

Pearl River Delta
Regional Air Quality Monitoring Network

A Report of Monitoring Results in 2011

Report Number : **PRDAIR-2011-2**

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Environmental Monitoring
Centre**

**Environmental Protection
Department, HKSAR**

Approved by : **Pearl River Delta Air Quality
Management and Monitoring
Special Panel**

Security Classification : **Unrestricted**

Purpose of the Report

This report provides the 2011 monitoring results from the Pearl River Delta Regional Air Quality Monitoring Network and their statistical analysis.

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1. Introduction to the Pearl River Delta Regional Air Quality Monitoring Network

The Pearl River Delta (PRD) Regional Air Quality Monitoring Network (the Network) was jointly established by the Guangdong Provincial Environmental Monitoring Centre (GDEMC) and the Environmental Protection Department of the Hong Kong Special Administrative Region (HKEPD) from 2003 to 2005. The Network came into operation on 30 November 2005 and its data have been used for reporting Regional Air Quality Index (RAQI) to the public since then.

The Network comprises 16 automatic air quality monitoring stations (see Figure 1) across the PRD region. Ten of these stations are operated by the Environmental Monitoring Centres of the individual cities in Guangdong while the three stations located in Hong Kong are managed by the HKEPD. The remaining three regional stations in the Network are operated by the GDEMC. The objectives of the Network are to :

- provide accurate air quality data that can help the Guangdong Provincial and HKSAR governments to appraise the air quality situation and pollution problems in the PRD region for formulating appropriate control measures;
- evaluate the effectiveness of the air pollution control measures through long-term monitoring;
- provide the public with information on the air quality of various places in the region.

In order to ensure that the air quality monitoring results attain a high degree of accuracy and reliability, the two governments had jointly developed a set of “Standard Operating Procedures on Quality Assurance and Quality Control of the PRD Air Quality Monitoring System for Hong Kong and Guangdong” (QA/QC Operating Procedures). The design and operation of the Network comply with the requirements set out in the QA/QC Operating Procedures.

All stations are installed with equipment to measure the ambient concentrations of respirable suspended particulates (PM₁₀ or RSP), sulphur dioxide (SO₂), nitrogen dioxide (NO₂) and ozone (O₃).

Annexes A and B set out, respectively, the site information of the monitoring stations in the Network and the methods used for measuring air pollutant concentrations.



Figure 1 : Spatial distribution of the PRD Regional Air Quality Monitoring Stations

2. Operation of the Network

The operation of the Network was generally smooth in 2011 with an average data capture rates at 95%.

In order to provide the public in both Guangdong and HKSAR with information on the daily air quality of different parts of the PRD region, the GDEMC and HKEPD established a daily reporting system of the Regional Air Quality Index (RAQI). The two Governments have been issuing the RAQI to the public at 4pm every day through the Internet since 30 November 2005.

2.1 Quality Control (QC) and Quality Assurance (QA) Activities

The two governments have fully implemented the agreed QA/QC programme, which include zero/span checks, precision checks, dynamic calibration, etc., in accordance with the QA/QC Operating Procedures so as to ensure that the air quality data from the monitoring stations are highly accurate and reliable. To ensure the operation of the Network continues to comply with the QA/QC requirements, the GDEMC and HKEPD have jointly set up the Guangdong-Hong Kong Quality Management Committee for the PRD Regional Air Quality Monitoring Network (the Quality Management Committee, QMC) to review, on a quarterly basis, the set-up of the network, its performance in QA/QC and the operation of its data transmission system. The QMC will also conduct system audit once a year to evaluate the effectiveness of the quality management system. The QMC will prepare a report summarizing the findings of the system audit including the deficiencies found, and take appropriate corrective measures.

2.2 Accuracy and Precision

The accuracy of the Network is assessed by means of performance audits. The control limits set for the gaseous pollutants and respirable suspended particulates (PM_{10}) are $\pm 15\%$ and $\pm 10\%$ respectively, these limits are similar to those of the United States Environmental Protection Agency and other international standards. In 2011, the GDEMC and HKEPD jointly carried out 365 audit checks on the analysers and samplers at the monitoring stations of the Network. The results showed that, based on the 95% probability limits, the accuracy of the Network varied between -8.4% to 12.9% and was within the specified control limits (see Figure 2).

