

Supporting Information for:

Assessing Long-Term Trend of Particulate Matter Pollution in the Pearl River Delta Region Using Satellite Remote Sensing

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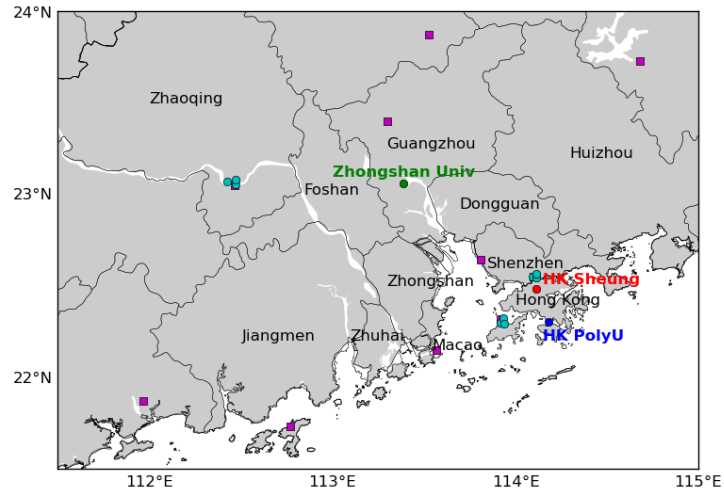


Figure S1. The location map of observation stations in the PRD region, which includes nine major cities in Guangdong province: the capital Guangzhou (GZ), the special economic zones of Shenzhen (SZ) and Zhuhai (ZH), Dongguan (DG), Foshan (FS), Zhongshan (ZS), Zhaoqing (ZQ), Jiangmen (JM) and Huizhou (HZ); and two special administrative regions (SARs): Hong Kong (HK) and Macao (MC). Colored circles (blue, green and red) indicate the locations of the three AERONET stations. The purple squares show the GTS stations in the PRD. The cyan circles show the 9 PM10 stations matched with 3 GTS stations in ZQ, SZ and HK.

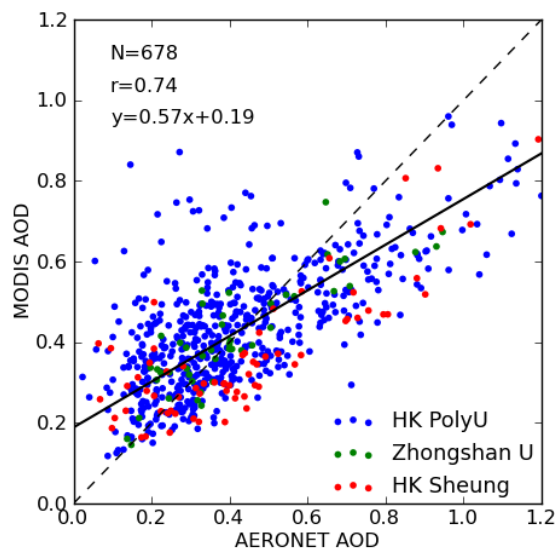


Figure S2. Comparison between MODIS AOD and AERONET level 2.0 AOD in the PRD region from 2001 to 2013. The two sources show good agreement, with $R=0.74$ ($N=678$).

