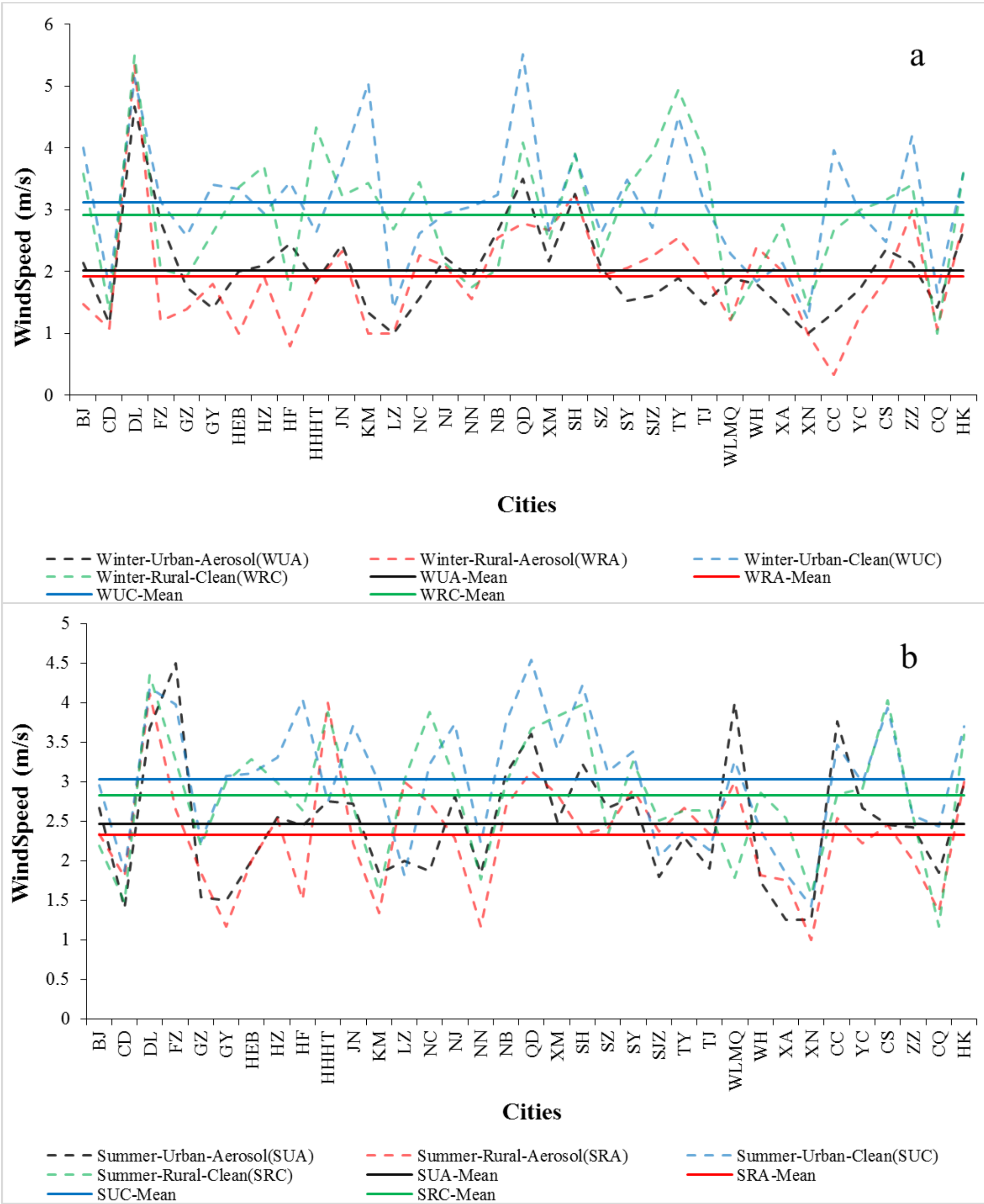

Figure S4. Comparison of wind speeds (unit: m s^{-1}) between urban and rural areas under heavy air pollution and clean conditions in (a) winter and (b) summer. City-specific values at each city: The black and red dashed lines show the urban and rural wind speeds, respectively, under polluted conditions. The blue and green dotted lines show the urban and rural wind speeds, respectively, under clean conditions. Considering all cites: The black and red lines show the mean urban and rural wind speeds, respectively, under polluted conditions. The blue and green lines show the mean urban and rural wind speeds, respectively, under clean conditions.

