Supplement of Atmos. Chem. Phys., 19, 10497–10523, 2019
https://doi.org/10.5194/acp-19-10497-2019-supplement
© Author(s) 2019. This work is distributed under
the Creative Commons Attribution 4.0 License.

Atmospheric Chemistry and Physics
Open Access
EGU

Supplement of

Large contribution of meteorological factors to inter-decadal changes in regional aerosol optical depth

Huizheng Che et al.

Correspondence to: Huizheng Che (chehz@cma.gov.cn) and Xiaoye Zhang (xiaoye@cma.gov.cn)

The copyright of individual parts of the supplement might differ from the CC BY 4.0 License.

This PDF file includes:

[5],

Figs. S1 to S20

Tables. S1 to S5

Supplementary Figure captions:

Fig. S1. Spatial distributions of annual trends in AOD calculated from the time series value of the de-seasonalized monthly anomaly from (a) MODIS/Terra and (b) MODIS/Aqua between 2003 and 2016. The grid areas with black dots indicate statistical significance at the 95% confidence level.

Fig. S2. Validations of AERONET AOD measurements against the three-hourly MERRA-2 AOD over the 12 ROIs, as defined in Figure 1. The color-coded dots indicate the number of samples. Where the solid red line is the line of best fit and the black dashed line is the 1:1 line.

Fig. S3. Validations of CARSNET AOD measurements against the three-hourly MERRA-2 AOD over (a) NC, (b) SC, and (c) NWC, as defined in Figure 1. The color-coded dots indicate the number of samples. Where the solid red line is the line of best fit and the black dashed line is the 1:1 line.

Fig. S4. Inter-annual variations in AOD from MERRA-2, MODIS/Terra and MISR over the 12 ROIs. The vertical bars represent the ± 1 standard deviation of annual mean AOD within the specified regions. The *R* between three regional annual mean AOD time series calculated by three different AOD products are given in the top panels.

Fig. S5. Spatial distributions of the *R* between (a) MERRA-2 and MODIS/Terra AOD, (b) MERRA-2 and MISR AOD, and (c) MODIS/Terra and MISR AOD during 2001–2016.

Fig. S6. Spatial distributions of annual and seasonal mean AODs during different periods for different AOD products. The first column represents spatial distribution of the annual and seasonal mean MERRA-2 AOD for 1980-2016, while the second and fourth columns represent the annual and seasonal spatial distribution of MERRA-2, MODIS and MISR AODs for 2001-2016, respectively.

Fig. S7. Inter-comparisons of global and regional seasonal trends in AOD calculated from the time series value of de-seasonalized monthly anomaly of MERRA-2, MODIS/Terra and MISR during the four periods of 1980–2016, 1980–1997, 1998–2016, and 2001–2016. Error bars represent the uncertainty associated with the calculated trend. The trend bars with shadow indicate statistical significance at the 95% confidence level.

Fig. S8. Sliding-window trend analyses of the Spring (March, April, and May) mean MERRA-2 AOD from 1998 to 2016 over the 12 ROIs (see Figure 1 for names and locations of regions), with at least 10 years used to calculate trends. The *x*-axis and *y*-axis indicate the start year and the length of the time series to calculate the trend, respectively. The colors of rectangles represent the intensity of the trend (units: /year), and those with black ‘x’ signs indicate linear trends above the 95% significance level.

Fig. S9. The same as Figure S8, but for the Summer (June, July, and August).

Fig. S10. The same as Figure S8, but for the Autumn (September, October, and November).

Fig. S11. The same as Figure S8, but for the Winter (December, January, and February).

Fig. S12. Time series of decadal trends in the annual and seasonal mean AOD for the 12 ROIs. The trends are calculated for each 10-year interval starting from 1998 to 2006 (*x*-axis).

Fig. S13. Spatial distributions of the *R* between MERRA-2 AOD and total anthropogenic emissions of total suspended particles (TSP), SO_2, black carbon (BC), and organic carbon (OC) for the period of 1980-2014. Only the R with 95% confidence level was shown.

Fig. S14. Spatial distributions of linear trends (units: $kg/km^2/year$) in total anthropogenic emissions of TSP, SO_2, BC, and OC during 1980–1997 derived from the Peking University emissions inventory (http://inventory.pku.edu.cn/). Only linear trend values with statistical significance at the 95% confidence level are shown.

Fig. S15. Spatial distributions of the *R* between MERRA-2 AOD and total anthropogenic emissions of TSP, SO_2, BC, and OC for 1980–1997. Only the *R* with 95% confidence level was shown.

Fig. S16. The same as Figure S14, but for 1998-2014.

Fig. S17. The same as Figure S15, but for 1998-2014.

Fig. S18. Pearson's *R* for spatially-averaged, MERRA-2 AOD versus meteorological variables during (a) 1980–1997 (top panel), (b) 1998-2014 (middle panel), and (c) 1980-2014 (bottom panel) over the 12 ROIs. Colored squares marked with 'x' signs indicate *R* above 95% significance level.

Fig. S19. Time series of MERRA-2 (in black) and modeled AOD monthly normalized anomalies from 1980 to 1997 over the 12 regions of interest. The coefficient of determination (R^2) of the regression fit of the stepwise MLR model with emission factors (in blue), meteorology (in green), and both emissions and meteorology (in red) as predictors are given in the top-right of each panel.

Fig. S20. Time series of MERRA-2 (in black) and modeled AOD monthly normalized anomalies from 1998 to 2014 over the 12 regions of interest. The coefficient of determination (R^2) of the regression fit of the stepwise MLR model with emission factors (in blue), meteorology (in green), and both emissions and meteorology (in red) as predictors are given in the top-right of each panel.

Supplementary Table captions:

Table S1. Global and regional annual and seasonal trends (unit: /year) derived based upon MERRA-2, MODIS/Terra and MISR AOD datasets during the four historical periods, 1980-2016, 1980-1997, 1998-2016, and 2001-2016. Bold font indicates the trend is statistically significant at the 95% level.

Table S2. Stepwise multiple linear regression (MLR) models for monthly AOD over the 12 ROIs during three different periods: 1980-1997, 1998-2014, and 1980-2014. Note that after implementing variable filtering based on stepwise MLR model, the number of explanatory variables retained for each ROI is different.

Table S3. The LMG method for estimated relative importance (%) of the retained variables based on stepwise MLR model over the 12 ROIs during three different periods: 1980-1997, 1998-2014, and 1980-2014. Note that after implementing variable filtering based on stepwise MLR model, the number of explanatory variables retained for each ROI is different.

Table S4. Location information from the selected 468 AERONET sites worldwide and results for the statistical comparison with three-hourly MERRA-2 AOD. R is (Pearson) correlation coefficient, MAE is the mean absolute error, RMSE is the root-mean-square error of the differences, RMB is the relative mean bias, MFE is the mean fractional error, FGE is the fractional gross error and IOA is the index of agreement.

Table S5. Location information from the 37 CARSNET sites in China and results for the statistical comparison with three-hourly MERRA-2 AOD. R is (Pearson) correlation coefficient, MAE is the mean absolute error, RMSE is the root-mean-square error of the differences, RMB is the relative mean bias, MFE is the mean fractional error, FGE is the fractional gross error and IOA is the index of agreement.

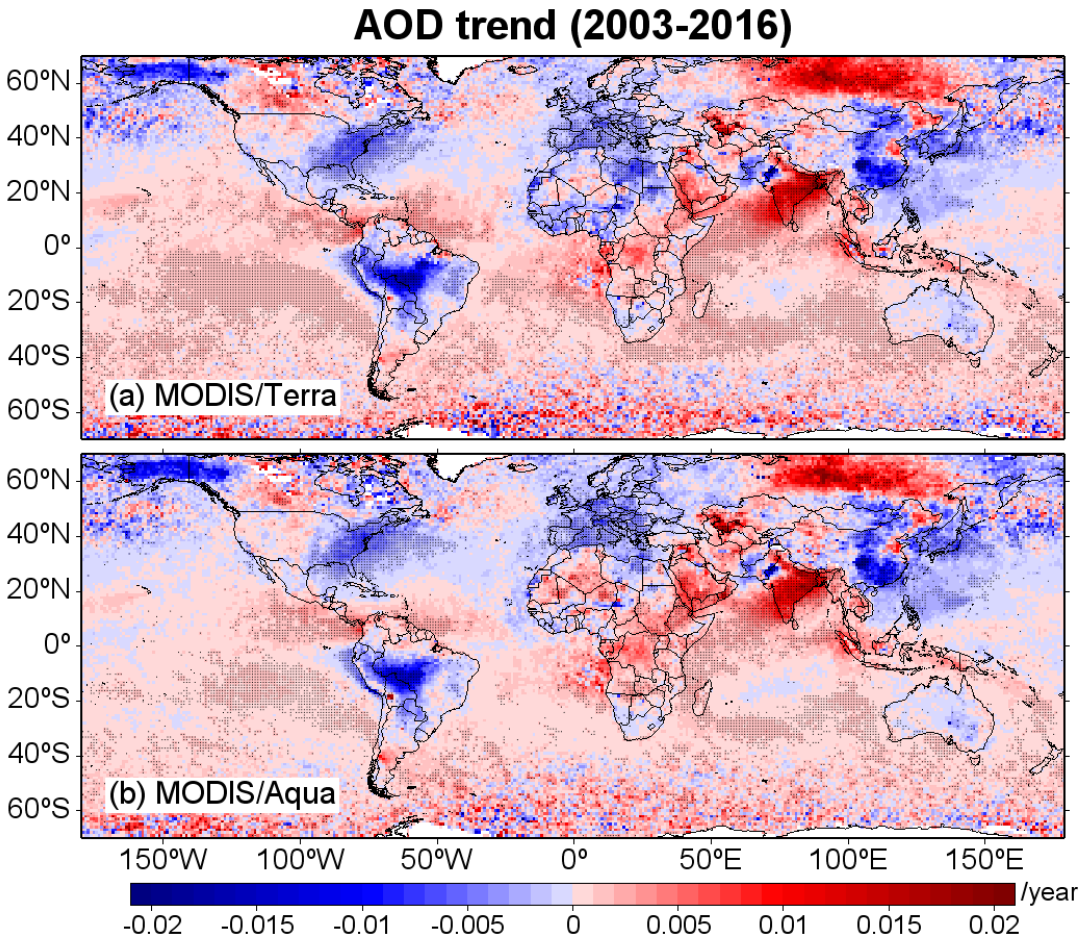

Fig. S1. Spatial distributions of annual trends in AOD calculated from the time series value of the de-seasonalized monthly anomaly from (a) MODIS/Terra and (b) MODIS/Aqua between 2003 and 2016. The grid areas with black dots indicate statistical significance at the 95% confidence level.

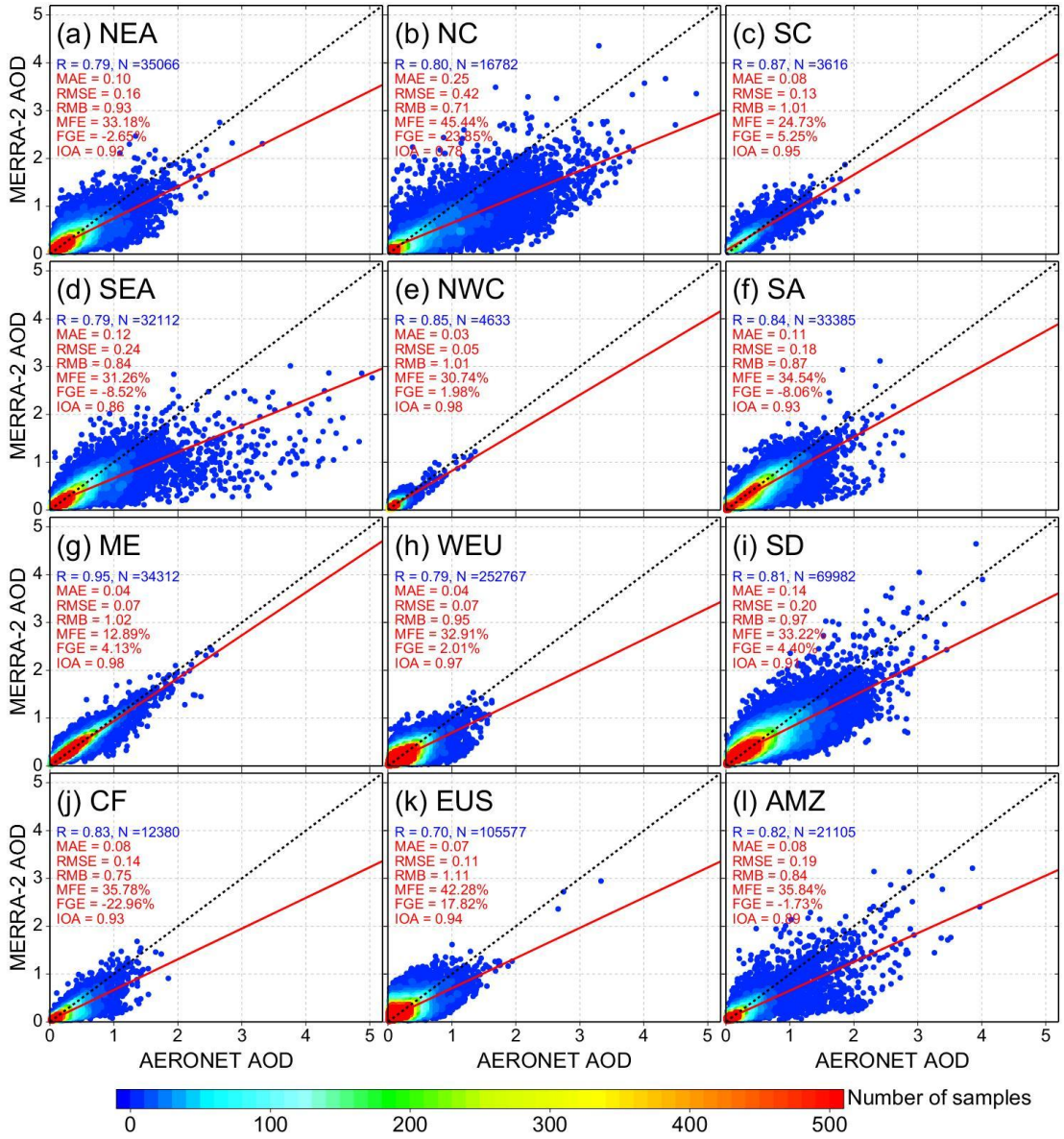

Fig. S2. Validations of AERONET AOD measurements against the three-hourly MERRA-2 AOD over the 12 ROIs, as defined in Figure 1. The color-coded dots indicate the number of samples. Where the solid red line is the line of best fit and the black dashed line is the 1:1 line.

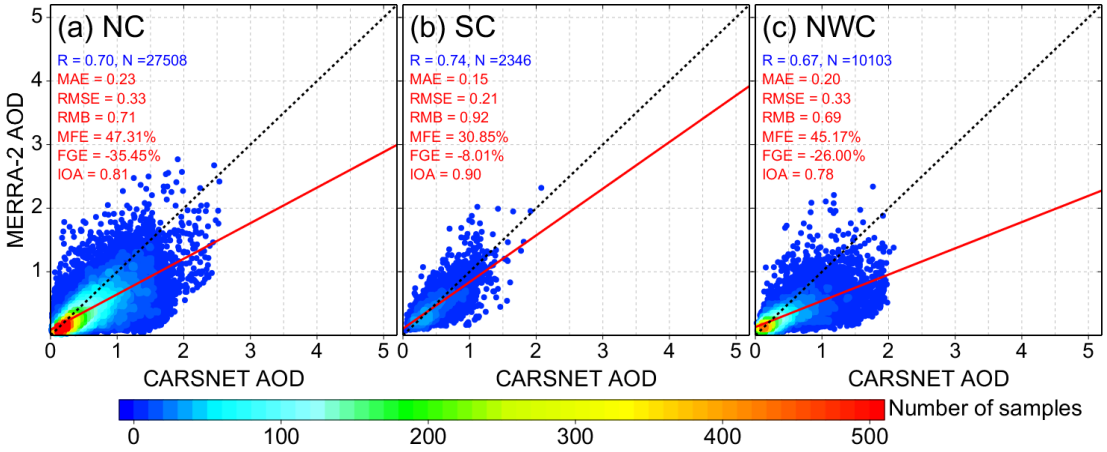

Fig. S3. Validations of CARSNET AOD measurements against the three-hourly MERRA-2 AOD over (a) NC, (b) SC, and (c) NWC, as defined in Figure 1. The color-coded dots indicate the number of samples. Where the solid red line is the line of best fit and the black dashed line is the 1:1 line.

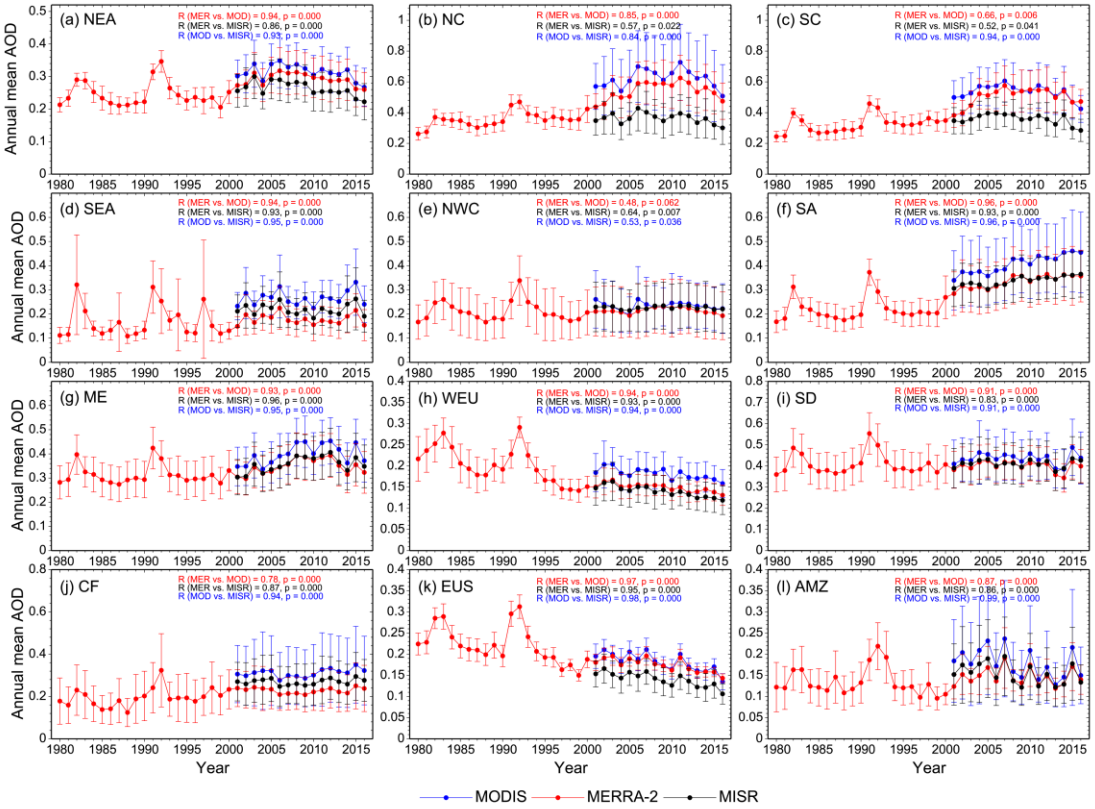

Fig. S4. Inter-annual variations in AOD from MERRA-2, MODIS/Terra and MISR over the 12 ROIs. The vertical bars represent the ± 1 standard deviation of annual mean AOD within the specified regions. The *R* between three regional annual mean AOD time series calculated by three different AOD products are given in the top panels.