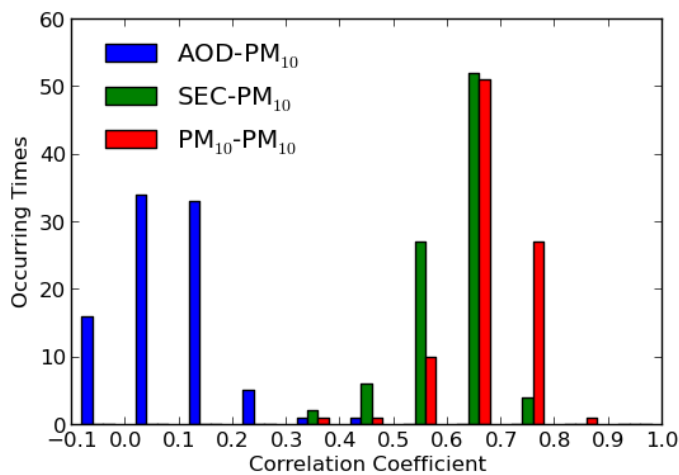
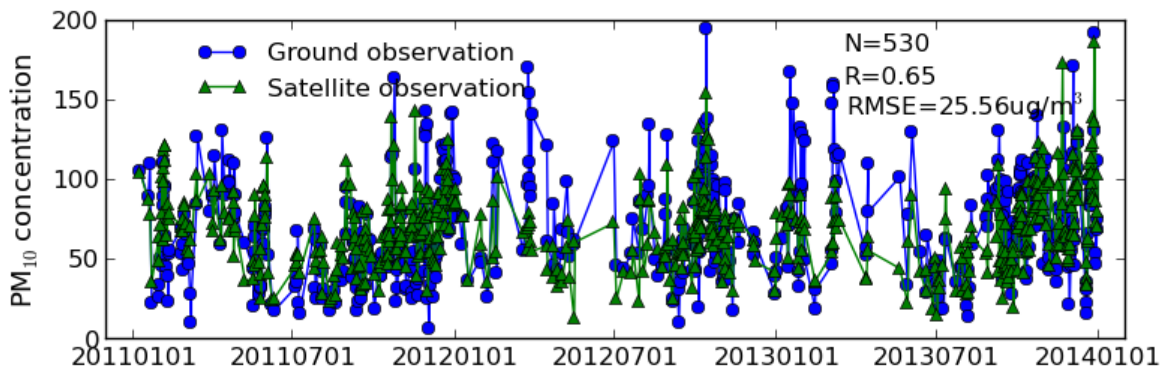
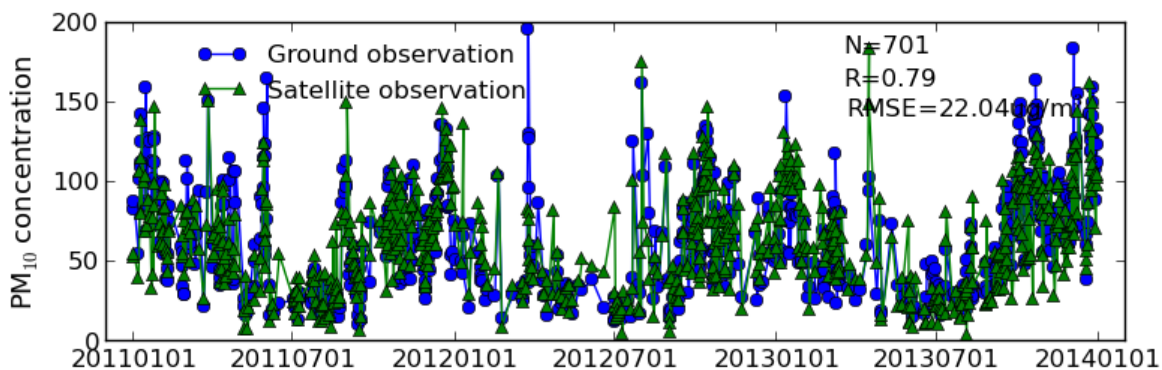


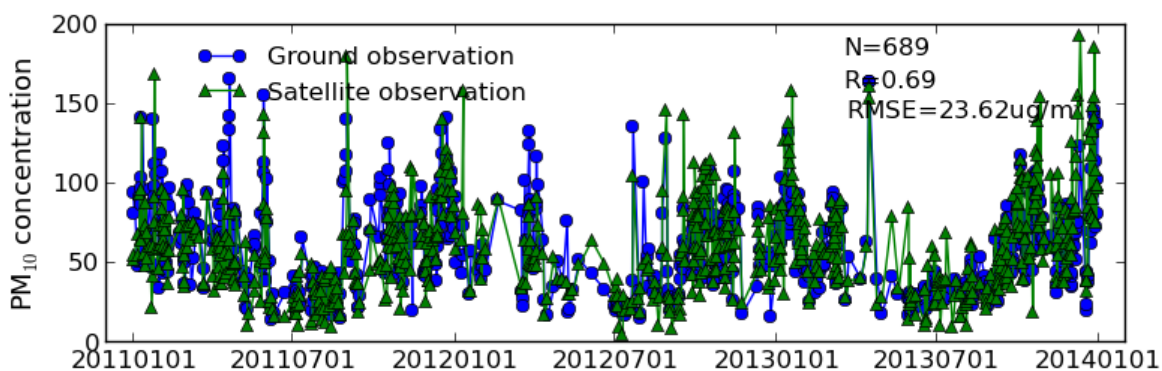
Figure S3. Histogram distribution of temporal correlation coefficients between ground-observed hour-specific PM_{10} and satellite AOD, the satellite-derived surface extinction coefficient and satellite-retrieved PM_{10} from 2011 to 2013.



