Supporting Information for

Himawari-8-derived diurnal variations of ground-level $PM_{2.5}$ pollution across China using a fast space-time Light Gradient Boosting Machine

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Contents of this file

Table S1. Summary of data sources used in this study.

Dataset	Variable	Content	Unit	Spatial Resolution	Temporal Resolution	Data source
$PM_{2.5}$	$PM_{2.5}$	$PM_{2.5}$	$\mu g/m^3$	In situ	Hourly	CNEMC
AOD	AOD	Himawari-8 AOD	-	5 km × 5 km	Hourly	Himawari-8
Meteorology	ET	Total evaporation	mm	0.1°×0.1°	Hourly	ERA5
	SP	Surface pressure	hPa	0.1°×0.1°		
	TEM	2-m temperature	K	0.1°×0.1°		
	WU	10-m u-component of wind	m/s	0.1°×0.1°		
	WV	10-m v-component of wind	m/s	0.1°×0.1°		
	BLH	Boundary layer height	m	0.25°×0.25°		
	RH	Relative humidity	%	0.25°×0.25°		
Emission	NH_3	Ammonia	Mg/grid	0.25°×0.25°	Monthly	MEIC
	NO_x	Nitrogen oxide	Mg/grid			
	SO_2	Sulfur dioxide	Mg/grid			
	VOC	Volatile organic compounds	Mg/grid			
	PM	PMcoarse	Mg/grid			
Land cover	NDVI	NDVI	-	0.05°×0.05°	Monthly	MOD13C2
Topography	DEM	Surface elevation	m	90 m × 90 m	-	SRTM
Population	POP	Ambient population	-	1 km × 1 km	Yearly	LandScan™

Table S2. Annual and seasonal mean $PM_{2.5}$ concentrations ($\mu g/m^3$) in 2018 in China, eastern China (ECHN), the Beijing-Tianjin-Hebei (BTH) region, the Yangtze River Delta (YRD) region, and the Pearl River Delta (PRD) region.

Time	China	ECHN	BTH	YRD	PRD
Annual	28.99±10.31	32.56±10.78	39.32±11.74	38.64±8.27	32.98±4.53
Spring	32.84±11.49	34.93±10.95	45.75±12.96	40.35±9.55	33.97±4.50
Summer	22.86±7.05	24.16±6.29	29.99±7.46	26.16±4.58	23.56±3.18
Autumn	23.76±10.97	28.64±11.60	35.98±11.20	35.97±7.80	29.54±4.43
Winter	39.04±16.32	48.34±17.47	48.36±18.92	57.41±16.88	43.92±8.56

Table S3. Comparison in model performance with previous studies in hourly $PM_{2.5}$ estimations from the Himawari-8 data in China (N = 162,840).

Model	Out-of-sample validation			Out-of-station validation		
	CV-R^2	RMSE	MAE	CV-R^2	RMSE	MAE
MLR	0.19	24.17	22.89	0.19	24.19	22.91
GWR	0.39	21.96	20.74	0.37	22.42	21.02
GAM	0.39	19.09	18.64	0.36	19.77	18.89
LME	0.50	18.91	17.34	0.48	19.06	17.95
Two-stage	0.58	17.60	15.71	0.54	17.99	16.01
STLG	0.85	13.09	8.11	0.81	14.63	9.29

