Supplement of

Anthropogenic emission controls reduce summertime ozone-temperature sensitivity in the United States

Shuai Li et al.

Correspondence to Xiao Lu (luxiao25@mail.sysu.edu.cn)

Text S1. Site selection

We apply the following criteria to select sites with sufficient hourly ozone observations for the calculation of MDA8 ozone and long-term trend estimate:

(1) Only days have at least 16 hourly observations per day are included;

(2) Only summers (JJA) have at least 45 available daily MDA8 ozone records are included;

(3) Only sites with valid ozone measurements for at least 24 years (i.e. >75%) in the 1990-2021 period and for at least 3 years in 2017-2021 are selected.

A total of 608 sites, including 319 urban sites and 289 rural sites, are selected in this study.

Table S1 $m_{\Delta O3\text{-}\Delta Tmax}$(ppbv) and $r_{\Delta O3\text{-}\Delta Tmax}$ in present-day (2017-2021) and $m_{\Delta O3\text{-}\Delta Tmax}$ trends (ppbv/K/year) from 1990 to 2021 in seven areas

	NEUS	SEUS	Midwest	Plains	Intermountain West	NWUS	SWUS
			$m_{\Delta O3\text{-}\Delta Tmax}$ (ppbv/K)				
Mean	1.96±0.65	1.32±0.62	2.07±0.61	1.05±0.63	0.58±0.29	1.54±0.39	1.34±0.70
Urban	2.17±0.58	1.42±0.66	2.23±0.55	1.14±0.67	0.72±0.21	1.68±0.21	1.48±0.77
Rural	1.79±0.66	1.23±0.57	1.91±0.64	0.76±0.42	0.47±0.30	1.50±0.43	1.07±0.44
			$r_{\Delta O3\text{-}\Delta Tmax}$				
Mean	0.52±0.09	0.29±0.11	0.50±0.12	0.24±0.16	0.24±0.11	0.63±0.08	0.47±0.18
Urban	0.56±0.06	0.30±0.11	0.53±0.10	0.23±0.13	0.28±0.08	0.65±0.08	0.49±0.19
Rural	0.49±0.10	0.28±0.10	0.47±0.13	0.27±0.22	0.21±0.12	0.62±0.08	0.43±0.15
			$m_{\Delta O3\text{-}\Delta Tmax}$ trends (ppbv/K/year)				
Mean	-0.83**	-0.61**	-0.52**	-0.27	-0.08*	-0.30**	-0.60**
Urban	-0.84**	-0.67**	-0.52**	-0.33	-0.09*	-0.35**	-0.88**
Rural	-0.81**	-0.56**	-0.50**	-0.15	-0.07	-0.27**	-0.34**

**represents p-value<0.01, *represents p-value<0.05(Only in $m_{\Delta O3\text{-}\Delta Tmax}$ trends)

Table S2 Observed vs simulated $m_{\Delta O3\text{-}\Delta Tmax}$(ppbv/K) and their correlation coefficients (r) in different periods and areas

Period	SIM	OBS	r	SIM	OBS	r
	CONUS			NEUS		
1995-1999	2.61±1.53	2.91±1.77	0.65	3.06±0.97	4.10±1.44	0.65
2001-2005	2.78±1.63	2.81±1.85	0.71	3.29±1.34	3.58±1.28	0.52
2007-2011	2.33±1.42	2.15±1.52	0.67	3.27±1.28	2.89±1.04	0.67
2013-2017	2.16±1.15	1.68±1.29	0.61	2.23±0.98	1.99±1.22	0.63
	SEUS			Midwest		
1995-1999	3.07±1.78	3.34±1.82	0.61	2.98±0.89	2.74±1.17	0.64
2001-2005	3.18±2.09	3.30±2.42	0.73	3.41±1.1	3.03±1.2	0.66
2007-2011	1.98±1.66	1.90±1.78	0.71	2.87±0.86	2.47±1.32	0.49
2013-2017	2.54±1.19	1.60±1.38	0.58	2.79±0.96	2.10±1.23	0.77
	Plains			Intermountain West		
1995-1999	2.27±2.31	1.77±2.48	0.79	0.67±0.58	0.79±0.64	0.17
2001-2005	1.67±1.17	1.62±1.32	0.56	1.17±0.6	0.87±0.92	0.45
2007-2011	1.80±1.38	1.73±1.55	0.63	0.84±0.73	0.64±0.81	0.27
2013-2017	1.44±0.92	1.44±1.36	0.75	0.88±0.48	0.86±0.63	0.43
	NWUS			SWUS		
1995-1999	2.27±0.63	2.59±0.85	0.55	2.05±1.18	2.52±1.42	0.22
2001-2005	1.82±0.54	2.55±0.71	0.11	2.15±1.11	2.31±1.54	0.51
2007-2011	1.67±0.44	2.00±0.62	0.32	2.22±0.97	2.29±1.40	0.42
2013-2017	1.60±0.57	1.76±0.75	0.27	1.71±0.95	1.41±1.26	0.38