Precision is a measure of repeatability and is calculated in accordance with the QA/QC Operating Procedures. The control limits adopted for the gaseous pollutants and respirable suspended particulates (PM_{10}) are $\pm 20\%$ and $\pm 10\%$ respectively. In 2011, the GDEMC and HKEPD jointly carried out 1569 precision checks on the analysers and samplers at the monitoring stations of the Network. The results showed that, based on the 95% probability limits, the precision of the Network varied between -10.6% and 13.4% and was within the specified control limits (see Figure 3). Overall, the QA/QC performance of the monitoring network was good in 2011, and met all the requirements specified in the QA/QC Operating Procedures.

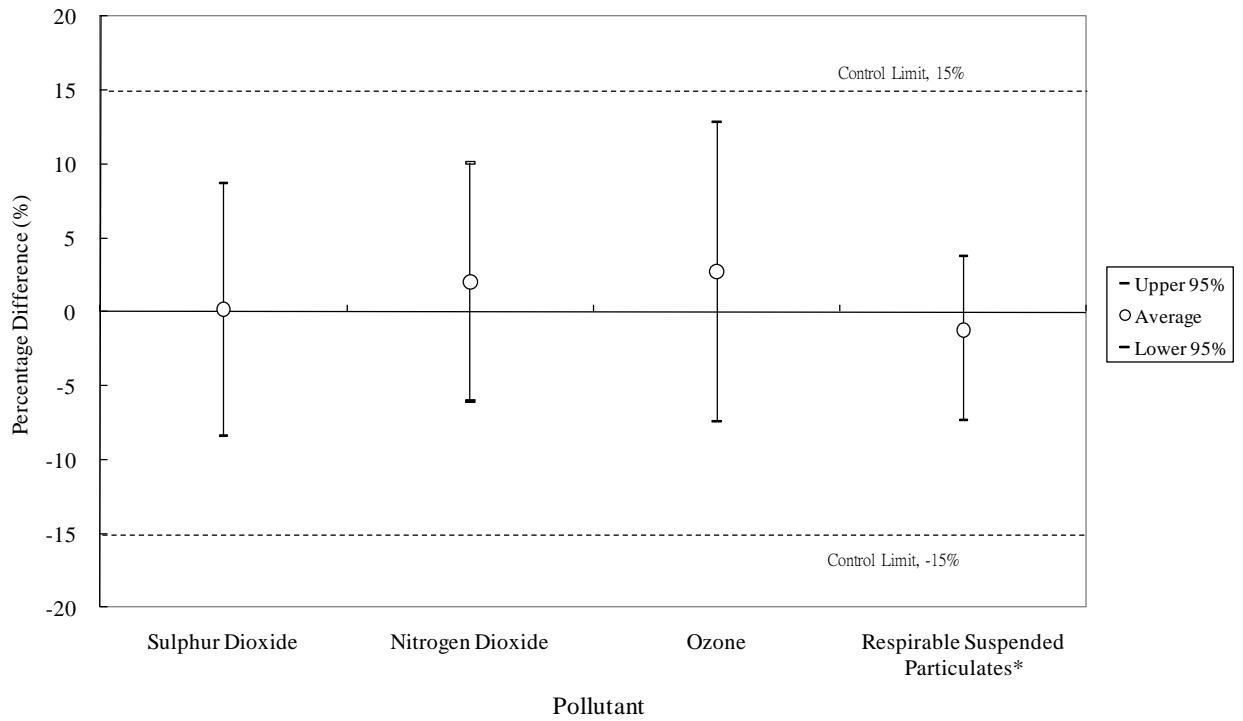


Figure 2 : Accuracy of the PRD Regional Air Quality Monitoring Network in 2011

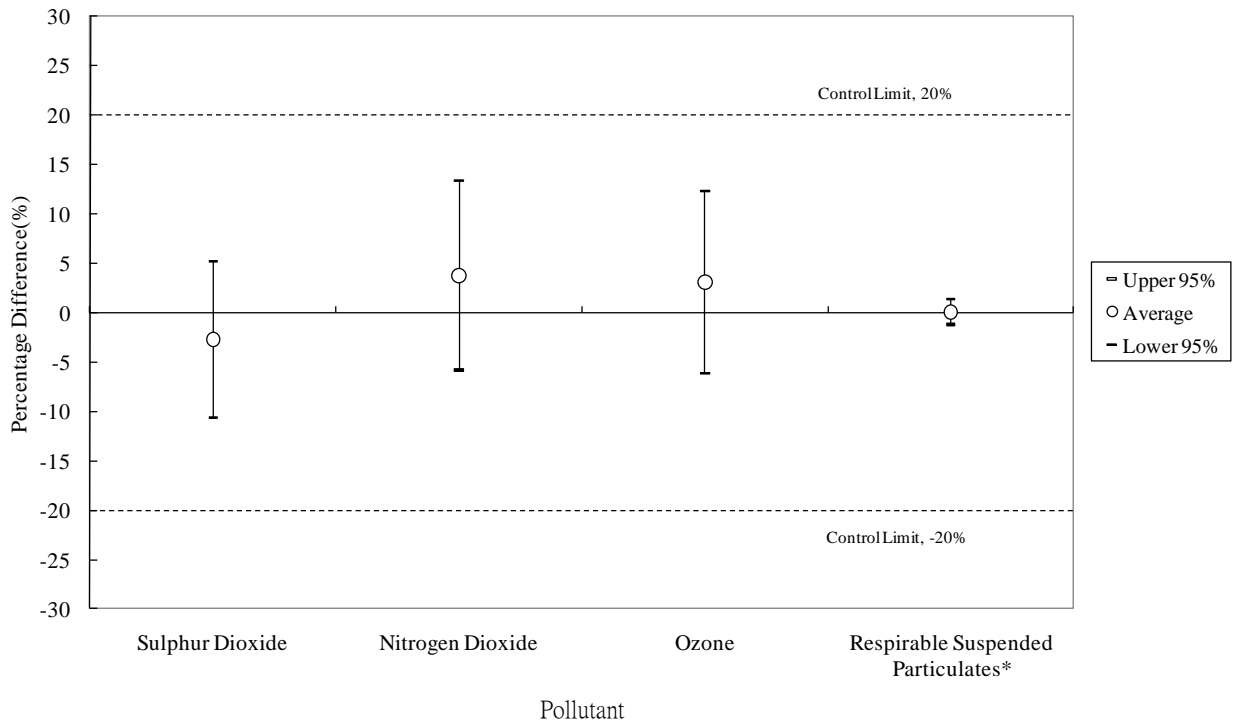


Figure 3 : Precision of the PRD Regional Air Quality Monitoring Network in 2011

* Both the accuracy and precision of the respirable suspended particulates (PM₁₀) adopt a control limit of $\pm 10\%$.

3. Statistical Analysis of Pollutant Concentrations

3.1 Sulphur Dioxide (SO₂)

Sulphur dioxide (SO₂) comes mainly from the combustion of sulphur-containing fossil fuel. Its major sources of emissions include power plants, fuel combustion plants, vehicles and vessels. Apart from its impact on the human respiratory system, SO₂ can also be oxidized in the air to form sulphate, which has significant impact on the levels of respirable suspended particulates (PM₁₀), acid rain and visibility in the region.

The annual averages of SO₂ at various monitoring stations in the Network ranged from 0.009 mg/m³ to 0.040 mg/m³ in 2011; all were in compliance with the national annual air quality standard[#] (0.06 mg/m³). As shown in Figure 4, the average levels of SO₂ along the coastal areas of PRD were in general lower than those of other areas. Summary of the monthly and annual averages of SO₂ at various stations are in Table 3.1c.