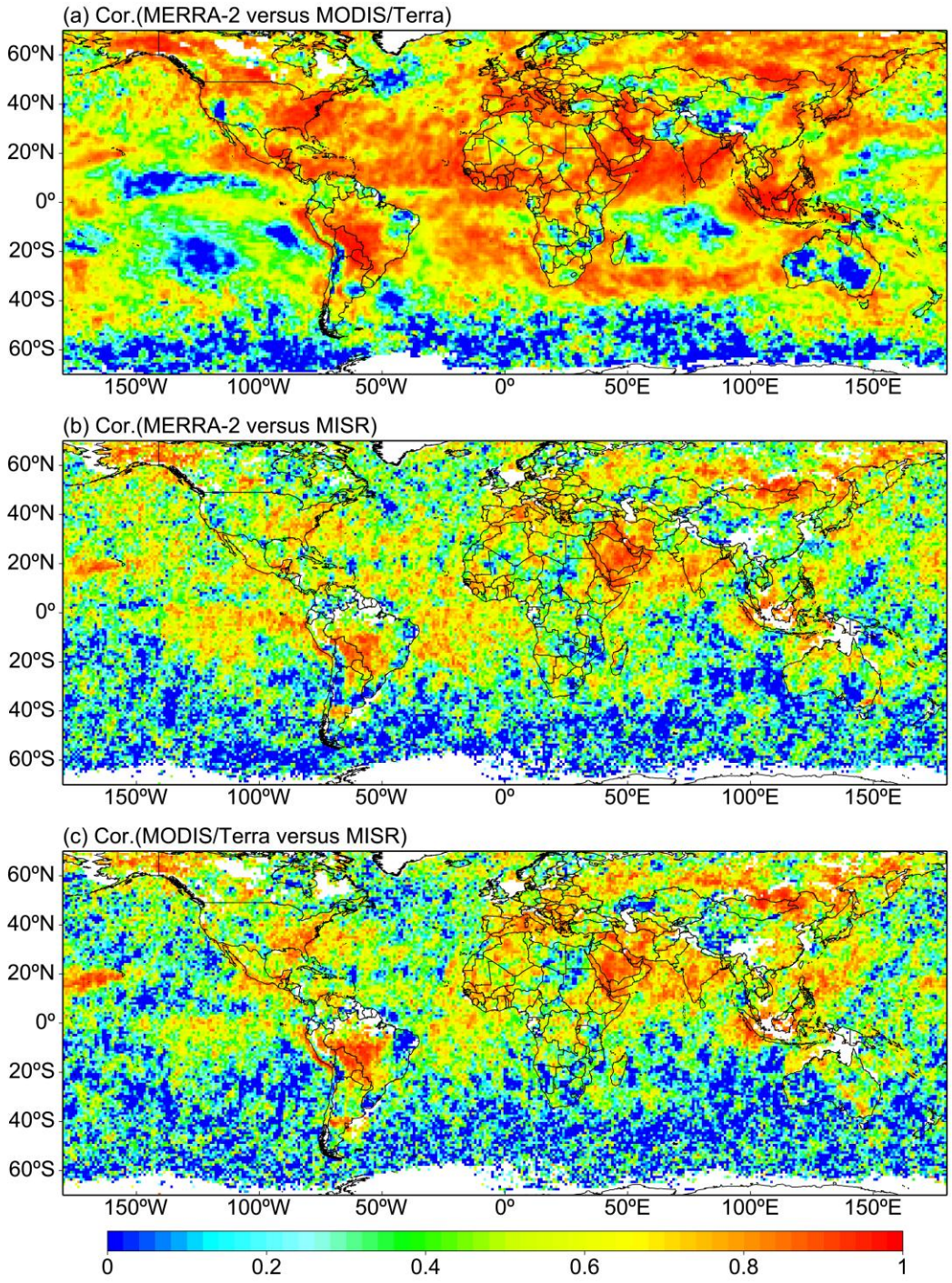

Fig. S5. Spatial distributions of the *R* between (a) MERRA-2 and MODIS/Terra AOD, (b) MERRA-2 and MISR AOD, and (c) MODIS/Terra and MISR AOD during 2001–2016.

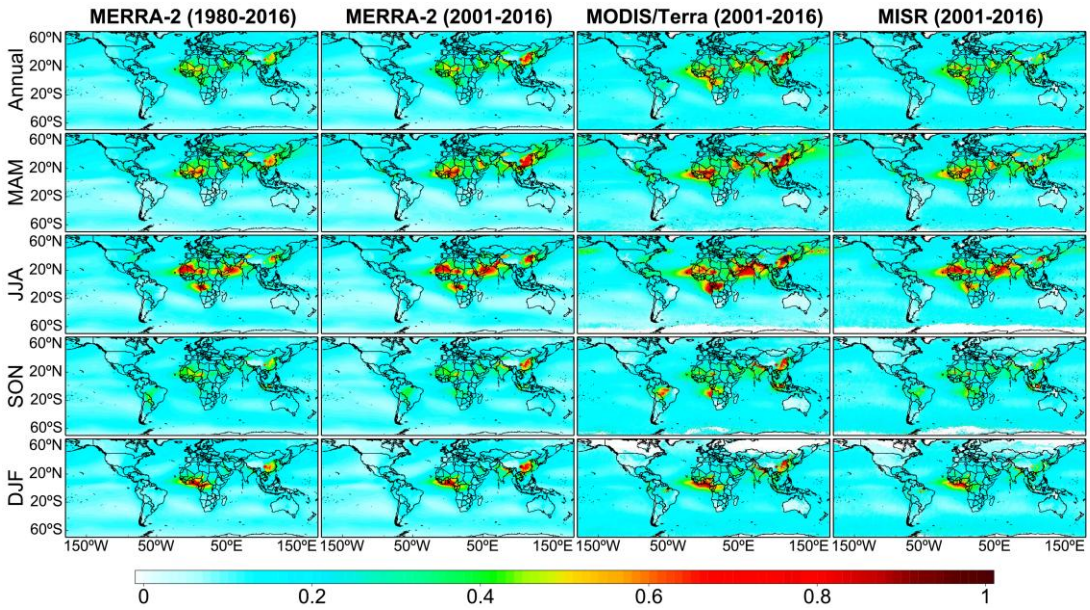

Fig. S6. Spatial distributions of annual and seasonal mean AODs during different periods for different AOD products. The first column represents spatial distribution of the annual and seasonal mean MERRA-2 AOD for 1980-2016, while the second and fourth columns represent the annual and seasonal spatial distribution of MERRA-2, MODIS and MISR AODs for 2001-2016, respectively.

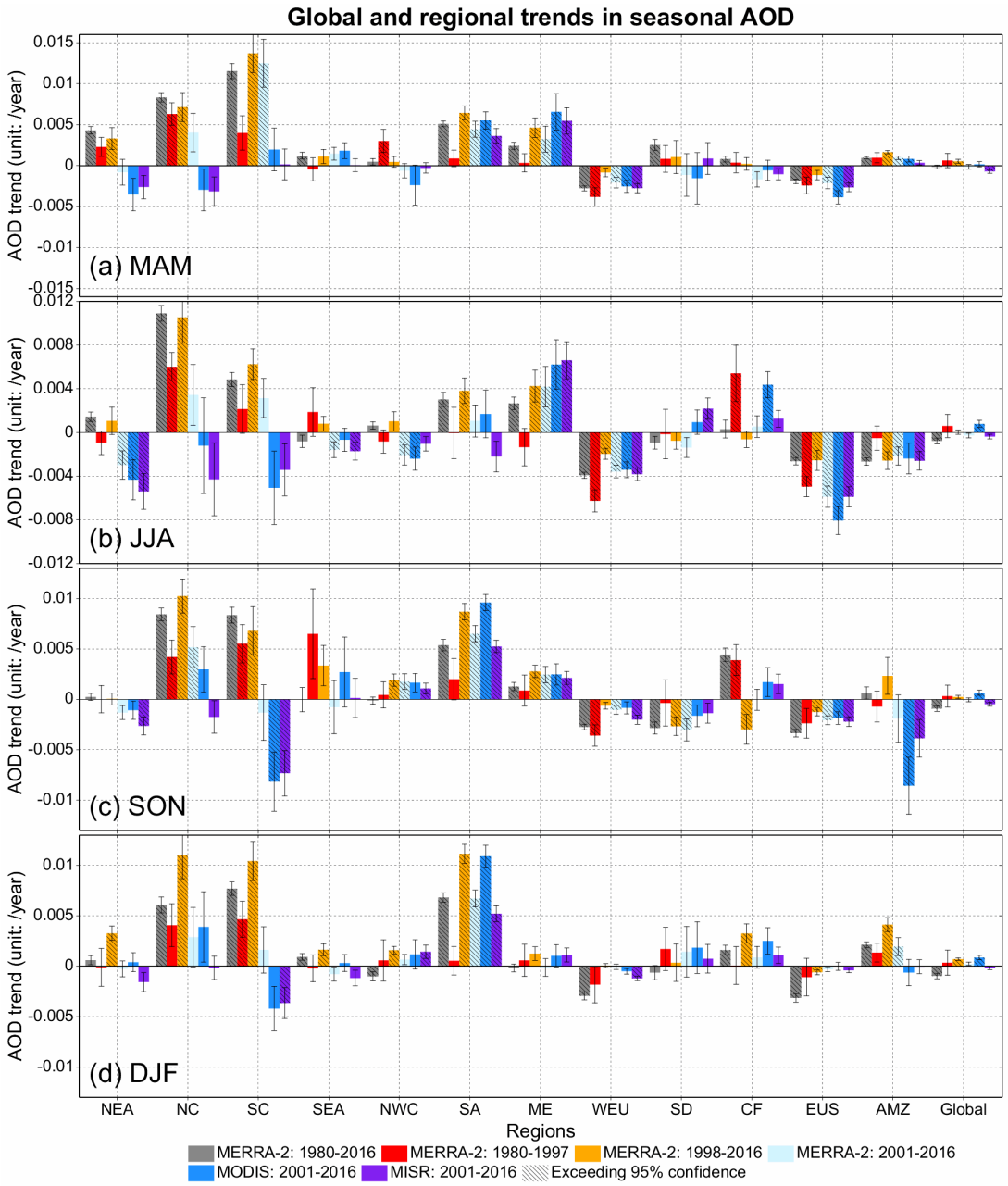

Fig. S7. Inter-comparisons of global and regional seasonal trends in AOD calculated from the time series value of de-seasonalized monthly anomaly of MERRA-2, MODIS/Terra and MISR during the four periods of 1980–2016, 1980–1997, 1998–2016, and 2001–2016. Error bars represent the uncertainty associated with the calculated trend. The trend bars with shadow indicate statistical significance at the 95% confidence level.

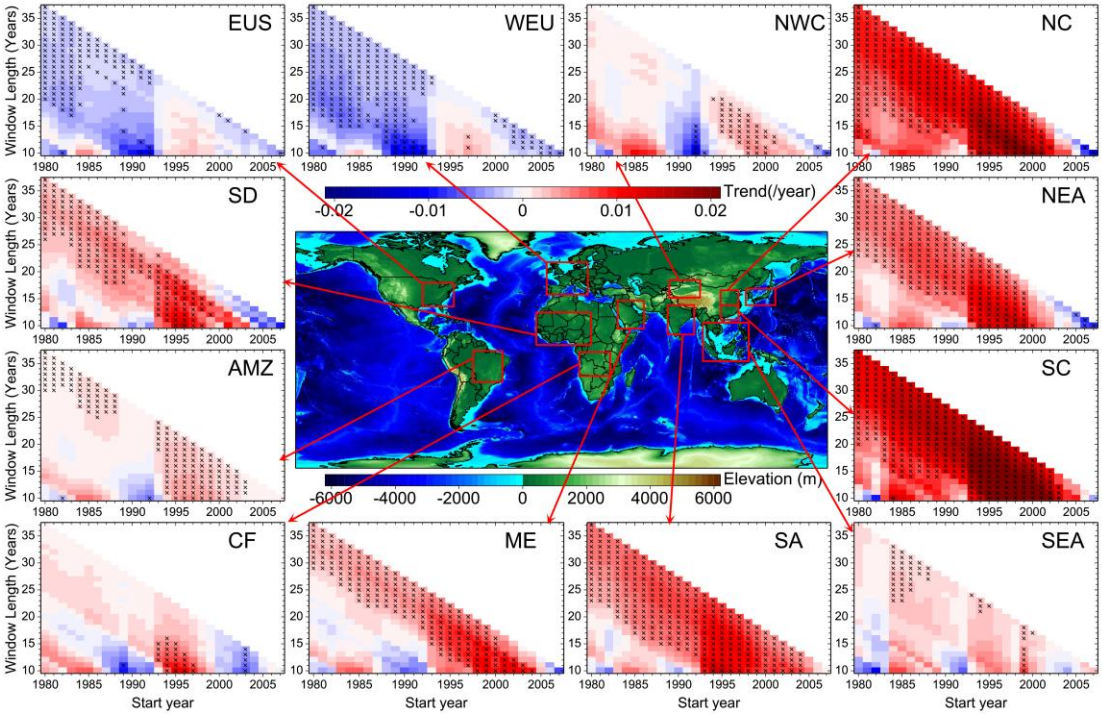

Fig. S8. Sliding-window trend analyses of the Spring (March, April, and May) mean MERRA-2 AOD from 1998 to 2016 over the 12 ROIs (see Figure 1 for names and locations of regions), with at least 10 years used to calculate trends. The *x*-axis and *y*-axis indicate the start year and the length of the time series to calculate the trend, respectively. The colors of rectangles represent the intensity of the trend (units: /year), and those with black 'x' signs indicate linear trends above the 95% significance level.

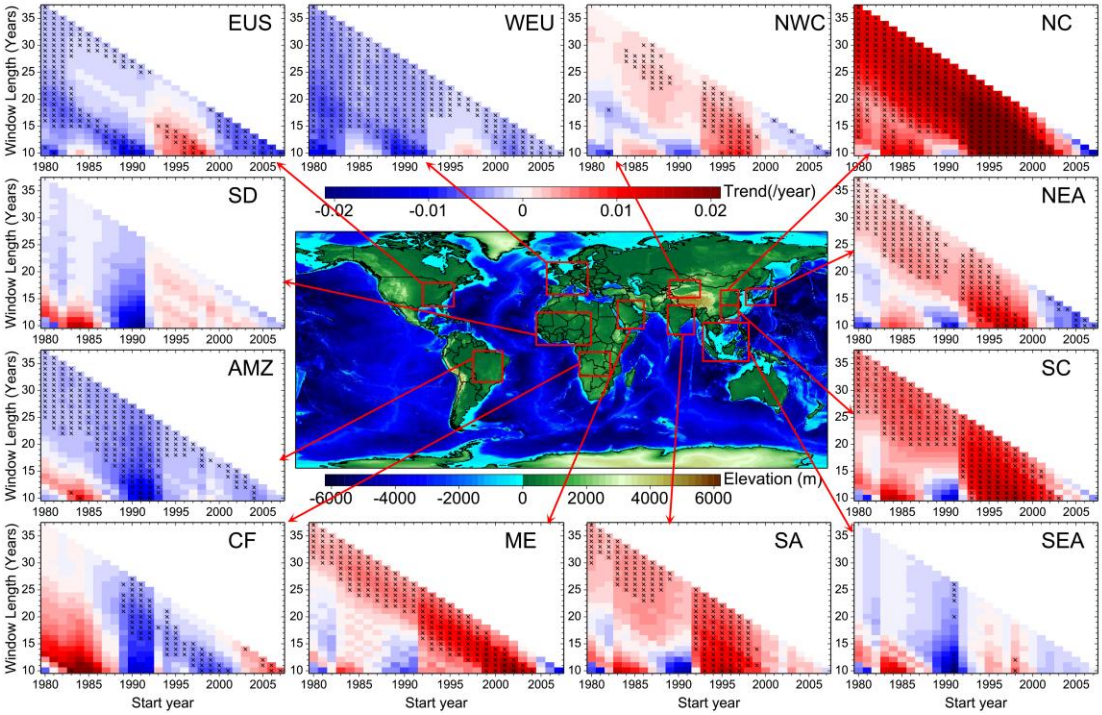

Fig. S9. The same as Figure S8, but for the Summer (June, July, and August).

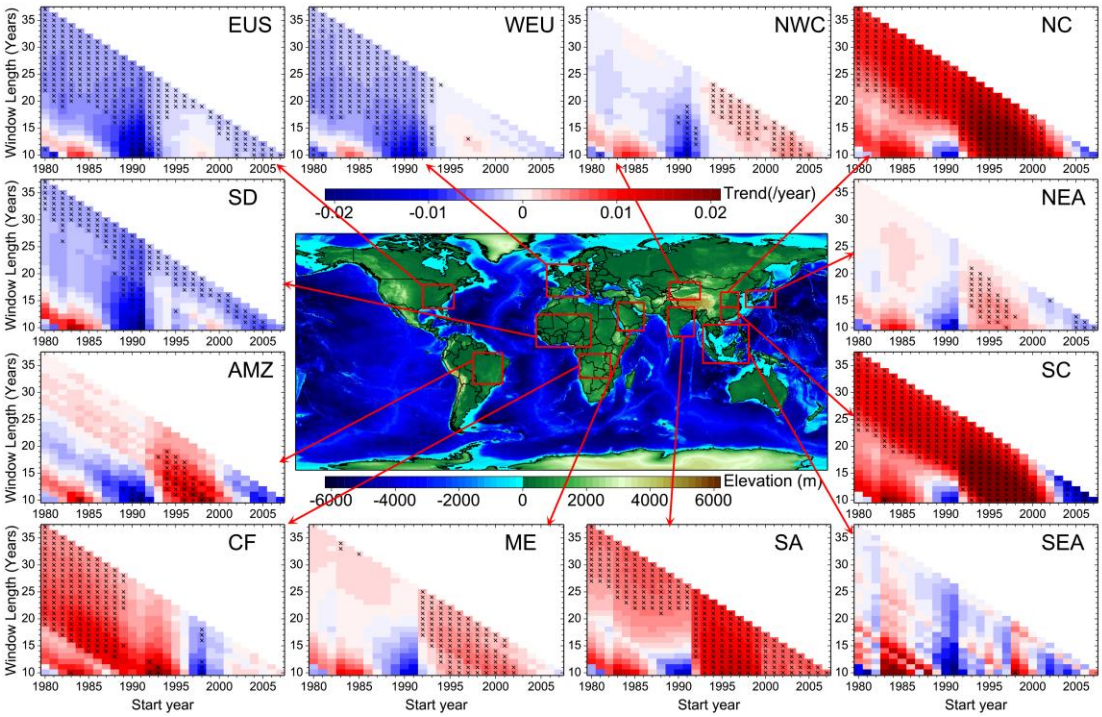

Fig. S10. The same as Figure S8, but for the Autumn (September, October, and November).