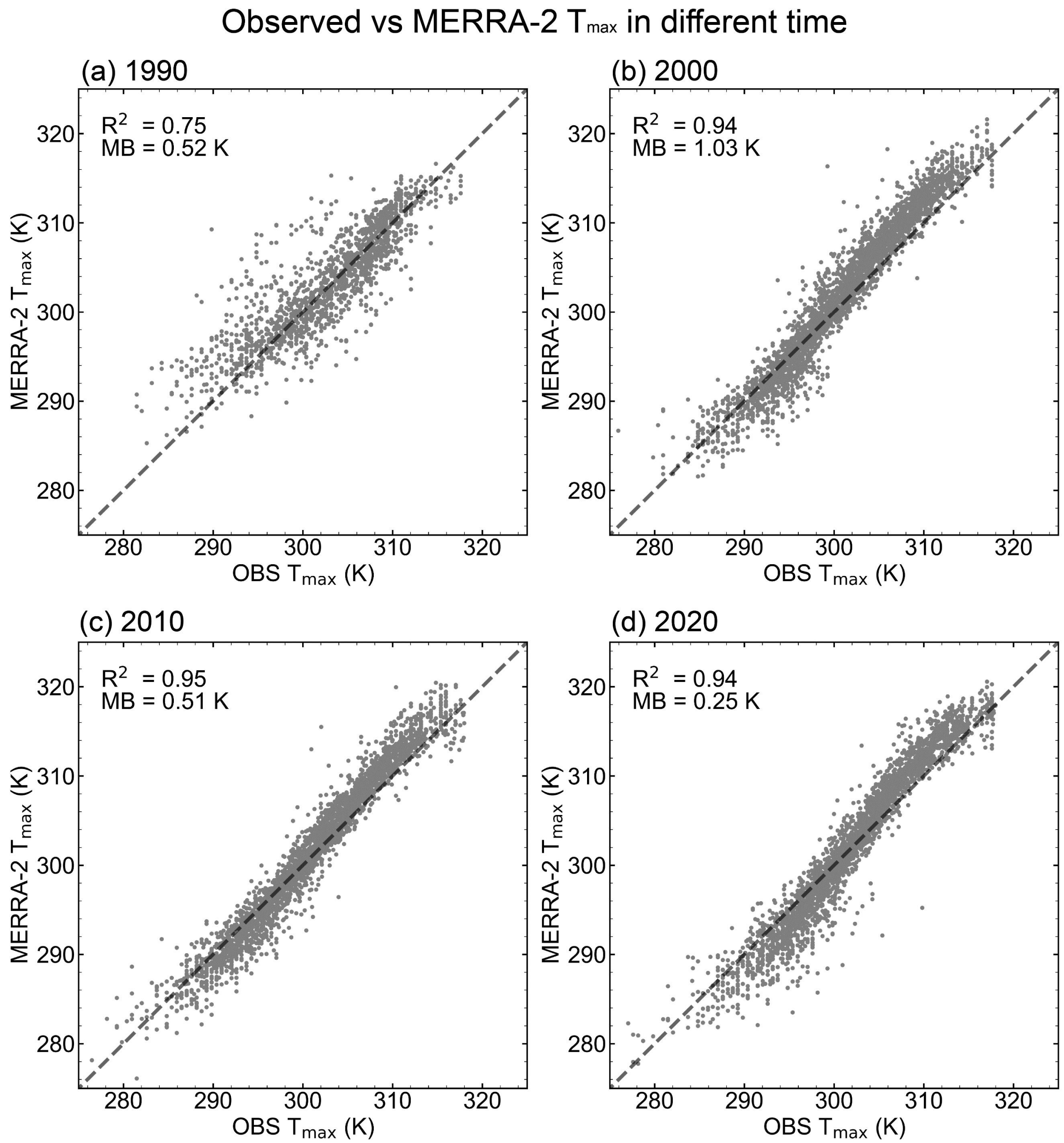

Figure S1. Observed (AQS) vs MERRA-2 T_{max} (daily maximum temperature) at summertime (June, July, August) in 1990(a),2000(b),2010(c) and 2020(d)). The explained variance (R^2) and mean bias (MB) are shown in the inset.