(a)



(b)



(c)

Figure S4. Daily variation in PM₁₀ at (a) THZY, (b) Yuen Long and (c) Mong Kok from 2011 to 2013. Correlation coefficients of 0.65 (N=530), 0.79 (N=701) and 0.69 (N=689) were derived for the three stations, respectively.

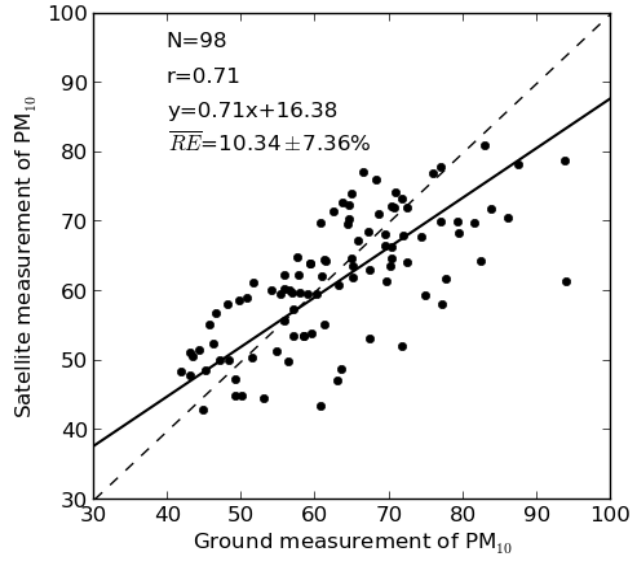


Figure S5. Spatial correlation coefficient between the average satellite-retrieved PM_{10} and average ground-observed PM_{10} ; a good spatial correlation with $R=0.71$ ($N=98$, $p<0.01$) is estimated.