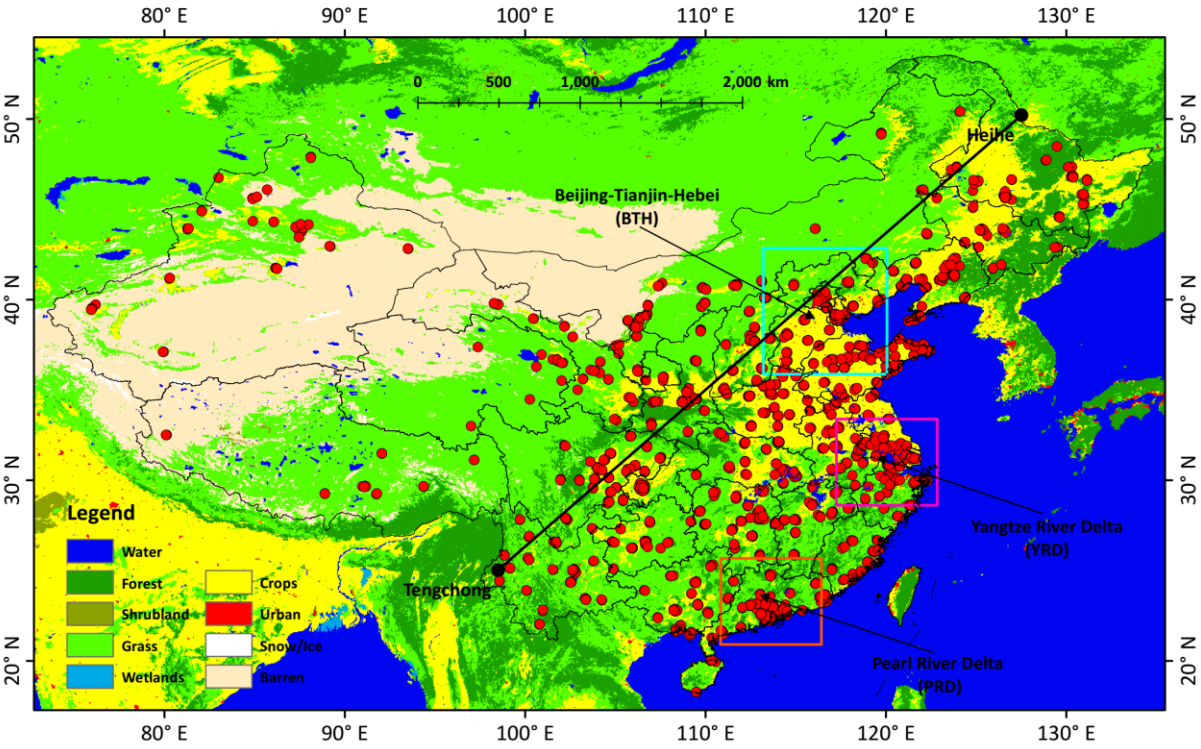

Figure S1. Spatial distribution of ground-based $PM_{2.5}$ monitoring stations in 2018 across China.

