

## Supplementary Information

Table S1 The regression and coefficient for calibrated PM<sub>2.5</sub> at 16 AQMS in Big Taipei city for 2014

City	AQMS with FEM	Regression model	Coefficient of determination ( $R^2$ )	AQMS with FRM	Distance (km)
Taipei City	Shi-lin (SL)	$y = 0.90x - 3.84$	0.95	Shi-lin (SL)	0
	Wan-hua (WH)	$y = 1.01x - 5.43$	0.95	Wan-hua (WH)	0
	Song-shan (SS)	$y = 0.93x - 5.49$	0.94	Xi-zhi (XZ)	6.7
	Zhong-shan (ZS)	$y = 0.96x - 11.39$	0.91	Wan-hua (WH)	2.6
	Gu-ting (GT)	$y = 1.04x - 4.62$	0.93	Wan-hua (WH)	3.6
	Da-tong (DT)	$y = 0.90x - 7.33$	0.91	Wan-hua (WH)	1.9
New Taipei City	Xi-zhi (XZ)	$y = 0.85x - 0.20$	0.97	Xi-zhi (XZ)	0
	Ban-qiao (BQ)	$y = 0.84x + 0.29$	0.97	Ban-qiao (BQ)	0
	Tu-cheng (TC)	$y = 0.87x - 1.44$	0.95	Ban-qiao (BQ)	3.4
	Xin-zhuang (XZ)	$y = 0.99x - 5.42$	0.93	Ban-qiao (BQ)	3.8
	Lin-kou (LK)	$y = 0.92x - 1.48$	0.83	Taoyuan	10.8
	Tam-sui (TS)	$y = 0.91x - 4.77$	0.92	Shi-lin (SL)	8.4
	Xin-dian (XD)	$y = 0.91x + 2.61$	0.87	Wan-hua (WH)	8.2
	Cai-liao (CL)	$y = 0.91x - 6.90$	0.92	Wan-hua (WH)	3.7
	San-chong (SC)	$y = 0.93x - 11.96$	0.86	Wan-hua (WH)	3.2
	Yong-he (YH)	$y = 0.94x - 3.72$	0.97	Wan-hua (WH)	3.4

y: FRM-like PM<sub>2.5</sub>, x: FEM PM<sub>2.5</sub>

Table S2 The regression and coefficient for calibrated PM<sub>2.5</sub> at 16 AQMS in Big Taipei city for 2015

City	AQMS FEM	Regression model	Coefficient of determination ( $R^2$ )	AQMS with FRM	Distance (km)
Taipei City	Shi-lin (SL)	$y = 0.89x - 3.52$	0.94	Shi-lin (SL)	0
	Wan-hua (WH)	$y = 0.98x - 3.79$	0.94	Wan-hua (WH)	0
	Song-shan (SS)	$y = 0.94x - 4.41$	0.93	Xi-zhi (XZ)	6.7
	Zhong-shan (ZS)	$y = 0.94x - 10.16$	0.93	Wan-hua (WH)	2.6
	Gu-ting (GT)	$y = 0.87x + 0.31$	0.93	Wan-hua (WH)	3.6
	Da-tong (DT)	$y = 0.91x - 5.82$	0.91	Wan-hua (WH)	1.9
New Taipei City	Xi-zhi (XZ)	$y = 0.85x - 0.41$	0.93	Xi-zhi (XZ)	0
	Ban-qiao (BQ)	$y = 0.89x - 0.55$	0.97	Ban-qiao (BQ)	0
	Tu-cheng (TC)	$y = 0.85x - 3.27$	0.94	Ban-qiao (BQ)	3.4
	Xin-zhuang (XZ)	$y = 0.82x - 1.70$	0.92	Ban-qiao (BQ)	3.8
	Lin-kou (LK)	$y = 0.84x + 0.17$	0.90	Taoyuan	10.8
	Tam-sui (TS)	$y = 0.82x + 1.15$	0.85	Shi-lin (SL)	8.4
	Xin-dian (XD)	$y = 0.90x + 2.30$	0.91	Wan-hua (WH)	8.2
	Cai-liao (CL)	$y = 0.70x - 1.32$	0.84	Wan-hua (WH)	3.7
	San-chong (SC)	$y = 0.89x - 7.44$	0.91	Wan-hua (WH)	3.2
Yong-he (YH)	$y = 0.91x - 1.99$	0.96	Wan-hua (WH)	3.4	

y: FRM-like PM<sub>2.5</sub>, x: FEM PM<sub>2.5</sub>

Table S3 The regression and coefficient for calibrated PM<sub>2.5</sub> at 16 AQMS in Big Taipei city for 2016