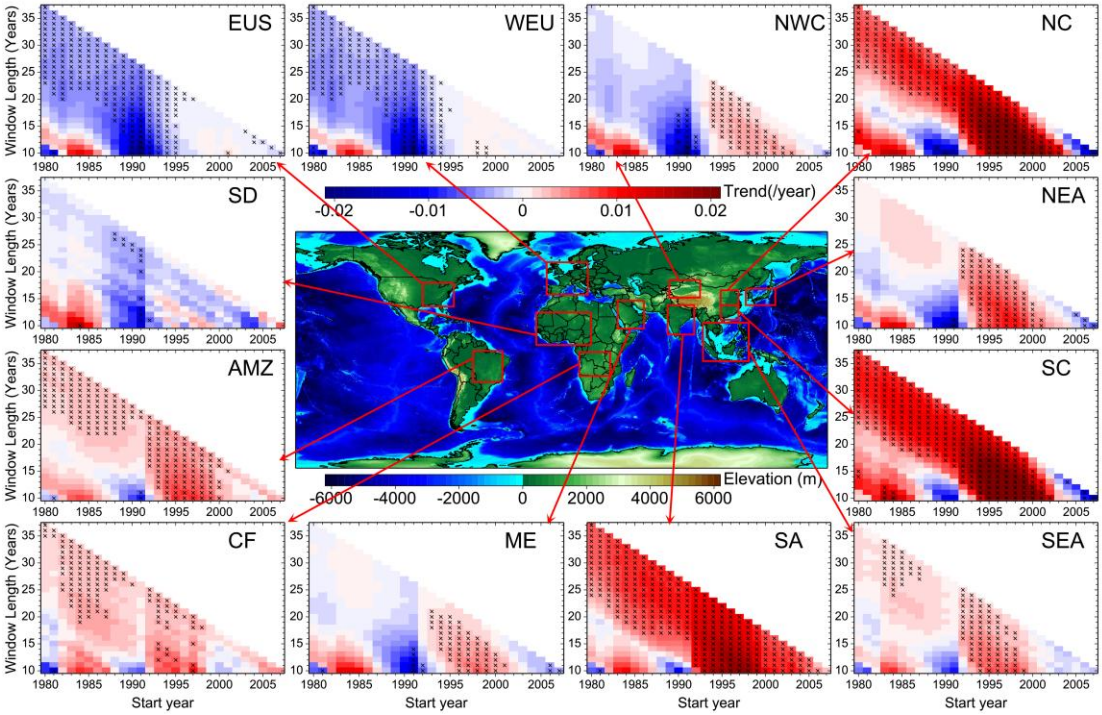

Fig. S11. The same as Figure S8, but for the Winter (December, January, and February).

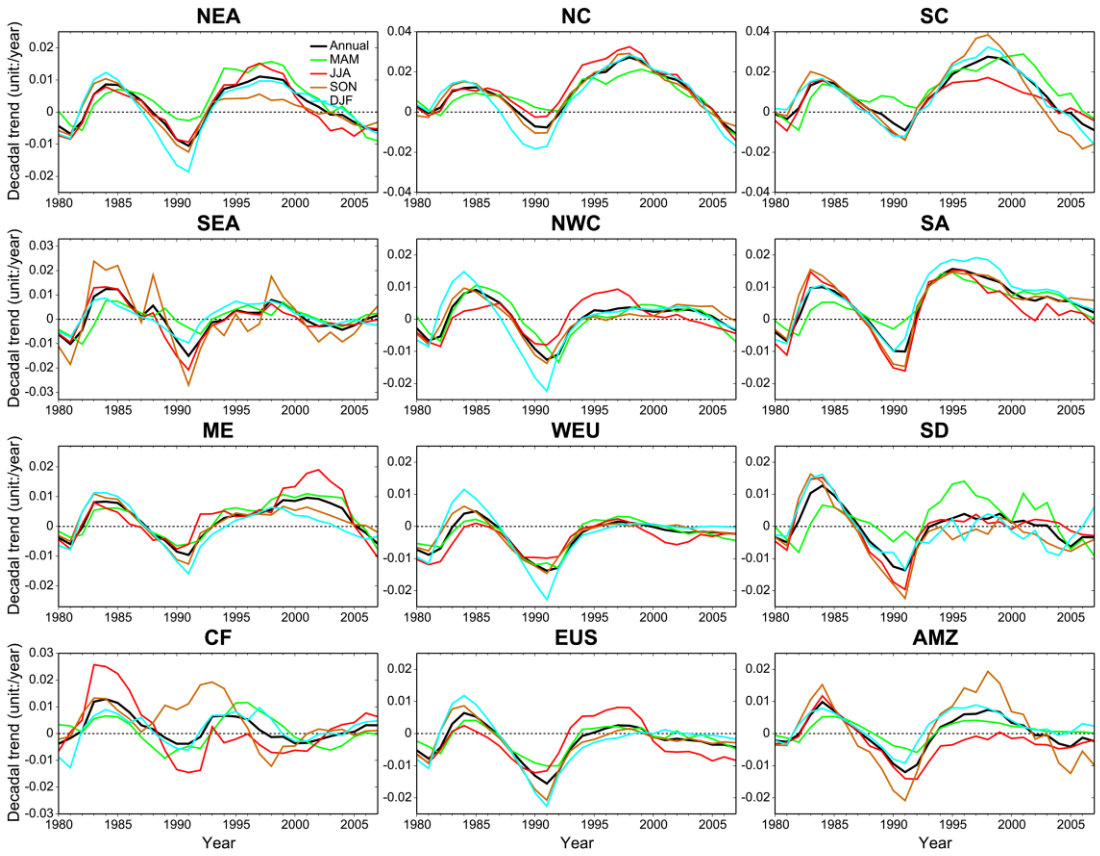

Fig. S12. Time series of decadal trends in the annual and seasonal mean AOD for the 12 ROIs. The trends are calculated for each 10-year interval starting from 1998 to 2006 (*x*-axis).

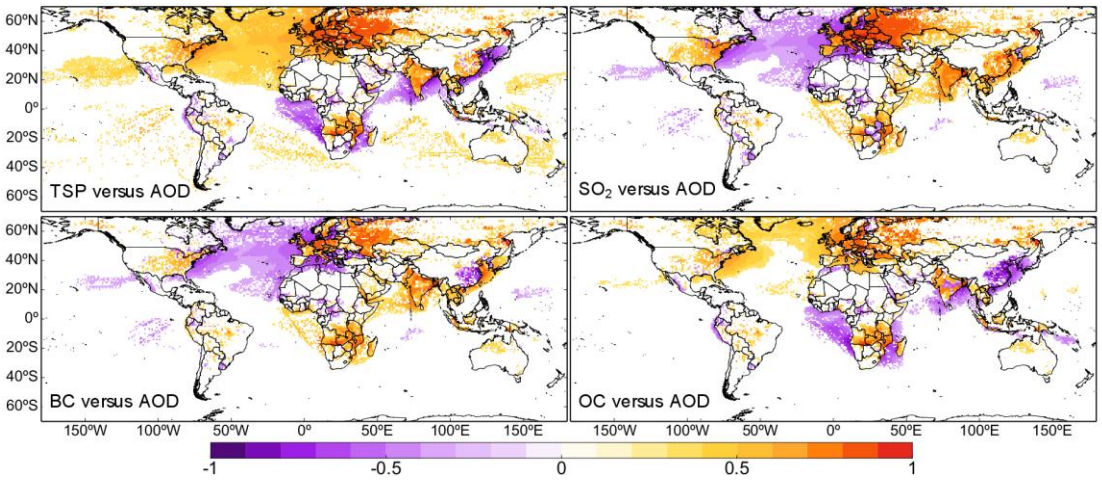

Fig. S13. Spatial distributions of the *R* between MERRA-2 AOD and total anthropogenic emissions of total suspended particles (TSP), SO_2, black carbon (BC), and organic carbon (OC) for the period of 1980-2014. Only the *R* with 95% confidence level was shown.

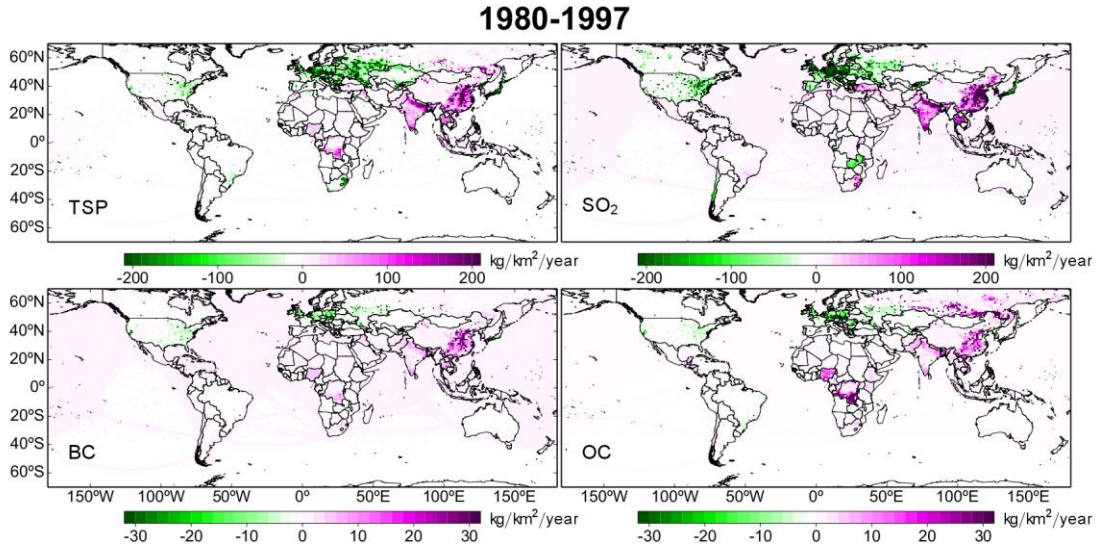

Fig. S14. Spatial distributions of linear trends (units: kg/km^2/year) in total anthropogenic emissions of TSP, SO_2, BC, and OC during 1980–1997 derived from the Peking University emissions inventory (http://inventory.pku.edu.cn/). Only linear trend values with statistical significance at the 95% confidence level are shown.

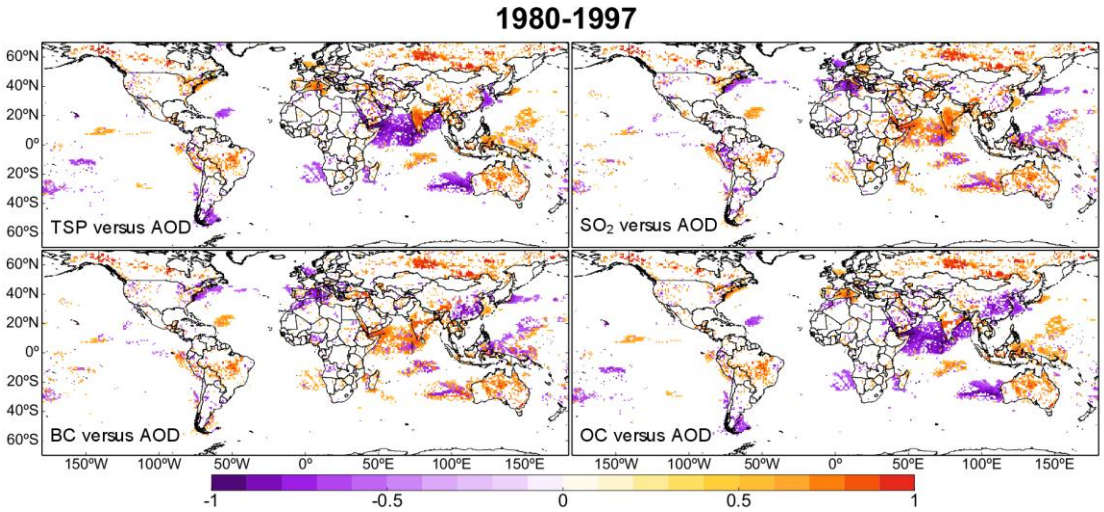

Fig. S15. Spatial distributions of the *R* between MERRA-2 AOD and total anthropogenic emissions of TSP, SO_2, BC, and OC for 1980–1997. Only the *R* with 95% confidence level was shown.

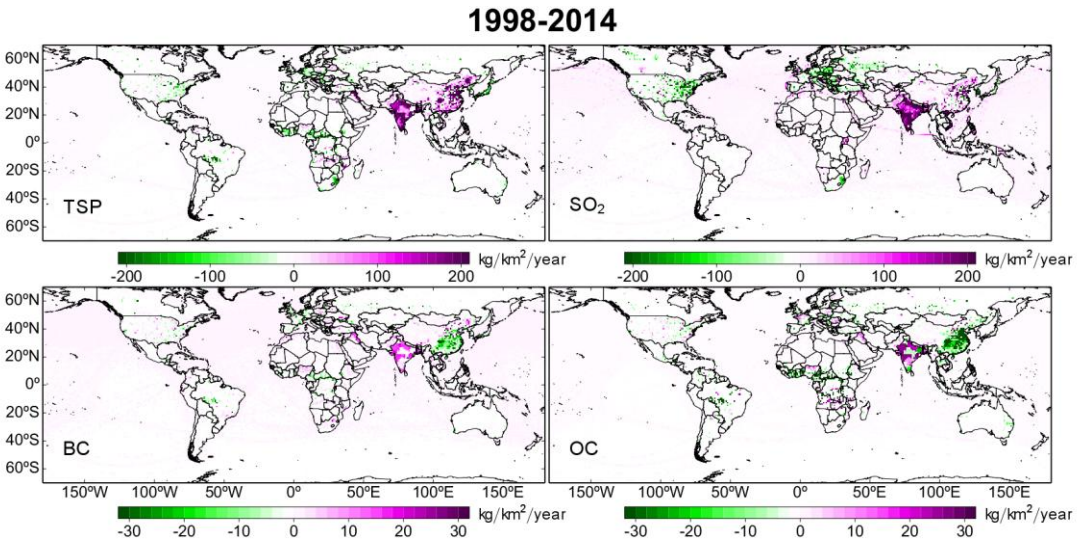

Fig. S16. The same as Figure S14, but for 1998-2014.

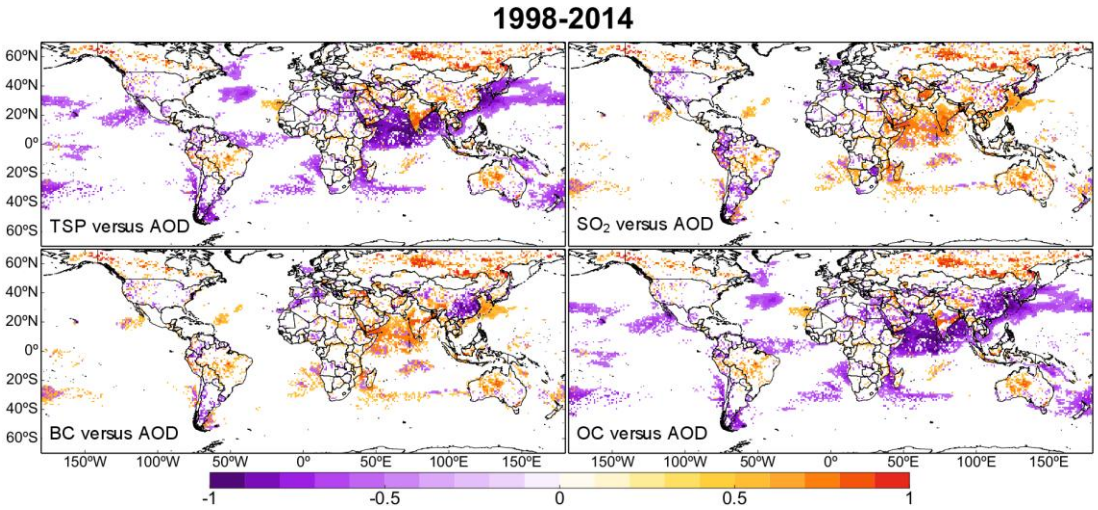

Fig. S17. The same as Figure S15, but for 1998-2014.