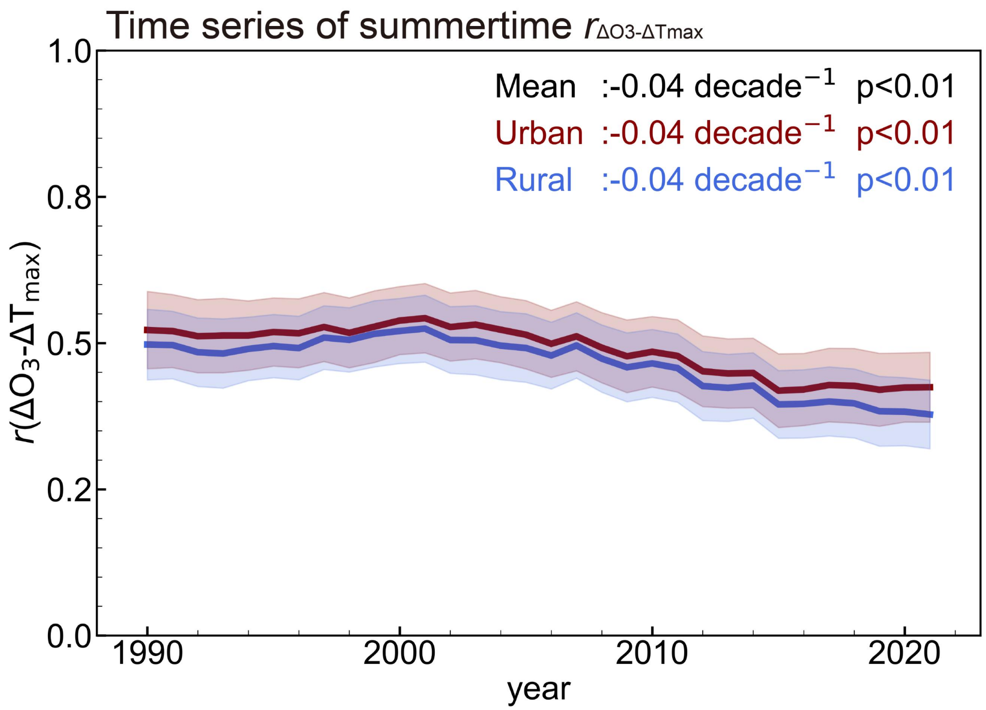

Figure S2. Same as Figure 3a but for $r_{\Delta O3\text{-}\Delta Tmax}$.

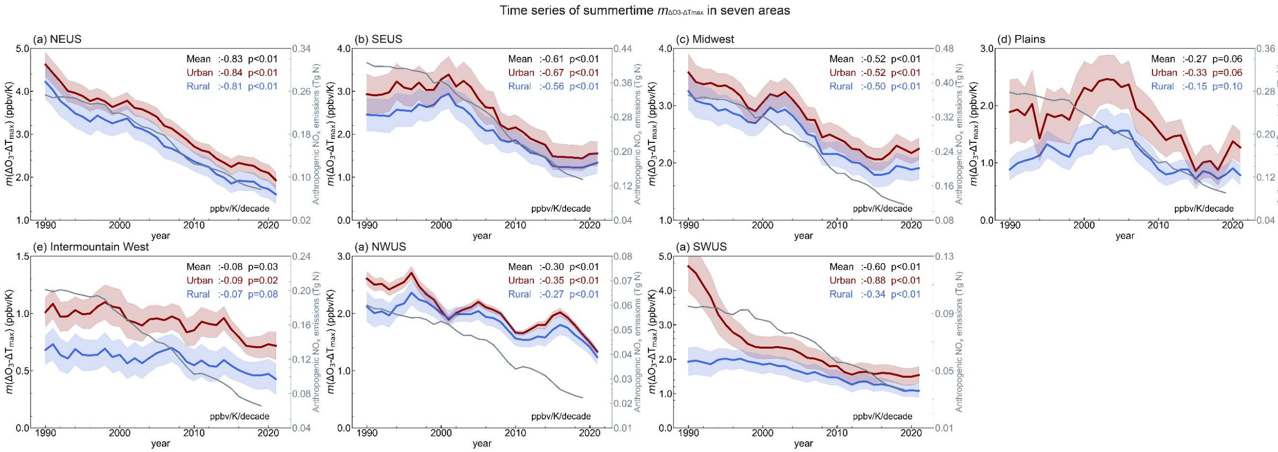

Figure S3. Same as Figure 3a but in seven areas.

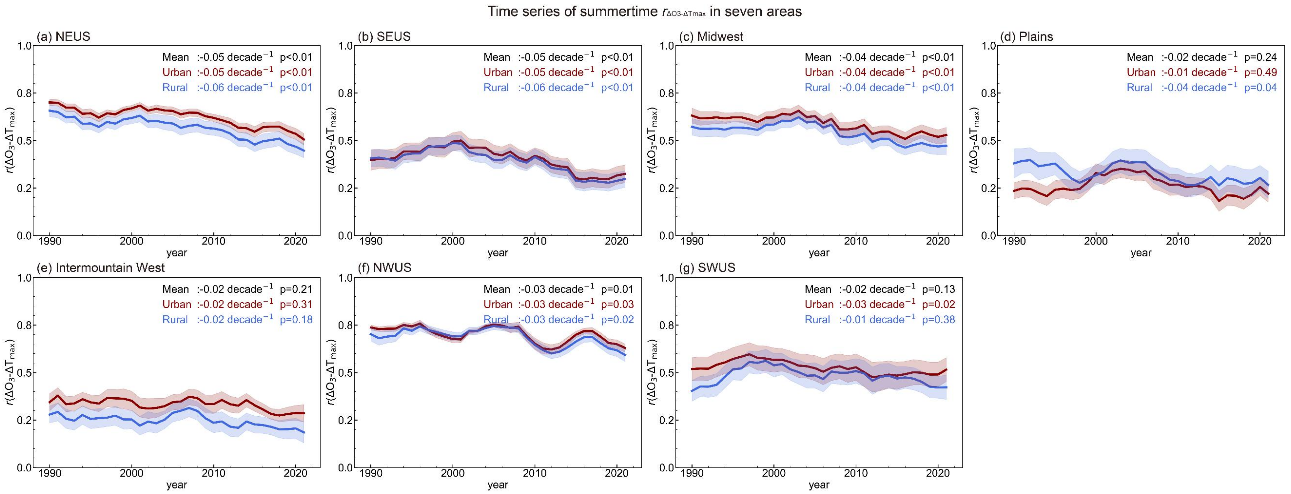

Figure S4. Same as Figure S3 but for $r_{\Delta O3\text{-}\Delta Tmax}$.