City	AQMS FEM	Regression model	Coefficient of determination ( $R^2$ )	AQMS with FRM	Distance (km)
Taipei City	Shi-lin (SL)	$y = 0.87x - 3.16$	0.94	Shi-lin (SL)	0
	Wan-hua (WH)	$y = 0.99x - 4.48$	0.94	Wan-hua (WH)	0
	Song-shan (SS)	$y = 0.93x - 3.22$	0.96	Xi-zhi (XZ)	6.7
	Zhong-shan (ZS)	$y = 0.83x - 7.17$	0.93	Wan-hua (WH)	2.6
	Gu-ting (GT)	$y = 0.91x + 1.36$	0.91	Wan-hua (WH)	3.6
	Da-tong (DT)	$y = 0.95x - 7.15$	0.93	Wan-hua (WH)	1.9
New Taipei City	Xi-zhi (XZ)	$y = 0.89x + 0.55$	0.94	Xi-zhi (XZ)	0
	Ban-qiao (BQ)	$y = 0.85x - 0.01$	0.94	Ban-qiao (BQ)	0
	Tu-cheng (TC)	$y = 0.90x - 1.69$	0.96	Ban-qiao (BQ)	3.4
	Xin-zhuang (XZ)	$y = 0.84x - 2.03$	0.91	Ban-qiao (BQ)	3.8
	Lin-kou (LK)	$y = 0.97x - 2.79$	0.89	Taoyuan	10.8
	Tam-sui (TS)	$y = 0.91x - 3.53$	0.93	Shi-lin (SL)	8.4
	Xin-dian (XD)	$y = 0.99x + 1.29$	0.92	Wan-hua (WH)	8.2
	Cai-liao (CL)	$y = 0.85x - 1.04$	0.93	Wan-hua (WH)	3.7
	San-chong (SC)	$y = 0.92x - 8.82$	0.92	Wan-hua (WH)	3.2
	Yong-he (YH)	$y = 0.97x - 1.36$	0.95	Wan-hua (WH)	3.4

y: FRM-like PM<sub>2.5</sub>, x: FEM PM<sub>2.5</sub>

Table S4 The regression and coefficient for calibrated PM<sub>2.5</sub> at 16 AQMS in Big Taipei city for 2017

City	AQMS FEM	Regression model	Coefficient of determination ( $R^2$ )	AQMS with FRM	Distance (km)
Taipei City	Shi-lin (SL)	$y = 0.97x - 5.39$	0.95	Shi-lin (SL)	0
	Wan-hua (WH)	$y = 1.00x - 4.87$	0.94	Wan-hua (WH)	0
	Song-shan (SS)	$y = 0.94x - 4.17$	0.94	Xi-zhi (XZ)	6.7
	Zhong-shan (ZS)	$y = 0.88x - 8.46$	0.94	Wan-hua (WH)	2.6
	Gu-ting (GT)	$y = 0.90x + 0.50$	0.94	Wan-hua (WH)	3.6
	Da-tong (DT)	$y = 0.85x - 2.91$	0.83	Wan-hua (WH)	1.9
New Taipei City	Xi-zhi (XZ)	$y = 0.90x - 2.33$	0.96	Xi-zhi (XZ)	0
	Ban-qiao(BQ)	$y = 0.89x + 0.53$	0.96	Ban-qiao (BQ)	0
	Tu-cheng (TC)	$y = 0.93x - 1.84$	0.93	Ban-qiao (BQ)	3.4
	Xin-zhuang (XZ)	$y = 0.86x + 0.82$	0.92	Ban-qiao (BQ)	3.8
	Lin-kou (LK)	$y = 0.84x - 2.44$	0.91	Taoyuan	10.8
	Tam-sui (TS)	$y = 0.83x - 1.77$	0.88	Shi-lin (SL)	8.4
	Xin-dian (XD)	$y = 0.98x + 0.27$	0.88	Wan-hua (WH)	8.2
	Cai-liao (CL)	$y = 0.82x - 0.21$	0.93	Wan-hua (WH)	3.7
	San-chong (SC)	$y = 0.92x - 7.96$	0.91	Wan-hua (WH)	3.2
	Yong-he (YH)	$y = 0.95x - 2.01$	0.93	Wan-hua (WH)	3.4