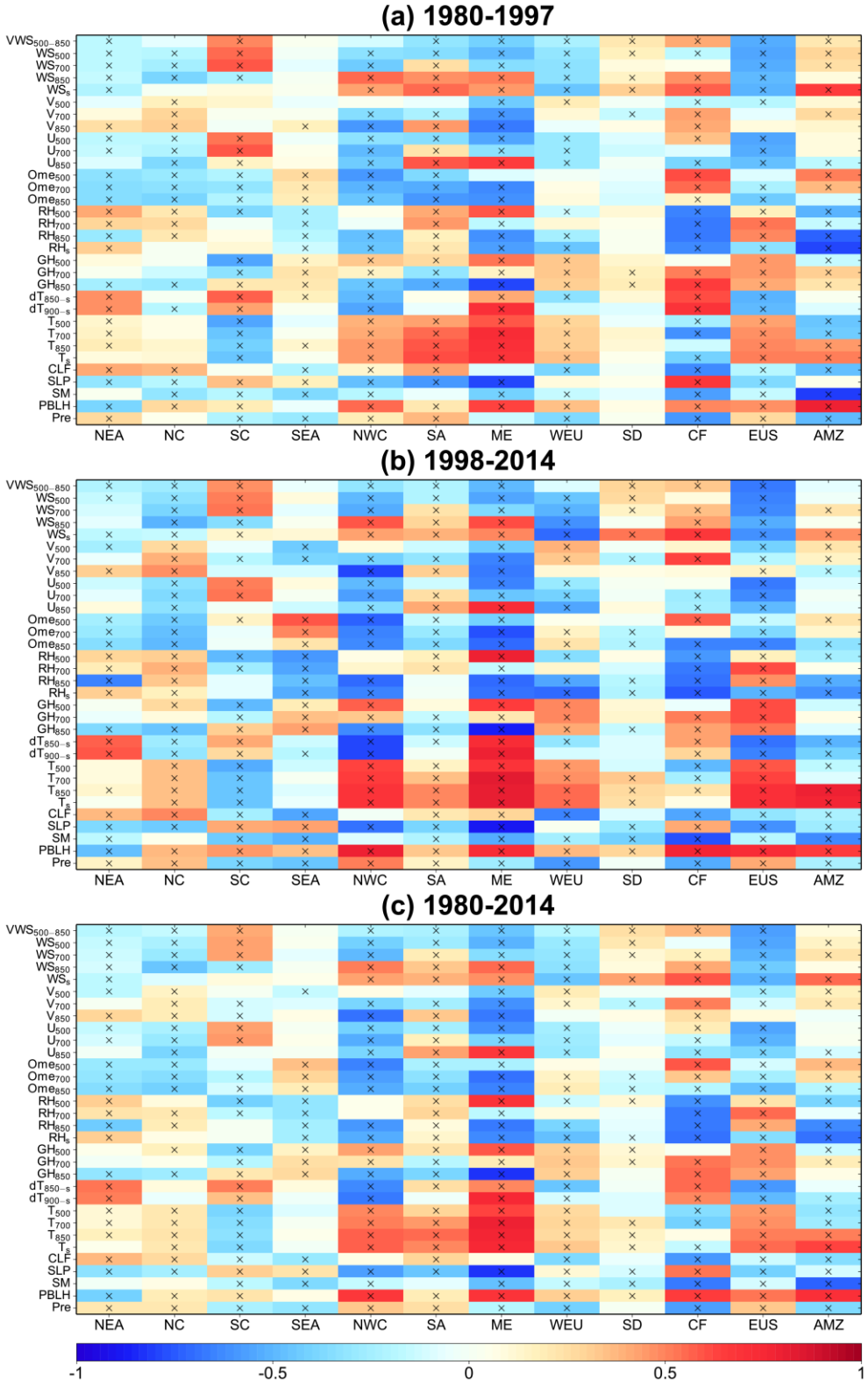

Fig. S18. Pearson's *R* for spatially-averaged, MERRA-2 AOD versus meteorological variables during (a) 1980–1997 (top panel), (b) 1998-2014 (middle panel), and (c) 1980-2014 (bottom panel) over the 12 ROIs. Colored squares marked with 'x' signs indicate *R* above 95% significance level.

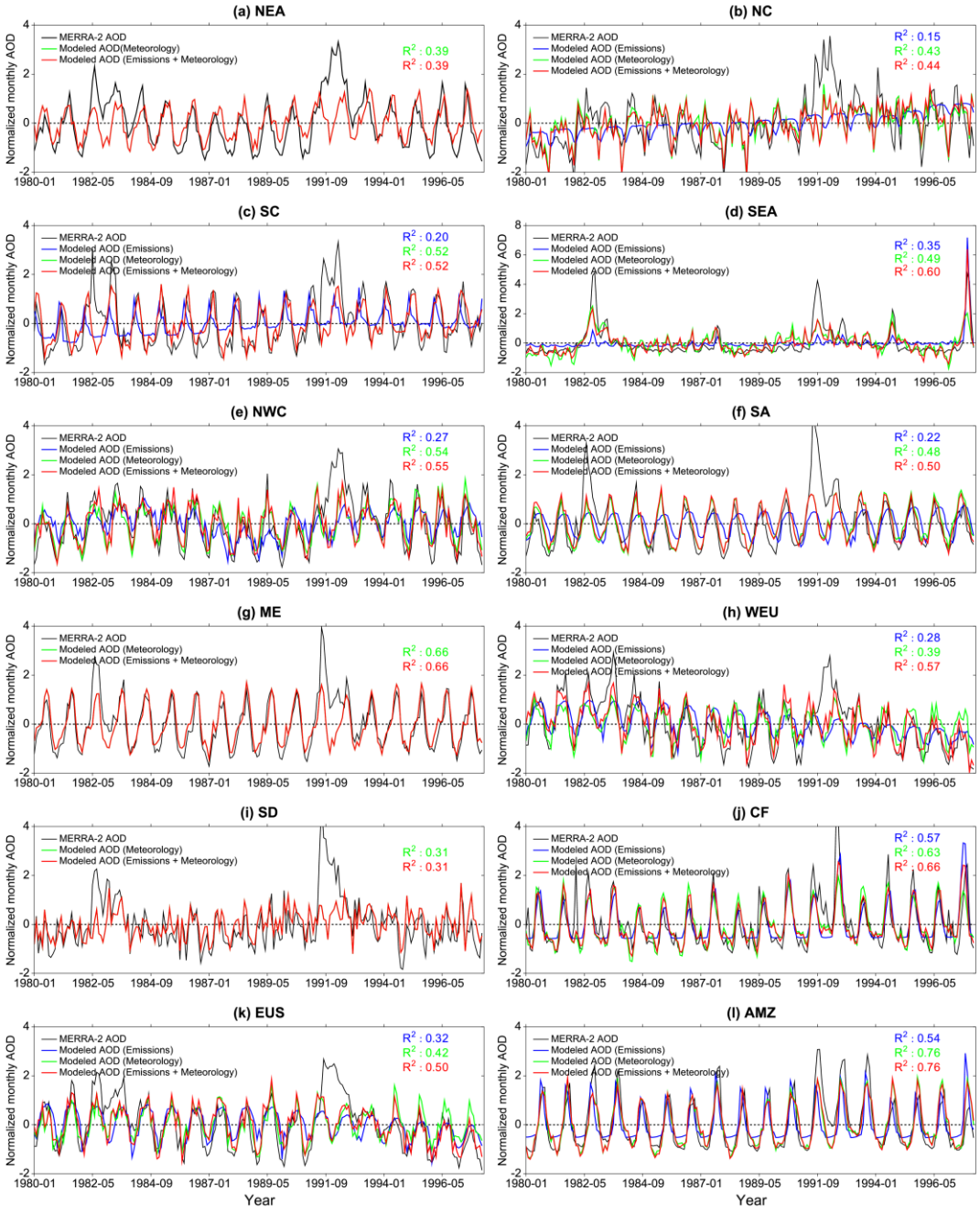

Fig. S19. Time series of MERRA-2 (in black) and modeled AOD monthly normalized anomalies from 1980 to 1997 over the 12 regions of interest. The coefficient of determination (R^2) of the regression fit of the stepwise MLR model with emission factors (in blue), meteorology (in green), and both emissions and meteorology (in red) as predictors are given in the top-right of each panel.

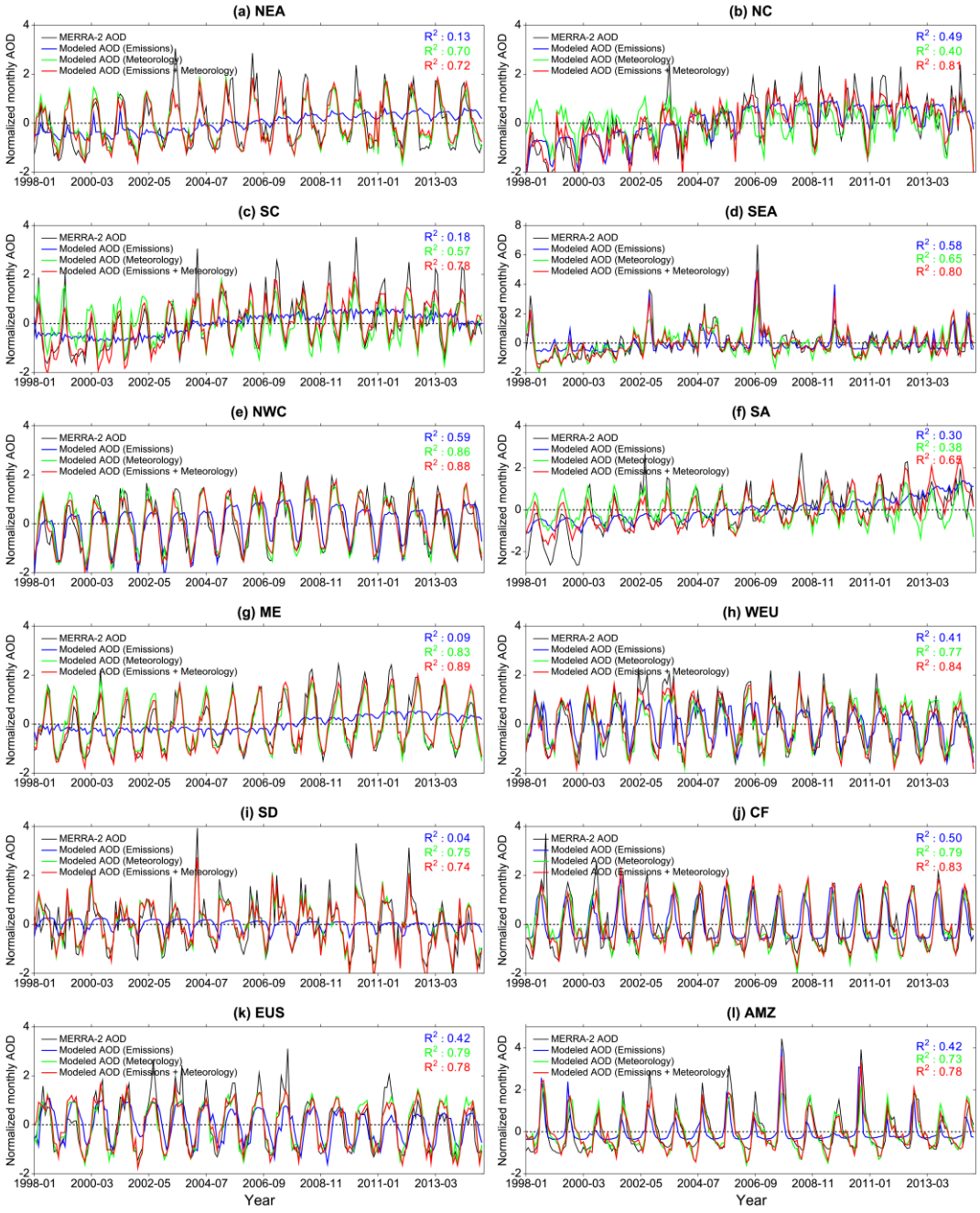

Fig. S20. Time series of MERRA-2 (in black) and modeled AOD monthly normalized anomalies from 1998 to 2014 over the 12 regions of interest. The coefficient of determination (R^2) of the regression fit of the stepwise MLR model with emission factors (in blue), meteorology (in green), and both emissions and meteorology (in red) as predictors are given in the top-right of each panel.

Table S1. Global and regional annual and seasonal trends (unit: /year) derived based upon MERRA-2, MODIS/Terra and MISR AOD datasets during the four historical periods, 1980-2016, 1980-1997, 1998-2016, and 2001-2016. Bold font indicates the trend is statistically significant at the 95% level.

Seasonal	Dataset (period)	Regions												
		NEA	NC	SC	SEA	NWC	SA	ME	WEU	SD	CF	WUS	AMZ	Global
Annual	MERRA-2 (1980-2016)	**0.00171**	**0.00855**	**0.00819**	0.00037	0.00005	**0.00508**	**0.00155**	**-0.00307**	-0.00047	**0.00175**	**-0.00274**	0.00028	**-0.00068**
	MERRA-2 (1980-1997)	0.00038	**0.00529**	**0.00412**	0.00202	0.00089	0.00094	0.00012	**-0.00382**	0.00043	**0.00216**	**-0.00270**	0.00026	0.00050
	MERRA-2 (1998-2016)	**0.00192**	**0.00973**	**0.00929**	**0.00173**	**0.00124**	**0.00752**	**0.00323**	**-0.00084**	-0.00051	-0.00004	**-0.00139**	**0.00138**	**0.00038**
	MERRA-2 (2001-2016)	-0.00110	**0.00447**	**0.00487**	-0.00018	-0.00003	**0.00476**	**0.00251**	**-0.00167**	-0.00102	-0.00012	**-0.00263**	-0.00016	-0.00002
	MODIS (2001-2016)	**-0.00199**	0.00117	**-0.00325**	0.00122	-0.00034	**0.00696**	**0.00419**	**-0.00185**	-0.00006	**0.00179**	**-0.00345**	**-0.00261**	**0.00066**
	MISR (2001-2016)	**-0.00286**	**-0.00225**	**-0.00330**	-0.00060	0.00023	**0.00288**	**0.00386**	**-0.00247**	0.00053	0.00055	**-0.00282**	**-0.00158**	**-0.00043**
Spring	MERRA-2 (1980-2016)	**0.00432**	**0.00833**	**0.01153**	**0.00122**	0.00048	**0.00510**	0.00242	**-0.00277**	**0.00252**	**0.00080**	**-0.00192**	**0.00095**	-0.00016
	MERRA-2 (1980-1997)	0.00228	**0.00630**	0.00399	-0.00045	**0.00300**	0.00087	0.00033	**-0.00382**	0.00083	0.00037	**-0.00242**	0.00096	0.00062
	MERRA-2 (1998-2016)	**0.00331**	**0.00714**	**0.01370**	0.00112	0.00046	**0.00643**	**0.00463**	-0.00084	0.00104	0.00021	-0.00115	**0.00164**	**0.00053**
	MERRA-2 (2001-2016)	-0.00081	0.00403	**0.01250**	0.00145	-0.00063	**0.00444**	**0.00323**	**-0.00208**	-0.00114	-0.00168	**-0.00213**	**0.00096**	-0.00014
	MODIS (2001-2016)	-0.00354	-0.00296	0.00197	0.00182	-0.00238	**0.00551**	**0.00657**	**-0.00254**	-0.00154	-0.00057	**-0.00386**	**0.00082**	0.00016
	MISR (2001-2016)	-0.00261	-0.00315	0.00015	0.00006	-0.00028	**0.00363**	**0.00546**	**-0.00276**	0.00087	-0.00105	**-0.00265**	0.00035	**-0.00070**
Summer	MERRA-2 (1980-2016)	**0.00144**	**0.01090**	**0.00485**	-0.00081	0.00064	**0.00303**	**0.00267**	**-0.00392**	-0.00094	0.00031	**-0.00263**	**-0.00266**	**-0.00078**
	MERRA-2 (1980-1997)	-0.00094	**0.00601**	0.00215	0.00188	-0.00083	-0.00005	-0.00134	**-0.00626**	-0.00015	**0.00542**	**-0.00496**	-0.00052	0.00060
	MERRA-2 (1998-2016)	0.00107	**0.01054**	**0.00625**	0.00080	0.00103	**0.00382**	**0.00425**	**-0.00196**	-0.00076	-0.00063	**-0.00255**	**-0.00257**	0.00003
	MERRA-2 (2001-2016)	**-0.00298**	0.00344	0.00315	**-0.00158**	**-0.00206**	0.00106	**0.00419**	**-0.00358**	-0.00137	0.00054	**-0.00588**	**-0.00215**	-0.00028
	MODIS (2001-2016)	**-0.00433**	-0.00121	-0.00506	-0.00067	**-0.00239**	0.00169	**0.00622**	**-0.00341**	0.00095	**0.00437**	**-0.00806**	-0.00238	**0.00079**
	MISR (2001-2016)	**-0.00539**	-0.00429	-0.00342	**-0.00172**	-0.00103	-0.00221	**0.00661**	**-0.00382**	**0.00218**	0.00126	**-0.00589**	**-0.00259**	-0.00037
Autumn	MERRA-2 (1980-2016)	0.00025	**0.00843**	**0.00836**	-0.00003	-0.00013	**0.00538**	**0.00128**	**-0.00274**	**-0.00284**	**0.00442**	**-0.00335**	0.00063	**-0.00092**
	MERRA-2 (1980-1997)	0.00003	**0.00420**	**0.00551**	0.00650	0.00044	0.00200	0.00088	**-0.00358**	-0.00036	**0.00389**	-0.00237	-0.00072	0.00032
	MERRA-2 (1998-2016)	0.00005	**0.01025**	**0.00679**	0.00335	**0.00191**	**0.00869**	**0.00277**	-0.00063	**-0.00267**	**-0.00297**	**-0.00125**	0.00233	0.00024
	MERRA-2 (2001-2016)	-0.00130	**0.00517**	-0.00131	-0.00078	**0.00176**	**0.00652**	**0.00245**	**-0.00103**	**-0.00303**	-0.00004	**-0.00207**	-0.00190	-0.00005
	MODIS (2001-2016)	-0.00107	0.00297	**-0.00816**	0.00271	0.00166	**0.00960**	**0.00247**	-0.00084	-0.00162	0.00171	**-0.00185**	**-0.00856**	**0.00066**
	MISR (2001-2016)	**-0.00263**	-0.00174	**-0.00732**	0.00014	**0.00108**	**0.00525**	**0.00213**	**-0.00201**	-0.00137	0.00153	**-0.00221**	**-0.00386**	**-0.00048**
Winter	MERRA-2 (1980-2016)	0.00061	**0.00608**	**0.00769**	**0.00093**	**-0.00100**	**0.00682**	-0.00017	**-0.00294**	-0.00063	**0.00161**	**-0.00314**	**0.00213**	**-0.00097**
	MERRA-2 (1980-1997)	-0.00011	0.00407	**0.00465**	-0.00021	0.00058	0.00055	0.00059	-0.00183	0.00171	0.00007	-0.00108	0.00136	0.00036
	MERRA-2 (1998-2016)	**0.00327**	**0.01100**	**0.01043**	**0.00164**	**0.00159**	**0.01115**	0.00126	0.00006	0.00035	**0.00325**	**-0.00060**	**0.00413**	**0.00070**
	MERRA-2 (2001-2016)	-0.00026	0.00288	0.00162	-0.00078	0.00066	**0.00673**	-0.00012	-0.00005	0.00143	0.00089	-0.00029	**0.00195**	0.00025
	MODIS (2001-2016)	0.00040	0.00391	-0.00420	0.00032	0.00118	**0.01092**	0.00104	-0.00050	0.00185	0.00251	-0.00002	-0.00063	**0.00086**
	MISR (2001-2016)	-0.00157	-0.00016	**-0.00365**	-0.00117	**0.00144**	**0.00521**	0.00112	**-0.00120**	0.00075	0.00109	-0.00041	-0.00004	-0.00015

Table S2. Stepwise multiple linear regression (MLR) models for monthly AOD over the 12 ROIs during three different periods: 1980-1997, 1998-2014, and 1980-2014. Note that after implementing variable filtering based on stepwise MLR model, the number of explanatory variables retained for each ROI is different.

