

Supplementary Information for

Estimating the 1-km PM_{2.5} concentrations across China using the space-time random forest approach

Contents of this file

Figure S1

Tables S1-S7

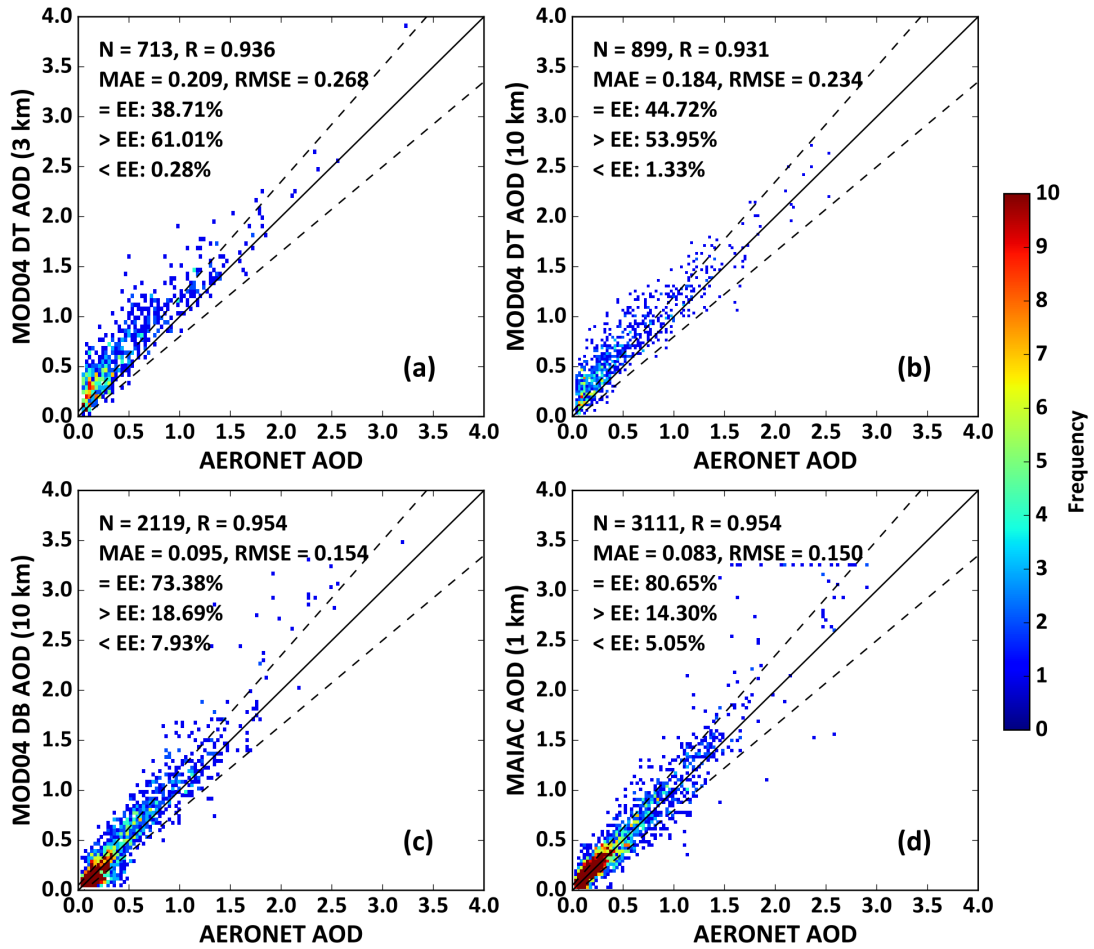


Figure S1. Validation of operational MODIS AOD products at different spatial resolutions against AERONET AOD measurements from 2015 to 2016 in China. The dotted lines represent EE lines and the solid black line represents the 1:1 line.

Table S1. Land cover types description for the Legend in Figure 1.