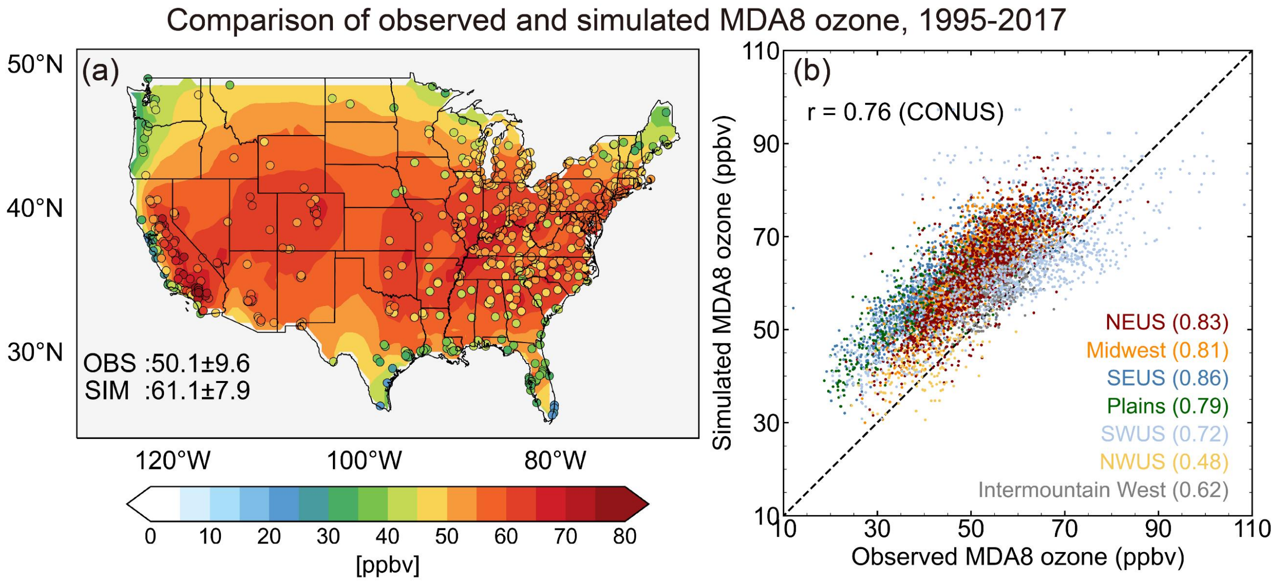

Figure S5. Same as Figure 4 but for MDA8 ozone.