	1980-1997						1998-2014						1980-2014					
ROIs	Emissions	R^2	Meteorology	R^2	Emissions + Meteorology	R^2	Emissions	R^2	Meteorology	R^2	Emissions + Meteorology	R^2	Emissions	R^2	Meteorology	R^2	Emissions+ Meteorology	R^2
NEA	/	/	$dT_{850\text{-}s}$, GH_{700}, Ome_{500}	0.39	$dT_{850\text{-}s}$, GH_{700}, Ome_{500}	0.39	BC, OC	0.13	RH_{850}, GH_{850}, Ome_{850}, T_s	0.70	RH_{850}, CLF, GH_{850}, TSP, OME_{850}, Ts	0.72	BC, OC	0.14	$dT_{850\text{-}s}$, GH_{500}	0.50	GH_{500}, PBLH, BC, $VWS_{500\text{-}850}$, Pre	0.60
NC	SO_2, TSP	0.15	WS_{850}, SM, RH_{850}, GH_{700}, $dT_{850\text{-}s}$	0.43	WS_{850}, SM, RH_{850}, GH_{700}, SO_2	0.44	SO_2, TSP, BC	0.49	WS_{850}, GH_{850}, $VWS_{500\text{-}850}$, SM	0.40	SO_2, GH_{700}, Ome_{850}, WS_{850}, WS_s, Pre, BC, TSP, CLF	0.81	SO_2, BC, TSP	0.58	WS_{850}, $dT_{850\text{-}s}$, GH_{850}, U_{850}, V_{700}, $dT_{900\text{-}s}$	0.42	SO_2, BC, TSP, GH_{700}, WS_{850}, RH_{850}, SM	0.76
SC	OC	0.20	PBLH, Ome_{700}, $dT_{850\text{-}s}$, T_{500}	0.52	PBLH, Ome_{700}, $dT_{850\text{-}s}$, T_{500}	0.52	TSP, SO_2	0.18	Ome_{850}, Pre, RH_s, WS_{700}, V_{700}	0.57	BC, Ome_{850}, Pre, SO_2, V_{700}, WS_{700}, RHs, V_{500}, TSP, PBLH, V_{850}	0.78	SO_2, BC, OC, TSP	0.37	$dT_{850\text{-}s}$, PBLH, Ome_{700}, V_{700}, Pre, T_s, WS_{700}	0.49	BC, PBLH, TSP, Ome_{850}, T_{500}, SO_2, Pre, V_{700}, WS_{700}	0.73
SEA	BC	0.35	SM, $dT_{900\text{-}s}$, PBLH, RH_{500}, Ome_{700}, V_{500}, T_s, V_{850}, WS_{500}	0.49	BC, SM, U_{500}, T_s, WS_{500}, V_{850}, RH_{850}, RH_{500}, Pre	0.60	BC	0.58	V_{500}, T_{700}, SM, Pre, V_{850}, RH_{500}, WS_{500}, PBLH, T_{850}, RH_s	0.65	BC, RH_{500}, SO_2, WS_{500}, U_{500}, WS_{700}, SM, T_{700}, V_{500}, WS_{850}, Pre	0.80	BC	0.37	SM, $dT_{850\text{-}s}$, T_{500}, U_{850}, Ome_{850}, Ome_{500}, Pre	0.33	BC, SM, T_{700}, $dT_{900\text{-}s}$, PBLH, SO_2, V_{500}, $dT_{850\text{-}s}$, GH_{500}, Pre	0.55
NWC	SO_2, OC	0.27	Ome_{500}, U_{850}, WS_{850}, CLF, RH_s	0.54	Ome_{500}, U_{850}, TSP, Pre, V_{500}, WS_{850}, Ome_{700}	0.55	BC, TSP, SO_2	0.59	WS_s, PBLH, U_{850}, $dT_{900\text{-}s}$, CLF, RH_{700}, SM	0.86	WS_s, BC, U_{700}, TSP, PBLH, CLF, RH_{700}, OC, WS_{850}	0.88	OC, SO_2, TSP, BC	0.37	V_{850}, CLF, RH_s, U_{850}, V_{700}, $dT_{850\text{-}s}$	0.65	V_{850}, CLF, RH_s, U_{850}, V_{700}, $dT_{850\text{-}s}$, BC	0.67
SA	OC, TSP	0.22	U_{700}, $dT_{900\text{-}s}$, T_{850}, V_{700}	0.48	U_{700}, $dT_{900\text{-}s}$, T_{850}, V_{700}, SO_2	0.50	SO_2, OC	0.30	T_{850}, U_{700}, V_{700}, $dT_{850\text{-}s}$, T_{500}	0.38	SO_2, T_{850}, U_{700}, V700, $dT_{850\text{-}s}$, SM	0.65	SO_2, OC	0.41	T_{850}, WS_{850}	0.34	SO_2, T_s, WS_s, Pre	0.61
ME	/	/	SLP, $VWS_{500\text{-}850}$	0.66	SLP, $VWS_{500\text{-}850}$	0.66	TSP, OC	0.09	SLP, T_{500}, WS_s	0.83	SLP, TSP, U_{500}, V_{500}, RH_{500}	0.89	TSP	0.04	SLP, $VWS_{500\text{-}850}$	0.73	SLP, $VWS_{500\text{-}850}$, TSP	0.76
WEU	SO_2, OC	0.28	RH_s, SM, $VWS_{500\text{-}850}$, T_{700}, Ome_{500}	0.39	RH_s, SO_2, U_{500}, OC, SM, $dT_{850\text{-}s}$, Ome_{850}, SLP, PBLH	0.57	OC, TSP	0.41	WS_s, SM, RH_s, V_{700}, $VWS_{500\text{-}850}$	0.77	WS_s, SM, RHs, V_{700}, $VWS_{500\text{-}850}$, TSP, OC, SO_2, RH_{500}, Pre, OME_{500}	0.84	SO_2, OC	0.46	RH_s, $dT_{850\text{-}s}$, $dT_{900\text{-}s}$, U500	0.50	SO_2, RHs, SM, OC, $dT_{850\text{-}s}$, Ome_{500}, U_{500}, SLP, RH_{850}	0.69
SD	/	/	WS_s, U_{700}, $VWS_{500\text{-}850}$, CLF, Pre, Ome_{850}	0.31	WS_s, U_{700}, $VWS_{500\text{-}850}$, CLF, Pre, Ome_{850}	0.31	SO_2	0.04	WS_s, T_{850}, V_{700}, U_{700}, WS_{700}, WS_{850}, U_{850}, V_{850}	0.74	WS_s, T_{850}, V_{700}, U_{700}, WS_{700}, WS_{850}, U_{850}	0.74	SO_2	0.01	WS_s, Ome_{700}, U_{850}, Pre, RH_{500}	0.42	WS_s, Ome_{700}, U_{850}, Pre, RH_{500}	0.42
CF	BC	0.57	$dT_{900\text{-}s}$, U_{850}, SM, SLP	0.63	BC, $dT_{900\text{-}s}$, U_{850}, SM	0.66	TSP	0.50	Ome_{850}, RH_{700}, U_{700}, PBLH	0.79	Ome_{850}, SO_2, SLP, Ome_{500}, U_{850}	0.83	TSP	0.48	RH_s, U_{700}	0.53	RH_s, TSP, V_{850}, T_s	0.60
EUS	OC, SO_2	0.32	WS_{500}, RH_{500}	0.42	RH_{500}, SO_2, BC, WS_{850}	0.50	OC, TSP	0.42	PBLH, Ome_{850}, V_{500}, GH_{850}, SM, WS_s, $dT_{900\text{-}s}$, RH_{500}	0.79	PBLH, Ome_{850}, V_{500}, TSP, U_{500}, CLF	0.78	SO_2, OC	0.40	$dT_{850\text{-}s}$, RH_{500}, U_{500}	0.51	$dT_{850\text{-}s}$, RH_{500}, SO_2, U_{500}, PBLH, OME_{850}, SM, WS_s	0.66
AMZ	OC	0.54	SM, RH_{700}, T_{500}, T_{850}, RH_{500}	0.76	SM, RH_{700}, T_{500}, T_{850}	0.76	BC	0.42	T_{850}, GH_{500}, WS_s, Ome_{850}	0.73	T_{850}, BC, GH_{500}	0.78	OC	0.44	SM, Ome_{850}, V_{850}	0.66	SM, Ome_{850}, OC	0.68

Table S3. The LMG method for estimated relative importance (%) of the retained variables based on stepwise MLR model over the 12 ROIs during three different periods: 1980-1997, 1998-2014, and 1980-2014. Note that after implementing variable filtering based on stepwise MLR model, the number of explanatory variables retained for each ROI is different.

	1980-1997		1998-2014		1980-2014	
ROIs	Relative contribution of variables (%)	R^2 (%)	Relative contribution of variables (%)	R^2 (%)	Relative contribution of variables (%)	R^2 (%)
NEA	$dT_{850\text{-}s}$ (19.3%), GH_{700} (10.4%), Ome_{500} (9.7%)	39.4%	RH_{850} (31.9 %), CLF (7.2 %), GH_{850} (12.3 %), TSP (2.7 %), OME_{850} (12.3 %), Ts (6.1 %)	72.4%	GH_{500} (14.1 %), PBLH (30.2 %), BC (7.4 %), $VWS_{500\text{-}850}$ (5.8 %), Pre (2.6 %)	60.0%
NC	WS_{850} (12.3%), SM (10.9%), RH_{850} (9.8%), GH_{700} (5.5%), SO_2 (5.1%)	43.6%	SO_2 (9.7 %), GH_{700} (5.0 %), Ome_{850} (10.4 %), WS_{850} (10.4 %), WS_s (1.5 %), Pre (4.0 %), BC (20.7 %), TSP (11.4 %), CLF (7.9 %)	81.0%	SO_2 (24.9 %), BC (18.2 %), TSP (12.9 %), GH_{700} (4.3 %), WS_{850} (11.4 %), RH_{850} (3.9 %), SM (0.8 %)	76.4%
SC	PBLH (6.1 %), Ome_{700} (11.8 %), $dT_{850\text{-}s}$ (17.2 %), T_{500} (16.7 %)	51.9%	BC (5.5 %), Ome_{850} (6.5 %), Pre (10.4 %), SO_2 (7.1 %), V_{700} (4.2 %), WS_{700} (22.9 %), RHs (1.3 %), V_{500} (1.4 %), TSP (6.8 %), PBLH (10.4 %), V_{850} (1.6 %)	77.9%	BC (9.9 %), PBLH (3.2 %), TSP (10.5 %), Ome_{850} (6.8 %), T_{500} (8.6 %), SO_2 (15.2 %), Pre (4.6 %), V_{700} (2.5 %), WS_{700} (11.6 %)	73.0%
SEA	BC (26.1 %), SM (9.5 %), U_{500} (1.0 %), T_s (5.2 %), WS_{500} (1.5%), V_{850} (7.8 %), RH_{850} (1.7 %), RH_{500} (3.8 %), Pre (3.3 %)	60.1%	BC (33.1 %), RH_{500} (11.8 %), SO_2 (7.3 %), WS_{500} (2.0 %), U_{500} (0.9 %), WS_{700} (0.6 %), SM (10.0 %), T_{700} (2.1 %), V_{500} (6.5 %), WS_{850} (0.6 %), Pre (5.3 %)	80.0%	BC (27.7 %), SM (11.7 %), T_{700} (1.1 %), $dT_{900\text{-}s}$ (1.9 %), PBLH (1.9 %), SO_2 (2.7 %), V_{500} (1.1 %), $dT_{850\text{-}s}$ (1.1 %), GH_{500} (1.2 %), Pre (4.4 %)	54.8%
NWC	Ome_{500} (15.7 %), U_{850} (11.0 %), TSP (3.8 %), Pre (3.1 %), V_{500} (1.7 %), WS_{850} (11.1 %), Ome_{700} (8.9 %)	55.2%	WS_s (12.3 %), BC (16.6 %), U_{700} (10.2 %), TSP (2.0 %), PBLH (21.6 %), CLF (3.8 %), RH_{700} (1.3 %), OC (10.8 %), WS_{850} (9.1 %)	87.6%	V_{850} (19.0 %), CLF (8.7 %), RH_s (10.9 %), U_{850} (6.8 %), V_{700} (4.5 %), $dT_{850\text{-}s}$ (11.7 %), BC (5.2 %)	66.8%
SA	U_{700} (6.4 %), $dT_{900\text{-}s}$ (3.7 %), T_{850} (35.0 %), V_{700} (4.0 %), SO_2 (0.6 %)	49.6%	SO_2 (29.3 %), T_{850} (15.1 %), U_{700} (5.1 %), V700 (6.3 %), $dT_{850\text{-}s}$ (4.4 %), SM (4.6 %)	64.9%	SO_2 (32.6 %), T_s (15.9 %), WS_s (9.7 %), Pre (3.1 %)	61.3%
ME	SLP (55.6 %), $VWS_{500\text{-}850}$ (10.8 %)	66.4%	SLP (38.7 %), TSP (5.0 %), U_{500} (14.9 %), V_{500} (5.1 %), RH_{500} (24.7 %)	88.5%	SLP (60.9 %), $VWS_{500\text{-}850}$ (11.9 %), TSP (3.2 %)	76.0%
WEU	RH_s (11.9 %), SO_2 (12.7 %), U_{500} (6.9 %), OC (7.2 %), SM (4.7 %), $dT_{850\text{-}s}$ (5.3 %), Ome_{850} (2.3 %), SLP (1.8 %), PBLH (4.4 %)	57.1%	WS_s (15.1 %), SM (6.4 %), RHs (20.0 %), V_{700} (4.0 %), $VWS_{500\text{-}850}$ (0.9 %), TSP (3.3 %), OC (11.2 %), SO_2 (1.4 %), RH_{500} (3.9 %), Pre (14.8 %), OME_{500} (3.4 %)	84.4%	SO_2 (21.7 %), RH_s (14.1 %), SM (4.0 %), OC (5.1 %),$dT_{850\text{-}s}$ (8.7 %), Ome_{500} (2.1 %), U_{500} (4.9 %), SLP (1.1 %), RH_{850} (7.4 %)	69.0%
SD	WS_s (8.9 %), U_{700} (8.8 %), $VWS_{500\text{-}850}$ (7.7 %), CLF (1.4 %), Pre (2.1 %), Ome_{850} (2.6 %)	31.4%	WSs (42.1 %), T_{850} (13.1 %), V_{700} (4.3 %), U_{700} (6.2 %), WS_{700} (2.3 %), WS_{850} (4.5 %), U_{850} (1.5 %)	74.0%	WS_s (27.4 %), Ome_{700} (6.5 %), U_{850} (2.4 %), Pre (3.1 %), RH_{500} (2.9 %)	42.3%
CF	BC (26.1 %), $dT_{900\text{-}s}$ (21.0 %), U_{850} (7.3%), SM (11.2 %)	65.6%	Ome_{850} (29.9 %), SO_2 (25.1 %), SLP (8.4 %), Ome_{500} (14.0 %), U_{850} (5.3 %)	82.6%	RH_s (28.0 %), TSP (24.8 %), V_{850} (5.1 %), T_s (2.4 %)	60.3%
EUS	RH_{500} (8.4 %), SO_2 (11.7 %), BC (9.7 %), WS_{850} (20.5 %)	50.3%	PBLH (22.5 %), Ome_{850} (23.7 %), V_{500} (7.4 %), TSP (1.2 %), U_{500} (17.7 %), CLF (5.6 %)	78.2%	$dT_{850\text{-}s}$ (9.4 %), RH_{500} (6.0 %), SO_2 (12.7 %), U_{500} (10.0 %), PBLH (8.5 %), OME_{850} (7.5 %), SM (3.4 %), WS_s (8.0 %)	65.5%
AMZ	SM (44.8 %), RH_{700} (3.9 %), T_{500} (12.4 %), T_{850} (14.5 %)	75.5%	T_{850} (46.4 %), BC (28.6 %), GH_{500} (3.0 %)	78.1%	SM (35.5 %), Ome_{850} (8.6 %), OC (24.0 %)	68.1%

Table S4. Location information from the selected 468 AERONET sites worldwide and results for the statistical comparison with three-hourly MERRA-2 AOD. R is (Pearson) correlation coefficient, MAE is the mean absolute error, RMSE is the root-mean-square error of the differences, RMB is the relative mean bias, MFE is the mean fractional error, FGE is the fractional gross error and IOA is the index of agreement.