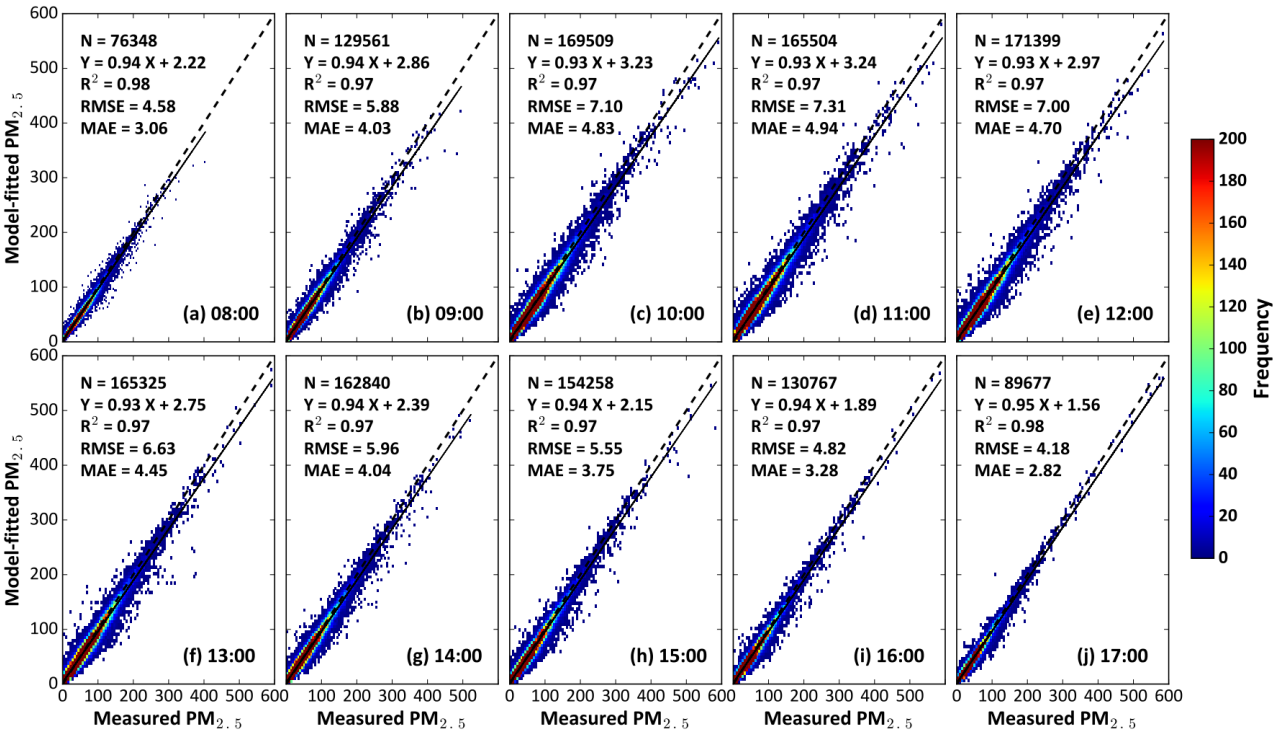

Figure S2. Density scatterplots of model-fitted hourly $PM_{2.5}$ concentrations for each hour from 08:00 to 17:00 local time in 2018 across China. Dashed lines denote 1:1 lines, and solid lines denote best-fit lines from linear regression.