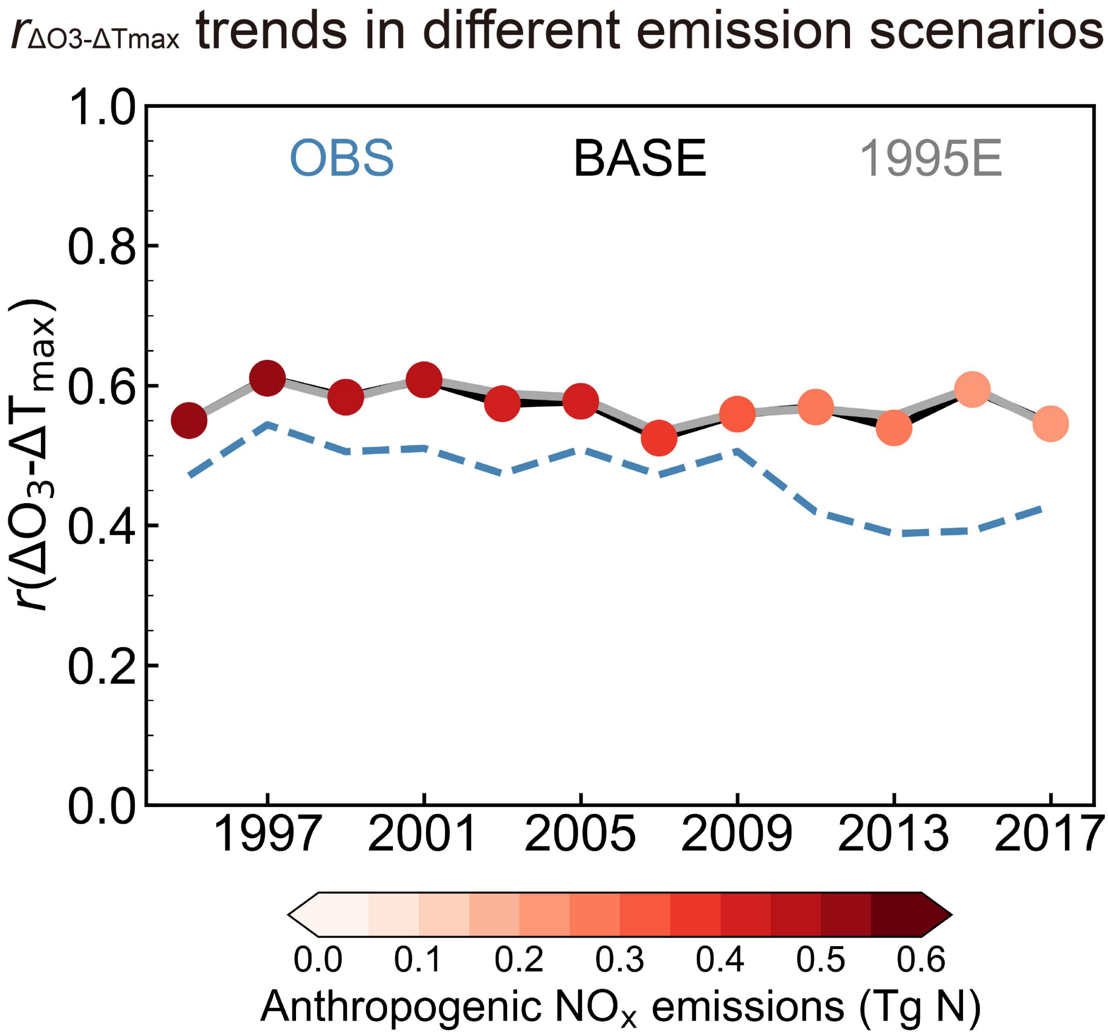

Figure S6. Same as Figure 5b but for $r_{\Delta O3-\Delta Tmax}$.

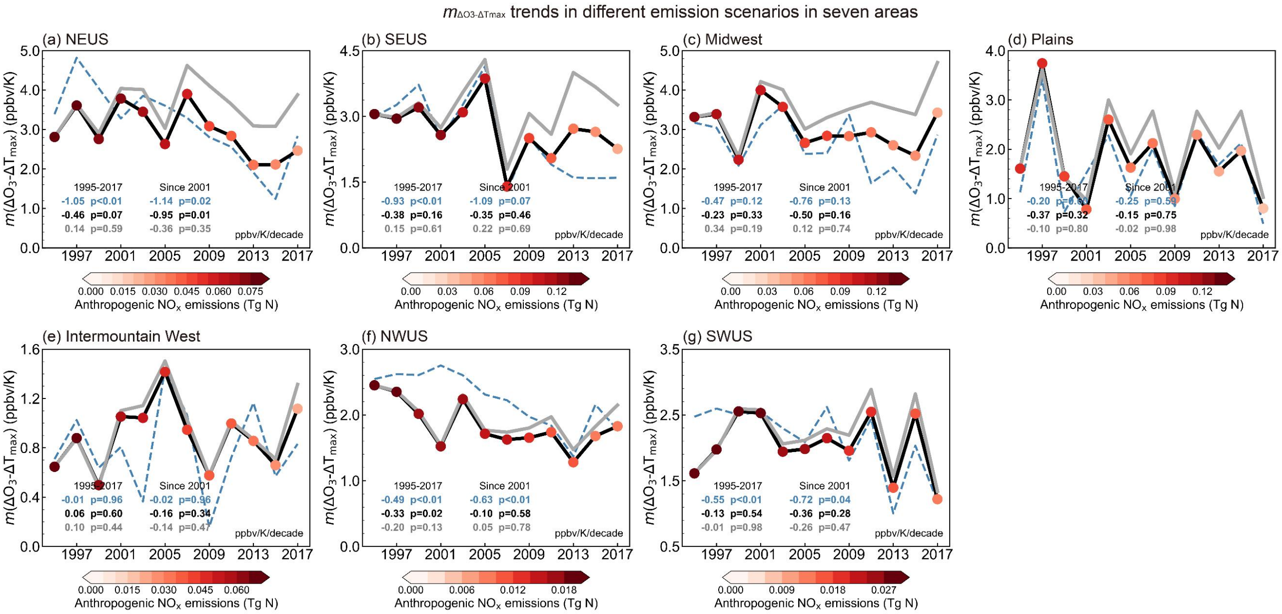

Figure S7. Same as Figure 5b but in seven areas.