Site names	Lat.	Lon.	Number of collocations	R	MAE	RMSE	RMB	MFE (%)	FGE (%)	IOA
Abracos_Hill	-62.36	-10.76	2025	0.82	0.11	0.23	0.82	33.29	-12.67	0.89
AgiaMarina_Xyliatou	33.06	35.04	1238	0.79	0.04	0.06	1.10	35.07	17.89	0.97
Agoufou	-1.48	15.35	5584	0.77	0.16	0.23	0.96	35.23	7.05	0.88
Alta_Floresta	-56.10	-9.87	6448	0.77	0.13	0.29	0.78	37.86	-6.69	0.83
Amazon_ATTO_Tower	-59.00	-2.14	378	0.69	0.05	0.08	0.97	30.94	-6.22	0.96
American_Samoa	-170.56	-14.25	386	0.41	0.03	0.04	0.94	35.66	-2.74	0.97
Ames	-93.77	42.02	3313	0.67	0.07	0.11	1.02	44.26	4.76	0.93
Amsterdam_Island	77.57	-37.80	1323	0.31	0.04	0.09	0.77	40.83	-4.69	0.91
Andenes	16.01	69.28	1558	0.69	0.02	0.04	1.06	31.03	8.98	0.98
Anmyon	126.33	36.54	3179	0.82	0.11	0.18	0.96	31.09	1.07	0.93
Appalachian_State	-81.69	36.21	2599	0.70	0.05	0.07	1.26	45.25	30.03	0.96
Appledore_Island	-70.62	42.99	767	0.63	0.06	0.10	1.28	40.91	25.74	0.93
Aras_de_los_Olmos	-1.10	39.95	585	0.84	0.03	0.04	0.98	43.32	18.12	0.98
Arcachon	-1.16	44.66	3085	0.72	0.04	0.06	1.06	31.67	9.46	0.97
Arica	-70.31	-18.47	7582	0.55	0.07	0.10	0.89	33.33	-11.84	0.94
ARM_Darwin	130.89	-12.43	2237	0.74	0.04	0.06	1.04	31.64	8.97	0.97
ARM_Graciosa	-28.03	39.09	945	0.61	0.03	0.04	1.14	36.06	15.79	0.97
Ascension_Island	-14.41	-7.98	5525	0.79	0.04	0.06	1.05	27.45	8.30	0.97
ATHENS-NOA	23.72	37.97	4227	0.74	0.05	0.07	0.96	29.17	-1.00	0.97
Aubiere_LAMP	3.11	45.76	2533	0.72	0.04	0.06	0.90	37.98	-4.43	0.97
Autilla	-4.60	42.00	3889	0.75	0.03	0.04	1.10	35.95	13.71	0.98

Avignon	4.88	43.93	7355	0.78	0.04	0.06	0.89	32.38	-9.52	0.97
Azores	-28.63	38.53	631	0.66	0.03	0.05	1.03	34.47	9.37	0.97
Bac_Giang	106.23	21.29	1571	0.87	0.15	0.24	0.84	23.12	-15.12	0.91
Bac_Lieu	105.73	9.28	2088	0.66	0.08	0.16	0.90	28.84	-0.38	0.90
Badajoz	-7.01	38.88	1429	0.80	0.03	0.05	1.01	36.36	9.42	0.97
Baengnyeong	124.63	37.97	1777	0.82	0.09	0.16	1.08	29.78	12.03	0.93
Bahrain	50.61	26.21	2769	0.93	0.04	0.07	1.05	14.45	6.20	0.98
Bakersfield	-119.00	35.33	1445	0.48	0.05	0.08	0.76	43.97	-27.55	0.94
Balbina	-59.49	-1.92	813	0.73	0.05	0.07	0.87	32.37	-11.68	0.96
Bandung	107.61	-6.89	2004	0.47	0.18	0.28	0.73	47.64	-20.53	0.78
Banizoumbou	2.67	13.55	13742	0.76	0.15	0.22	1.02	34.56	10.18	0.89
Barbados	-59.62	13.15	862	0.63	0.07	0.10	0.88	42.64	-0.27	0.93
Barcelona	2.11	41.39	6744	0.75	0.05	0.07	0.88	33.78	-8.06	0.97
Bari_University	16.88	41.11	1079	0.87	0.03	0.05	0.96	19.18	-2.82	0.98
Barrow	-156.66	71.31	1656	0.56	0.06	0.10	1.19	49.16	29.64	0.92
Bayfordbury	-0.10	51.78	803	0.70	0.04	0.06	1.02	33.79	8.11	0.96
Beijing	116.38	39.98	7528	0.78	0.28	0.46	0.64	51.34	-34.02	0.73
Beijing-CAMS	116.32	39.93	2273	0.76	0.26	0.43	0.67	51.07	-26.97	0.75
Belsk	20.79	51.84	5120	0.84	0.04	0.07	0.94	23.75	-4.95	0.97
Belterra	-54.95	-2.65	1026	0.72	0.07	0.11	0.74	35.87	-25.13	0.93
Ben_Salem	9.91	35.55	2783	0.82	0.05	0.09	1.06	31.38	9.39	0.96
Bermuda	-64.70	32.37	1774	0.58	0.04	0.06	0.97	36.66	3.76	0.96
Bethlehem	28.33	-28.25	933	0.84	0.03	0.05	0.89	30.84	-5.77	0.98
Bhola	90.76	22.23	1316	0.80	0.15	0.21	0.86	27.62	-13.26	0.91
Bidi_Bahn	-2.45	14.06	852	0.56	0.22	0.31	0.84	47.30	-0.17	0.75
Billerica	-71.27	42.53	5446	0.65	0.06	0.10	1.29	47.20	31.17	0.94

Birdsville	139.35	-25.90	6117	0.62	0.04	0.06	1.94	71.07	68.67	0.95
Birkenes	8.25	58.39	1855	0.78	0.03	0.04	1.07	29.81	10.39	0.98
Blida	2.88	36.51	3715	0.86	0.06	0.09	0.81	31.70	-19.57	0.96
Bonanza	19.59	-21.83	873	0.88	0.04	0.05	1.03	39.11	16.00	0.98
Bonanza_Creek	-148.32	64.74	3914	0.76	0.09	0.18	1.13	51.07	27.73	0.86
BONDVILLE	-88.37	40.05	7131	0.64	0.07	0.11	1.07	41.76	10.73	0.94
BORDEAUX	-0.58	44.79	775	0.78	0.05	0.07	0.87	30.81	-13.59	0.97
Bozeman	-111.05	45.66	4255	0.64	0.04	0.08	1.16	44.20	20.74	0.94
Bratts_Lake	-104.71	50.20	6157	0.57	0.05	0.08	1.19	42.92	21.47	0.94
Brisbane-Uni_of_QLD	153.01	-27.50	1127	0.72	0.03	0.05	1.21	42.63	29.03	0.97
Brookhaven	-72.88	40.87	1291	0.63	0.08	0.13	1.23	48.99	27.99	0.92
Brussels	4.35	50.78	2400	0.77	0.05	0.08	0.90	28.59	-7.07	0.96
BSRN_BAO_Boulder	-105.01	40.05	7655	0.57	0.04	0.06	1.10	41.39	14.33	0.96
Bucharest_Inoe	26.03	44.35	2898	0.81	0.05	0.07	0.94	25.75	-6.20	0.97
Bujumbura	29.38	-3.38	1018	0.73	0.27	0.32	0.42	83.98	-82.98	0.68
Bure_OPE	5.51	48.56	1345	0.72	0.04	0.05	1.02	34.56	6.69	0.97
Burjassot	-0.42	39.51	6029	0.82	0.04	0.06	0.89	29.04	-5.72	0.97
Cabauw	4.93	51.97	3287	0.65	0.07	0.11	0.78	38.51	-19.10	0.92
Cabo_da_Roca	-9.50	38.78	4129	0.84	0.04	0.06	1.09	34.73	15.50	0.97
Caceres	-6.34	39.48	3946	0.83	0.03	0.04	1.03	25.53	7.12	0.98
Cairo_EMA_2	31.29	30.08	5324	0.53	0.13	0.19	0.71	44.39	-33.38	0.84
Calern_OCA	6.92	43.75	946	0.83	0.03	0.04	1.07	29.77	12.63	0.98
Calhau	-24.87	16.86	868	0.88	0.06	0.10	0.91	25.35	-6.29	0.97
CalTech	-118.13	34.14	2521	0.56	0.04	0.06	0.89	43.42	0.58	0.96
Camaguey	-77.85	21.42	2510	0.68	0.04	0.06	1.06	31.30	8.57	0.97
Campo_Grande_SONDA	-54.54	-20.44	3125	0.91	0.04	0.09	0.99	33.13	10.67	0.96

Canberra	149.11	-35.27	7434	0.72	0.03	0.04	1.14	39.79	18.92	0.97
Cape_San_Juan	-65.62	18.38	3306	0.82	0.05	0.07	1.03	33.59	8.93	0.97
Capo_Verde	-22.94	16.73	9163	0.85	0.08	0.13	0.94	27.82	-2.29	0.95
Carpentras	5.06	44.08	9152	0.82	0.03	0.05	0.97	30.62	2.11	0.98
CARTEL	-71.93	45.38	5316	0.57	0.05	0.09	1.11	40.80	12.18	0.94
CASLEO	-69.30	-31.80	3027	0.44	0.03	0.04	2.08	64.72	58.94	0.95
CCNY	-73.95	40.82	4445	0.71	0.07	0.11	1.10	41.46	15.47	0.94
CEILAP-BA	-58.51	-34.56	7410	0.58	0.05	0.07	1.17	44.19	19.73	0.94
CEILAP-Bariloche	-71.16	-41.15	1212	0.56	0.02	0.03	1.33	39.95	22.71	0.98
CEILAP-Comodoro	-67.46	-45.79	1879	0.35	0.03	0.04	1.73	62.43	52.49	0.96
CEILAP-Neuquen	-68.14	-38.95	1741	0.54	0.04	0.06	1.62	56.21	42.64	0.95
CEILAP-RG	-69.32	-51.60	2860	0.20	0.03	0.04	2.02	68.95	63.42	0.95
CENER	-1.60	42.82	1781	0.69	0.04	0.06	0.97	38.71	3.73	0.97
Cerro_Poyos	-3.49	37.11	1937	0.83	0.05	0.06	1.33	52.62	42.82	0.97
Chapais	-74.98	49.82	2696	0.62	0.05	0.08	1.26	46.65	27.80	0.94
Chen-Kung_Univ	120.20	22.99	3705	0.72	0.17	0.26	0.79	38.17	-16.42	0.86
Chequamegon	-90.25	45.93	996	0.55	0.05	0.09	1.08	48.62	16.52	0.94
Chiang_Mai_Met_Sta	98.97	18.77	4817	0.89	0.14	0.20	0.76	37.44	-28.96	0.92
Chiayi	120.50	23.50	1191	0.51	0.29	0.40	0.57	58.33	-47.57	0.64
Chiba_University	140.10	35.62	927	0.72	0.06	0.09	1.25	40.81	27.29	0.95
Chilbolton	-1.44	51.14	2930	0.79	0.04	0.07	0.95	29.54	0.04	0.97
Churchill	-93.82	58.74	2367	0.60	0.06	0.13	1.19	45.36	25.90	0.89
CLUJ_UBB	23.55	46.77	2240	0.73	0.05	0.08	0.80	35.12	-21.81	0.96
Coconut_Island	-157.79	21.43	969	0.40	0.03	0.04	1.15	39.78	19.64	0.97
Columbia_SC	-81.04	34.02	1041	0.82	0.07	0.11	0.93	35.12	-0.04	0.95
Cordoba-CETT	-64.46	-31.52	4182	0.63	0.04	0.06	1.09	37.62	13.49	0.96

Coruna	-8.42	43.36	2159	0.66	0.04	0.06	0.86	34.14	-10.30	0.96
COVE	-75.71	36.90	3591	0.76	0.07	0.12	1.08	39.35	16.77	0.94
Crozet_Island	51.85	-46.43	500	0.30	0.04	0.06	0.96	47.02	9.48	0.95
CRPSM_Malindi	40.19	-3.00	2150	0.71	0.05	0.08	0.84	28.54	-14.45	0.96
CUIABA-MIRANDA	-56.07	-15.73	4919	0.87	0.08	0.16	0.83	35.96	-7.11	0.93
CUT-TEPAK	33.04	34.67	2385	0.84	0.04	0.06	0.94	23.81	-4.42	0.98
Dahkla	-15.95	23.72	1842	0.89	0.08	0.13	1.10	29.40	12.07	0.96
Dakar	-16.96	14.39	10684	0.83	0.10	0.15	1.00	25.57	2.52	0.94
Dalanzadgad	104.42	43.58	7371	0.84	0.03	0.05	1.13	34.45	16.57	0.97
Darwin	130.89	-12.42	1581	0.78	0.04	0.06	1.05	29.02	10.09	0.97
Davos	9.84	46.81	3457	0.79	0.03	0.04	1.20	39.07	25.46	0.98
Dayton	-84.11	39.78	1530	0.60	0.06	0.09	1.22	43.39	20.30	0.94
Denver_LaCasa	-105.01	39.78	1126	0.63	0.03	0.05	1.02	40.99	5.37	0.97
Dhabi	54.38	24.48	2182	0.97	0.04	0.06	1.00	11.02	0.93	0.99
Dhadnah	56.32	25.51	3958	0.97	0.03	0.05	1.01	10.63	3.00	0.99
Dhaka_University	90.40	23.73	1644	0.70	0.28	0.38	0.69	39.80	-34.16	0.73
Djougou	1.60	9.76	1736	0.79	0.18	0.26	0.86	32.62	-20.32	0.88
DMN_Maine_Soroa	12.02	13.22	2808	0.69	0.18	0.25	1.12	39.83	20.48	0.86
Dongsha_Island	116.73	20.70	1215	0.90	0.06	0.09	0.94	25.07	-0.07	0.97
Dry_Tortugas	-82.87	24.63	2820	0.58	0.04	0.06	1.01	35.42	7.35	0.96
Dunedin	170.51	-45.86	723	0.49	0.03	0.04	1.39	47.01	32.47	0.97
Dunkerque	2.37	51.04	3358	0.74	0.05	0.09	0.91	31.71	-5.42	0.95
Durban_UKZN	30.94	-29.82	445	0.89	0.05	0.07	0.79	33.06	-20.08	0.97
Dushanbe	68.86	38.55	3406	0.79	0.07	0.11	0.83	29.94	-16.62	0.94
Easton_Airport	-76.07	38.81	1259	0.67	0.06	0.10	1.17	37.25	19.13	0.94
Easton-MDE	-76.08	38.79	920	0.59	0.06	0.09	1.46	54.75	42.15	0.94

Edinburgh	-3.18	55.92	504	0.62	0.04	0.05	1.16	39.09	18.58	0.96
Eforie	28.63	44.08	2230	0.85	0.03	0.05	0.96	20.12	-2.67	0.98
Egbert	-79.78	44.23	6532	0.61	0.06	0.10	1.15	44.07	19.93	0.94
Eilat	34.92	29.50	4856	0.91	0.03	0.06	0.99	19.70	0.96	0.98
El_Arenosillo	-6.73	37.11	7755	0.83	0.04	0.06	0.98	29.64	2.50	0.98
El_Farafra	27.99	27.06	3010	0.80	0.09	0.12	1.45	54.19	47.27	0.93
El_Segundo	-118.38	33.91	2936	0.56	0.04	0.05	0.98	37.41	5.26	0.97
EPA-NCU	121.19	24.97	2171	0.67	0.14	0.22	0.82	40.66	-10.35	0.86
EPA-Res_Triangle_Pk	-78.87	35.88	1453	0.63	0.05	0.08	1.10	42.47	14.09	0.96
Ersa	9.36	43.00	4774	0.78	0.04	0.06	1.15	32.43	18.04	0.97
ETNA	15.02	37.61	2837	0.81	0.05	0.07	0.95	34.00	1.41	0.97
EVK2-CNR	86.81	27.96	1715	0.76	0.03	0.04	1.79	62.90	58.46	0.97
Evora	-7.91	38.57	8392	0.81	0.03	0.05	1.05	32.90	12.57	0.98
Fontainebleau	2.68	48.41	1846	0.80	0.04	0.07	0.96	24.76	-1.83	0.97
Fort_McKay	-111.64	57.18	1131	0.59	0.10	0.22	1.37	53.68	24.50	0.79
Fort_McMurray	-111.48	56.75	3631	0.65	0.07	0.15	1.22	47.28	24.89	0.88
FORTH_CRETE	25.28	35.33	6461	0.87	0.03	0.05	0.97	20.71	-0.99	0.98
Fowlers_Gap	141.70	-31.09	2310	0.52	0.03	0.04	1.83	66.02	61.32	0.95
Frenchman_Flat	-115.93	36.81	4114	0.66	0.03	0.04	1.35	45.08	34.62	0.97
Fresno	-119.77	36.78	4824	0.39	0.05	0.08	0.78	40.61	-17.57	0.94
Fresno_2	-119.77	36.79	2713	0.50	0.04	0.07	0.89	40.15	-10.16	0.94
Frioul	5.29	43.27	3306	0.81	0.03	0.05	1.17	33.11	21.03	0.98
Fukuoka	130.48	33.52	1951	0.71	0.09	0.14	0.89	34.16	-8.67	0.92
FZJ-JOYCE	6.41	50.91	1355	0.68	0.05	0.08	0.87	32.45	-7.21	0.96
Gandhi_College	84.13	25.87	3393	0.82	0.11	0.16	0.97	19.15	-2.35	0.94
Gangneung_WNU	128.87	37.77	1953	0.76	0.09	0.14	0.90	38.10	-11.35	0.93

Georgia_Tech	-84.40	33.78	2414	0.71	0.05	0.07	1.10	36.99	14.23	0.96
GISS	-73.96	40.80	855	0.69	0.10	0.16	1.03	47.31	12.30	0.91
Gobabeb	15.04	-23.56	2502	0.81	0.06	0.07	1.47	55.58	49.39	0.95
Goldstone	-116.79	35.23	4739	0.68	0.04	0.05	1.61	58.14	53.33	0.96
Gosan_SNU	126.16	33.29	2421	0.80	0.09	0.15	0.98	26.42	2.81	0.94
Gotland	18.95	57.92	1110	0.91	0.03	0.05	1.05	25.73	10.67	0.98
Gozo	14.26	36.03	766	0.82	0.05	0.08	1.14	32.03	15.67	0.96
Granada	-3.61	37.16	6670	0.85	0.04	0.06	0.92	28.51	-7.78	0.98
Grand_Forks	-97.33	47.91	1191	0.73	0.06	0.11	1.20	47.32	23.44	0.92
GSFC	-76.84	38.99	12429	0.67	0.08	0.13	1.08	42.38	16.97	0.92
Guadeloup	-61.53	16.22	3881	0.82	0.05	0.08	1.04	38.49	12.54	0.97
Gual_Pahari	77.15	28.43	910	0.76	0.11	0.18	0.95	19.10	-3.83	0.92
Gwangju_GIST	126.84	35.23	3905	0.79	0.12	0.19	0.89	31.88	-10.27	0.91
Hada_El-Sham	39.73	21.80	992	0.81	0.08	0.12	0.96	28.32	3.98	0.95
Halifax	-63.59	44.64	5459	0.63	0.05	0.08	1.26	40.26	24.58	0.94
Hamburg	9.97	53.57	3763	0.80	0.04	0.07	0.94	27.03	-2.38	0.97
Hamim	54.30	22.97	2214	0.98	0.03	0.04	1.05	9.64	6.42	0.99
Hankuk_UFS	127.27	37.34	1056	0.75	0.14	0.22	0.75	43.36	-25.50	0.88
Harvard_Forest	-72.19	42.53	3315	0.63	0.06	0.09	1.30	45.55	29.51	0.94
Helgoland	7.89	54.18	2101	0.74	0.04	0.07	0.99	28.13	3.24	0.96
Helsinki	24.96	60.20	2034	0.86	0.03	0.04	1.12	27.26	15.21	0.98
Henties_Bay	14.26	-22.10	709	0.78	0.04	0.06	1.13	34.85	18.70	0.97
Hermosillo	-110.96	29.07	1606	0.74	0.03	0.04	1.15	30.95	14.01	0.98
HESS	16.50	-23.27	1187	0.80	0.03	0.05	1.22	52.03	38.80	0.97
HJAndrews	-122.22	44.24	4650	0.63	0.04	0.05	1.39	54.80	43.28	0.96
HohenpeissenbergDWD	11.01	47.80	1361	0.72	0.04	0.05	1.02	41.28	13.24	0.97