Class	Description	Class	Description
0	Water	9	Savannas
1	Evergreen Needleleaf forest	10	Grasslands
2	Evergreen Broadleaf forest	11	Permanent wetlands
3	Deciduous Needleleaf forest	12	Croplands
4	Deciduous Broadleaf forest	13	Urban and built-up
5	Mixed forest	14	Cropland/Natural vegetation mosaic
6	Closed shrublands	15	Snow and ice
7	Open shrublands	16	Barren or sparsely vegetated
8	Woody savannas	255	Unclassified

Table S2. Summary of detail information of used AERONET sites over China

AERONET site	Longitude (°)	Latitude (°)	Elevation (m)	Time range
AOE_Baotou	109.629	40.852	1270	2013-2017
Beijing	116.381	39.977	92	2001-2017
Beijing_PKU	116.310	39.992	53	2016-2017
Beijing_RADI	116.379	40.005	59	2010-2017
Beijing-CAMS	116.317	39.933	106	2012-2017
Hong_Kong_PolyU	114.180	22.303	30	2005-2017
Hong_Kong_Sheung	114.117	22.483	40	2012-2016
Lingshan_Mountain	115.496	40.054	1653	2014-2015
NAM_CO	90.962	30.773	4740	1997-2016
QOMS_CAS	86.948	28.365	4276	2009-2017
SONET_Harbin	126.614	45.705	187	2016-2016
SONET_Hefei	117.162	31.905	36	2016-2016
SONET_Nanjing	118.957	32.115	52	2016-2016
SONET_Shanghai	121.481	31.284	84	2016-2016
SONET_Xingtai	114.360	37.182	185	2016-2016
SONET_Zhoushan	122.188	29.994	29	2016-2016
Taihu	120.215	31.421	20	2005-2017
XiangHe	116.962	39.754	36	2001-2017
Xinglong	117.578	40.396	970	2006-2015
XuZhou-CUMT	117.142	34.217	59	2013-2017

Table S3. Linear relationships between Terra and Aqua MAIAC AOD products in China.

Month	$AOD_{Terra} = a * AOD_{Aqua} + b$		$AOD_{Aqua} = a * AOD_{Terra} + b$			
	a	b	a	b	R ²	N
January	0.9563	0.0377	0.8771	0.0117	0.839	16382
February	0.8885	0.0570	0.8659	0.0298	0.769	15414
March	0.9433	0.0206	0.9312	0.0362	0.878	16383
April	0.9168	0.0246	0.8630	0.0452	0.791	13265
May	0.8440	0.0371	0.8703	0.0406	0.735	12475
June	0.7909	0.0481	0.8662	0.0527	0.685	7452
July	0.8430	0.0389	0.8993	0.0428	0.758	8886
August	0.8278	0.0327	0.9086	0.0326	0.752	9806
September	0.8992	0.0216	0.9587	0.0272	0.862	11602
October	0.9151	0.0234	0.9506	0.0154	0.870	18173
November	0.8401	0.0509	0.9116	0.0222	0.766	14185
December	0.9012	0.0456	0.9115	0.0206	0.822	18071

Table S4. Summary of the data sources used in this study.

Product	Content	Unit	Spatial Resolution	Temporal Resolution
PM _{2.5}	PM _{2.5}	ug/m ³	-	Hourly
MCD19A2	MAIAC AOD at 550 nm	-	1 km × 1 km	Daily
MOD13A3	NDVI	-	1 km × 1 km	Monthly
MCD12Q1	Land use cover	-	500 m × 500 m	Annually
VIIRS	Night light	-	500 m × 500 m	Annually
SRTM	Elevation	m	90 m × 90 m	-
ERA-Interim	2m air temperature	K	0.125°×0.125°	6-hour
	Surface pressure	hPa	0.125°×0.125°	6-hour
	10m U wind component	m/s	0.125°×0.125°	6-hour
	10m V wind component	m/s	0.125°×0.125°	6-hour
	Boundary layer height	m	0.125°×0.125°	3-hour
	Total precipitation	mm	0.125°×0.125°	3-hour
	Evaporation	mm	0.125°×0.125°	3-hour
	Relative humidity	%	0.125°×0.125°	3-hour

Table S5. Correlation analysis among all the variables.