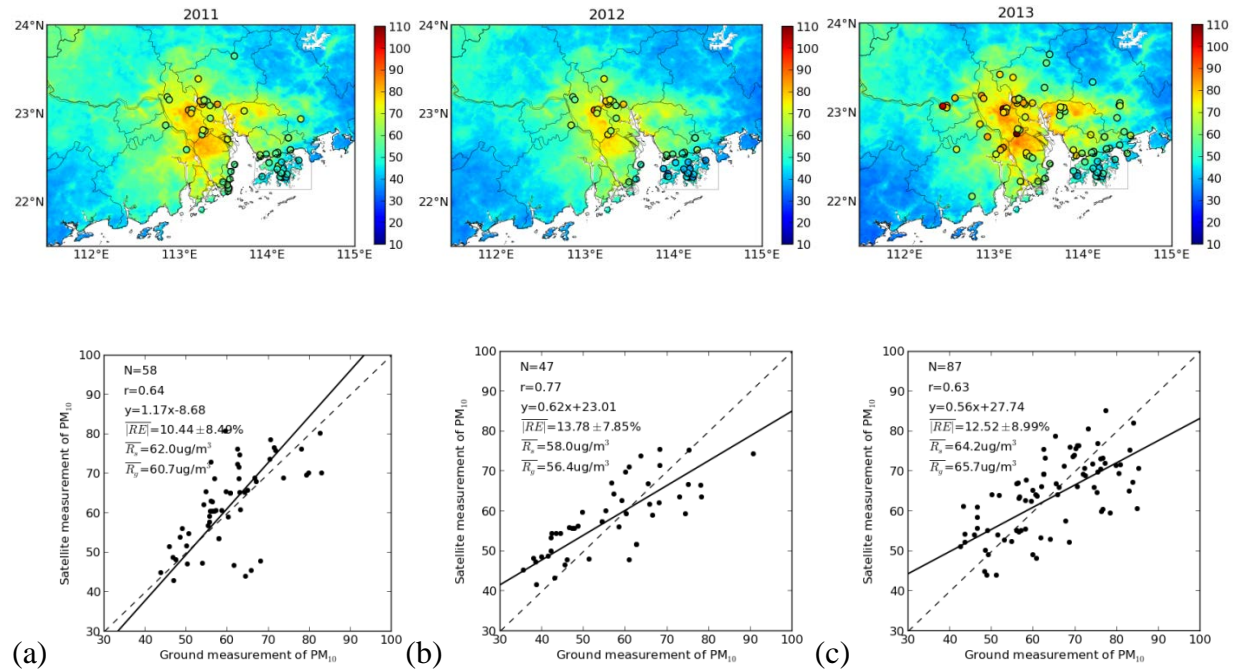
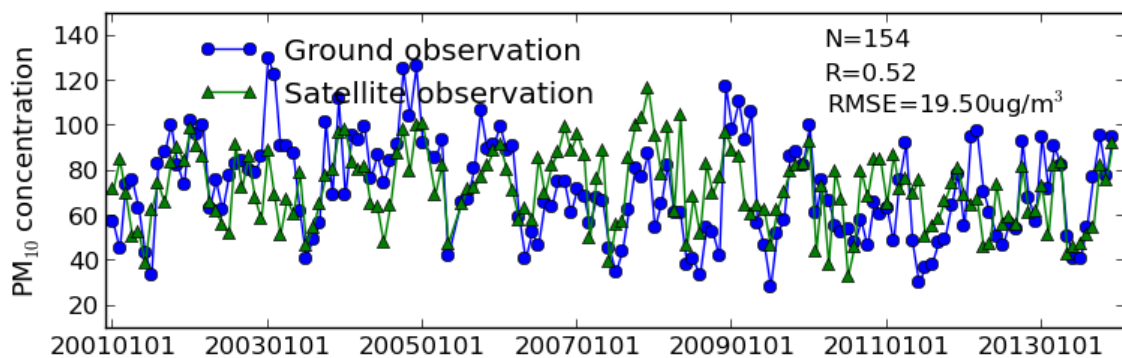
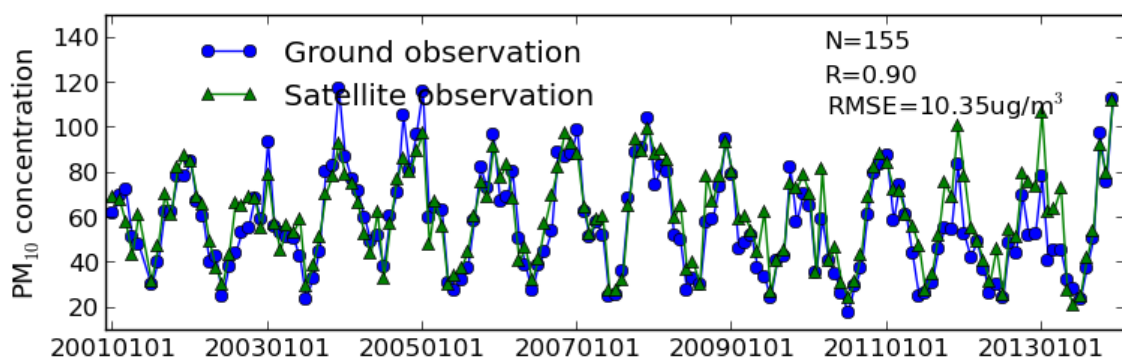