Hokkaido_University	141.34	43.08	559	0.79	0.07	0.12	1.14	37.77	11.39	0.94
Hong_Kong_PolyU	114.18	22.30	2401	0.84	0.10	0.15	1.03	24.56	7.94	0.94
Hornsund	15.54	77.00	1584	0.69	0.02	0.05	0.97	26.33	-1.41	0.97
Howland	-68.74	45.20	2690	0.61	0.05	0.09	1.18	42.86	20.09	0.94
Huancayo-IGP	-75.32	-12.04	1546	0.22	0.07	0.10	1.47	60.17	26.70	0.90
Huelva	-6.57	37.02	3592	0.81	0.04	0.06	1.06	35.09	14.36	0.97
Hyytiala	24.30	61.85	1749	0.83	0.02	0.04	1.01	25.49	3.63	0.98
IASBS	48.51	36.71	2848	0.78	0.06	0.08	1.10	33.85	12.33	0.97
Iasi_LOASL	27.56	47.19	2081	0.77	0.05	0.07	0.91	28.75	-7.69	0.97
ICIPE-Mbita	34.21	-0.43	3240	0.75	0.07	0.10	0.73	40.66	-30.85	0.94
IER_Cinzana	-5.93	13.28	8393	0.80	0.12	0.18	0.89	30.39	-7.70	0.92
Ilorin	4.67	8.48	5986	0.89	0.15	0.22	0.91	24.57	-10.75	0.93
IMAA_Potenza	15.72	40.60	3701	0.80	0.04	0.05	1.00	29.23	5.55	0.98
IMC_Oristano	8.50	39.91	2223	0.83	0.05	0.07	0.88	29.44	-7.87	0.97
IMPROVE-MammothCave	-86.15	37.13	1543	0.63	0.06	0.08	1.11	43.08	14.76	0.95
IMS-METU-ERDEMLI	34.26	36.56	7585	0.79	0.06	0.10	0.79	29.55	-19.43	0.95
Iqaluit	-68.54	63.75	1142	0.66	0.04	0.06	1.23	42.35	28.13	0.96
Irkutsk	103.09	51.80	1977	0.80	0.05	0.09	0.78	35.18	-19.95	0.95
ISDGM_CNR	12.33	45.44	2075	0.80	0.07	0.12	0.95	27.44	0.73	0.95
Ispra	8.63	45.80	5941	0.72	0.11	0.19	0.71	41.74	-21.16	0.88
Issyk-Kul	76.98	42.62	4633	0.85	0.03	0.05	1.01	30.74	1.98	0.98
Itajuba	-45.45	-22.41	891	0.68	0.04	0.06	0.88	42.26	-5.71	0.96
Ittoqqortoormiit	-21.95	70.48	1590	0.60	0.03	0.04	1.26	40.46	27.89	0.97
Izana	-16.50	28.31	10711	0.81	0.08	0.10	2.41	111.15	109.03	0.92
Jabiru	132.89	-12.66	6684	0.77	0.05	0.07	1.16	36.31	22.80	0.97
Jaipur	75.81	26.91	4417	0.84	0.09	0.13	0.89	23.36	-14.08	0.95

Jambi	103.64	-1.63	1089	0.82	0.28	0.48	0.59	49.79	-36.22	0.66
Ji_Parana_SE	-61.85	-10.93	3716	0.88	0.08	0.18	0.95	32.33	2.11	0.93
Jomsom	83.71	28.78	1138	0.83	0.04	0.06	1.16	40.13	20.50	0.98
Kaashidhoo	73.47	4.97	1056	0.78	0.05	0.08	0.80	29.98	-19.13	0.96
Kangerlussuaq	-50.62	67.00	2162	0.60	0.02	0.04	1.23	34.95	24.08	0.98
Kanpur	80.23	26.51	8367	0.84	0.10	0.16	0.94	17.74	-5.65	0.94
Kanzelhohe_Obs	13.90	46.68	1923	0.75	0.04	0.05	1.19	41.43	24.62	0.97
Karachi	67.14	24.95	3985	0.93	0.06	0.08	1.00	14.52	2.32	0.98
Karlsruhe	8.43	49.09	2208	0.70	0.05	0.08	0.86	32.42	-12.06	0.95
Kathmandu-Bode	85.39	27.68	862	0.69	0.20	0.28	0.60	55.46	-47.06	0.79
KAUST_Campus	39.10	22.30	2035	0.88	0.08	0.13	0.91	19.00	-5.58	0.95
Kellogg_LTER	-85.37	42.41	1968	0.69	0.07	0.11	1.06	41.37	10.73	0.94
Kelowna_UAS	-119.40	49.94	4458	0.58	0.04	0.08	1.12	41.10	13.29	0.93
Key_Biscayne	-80.16	25.73	3588	0.65	0.04	0.06	1.05	32.63	7.63	0.97
Key_Biscayne2	-80.16	25.73	2016	0.61	0.04	0.05	1.17	37.13	18.26	0.96
Kirtland_AFB	-106.51	34.95	1015	0.71	0.02	0.03	1.20	32.39	15.96	0.98
Koforidua_ANUC	-0.30	6.11	584	0.91	0.19	0.27	0.81	29.63	-22.58	0.91
KONZA_EDC	-96.61	39.10	5198	0.59	0.06	0.09	1.16	40.56	18.51	0.94
Kuching	110.35	1.49	682	0.86	0.15	0.33	0.72	35.23	-20.85	0.81
Kuopio	27.63	62.89	2273	0.84	0.02	0.04	1.06	26.75	9.99	0.98
Kuujjuarapik	-77.76	55.28	1082	0.64	0.05	0.08	1.09	39.66	12.59	0.94
Kuwait_University	47.97	29.33	1206	0.97	0.05	0.09	0.98	9.82	0.07	0.98
Kyiv	30.50	50.36	4277	0.79	0.05	0.07	0.93	29.55	-6.74	0.97
La_Jolla	-117.25	32.87	4094	0.62	0.04	0.05	1.07	38.94	16.05	0.97
La_Laguna	-16.32	28.48	3492	0.88	0.05	0.08	1.04	33.25	12.61	0.97
La_Parguera	-67.05	17.97	8972	0.82	0.04	0.07	1.01	34.03	6.46	0.97

La_Paz	-68.07	-16.54	4583	0.41	0.04	0.06	0.90	47.83	-18.32	0.95
Laegeren	8.36	47.48	2872	0.75	0.04	0.06	0.97	28.97	0.21	0.97
Lahore	74.26	31.48	3702	0.73	0.15	0.24	0.89	25.45	-11.53	0.87
Lake_Argyle	128.75	-16.11	8100	0.83	0.05	0.07	1.28	49.75	40.89	0.97
Lake_Lefroy	121.71	-31.25	2409	0.41	0.03	0.03	1.36	49.04	33.98	0.97
Lamezia_Terme	16.23	38.88	622	0.76	0.05	0.07	0.94	32.54	-0.83	0.97
Lampedusa	12.63	35.52	4839	0.87	0.04	0.07	1.08	26.37	10.10	0.97
LAMTO-STATION	-5.03	6.22	265	0.62	0.38	0.55	0.63	44.99	-39.46	0.51
Lanai	-156.92	20.74	3843	0.39	0.03	0.04	1.19	44.53	25.15	0.97
LAQUILA_Coppito	13.35	42.37	929	0.79	0.03	0.05	1.08	33.68	13.51	0.98
Le_Fauga	1.28	43.38	2533	0.73	0.05	0.07	0.86	35.98	-9.80	0.96
Lecce_University	18.11	40.34	7673	0.80	0.04	0.06	1.00	25.02	2.38	0.97
Leipzig	12.44	51.35	4206	0.83	0.05	0.07	0.93	26.62	-5.74	0.97
Lille	3.14	50.61	4827	0.75	0.05	0.09	0.89	31.50	-7.39	0.95
Loftus_MO	-0.86	54.56	199	0.68	0.03	0.05	1.16	37.68	21.75	0.97
Luang_Namtha	101.42	20.93	1292	0.83	0.20	0.33	0.83	42.95	-25.36	0.87
Lubango	13.45	-14.96	785	0.85	0.06	0.08	0.92	31.34	-4.91	0.97
Lulin	120.87	23.47	2059	0.56	0.23	0.27	4.35	134.47	134.20	0.63
Lumbini	83.28	27.49	496	0.72	0.22	0.31	0.71	41.27	-28.39	0.79
Madrid	-3.72	40.45	3524	0.76	0.03	0.05	0.94	36.78	2.28	0.98
Magurele_Inoe	26.03	44.35	994	0.78	0.05	0.07	0.95	29.86	-4.77	0.97
Mainz	8.30	50.00	3617	0.77	0.05	0.07	0.88	28.92	-10.48	0.97
Malaga	-4.48	36.72	4371	0.87	0.03	0.05	0.99	25.06	4.35	0.98
Manaus_EMBRAPA	-59.97	-2.89	1449	0.75	0.06	0.10	0.94	34.29	-2.98	0.95
Manila_Observatory	121.08	14.64	2284	0.45	0.11	0.20	0.69	45.83	-21.41	0.81
Manus	147.43	-2.06	753	0.60	0.03	0.04	1.07	38.50	16.33	0.97

Maricopa	-111.97	33.07	5058	0.64	0.04	0.05	1.35	40.77	30.41	0.96
Martova	36.95	49.94	1134	0.78	0.04	0.06	0.93	29.31	-5.75	0.98
Masdar_Institute	54.62	24.44	3174	0.91	0.06	0.08	1.00	16.92	-0.39	0.98
Mauna_Loa	-155.58	19.54	16676	0.20	0.07	0.08	5.25	135.92	135.09	0.85
MCO-Hanimaadhoo	73.18	6.78	3910	0.77	0.06	0.10	0.84	23.65	-15.73	0.95
MD_Science_Center	-76.61	39.28	8473	0.73	0.07	0.12	1.08	41.68	15.85	0.94
Medellin	-75.58	6.26	655	0.54	0.12	0.19	0.71	53.41	-32.03	0.86
Medenine-IRA	10.64	33.50	2118	0.86	0.05	0.08	1.13	31.57	16.94	0.97
Messina	15.57	38.20	3816	0.74	0.05	0.08	0.90	30.33	-7.95	0.96
MetObs_Lindenberg	14.12	52.21	641	0.79	0.05	0.07	0.93	30.35	-6.99	0.97
Mexico_City	-99.18	19.33	6282	0.42	0.18	0.25	0.55	70.81	-57.21	0.76
Mezaira	53.75	23.10	5513	0.93	0.05	0.08	1.07	15.82	8.84	0.98
Midway_Island	-177.38	28.21	3199	0.64	0.03	0.05	1.07	35.92	12.81	0.97
Mingo	-90.14	36.97	894	0.53	0.07	0.10	1.06	46.72	11.41	0.94
Minsk	27.60	53.92	4736	0.85	0.05	0.08	0.93	31.44	-6.29	0.97
Missoula	-114.08	46.92	5695	0.68	0.06	0.10	0.96	43.93	5.51	0.92
Modena	10.95	44.63	4627	0.65	0.08	0.12	0.82	36.77	-15.38	0.93
Modesto	-120.99	37.64	473	0.69	0.04	0.06	1.04	42.98	12.17	0.96
Moldova	28.82	47.00	7620	0.86	0.04	0.06	0.97	22.02	-3.88	0.98
Mongu	23.15	-15.25	8104	0.89	0.06	0.10	0.81	28.98	-16.24	0.96
Mongu_Inn	23.13	-15.27	2069	0.86	0.09	0.13	0.71	41.76	-28.92	0.94
Monterey	-121.85	36.59	4681	0.71	0.04	0.05	1.21	39.71	24.23	0.96
Montsec	0.73	42.05	2435	0.79	0.04	0.05	1.47	61.17	54.08	0.97
Moscow_MSU_MO	37.52	55.71	5119	0.92	0.04	0.07	0.92	22.08	-6.17	0.97
Mukdahan	104.68	16.61	3063	0.93	0.07	0.10	0.97	19.34	-1.96	0.98
Munich_University	11.57	48.15	3450	0.76	0.04	0.06	0.90	30.61	-8.73	0.97

Murcia	-1.17	38.00	3592	0.80	0.04	0.06	0.88	33.74	-3.47	0.97
Mussafa	54.47	24.37	2670	0.98	0.03	0.04	0.99	9.12	-0.28	0.99
Nainital	79.46	29.36	881	0.83	0.11	0.14	1.41	56.77	50.13	0.93
Nairobi	36.87	-1.34	784	0.47	0.05	0.08	0.72	36.92	-27.83	0.93
NAM_CO	90.96	30.77	2021	0.76	0.02	0.03	1.14	32.38	13.12	0.98
Namibe	12.18	-15.16	404	0.80	0.08	0.11	0.88	28.71	-11.03	0.95
Napoli_CeSMA	14.31	40.84	282	0.67	0.04	0.06	0.90	36.07	-6.45	0.96
NASA_KSC	-80.66	28.46	464	0.51	0.05	0.07	1.38	48.25	35.02	0.95
NASA_LaRC	-76.38	37.10	1938	0.63	0.06	0.08	1.25	43.71	26.69	0.95
Nauru	166.92	-0.52	3573	0.59	0.02	0.03	1.07	30.79	10.05	0.98
NCU_Taiwan	121.19	24.97	1900	0.50	0.20	0.33	0.68	47.47	-19.56	0.72
ND_Marbel_Univ	124.84	6.50	1854	0.65	0.06	0.09	0.71	43.63	-30.86	0.93
NEON_CVALLA	-105.17	40.16	2452	0.61	0.04	0.06	1.10	44.53	17.68	0.96
NEON_Harvard	-72.17	42.54	1008	0.53	0.06	0.09	1.62	64.28	55.15	0.93
NEON_KONZ	-96.56	39.10	818	0.61	0.06	0.08	1.42	50.09	36.93	0.94
NEON_MOAB	-109.39	38.25	1189	0.59	0.03	0.04	1.58	53.90	47.38	0.96
NEON_OAES	-99.06	35.41	1284	0.65	0.04	0.06	1.33	42.58	30.52	0.96
NEON_ONAQ	-112.45	40.18	1167	0.65	0.04	0.05	1.44	53.64	40.53	0.96
NEON_ORNL	-84.28	35.96	949	0.62	0.05	0.08	1.20	44.79	25.68	0.95
NEON_OSBS	-81.99	29.69	1350	0.68	0.05	0.07	1.40	44.77	35.91	0.96
NEON_RMNP	-105.55	40.28	881	0.62	0.03	0.05	1.60	67.03	57.06	0.96
NEON_SCBI	-78.14	38.89	910	0.66	0.07	0.10	1.42	52.15	39.59	0.93
NEON_SERC	-76.56	38.89	451	0.48	0.07	0.09	1.47	49.36	37.93	0.93
NEON_Sterling	-103.03	40.46	1241	0.59	0.04	0.06	1.59	57.45	49.60	0.95
NEON_TALL	-87.39	32.95	1150	0.58	0.06	0.08	1.32	48.37	35.43	0.95
NEON_UKFS	-95.19	39.04	563	0.52	0.05	0.07	1.24	40.80	20.35	0.96

NEON_UNDE	-89.54	46.23	793	0.67	0.06	0.10	1.36	52.58	38.28	0.92
NEON_WOOD	-99.24	47.13	734	0.76	0.07	0.15	1.24	52.37	32.49	0.89
NEON-CPER	-104.74	40.81	943	0.57	0.04	0.05	1.42	55.15	42.00	0.96
NEON-Disney	-81.44	28.13	816	0.58	0.05	0.07	1.34	43.18	30.92	0.95
Nes_Ziona	34.79	31.92	7873	0.90	0.04	0.06	0.99	19.90	0.95	0.98
NGHIA_DO	105.80	21.05	1089	0.78	0.24	0.34	0.70	42.03	-35.59	0.81
NhaTrang	109.21	12.20	1086	0.86	0.05	0.08	0.90	26.82	-4.60	0.97
Nong_Khai	102.72	17.88	784	0.87	0.17	0.24	0.81	31.04	-16.01	0.91
Noto	137.14	37.33	2082	0.80	0.08	0.12	1.14	31.94	16.76	0.95
OHP_OBSERVATOIRE	5.71	43.94	6675	0.80	0.03	0.05	1.16	38.15	24.18	0.98
Omkoi	98.43	17.80	1440	0.79	0.12	0.20	1.19	38.80	23.01	0.91
Oostende	2.93	51.22	3205	0.76	0.05	0.08	0.97	29.26	1.07	0.96
OPAL	-85.94	79.99	1639	0.58	0.03	0.04	1.34	43.03	32.14	0.97
Osaka	135.59	34.65	5534	0.74	0.09	0.14	0.93	34.03	-2.69	0.93
Ouagadougou	-1.49	12.42	4231	0.73	0.14	0.22	0.91	31.73	-4.51	0.89
Ouarzazate	-6.91	30.93	2714	0.81	0.05	0.08	1.04	41.44	11.44	0.97
Oujda	-1.90	34.65	2340	0.85	0.05	0.07	0.86	34.16	-7.33	0.97
Palaiseau	2.22	48.71	5110	0.78	0.05	0.07	0.99	30.39	3.66	0.97
Palangkaraya	113.95	-2.23	1433	0.81	0.23	0.56	0.57	43.54	-19.25	0.49
Palencia	-4.52	41.99	6596	0.75	0.03	0.05	1.03	36.74	8.02	0.97
Palma_de_Mallorca	2.63	39.55	3643	0.83	0.04	0.06	1.00	30.14	5.99	0.98
Pantnagar	79.52	29.05	984	0.88	0.11	0.16	0.85	24.50	-15.08	0.94
Paris	2.36	48.85	3632	0.79	0.04	0.07	0.93	28.71	-4.94	0.97
PEARL	-86.42	80.05	2501	0.62	0.03	0.04	1.40	46.89	38.88	0.97
Petrolina_SONDA	-40.32	-9.07	2947	0.74	0.03	0.04	1.06	36.40	17.04	0.98
Pickle_Lake	-90.22	51.45	3837	0.58	0.05	0.09	1.28	46.73	26.70	0.93

Pimai	102.56	15.18	1733	0.90	0.08	0.11	0.94	22.03	-5.31	0.97
Pokhara	83.98	28.19	3415	0.66	0.22	0.33	0.54	63.47	-56.85	0.72
Pontianak	109.19	0.08	1487	0.87	0.20	0.43	0.64	42.25	-24.53	0.73
Poprad-Ganovce	20.32	49.04	718	0.77	0.04	0.06	0.89	35.98	-8.33	0.97
Porquerolles	6.16	43.00	1531	0.82	0.04	0.06	1.09	36.14	18.37	0.98
Pretoria_CSIR-DPSS	28.28	-25.76	3137	0.78	0.05	0.07	0.77	36.02	-23.08	0.96
Puerto_Madryn	-65.01	-42.79	849	0.41	0.04	0.05	1.88	68.84	60.56	0.94
Pune	73.81	18.54	3466	0.73	0.13	0.17	0.75	39.74	-32.70	0.90
Pusan_NU	129.08	35.24	1039	0.77	0.09	0.14	0.89	34.51	-4.79	0.93
QOMS_CAS	86.95	28.37	3341	0.66	0.02	0.04	1.28	50.45	18.24	0.98
Raciborz	18.19	50.08	650	0.74	0.06	0.08	0.78	39.31	-26.16	0.95
Ragged_Point	-59.43	13.17	3845	0.86	0.04	0.06	1.06	32.03	11.99	0.98
Railroad_Valley	-115.69	38.50	8399	0.63	0.03	0.05	1.39	49.63	37.94	0.97
Rame_Head	-4.22	50.32	722	0.68	0.04	0.06	0.94	35.12	1.06	0.96
Ras_El_Ain	-7.60	31.67	1133	0.79	0.08	0.12	0.84	36.64	-17.62	0.95
Red_Mountain_Pass	-107.71	37.91	3822	0.63	0.03	0.04	1.54	61.86	51.51	0.97
Resolute_Bay	-94.97	74.71	1510	0.62	0.04	0.07	1.19	40.38	25.45	0.94
REUNION_ST_DENIS	55.48	-20.90	4423	0.62	0.02	0.03	1.15	32.33	17.05	0.98
Rimrock	-116.99	46.49	6250	0.71	0.04	0.07	1.15	43.41	19.89	0.95
Rio_Branco	-67.87	-9.96	5191	0.87	0.08	0.16	0.80	36.15	-16.15	0.93
Rogers_Dry_Lake	-117.89	34.93	4399	0.66	0.03	0.04	1.16	38.44	21.68	0.98
Rome_Tor_Vergata	12.65	41.84	8244	0.81	0.04	0.06	0.88	26.65	-11.11	0.97
Rottnest_Island	115.50	-32.00	1102	0.65	0.01	0.02	1.12	26.68	15.32	0.99
Saada	-8.16	31.63	7368	0.82	0.07	0.10	0.84	36.28	-17.12	0.96
Sable_Island	-60.01	43.93	938	0.54	0.04	0.07	1.23	37.13	22.03	0.94
SACOL	104.14	35.95	3471	0.63	0.13	0.19	0.69	44.46	-36.17	0.85