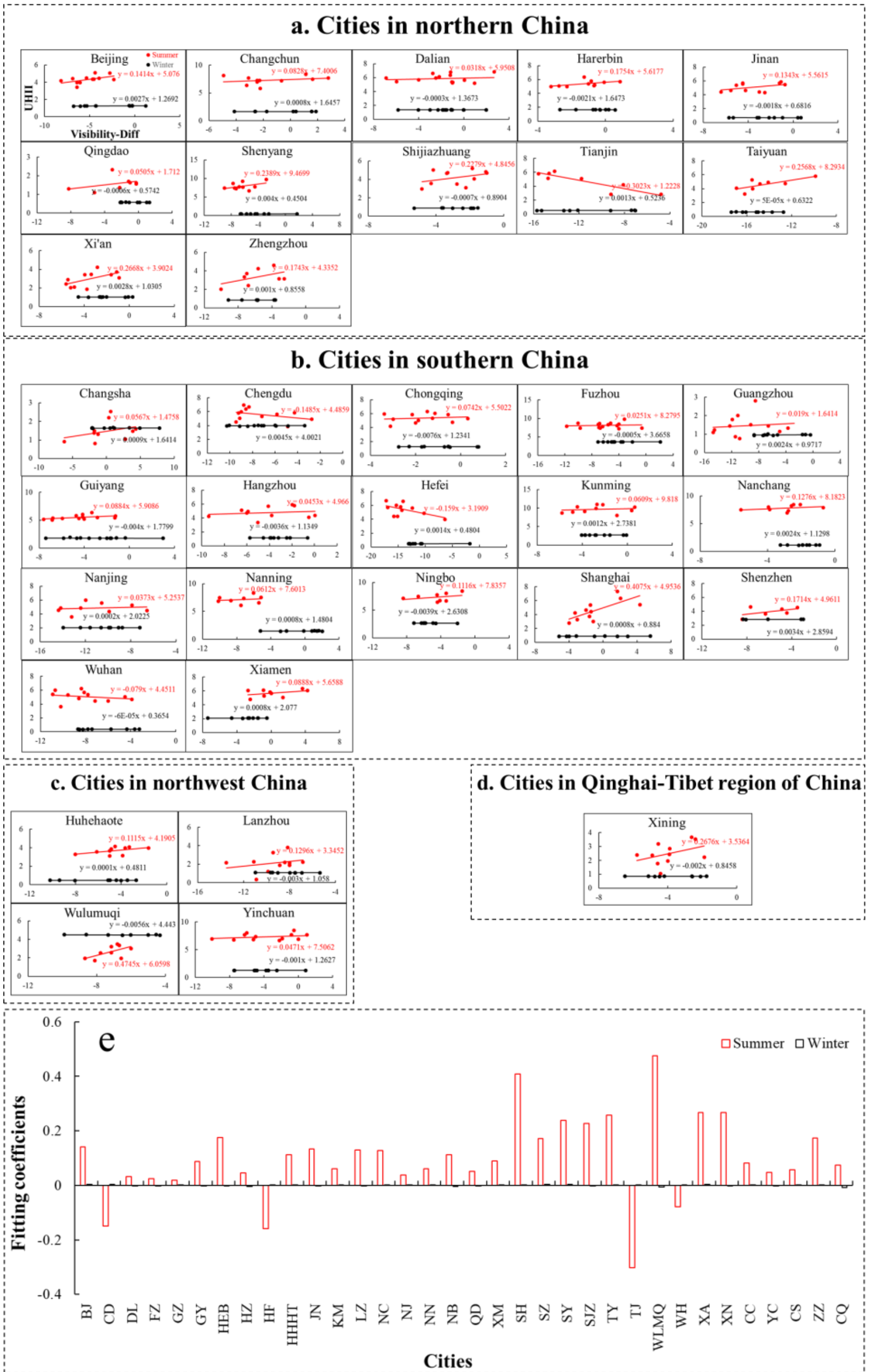

Figure S5. The relationship between UHII and visibility difference at the 35 cities grouped in different regions of China in summer(red points and lines) and winter (black points and lines) when the RH is less than 85%: northern China (a), southern China (b), northwest China (c), Qinghai-Tibet region (d) and the fitting coefficients of all cities (e) for the period from 2001 to 2015.