y: FRM-like PM<sub>2.5</sub>, x: FEM PM<sub>2.5</sub>

Table S5. Comparison of daily variations in PM<sub>2.5</sub> concentrations ( $\mu\text{g}/\text{m}^3$ ) between FRM and FEM measurements in 2014-2017

Year	Measure	N	Mean	SD	CV	$\sigma_w^2$	$\sigma_B^2$	$\sigma_{\text{total}}^2$
2014	FRM	591	20.8	11.6	0.568	0.271	0.004	0.275
	FEM from 5 sites	591	25.4	12.5	0.492	0.222	0.001	0.223
	FEM from 16 sites	1,900	27.3	12.7	0.465	0.196	0.027	0.224
2015	FRM	586	19.8	10.6	0.535	0.270	0.003	0.273
	FEM from 5 sites	577	23.8	11.4	0.479	0.236	0.001	0.237
	FEM from 16 sites	1,861	25.1	12.0	0.478	0.227	0.027	0.254
2016	FRM	589	18.4	12.1	0.667	0.392	0.002	0.394
	FEM from 5 sites	583	22.1	12.8	0.579	0.361	0.006	0.367
	FEM from 16 sites	1,877	23.0	13.1	0.570	0.307	0.03	0.337
2017	FRM	598	16.0	9.36	0.585	0.323	0.003	0.327
	FEM from 5 sites	596	19.9	9.7	0.487	0.229	0.007	0.236
	FEM from 16 sites	1,917	20.7	10.4	0.502	0.233	0.032	0.265
2014–2017	FRM	2,364	18.7	11.1	0.594	0.325	0.005	0.330
	FEM from 5 sites	2,347	22.8	11.8	0.518	0.272	0.003	0.275
	FEM from 16 sites	7,555	24.0	12.3	0.513	0.256	0.027	0.282

N: number of daily measurements; SD: standard variation; CV: Coefficient of variation; 5 sites: SL, XiZ, BQ, WH, and Taoyuan; 16 sites: all selected AQMSs

Table S6. Within and between daily variations explained by factors in mix-effects models

Model variables	$\sigma_w^2$	$\sigma_B^2$	$\sigma_{Total}^2$	$\sigma_w^2$ (%)	$\sigma_B^2$ (%)	Explained $\sigma_w^2$	Explained $\sigma_B^2$
Null Model	0.246	0.027	0.272	90.2%	9.8%	-	-
Model 1 :	0.201	0.025	0.226	88.9%	11.1%	18.3%	6.6%
Meteorological factors							
Model 2 :	0.133	0.020	0.153	87.2%	12.8%	45.8%	26.8%
Air pollutants factors							
Model 3 :	0.246	0.022	0.267	91.9%	8.1%	0.0%	19.5%
Type of instrument							
Model 4 :	0.122	0.023	0.145	84.4%	15.6%	50.2%	15.3%
All significant factors							

Table S7. Model coefficients for meteorological, air pollutant and sampling site factors associated with annual ambient PM<sub>2.5</sub> with FEM measurements