San_Nicolas	-119.49	33.26	2703	0.65	0.04	0.04	1.36	49.28	38.85	0.97
Sandia_NM_PSEL	-106.54	35.05	2096	0.64	0.03	0.04	1.31	43.42	29.52	0.98
SANTA_CRUZ	-63.18	-17.80	1133	0.88	0.06	0.11	0.86	36.32	-5.69	0.95
Santa_Cruz_Tenerife	-16.25	28.47	8101	0.87	0.05	0.08	0.95	34.89	2.84	0.97
SANTA_CRUZ_UTEPSA	-63.20	-17.77	1778	0.87	0.08	0.15	0.92	33.84	-4.01	0.93
Santa_Monica_Colg	-118.47	34.02	2714	0.57	0.04	0.06	1.00	42.33	9.59	0.96
Santiago_Beauchef	-70.66	-33.46	1385	0.55	0.10	0.13	0.44	84.18	-80.39	0.85
Sao_Martinho_SONDA	-53.82	-29.44	1273	0.62	0.05	0.08	1.20	47.59	28.28	0.93
Sao_Paulo	-46.73	-23.56	3485	0.68	0.08	0.12	0.68	47.96	-34.58	0.91
Saturn_Island	-123.13	48.78	4910	0.63	0.05	0.07	1.44	53.98	44.23	0.94
SEARCH-Centreville	-87.25	32.90	1683	0.65	0.06	0.08	1.23	45.32	29.97	0.95
SEARCH-OLF	-87.38	30.55	1885	0.65	0.06	0.08	1.23	44.01	28.25	0.95
SEARCH-Yorkville	-85.05	33.93	1291	0.58	0.05	0.08	1.21	44.91	26.92	0.95
SEDE_BOKER	34.78	30.86	14534	0.89	0.04	0.06	1.14	24.37	15.86	0.98
Seoul_SNU	126.95	37.46	1652	0.76	0.15	0.24	0.85	39.28	-14.30	0.88
SERC	-76.56	38.89	5624	0.74	0.07	0.12	1.10	40.02	17.91	0.94
Sevastopol	33.52	44.62	4259	0.88	0.03	0.04	0.99	17.76	-0.07	0.99
Sevilleta	-106.89	34.35	10558	0.67	0.03	0.04	1.31	43.05	29.73	0.97
Seysses	1.26	43.50	1436	0.73	0.04	0.06	0.93	35.05	-0.90	0.97
Shirahama	135.36	33.69	5948	0.80	0.07	0.10	1.03	27.82	6.62	0.95
Sigma_Space_Corp	-76.84	38.95	836	0.62	0.06	0.09	1.39	47.78	33.56	0.93
Silpakorn_Univ	100.04	13.82	5025	0.84	0.11	0.16	0.91	25.94	-4.99	0.94
Simonstown_IMT	18.45	-34.19	883	0.67	0.03	0.04	1.25	39.09	27.25	0.97
Singapore	103.78	1.30	3175	0.79	0.14	0.26	0.75	33.63	-18.91	0.83
Sioux_Falls	-96.63	43.74	5237	0.63	0.05	0.08	1.17	41.92	17.02	0.95
Sirmione_Museo_GC	10.61	45.50	891	0.68	0.08	0.12	0.86	40.67	-6.37	0.93

Skukuza	31.59	-24.99	5981	0.90	0.04	0.06	0.89	23.02	-6.39	0.98
SMHI	16.15	58.58	723	0.77	0.03	0.05	1.07	27.03	11.55	0.98
Sodankyla	26.63	67.37	1226	0.65	0.03	0.04	1.21	39.01	22.48	0.97
Solar_Village	46.40	24.91	11557	0.97	0.03	0.05	1.03	9.77	5.96	0.99
Son_La	103.91	21.33	699	0.86	0.24	0.34	0.83	34.17	-20.58	0.87
Songkhla_Met_Sta	100.60	7.18	2430	0.83	0.06	0.09	0.95	27.85	0.40	0.96
SP_Bayboro	-82.63	27.76	2016	0.52	0.05	0.07	1.43	49.74	38.93	0.94
St_Louis_University	-90.23	38.64	1455	0.73	0.06	0.09	1.17	42.62	21.93	0.95
Stennis	-89.62	30.37	1371	0.78	0.06	0.09	1.03	35.47	8.07	0.96
Strzyzow	21.86	49.88	1332	0.76	0.04	0.06	0.97	30.14	-1.50	0.97
Tabernas_PSA-DLR	-2.36	37.09	2192	0.88	0.03	0.05	1.00	30.87	9.59	0.98
Table_Mountain	-105.24	40.13	4387	0.59	0.03	0.05	1.15	46.29	22.39	0.97
TABLE_MOUNTAIN_CA	-117.68	34.38	6897	0.61	0.05	0.06	2.11	84.16	81.28	0.94
Tahiti	-149.61	-17.58	2346	0.34	0.03	0.04	1.03	37.20	3.04	0.97
Tai_Ping	114.36	10.38	446	0.82	0.03	0.05	0.88	24.44	-7.62	0.98
Taihu	120.22	31.42	2881	0.79	0.18	0.27	0.97	27.21	1.77	0.88
Taipei_CWB	121.54	25.01	2527	0.65	0.17	0.26	0.79	42.76	-11.28	0.83
Tallahassee	-84.30	30.45	1723	0.69	0.05	0.07	1.31	43.67	32.03	0.96
Tamanrasset_INM	5.53	22.79	8402	0.79	0.09	0.14	1.09	43.70	22.87	0.93
Taylor_Ranch_TWRS	-114.85	45.10	918	0.69	0.05	0.11	1.06	47.80	23.12	0.90
Technion_Haifa_IL	35.02	32.78	380	0.78	0.04	0.05	1.04	23.15	4.62	0.98
Teide	-16.64	28.27	1913	0.77	0.10	0.13	3.31	133.21	132.36	0.88
The_Hague	4.33	52.11	897	0.76	0.06	0.09	0.88	33.53	-10.60	0.95
Thessaloniki	22.96	40.63	6596	0.78	0.06	0.08	0.91	30.22	-7.68	0.96
Thompson	-97.85	55.80	1072	0.44	0.14	0.26	1.45	64.66	38.40	0.76
Thompson_Farm	-70.95	43.11	3913	0.58	0.06	0.09	1.25	45.88	26.20	0.94

Thule	-68.77	76.52	2882	0.62	0.02	0.04	1.11	31.84	14.82	0.97
Timisoara	21.23	45.75	745	0.80	0.05	0.07	0.94	24.40	-6.06	0.97
Tinga_Tingana	139.99	-28.98	4468	0.65	0.04	0.06	1.49	55.02	46.77	0.96
Tizi_Ouzou	4.06	36.70	1987	0.83	0.06	0.09	0.81	34.94	-23.19	0.96
Tomsk	85.05	56.48	2494	0.86	0.03	0.07	0.97	20.93	-0.45	0.97
Tomsk_22	84.07	56.42	1633	0.93	0.06	0.11	0.97	28.07	0.58	0.96
Toravere	26.47	58.26	4500	0.90	0.03	0.05	1.01	24.36	4.04	0.98
Toronto	-79.47	43.79	4246	0.65	0.06	0.10	1.13	42.15	17.53	0.94
Toulon	6.01	43.14	5307	0.77	0.04	0.06	1.06	33.21	11.92	0.97
Toulouse_MF	1.37	43.57	1355	0.68	0.04	0.05	0.98	36.39	1.85	0.97
Trelew	-65.31	-43.25	5736	0.30	0.05	0.06	2.09	70.86	63.17	0.93
Trinidad_Head	-124.15	41.05	3433	0.41	0.05	0.09	1.07	49.43	20.19	0.92
Tsumkwe	20.44	-19.62	865	0.86	0.05	0.07	0.99	39.97	15.41	0.97
TUBITAK_UZAY_Ankara	32.78	39.89	1020	0.81	0.03	0.05	0.92	20.67	-8.13	0.98
Tucson	-110.95	32.23	4371	0.69	0.03	0.04	1.33	42.36	30.81	0.97
Tudor_Hill	-64.88	32.26	1635	0.61	0.04	0.06	1.04	33.22	8.34	0.97
Tunis_Carthage	10.20	36.84	2811	0.79	0.05	0.08	0.94	31.02	-4.13	0.96
Tuxtla_Gutierrez	-93.15	16.75	2176	0.81	0.09	0.15	0.77	45.08	-30.59	0.92
U_of_Wisconsin_SSEC	-89.41	43.07	1792	0.71	0.06	0.10	1.12	42.75	19.28	0.94
UAHuntsville	-86.64	34.73	1443	0.75	0.05	0.07	1.03	34.86	8.01	0.96
Ubon_Ratchathani	104.87	15.25	2531	0.89	0.10	0.16	0.99	25.44	1.55	0.95
UCLA	-118.44	34.07	1447	0.62	0.05	0.08	0.75	41.38	-17.79	0.95
UCSB	-119.85	34.42	5097	0.65	0.03	0.05	0.95	41.35	6.61	0.97
UdeConcepcion-CEFOP	-73.03	-36.84	996	0.36	0.03	0.04	1.04	41.60	11.40	0.96
UH_Coastal_Center	-95.04	29.39	1303	0.56	0.06	0.09	1.11	41.89	15.37	0.94
UMBC	-76.71	39.25	2549	0.71	0.06	0.09	1.17	40.17	20.40	0.95

Univ_of_Houston	-95.34	29.72	4290	0.65	0.06	0.08	1.13	36.69	17.36	0.95
Univ_of_Lethbridge	-112.87	49.68	2524	0.69	0.05	0.08	1.26	48.12	28.73	0.94
Univ_of_Nevada-Reno	-119.81	39.54	3222	0.70	0.04	0.07	1.30	45.55	28.76	0.94
UPC-GEAB-Valledupar	-73.33	9.56	222	0.20	0.08	0.11	1.16	39.18	9.61	0.91
Upington	21.16	-28.38	863	0.69	0.03	0.05	1.19	52.59	31.11	0.97
UPRM_Lidar_Lab	-67.14	18.21	1108	0.86	0.04	0.06	1.08	37.82	15.69	0.98
USGS_Flagstaff_ROLO	-111.63	35.21	1415	0.66	0.03	0.04	1.58	54.78	47.05	0.97
USM_Penang	100.30	5.36	1616	0.78	0.12	0.19	0.78	35.87	-18.90	0.88
Ussuriysk	132.16	43.70	3342	0.71	0.08	0.15	0.98	33.77	-4.50	0.92
Valladolid	-4.71	41.66	2604	0.77	0.03	0.04	1.04	37.49	10.62	0.98
Venise	12.51	45.31	3947	0.75	0.07	0.12	1.01	30.46	8.51	0.94
Villefranche	7.33	43.68	4941	0.76	0.05	0.08	0.88	35.09	-8.34	0.96
Walker_Branch	-84.29	35.96	3744	0.70	0.08	0.12	0.95	42.44	5.66	0.93
Wallops	-75.47	37.93	6797	0.75	0.07	0.11	1.09	40.94	17.05	0.94
Waskesiu	-106.07	53.91	3351	0.52	0.06	0.11	1.18	47.95	24.64	0.91
Weizmann_Institute	34.81	31.91	817	0.80	0.04	0.07	0.96	25.99	-2.94	0.97
White_Sands_HELSTF	-106.34	32.63	6464	0.64	0.04	0.05	1.42	49.15	39.55	0.97
Windpoort	15.48	-19.37	1186	0.77	0.05	0.08	1.04	44.78	19.31	0.96
Wits_University	28.03	-26.19	1783	0.67	0.05	0.08	0.75	43.52	-22.01	0.95
Wytham_Woods	-1.33	51.77	936	0.74	0.05	0.07	0.95	32.53	-1.36	0.96
Xanthi	24.92	41.15	1394	0.76	0.07	0.09	0.80	32.00	-20.00	0.95
XiangHe	116.96	39.75	6981	0.84	0.22	0.37	0.79	37.25	-11.88	0.84
Xinglong	117.58	40.40	2778	0.82	0.13	0.21	1.15	41.63	17.84	0.91
Yakutsk	129.37	61.66	3878	0.80	0.05	0.12	1.00	32.50	7.94	0.93
Yekaterinburg	59.54	57.04	2592	0.92	0.04	0.07	0.96	24.16	-0.83	0.98
Yellowknife_Aurora	-114.38	62.45	2150	0.51	0.08	0.20	1.20	45.38	22.60	0.81

Yonsei_University	126.93	37.56	3419	0.78	0.15	0.24	0.84	38.16	-15.56	0.88
Yuma	-114.58	32.64	1831	0.49	0.05	0.06	1.68	59.30	54.42	0.94
Zaragoza	-0.88	41.63	2693	0.74	0.04	0.06	0.98	37.00	5.35	0.97
Zinder_Airport	8.99	13.78	4873	0.68	0.17	0.24	0.96	37.89	7.55	0.86
Zvenigorod	36.78	55.70	2448	0.87	0.03	0.05	0.97	23.49	-0.83	0.98

Table S5. Location information from the 37 CARSNET sites in China and results for the statistical comparison with three-hourly MERRA-2 AOD. R is (Pearson) correlation coefficient, MAE is the mean absolute error, RMSE is the root-mean-square error of the differences, RMB is the relative mean bias, MFE is the mean fractional error, FGE is the fractional gross error and IOA is the index of agreement.

Site names	Lat.	Lon.	Number of collocations	R	MAE	RMSE	RMB	MFE	MFB	IOA
Akedala	87.97	47.12	2205	0.56	0.06	0.13	0.95	37.00	5.19	0.89
Beijing	116.47	39.8	4930	0.69	0.27	0.41	0.60	53.90	-47.68	0.73
Changde	111.7	29.17	676	0.76	0.16	0.22	1.14	31.81	15.96	0.89
Chengdu	104.03	30.65	723	0.64	0.33	0.42	0.65	45.21	-40.41	0.66
Dalian	121.63	38.9	2564	0.81	0.14	0.22	0.84	34.32	-18.47	0.90
Datong	113.33	40.1	6859	0.66	0.24	0.31	0.46	79.44	-76.38	0.72
Dongsheng	109.98	39.83	615	0.73	0.18	0.26	0.65	56.57	-47.25	0.83
Dongtan	121.96	31.52	760	0.68	0.17	0.24	1.11	34.07	12.56	0.87
Dunhuang	94.68	40.15	7304	0.60	0.13	0.24	0.75	40.88	-13.92	0.81
Ejina	101.07	41.95	6767	0.65	0.09	0.17	0.90	33.89	1.37	0.87
Gucheng	115.8	39.13	2075	0.77	0.21	0.31	0.69	44.75	-37.70	0.83
Hami	93.52	42.82	2186	0.61	0.10	0.17	0.85	40.55	-3.92	0.87
Hotan	79.93	37.13	1911	0.68	0.26	0.39	0.59	55.45	-50.70	0.71
Huimin	117.53	37.48	2427	0.73	0.17	0.24	0.91	33.84	-12.94	0.89
Jiuquan	98.48	39.77	1276	0.59	0.12	0.23	0.72	38.54	-23.38	0.79
Lhasa	91.13	29.67	2351	0.51	0.05	0.06	0.54	71.02	-64.99	0.94
Linan	119.73	30.3	2987	0.71	0.17	0.24	0.81	33.54	-21.12	0.87
Minqin	103.08	38.63	3696	0.59	0.17	0.26	0.63	48.59	-35.60	0.77
Mt.Gaolan	103.85	36	2278	0.50	0.21	0.30	0.56	60.04	-52.00	0.69
Mt.Longfengshan	127.6	44.73	4325	0.71	0.12	0.19	0.77	43.62	-26.31	0.89
Mt.Tai	117.1	36.25	450	0.61	0.32	0.41	2.18	86.93	83.22	0.63

Nanning	108.35	22.82	1670	0.78	0.15	0.21	0.85	30.47	-17.72	0.90
Shangdianzi	117.12	40.65	6111	0.80	0.16	0.26	0.65	49.09	-37.57	0.86
Shangrila	99.73	28.02	1518	0.58	0.04	0.05	0.84	58.53	-24.62	0.96
Tazhong	83.67	39	6006	0.62	0.22	0.34	0.69	43.58	-26.18	0.76
Tianjin	117.17	39.1	4399	0.75	0.20	0.31	0.82	36.80	-22.31	0.85
Waliguan	100.92	36.28	1211	0.63	0.06	0.09	0.95	43.52	4.12	0.94
Wulate	108.52	41.57	1889	0.71	0.11	0.17	0.65	54.76	-46.46	0.88
Xi’an	108.97	34.43	1755	0.66	0.40	0.47	0.52	69.22	-67.98	0.55
Xilinhot	116.12	43.95	6773	0.67	0.11	0.19	0.60	58.06	-49.74	0.85
Yan’an	109.5	36.6	646	0.75	0.17	0.22	0.51	69.43	-67.76	0.81
Yinchuan	106.22	38.48	811	0.59	0.25	0.34	0.45	76.30	-75.02	0.61
Yulin	109.2	38.43	1266	0.73	0.13	0.19	0.67	47.13	-38.13	0.87
Yushe	112.98	37.07	3283	0.74	0.22	0.32	0.58	57.22	-53.04	0.77
Zhangbei	114.7	41.15	669	0.78	0.15	0.19	0.48	77.81	-76.42	0.83
Zhengzhou	113.68	34.78	2675	0.73	0.26	0.36	0.71	41.40	-34.40	0.78
Zhurihe	112.9	42.4	1135	0.78	0.09	0.14	0.74	48.28	-31.55	0.92