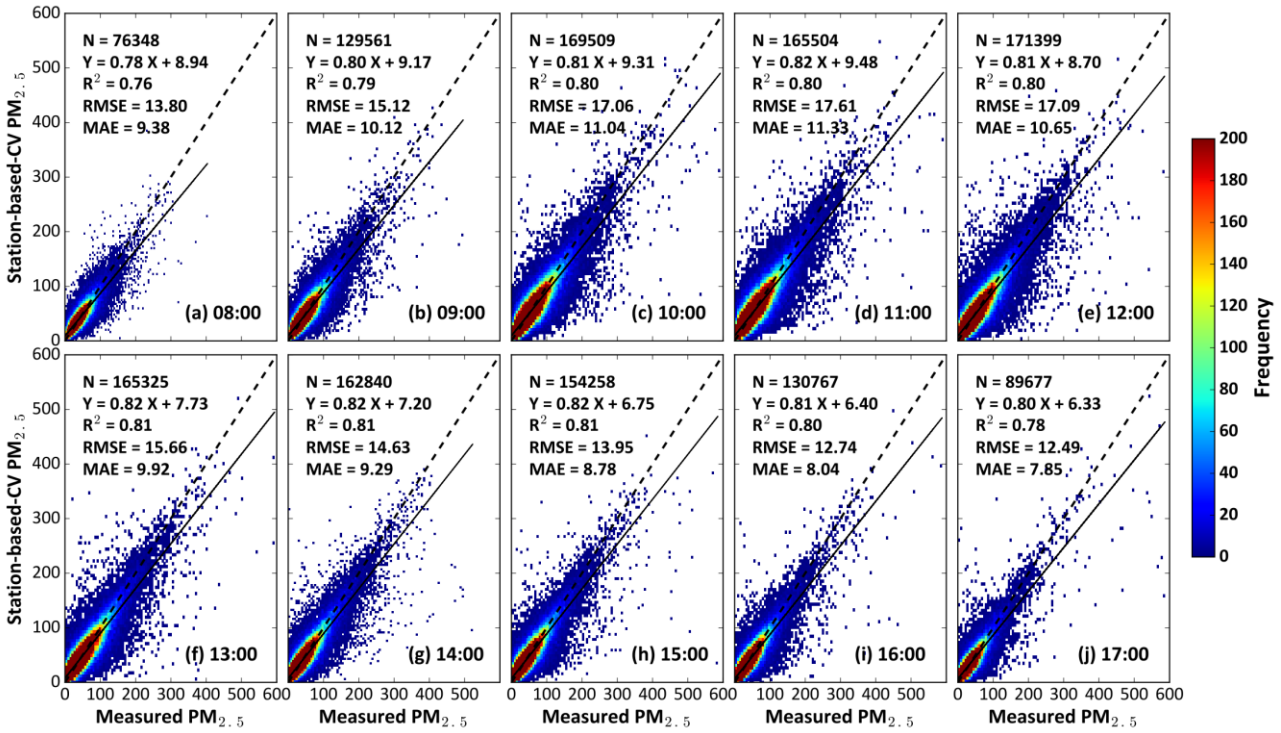

Figure S3. Density scatterplots of out-of-station cross-validation results of estimated hourly $PM_{2.5}$ concentrations ($\mu g/m^3$) for each hour from 08:00 to 17:00 local time in 2018 across China. Dashed and solid lines denote 1:1 and best-fit lines from linear regression.

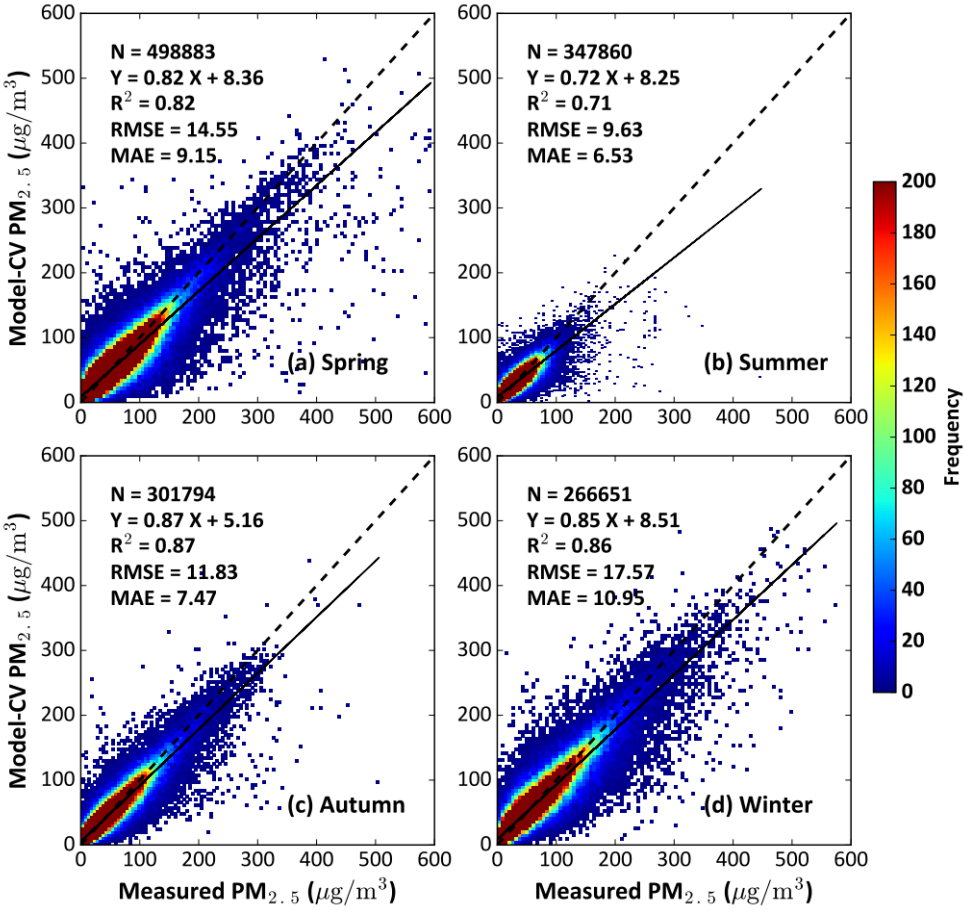

Figure S4. Density scatter plots of validation results of hourly $PM_{2.5}$ estimates for the four seasons in 2018 across China. Dashed and solid lines denote 1:1 and best-fit lines from linear regression.