R	PM _{2.5}	AOD	DEM	NDVI	LUC	NTL	TEM	PRE	ET	RH	SP	BLH	WS	WD
PM _{2.5}	1	.473	-.155	-.247	.151	-.024	-.221	-.112	.271	.032	.168	-.326	-.155	.007
AOD	**	1	-.271	.070	.054	-.063	.176	.056	-.081	.273	.269	-.129	-.136	-.166
DEM	**	**	1	-.183	.006	.019	-.307	0	.335	-.040	-.964	.012	-.121	.147
NDVI	**	**	**	1	-.276	-.278	.636	.187	-.619	.467	.124	.066	-.144	-.245
LUC	**	**	*	-.276	1	.155	-.077	-.062	.119	-.183	0.005	.084	-.010	.097
NTL	**	**	**	-.278	.155	1	-.043	-.019	.065	-.098	-.022	.059	.074	.077
TEM	**	**	**	**	**	**	1	.173	-.776	.330	.239	.339	-.008	-.253
PRE	**	**		**	**	**	**	1	-.189	.280	-.027	-.064	-.029	-.011
ET	**	**	**	**	**	**	**	**	1	-.339	-.306	-.259	-.081	.205
RH	**	**	**	**	**	**	**	**	**	1	.014	-.414	-.252	-.248
SP	**	**	**	**		**	**	**	**	**	1	-.034	.163	-.149
BLH	**	**	**	**	**	**	**	**	**	**	**	1	.276	.170
WS	**	**	**	**	**	**	**	**	**	**	**	**	1	.079
WD	**	**	**	**	**	**	**	**	**	**	**	**	**	1

** significant confidence at 0.01 level (bilateral). * significant confidence at 0.05 level (bilateral).

Table S6. Collinearity analysis among all independent variables.

Variable	AOD	DEM	NDVI	LUC	NTL	TEM	PRE
Tolerance	0.78	0.06	0.40	0.85	0.87	0.26	0.90
VIF	1.29	17.84	2.50	1.17	1.15	3.87	1.11
Variable	ET	RH	SP	BLH	WS	WD	
Tolerance	0.30	0.44	0.05	0.46	0.80	0.82	
VIF	3.35	2.26	21.25	2.19	1.25	1.23	

Table S7. Descriptive statistics of all variables used to fit the PM_{2.5}-estimation models for each season in China

Season		PM _{2.5} (µg/m ³)	AOD	NDVI	NTL	TEM (k)	PRE (mm)	ET (mm)	RH (%)	SP (kPa)	BLH (km)	WS (m/s)	WD (°)
Spring N=39255	Min	2.29	0.03	0.05	0.00	253.94	0.00	-12.17	3.82	55.28	0.018	0.21	3.52
	Max	578.83	3.72	0.91	94.30	305.01	62.52	0.65	99.01	103.50	3.65	13.60	358.08
	Mean	48.72	0.43	0.29	24.07	288.10	0.41	-2.04	45.76	94.43	1.31	3.69	202.38
	Std.	34.05	0.35	0.14	16.12	7.34	2.14	1.38	17.34	8.63	0.50	1.71	79.73
Summer N=32203	Min	1.43	0.04	0.00	0.00	274.13	0.00	-14.15	9.52	55.79	0.018	0.17	1.64
	Max	401.00	3.60	0.89	94.30	309.14	106.44	0.35	99.66	101.80	3.84	13.63	359.00
	Mean	29.28	0.37	0.46	23.43	299.65	1.21	-3.71	58.36	93.80	1.31	2.96	185.26
	Std.	17.30	0.29	0.14	16.04	5.11	3.21	1.64	14.75	8.13	0.46	1.48	80.75
Autumn N=38900	Min	1.00	0.03	0.02	0.00	256.43	0.00	-13.06	12.59	55.55	0.026	0.12	0.82
	Max	369.67	3.17	0.88	94.30	305.97	39.73	0.00	99.62	104.14	3.45	13.24	358.80
	Mean	49.82	0.38	0.36	23.73	287.49	0.33	-1.94	58.63	93.68	0.92	3.04	185.74
	Std.	36.79	0.31	0.14	16.07	9.52	1.41	1.34	14.16	9.81	0.40	1.52	90.27
Winter N=43290	Min	2.22	0.02	0.00	0.00	247.07	0.00	-12.34	1.94	54.84	0.024	0.29	1.90
	Max	596.00	3.00	0.79	94.30	298.65	23.45	0.08	99.55	104.26	3.00	13.46	358.49
	Mean	69.50	0.39	0.26	22.60	277.15	0.08	-0.99	50.49	94.93	0.75	2.96	201.98
	Std.	52.03	0.27	0.13	14.50	8.17	0.59	0.86	17.20	10.21	0.33	1.48	98.20