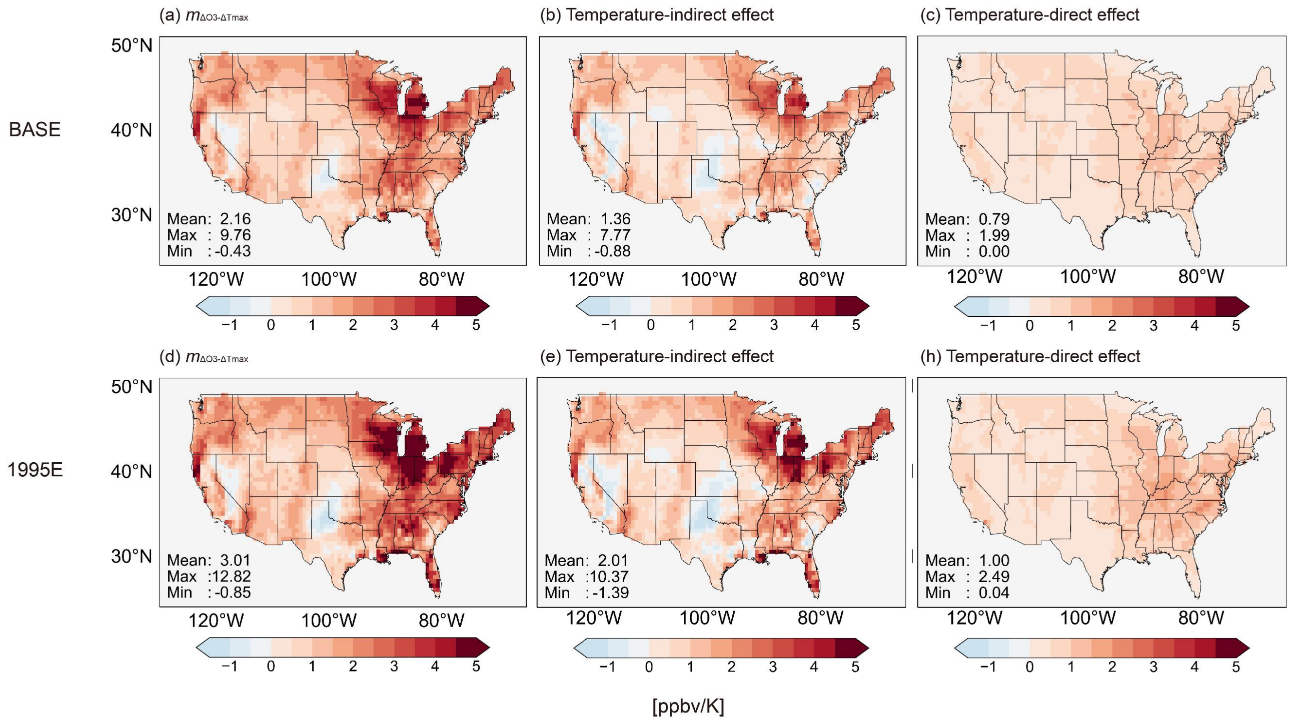

Figure S8. Contribution of the temperature-indirect and temperature-direct effects for $m_{\Delta O3\text{-}\Delta Tmax}$ in different emission scenarios. (a) the $m_{\Delta O3\text{-}\Delta Tmax}$ in the BASE. (d) the $m_{\Delta O3\text{-}\Delta Tmax}$ in the 1995E. (b) The contribution of the temperature-indirect effect to $m_{\Delta O3\text{-}\Delta Tmax}$ in the BASE-FTEMP. (e) is the same as (b), but in the 1995E-FTEMP. (c) The contribution of the temperature-direct effect to $m_{\Delta O3\text{-}\Delta Tmax}$, estimated as the difference of $m_{\Delta O3\text{-}\Delta Tmax}$ between BASE and BASE-FTEMP. (h) is the same as (c), but with anthropogenic NOx emission level fixed at 1995 level (*i.e.* estimated as the difference between 1995E and 1995E - FTEMP). Mean, maximum, and minimum values of the contributions among all CONUS sites are shown inset.