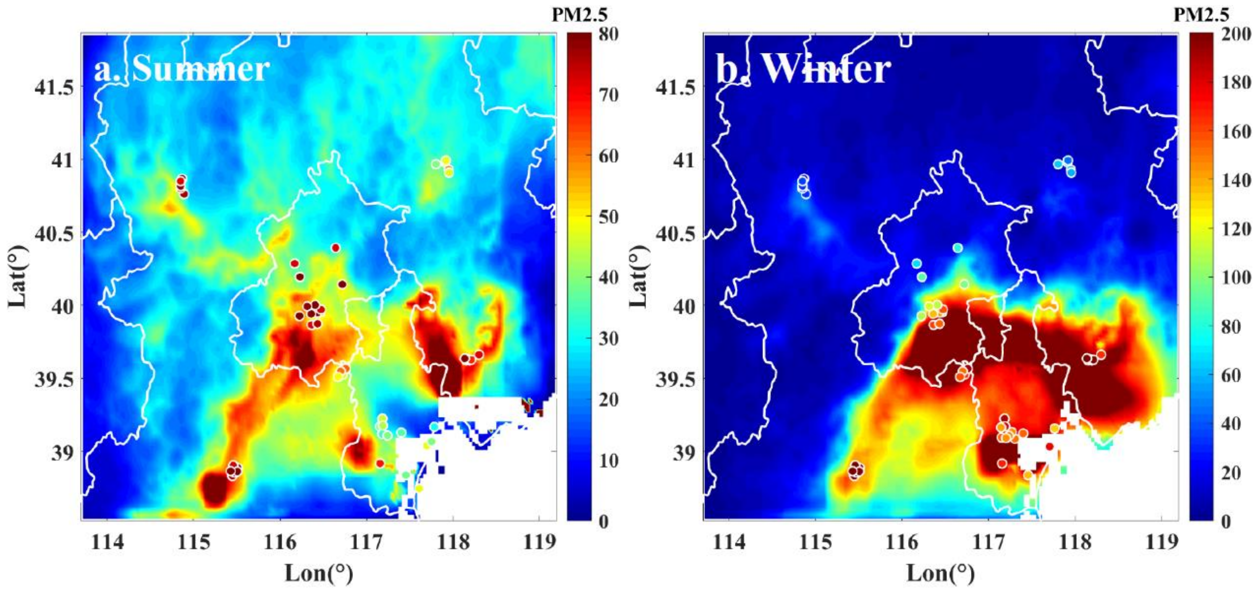

Figure S6. The spatial comparison between the simulated distribution of $PM_{2.5}$ (color map, unit: μg m^{-3}) and the site observations of $PM_{2.5}$ (color points, unit: μg m^{-3}) in typical days in (a) summer and (b) winter. The time periods for analysis are shown in Table S2.