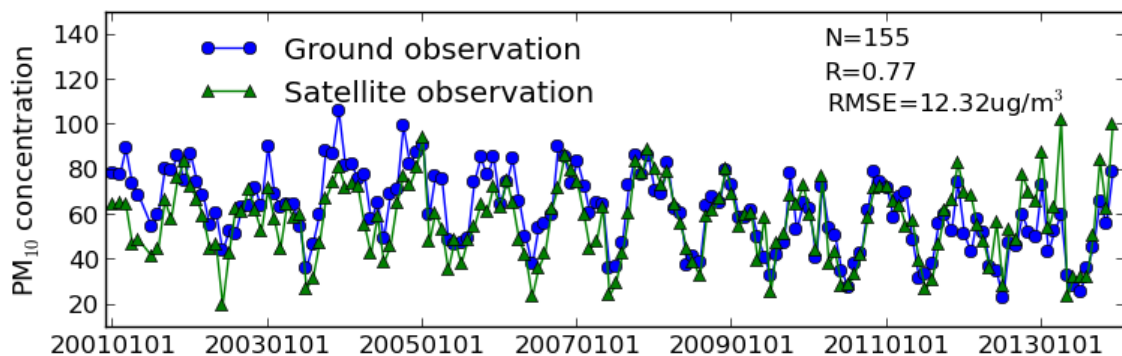
Figure S6. The annual average satellite-retrieved and ground-measured PM_{10} concentrations in (a) 2011, (b) 2012 and (c) 2013, respectively. Figures in top row show the spatial plot, while corresponding figures in the second line show the scatter plot.



(a)



(b)



(c)

Figure S7. Long-term variations in monthly PM₁₀ concentrations at (a) THZY, (b) Yuen Long and (c) Mong Kok from 2001 to 2013. Correlation coefficients of 0.52 (N=154), 0.90 (N=155) and 0.77 (N=155), respectively, were derived for the three stations.

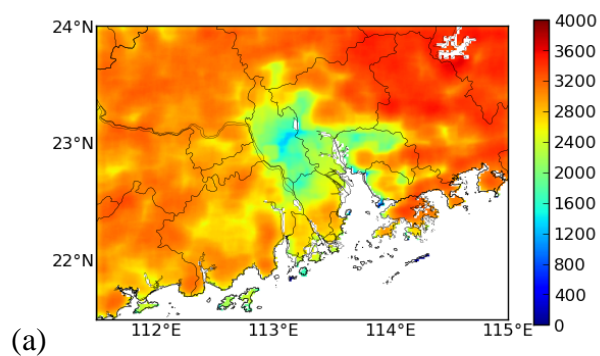


Figure S8. Sample size of Satellite AOD from 2001 to 2013.

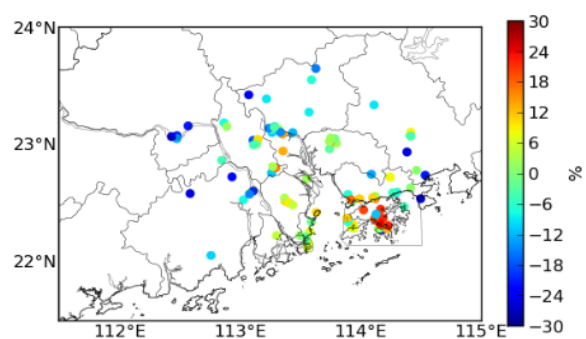


Figure S9. The percentage difference between average of satellite-based PM10 concentration and average of ground-based 24-h PM10 concentration from 2011 to 2013.

Table S1. Spatial means of the annual PM10 concentration in the PRD and different cities in different years. Cities are listed by the spatial means of the 13-year average PM10 values. The highest spatial means are marked in bold.