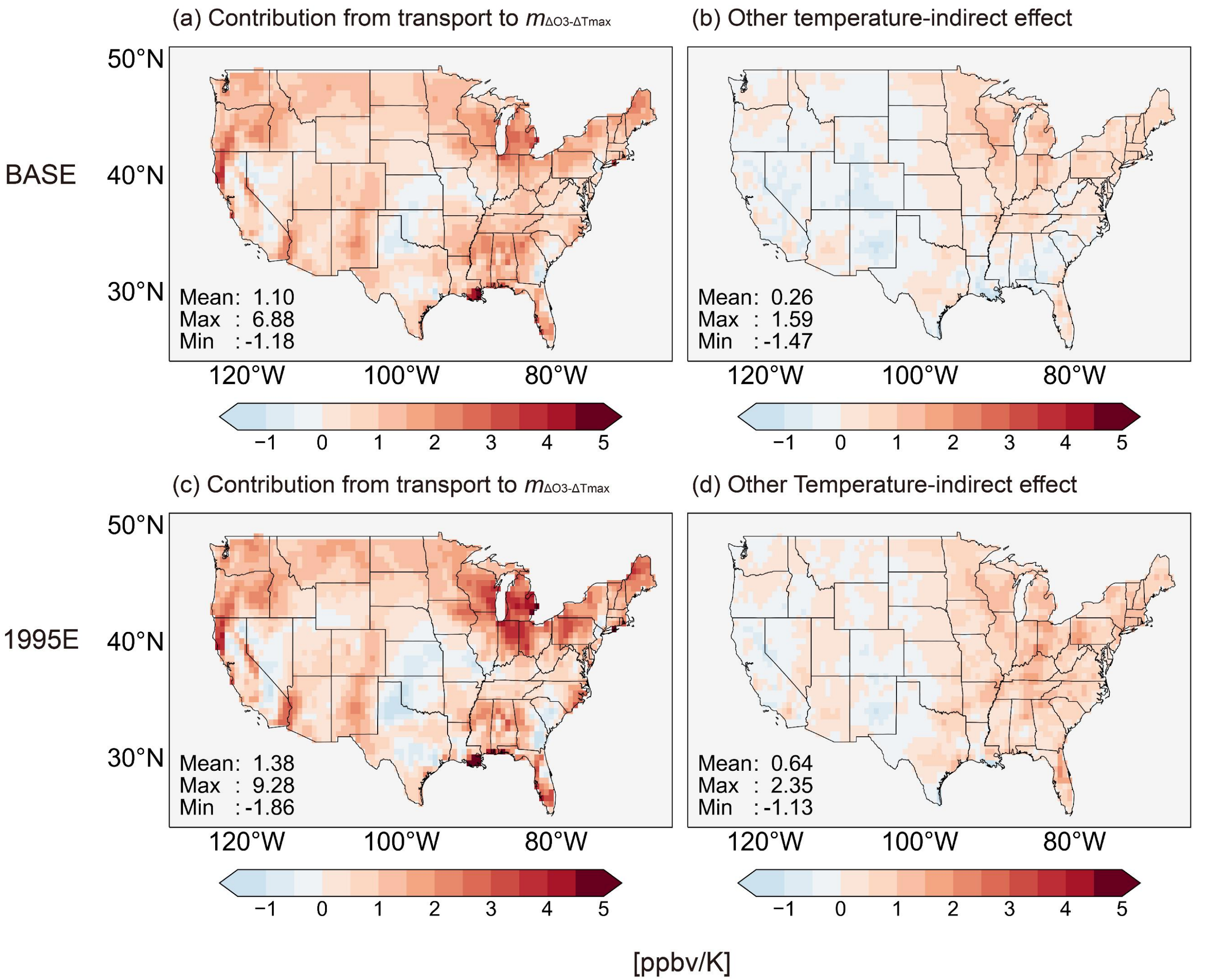

Figure S9. Contribution of the different temperature-indirect effects for $m_{\Delta O3\text{-}\Delta Tmax}$ in different emission scenarios. (a) The contribution of the transport effect to $m_{\Delta O3\text{-}\Delta Tmax}$ in the BASE-TRANS. (c) is the same as (a), but in the 1995E-TRANS. (b) The contribution of the other temperature-indirect effect to $m_{\Delta O3\text{-}\Delta Tmax}$, estimated as the difference of $m_{\Delta O3\text{-}\Delta Tmax}$ between BASE-FTEMP and BASE-TRANS. (d) is the same as (b), but with anthropogenic NOx emission level fixed at 1995 level (*i.e.* estimated as the difference between 1995E-FTEMP and 1995E-TRANS). Mean, maximum, and minimum values of the contributions among all CONUS sites are shown inset.