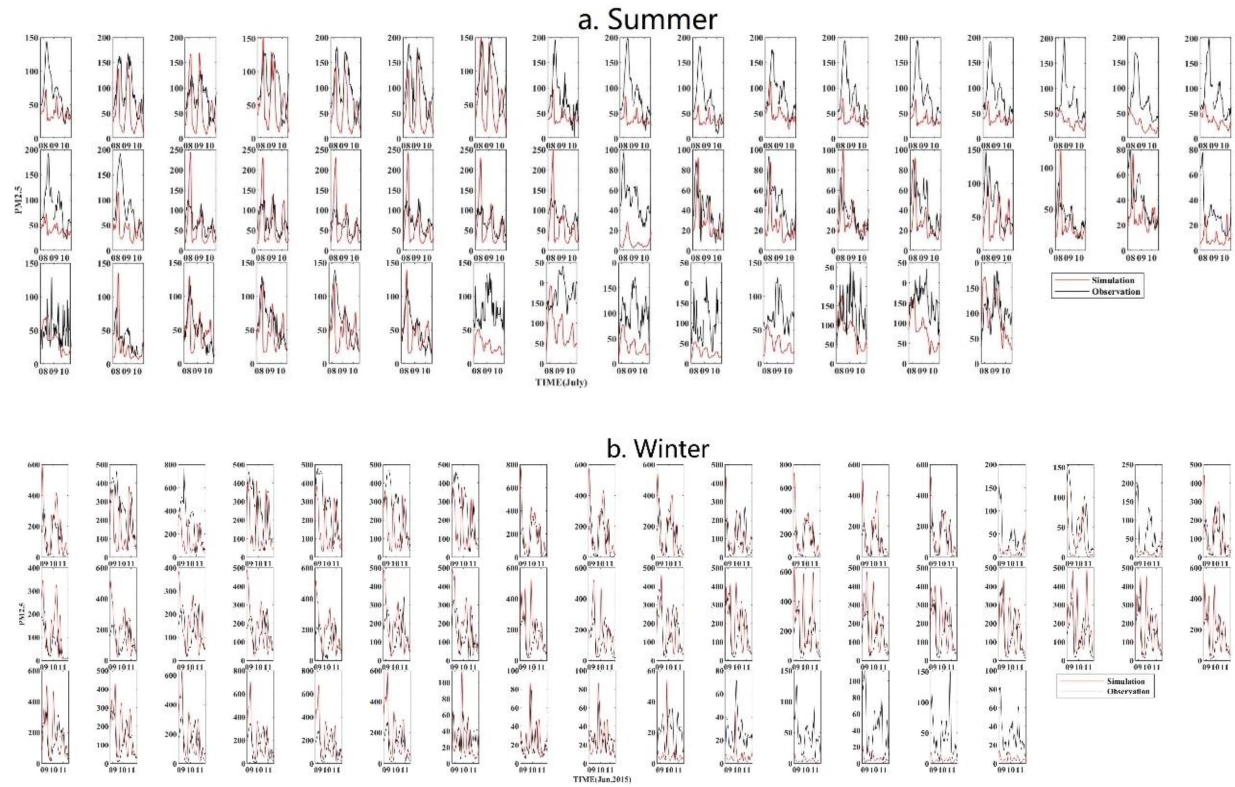

Figure S7. The comparison of temporal trends in each site between simulations (red curves) and observations (black curves) of *$PM_{2.5}$* (unit: ug m^{-3}) in (a) summer (20150706-20150710) and (b) winter (20150107-20150110).