Yr\city	PRD	ZS	FS	DG	ZH	GZ	SZ	JM	ZQ	HK	HZ
01	54.5±12.2	73.2±7.5	69.7±10.0	68.9±10.6	68.6±6.6	56.1±13.3	58.0±8.8	53.0±10.3	50.6±6.9	50.2±5.2	45.3±7.0
02	53.4±11.3	71.1±7.8	68.5±9.4	66.8±8.7	63.4±5.5	57.1±11.9	56.0±8.2	52.2±9.3	49.3±5.1	49.1±4.7	43.9±5.9
03	53.9±10.9	70.8±5.9	66.8±9.1	69.4±8.3	63.0±5.8	58.2±11.2	58.2±9.1	51.7±9.3	49.1±4.9	48.7±4.6	46.1±6.2
04	60.3±13.8	82.5±8.4	77.2±11.5	77.8±10.1	71.7±6.7	63.7±14.9	64.9±10.6	59.5±11.4	55.1±6.7	54.7±5.2	48.9±7.7
05	58.3±11.5	74.0±6.6	72.6±10.3	74.8±9.1	67.1±5.9	62.0±12.1	61.8±9.5	57.3±9.1	53.3±5.5	51.3±5.9	49.6±6.8
06	59.7±11.6	74.8±7.8	74.7±11.0	76.0±10.2	66.1±6.5	63.7±11.4	62.0±9.5	57.2±9.5	55.4±5.9	51.6±5.9	51.9±7.5
07	64.6±13.0	80.1±9.0	82.6±10.9	81.0±10.5	69.9±7.9	69.8±12.2	64.1±11.2	62.7±11.2	59.3±7.1	50.9±5.6	57.1±9.5
08	61.2±14.0	82.2±8.6	79.1±11.1	78.8±9.8	73.9±8.1	65.3±13.8	65.2±11.8	61.8±11.6	53.6±7.1	52.2±6.4	51.7±9.0
09	55.6±11.6	71.5±7.4	72.0±9.6	68.1±9.5	63.7±6.3	59.2±11.6	55.2±9.4	54.2±9.3	54.3±5.1	46.4±4.9	44.1±6.5
10	54.4±12.1	71.0±7.9	71.8±9.2	67.7±9.7	64.2±7.0	56.7±12.4	55.2±10.4	54.3±9.9	51.3±6.4	45.2±5.7	43.7±6.9
11	56.1±11.0	73.8±6.7	69.8±8.4	67.9±8.2	66.7±6.5	57.0±11.0	57.8±9.3	57.6±8.8	53.2±5.5	48.9±5.5	45.6±6.7
12	51.4±10.0	68.0±7.0	64.7±8.9	62.8±7.4	60.2±5.5	52.4±10.5	54.7±8.1	50.6±7.9	48.7±4.8	47.9±3.8	42.8±5.5
13	54.7±12.1	73.9±8.4	70.0±10.0	71.0±8.9	64.7±6.9	56.6±12.7	61.2±9.5	52.4±9.7	50.1±5.8	51.7±6.2	46.3±8.2
Ave.	56.8±3.6	74.4±4.3	72.3±4.8	71.6±5.3	66.4±3.7	59.8±4.6	59.6±3.7	55.7±3.8	52.6±3.0	49.9±2.5	47.5±4.0

Table S2. Mean annual trends of PM10 concentration in the PRD and different cities during 2001–2007 (T1), 2007–2013 (T2) and 2001–2013 (T0). Cities are ranked by mean trend during T1. The last column η shows the percentage of the area with a decreasing trend during T0 in each city.

Region	T1 ($\mu\text{g}\cdot\text{m}^{-3}\cdot\text{yr}^{-1}$)	T2 ($\mu\text{g}\cdot\text{m}^{-3}\cdot\text{yr}^{-1}$)	T0 ($\mu\text{g}\cdot\text{m}^{-3}\cdot\text{yr}^{-1}$)	η (%)
PRD	1.67 \pm 0.63	-1.74 \pm 0.69	-0.15 \pm 0.23	75.7
DG	2.26 \pm 0.58	-2.06 \pm 0.62	-0.32 \pm 0.32	88.4
GZ	2.01 \pm 0.48	-2.50 \pm 0.48	-0.35 \pm 0.19	97.9
FS	2.01 \pm 0.57	-2.22 \pm 0.49	-0.12 \pm 0.22	68.2
HZ	1.84 \pm 0.64	-1.80 \pm 0.67	-0.21 \pm 0.16	90.9
JM	1.61 \pm 0.44	-1.63 \pm 0.45	-0.05 \pm 0.17	61.8
ZQ	1.51 \pm 0.35	-1.48 \pm 0.44	-0.01 \pm 0.21	54.8
ZS	1.34 \pm 0.49	-1.47 \pm 0.53	-0.16 \pm 0.17	84.5
SZ	1.19 \pm 0.61	-0.99 \pm 0.53	-0.24 \pm 0.18	90.0
ZH	0.73 \pm 0.53	-1.25 \pm 0.46	-0.23 \pm 0.19	87.5
HK	0.34 \pm 0.96	-0.22 \pm 0.34	-0.21 \pm 0.16	93.6