Variables	univariate		multivariate	
	$\beta$	Exp( $\beta$ ) (S.E.)	$\beta$	Exp( $\beta$ ) (S.E.)
<b>Year</b>				
2014	0.261	1.30 (1.02) **	0.201	1.22 (1.03) **
2015	0.151	1.16 (1.02) **	0.115	1.22 (1.03) **
2016	0.062	1.06 (1.02) **	0.057	1.06 (1.02) **
2017	-	-	-	-
<b>Meteorological factors</b>				
Ambient Temperature	-0.309	0.734 (1.03) **	-0.050	0.95 (1.03)
Ambient Pressure	0.001	1.00 (1.01)	-	-
Relative humidity	-0.009	0.991 (1.01)	-	-
Wind speed	-0.120	0.887 (1.07)	-	-
Rainfall	-0.014	0.986 (1.03)	-	-
<b>Air pollutant factors</b>				
O <sub>3</sub>	-0.013	0.987 (1.01)	-	-
SO <sub>2</sub>	0.285	1.33 (1.04) **	0.07	1.07 (1.04)
<b>Sampling site factors</b>				
Station type				
Traffic	0.115	1.12 (1.09)	-	-
Ambient	-	-	-	-
Height of sampling port				
<13.5m	0.011	1.01 (1.09)	-	-
17.5m	-0.055	0.947 (1.09)	-	-
19.5-21.5m	-	-	-	-
Distance to main road				
1-10m	0.070	1.07 (1.08)	-	-
10-20m	0.061	1.063 (1.08)	-	-
20-100m	-	-	-	-
Type of Instrument				
VEREW F701	0.109	1.11 (1.07)	-	-
MetOne 1020	-	-	-	-

\* $P < 0.05$ , \*\* $p < 0.001$

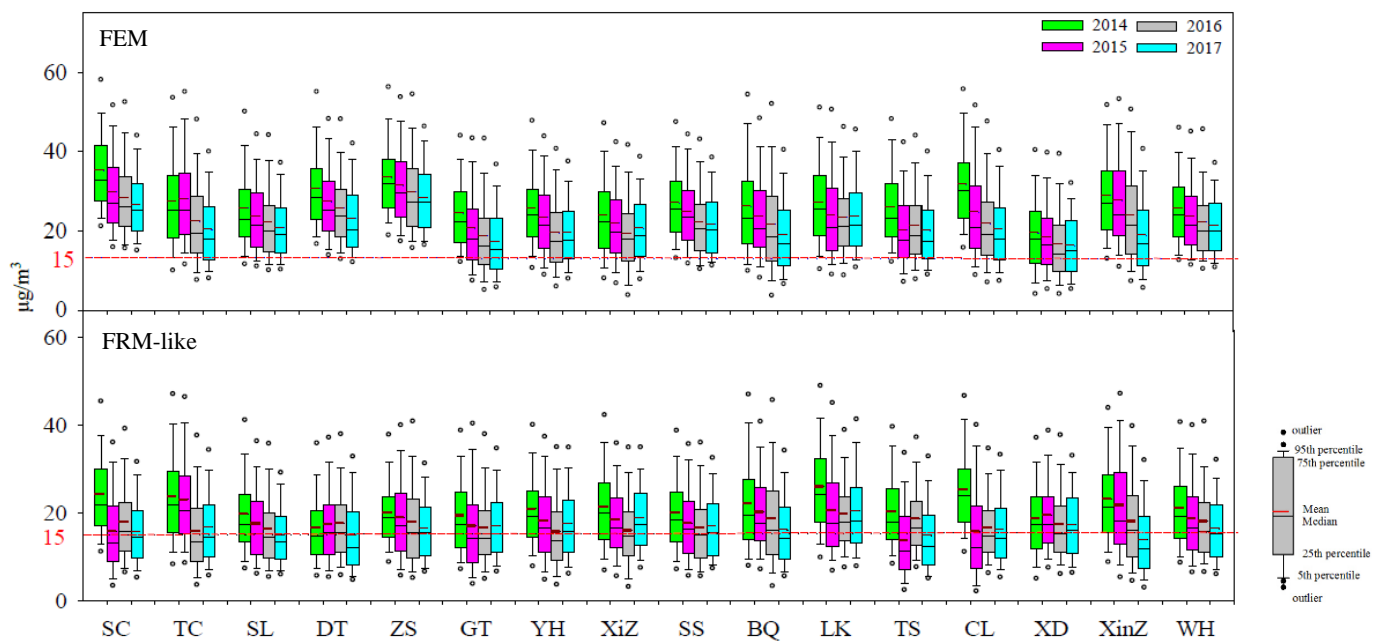


Fig S1 The boxplot of PM<sub>2.5</sub> concentrations for FEM and FRM-like measurements among 16 AQMSs in Big Taipei City for 2014–2017