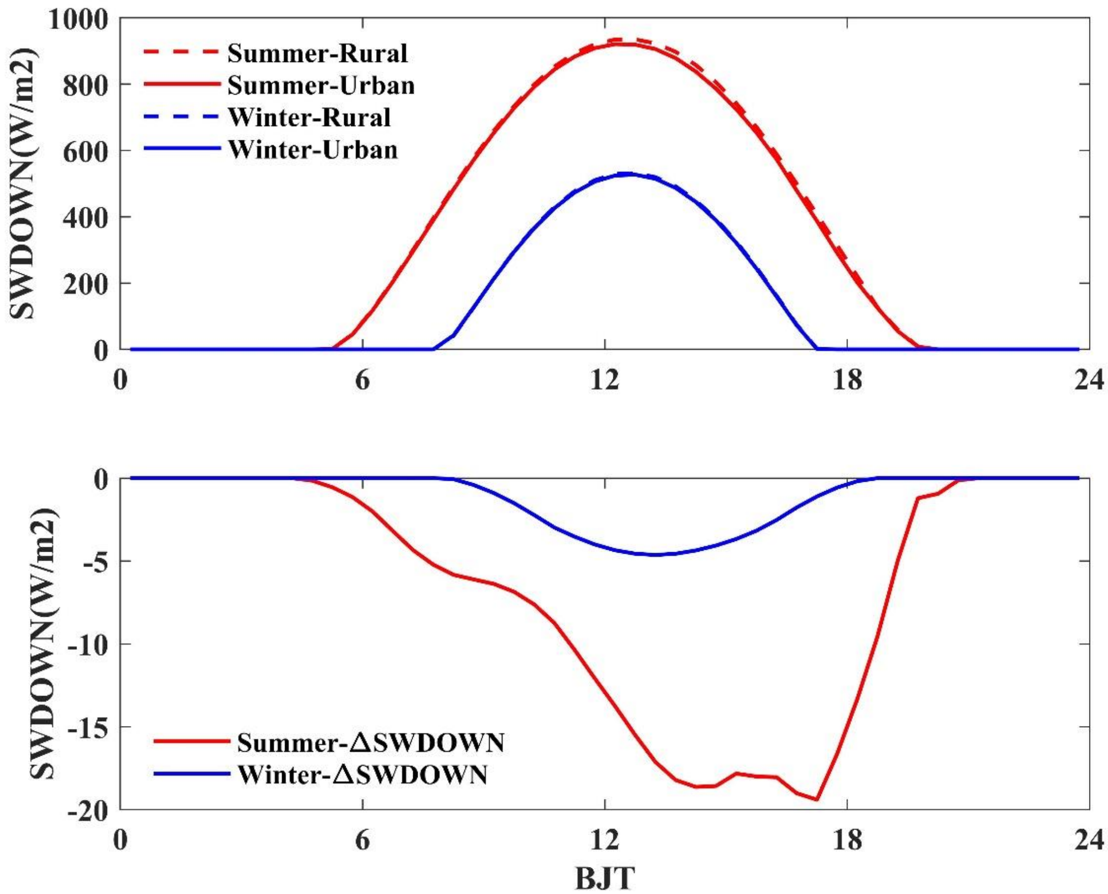

Figure S8. (a) The average diurnal variation of downward shortwave radiation at surface (SWDOWN) with ARE (unit: W m^{-2}) duing the course of typical days in summer (20150706-20150710) and and winter (20150107-20150110). (b) shows the diurnal variation of SWDOWN differences (unit: W m^{-2}). $\Delta SWDOWN$ is the SWDOWN difference between urban and rural areas. The blue and red represent winter and summer, the solid line and broken line represent urban and rural trends.