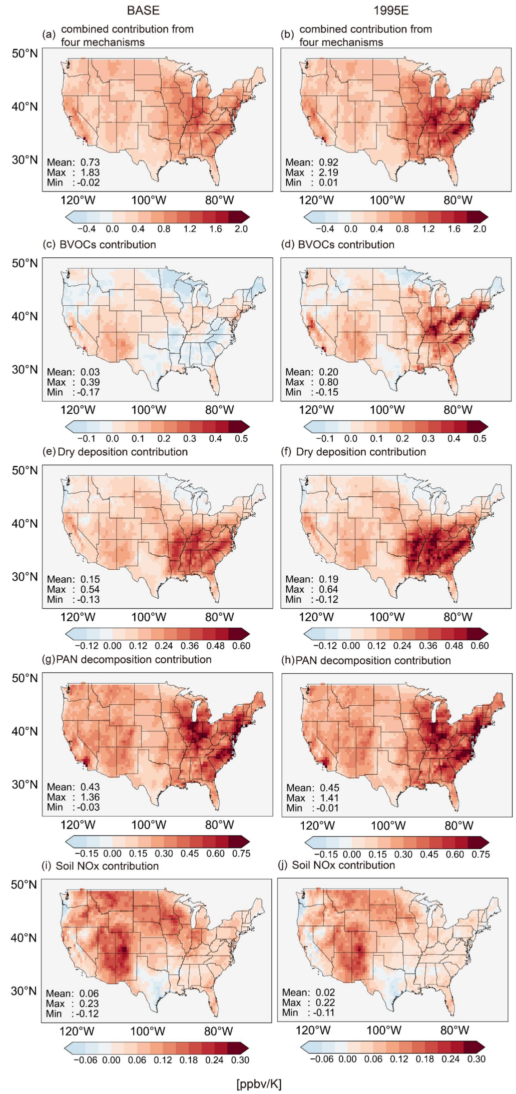

Figure S10. Contribution of the different temperature-direct effects for $m_{\Delta O3\text{-}\Delta Tmax}$ in different emission scenarios. (a) Combined contribution of the four temperature-dependent mechanisms (BVOCs emissions, dry deposition, PAN decomposition, and soil NOx emissions) to $m_{\Delta O3\text{-}\Delta Tmax}$, estimated as the difference of $m_{\Delta O3\text{-}\Delta Tmax}$ between BASE and BASE-FALL. (b) is the same as (a), but with anthropogenic NOx emission level fixed at 1995 level (*i.e.* estimated as the difference between 1995E and 1995E -FALL). (c-i, d-j) Individual contribution of BVOCs emissions, dry deposition, PAN decomposition, and soil NOx emissions) to $m_{\Delta O3\text{-}\Delta Tmax}$ with 2017 and 1995 emission level, respectively. Mean, maximum, and minimum values of the contributions among all CONUS sites are shown inset. Note that the value range of each figure is different.

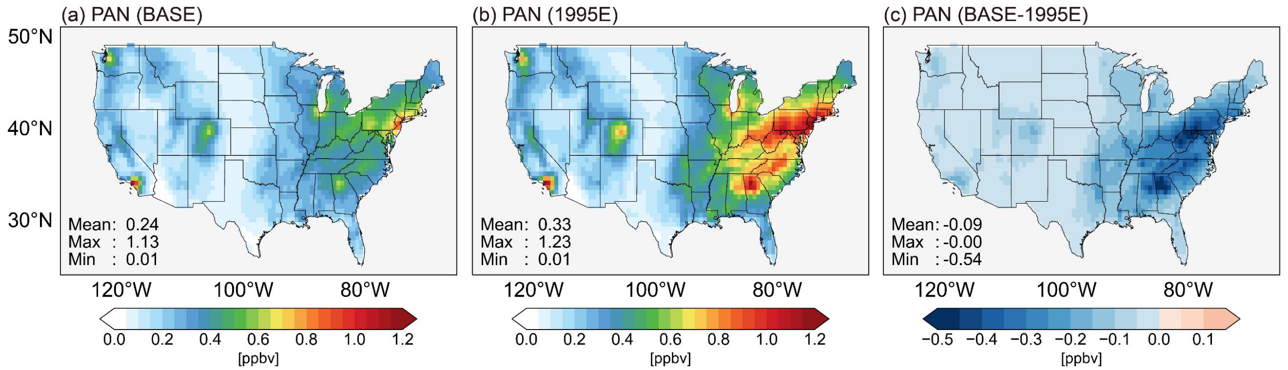

Figure S11. The distribution of mean PAN concentration in July 2017 from the BASE(a) and 1995E(b) simulation. (c) the difference for PAN concentration between BASE and 1995E. Mean, maximum, and minimum values in the CONUS are shown inset.

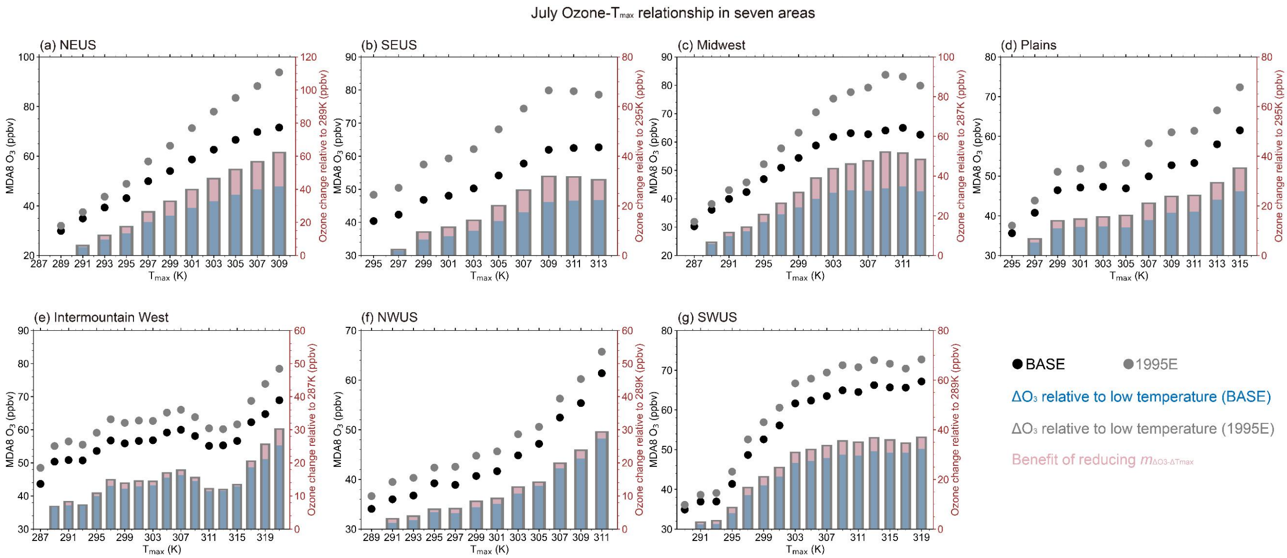

Figure S12. Same as Figure 9a but in seven areas. Note that the value range of each figure is different.