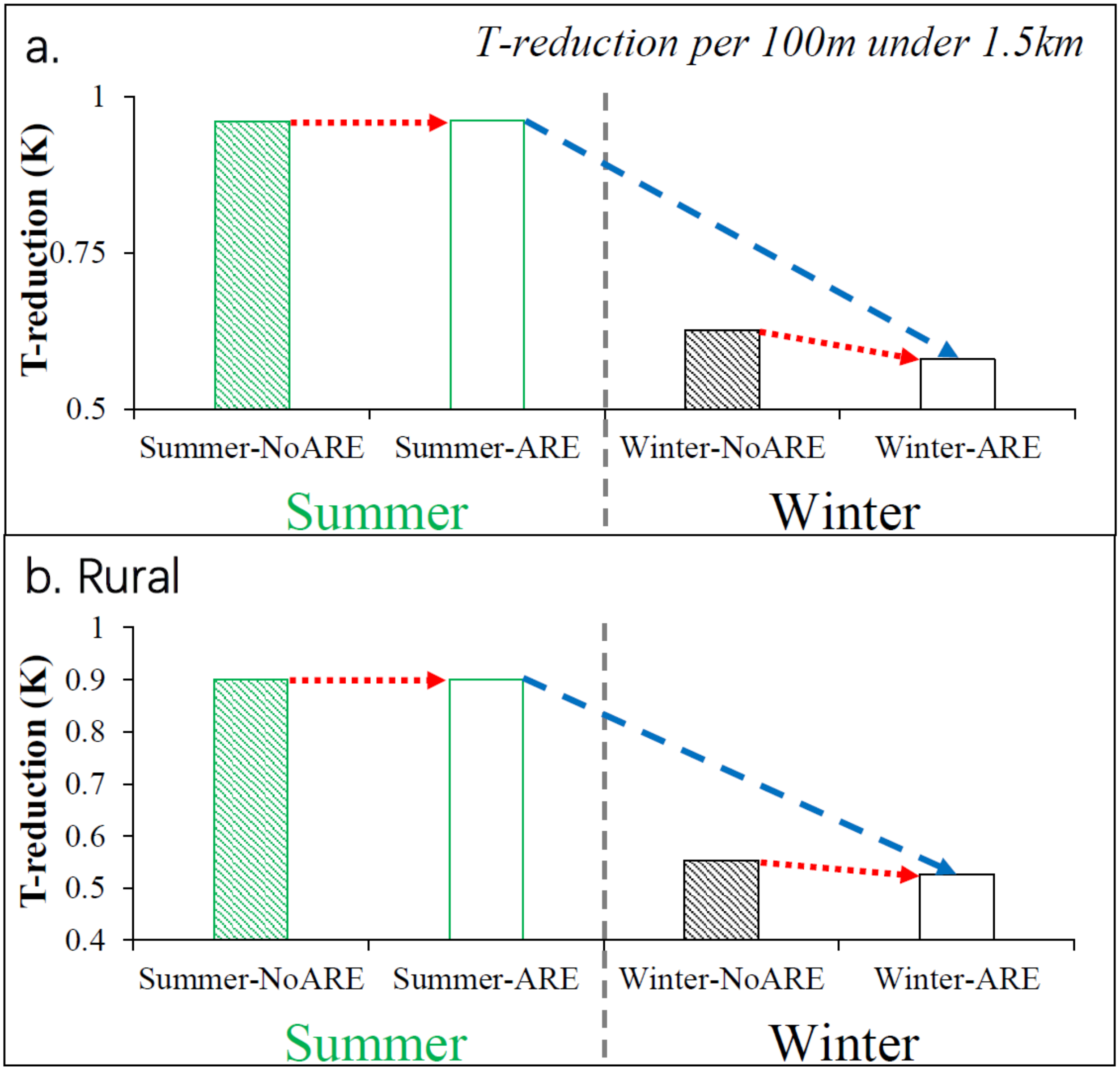

Figure S9. The temperature reductions of model simulated results below 1.5 km [unit: K (100 m)$^{-1}$] between without ARE (white bars) and with ARE (dark bars) for typical days in summer (green bars) and winter (black bars) in (a) urban areas and (b) rural areas, respectively.

Table S1. Study areas selected for this study.

City Level	City Name
Province-level municipality	Beijing (BJ), Chongqing (CQ), Shanghai (SH), Tianjin (TJ)
Provincial capital city	Changchun (CC), Changsha (CS), Chengdu (CD), Fuzhou (FZ), Guangzhou (GZ), Guiyang (GY), Haerbin (HEB), Haikou (HK), Hangzhou (HZ), Hefei (HF), Huhehaote (HHHT), Jinan (JN), Kunming (KM), Lanzhou (LZ), Nanchang (NC), Nanjing (NJ), Nanning (NN), Shenyang (SY), Shijiazhuang (SJZ), Taiyuan (TY), Wuhan (WH) , Wulumuqi (WLMQ), Xi'an (XA), Xining (XN), Yinchuan (YC), Zhengzhou (ZZ)
Municipalities with independent planning status under the national social and economic development	Dalian (DL), Ningbo (NB), Qingdao (QD), Shenzhen (SZ), Xiamen (XM)

Table S2. Details about time period and aerosol effect used for WRF-Chem experiments .

Experiments	Study period	Description
A1Summer	20150707-20150710	Swith on Aerosol radiative effect
A0Summer	20150707-20150710	Swith off Aerosol radiative effect
A1Winter	20150108-20150110	Swith on Aerosol radiative effect
A0Winter	20150108-20150110	Swith off Aerosol radiative effect

Table S3. Schemes of the simulations used in WRF-Chem3.9.1.

Type of schemes	Options
Microphysics scheme	Morrison et al. (Morrison et al. 2009)
Cumulus scheme	Kain-Fritsch (Kain and Fritsch 1990, Kain and Fritsch 1993, Kain 2004)
Radiation scheme	RRTMG (Iacono et al. 2008)
surface-layer option	Monin-Obukhov scheme (Monin and Obukhov 1954)
Land surface scheme	Noah LSM with Single-layer UCM (Chen and Dudhia 2001, Kusaka et al. 2001, Kusaka and Kimura 2004)
PBL scheme	YSU (Hong et al. 2006)
Chemical mechanism	CBMZ
Aerosol model	MOSAIC(8 bins)(Zaveri and Peters 1999, Zaveri, Easter et al. 2008)