During the year, all monitoring stations in the Network were in compliance with the national hourly standard (0.50 mg/m³) of SO₂ while one monitoring station had recorded exceedance of the national daily air quality standard (0.15 mg/m³) of SO₂. Details are shown in Table 3.1a and Table 3.1b.

Distribution of average SO₂
from Jan 2011 to Dec 2011



Figure 4 : Spatial distribution of average concentrations of Sulphur Dioxide (SO₂) in the Network

National Standards refer to Class 2 of the “National Ambient Air Quality Standards (GB 3095 – 1996 – revised version)”

Table 3.1a : The monthly maxima and minima of hourly averages of Sulphur Dioxide

[Class 2 NAAQS (Hourly) : 0.50 mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Hours	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.078	0.152	0.160	0.171	0.132	0.103	0.078	0.135	0.103	0.082	0.130	0.076	0	0.00%
	Min	0.003	0.001	0.001	0.004	0.001	0.000	0.002	0.002	0.000	0.000	0.001	0.005		
Wanqingsha (Guangzhou)	Max	0.177	0.147	0.240	0.150	0.222	0.130	0.145	0.142	0.169	0.161	0.171	0.231	0	0.00%
	Min	0.013	0.005	0.006	0.001	0.004	0.004	0.002	0.003	0.003	0.004	0.005	0.018		
Tianhu (Guangzhou)	Max	0.056	0.119	0.123	0.183	0.100	0.095	0.099	0.090	0.034	0.050	0.034	0.068	0	0.00%
	Min	0.000	0.001	0.001	0.008	0.017	0.032	0.001	0.004	0.004	0.003	0.004	0.006		
Liyuan (Shenzhen)	Max	0.055	0.044	0.039	0.066	0.030	0.053	0.060	0.054	0.038	0.031	0.025	0.049	0	0.00%
	Min	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.004		
Tangjia (Zhuhai)	Max	0.142	0.098	0.132	0.074	0.119	0.020	0.114	0.084	0.092	0.090	0.075	0.097	0	0.00%
	Min	0.004	0.003	0.002	0.000	0.000	0.000	0.003	0.000	0.002	0.004	0.001	0.003		
Jinjuzui (Foshan)	Max	0.094	0.120	0.118	0.168	0.140	0.122	0.111	0.149	0.100	0.174	0.134	0.176	0	0.00%
	Min	0.005	0.004	0.004	0.006	0.003	0.003	0.006	0.004	0.005	0.005	0.008	0.012		
Huijingcheng (Foshan)	Max	0.128	0.129	0.168	0.128	0.130	0.131	0.153	0.103	0.112	0.169	0.203	0.198	0	0.00%
	Min	0.012	0.009	0.013	0.017	0.017	0.015	0.003	0.008	0.007	0.008	0.013	0.019		
Donghu (Jiangmen)	Max	0.256	0.150	0.179	0.104	0.124	0.075	0.134	0.111	0.216	0.206	0.172	0.270	0	0.00%
	Min	0.000	0.004	0.008	0.006	0.002	0.001	0.000	0.002	0.002	0.002	0.006	0.007		
Chengzhong (Zhaoqing)	Max	0.105	0.278	0.321	0.224	0.258	0.191	0.125	0.115	0.133	0.193	0.223	0.192	0	0.00%
	Min	0.007	0.004	0.004	0.005	0.003	0.003	0.003	0.003	0.004	0.004	0.003	0.007		
Xiapu (Huizhou)	Max	0.082	0.046	0.056	0.105	0.041	0.074	0.115	0.072	0.038	0.095	0.052	0.083	0	0.00%
	Min	0.007	0.005	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.004	0.010		
Jinguowan (Huizhou)	Max	0.055	0.051	0.049	0.075	0.026	0.118	0.082	0.053	0.037	0.042	0.051	0.064	0	0.00%
	Min	0.004	0.000	0.012	0.006	0.000	0.000	0.000	0.000	0.009	0.004	0.000	0.003		
Haogang (Dongguan)	Max	0.226	0.107	0.210	0.333	0.257	0.307	0.184	0.145	0.178	0.189	0.186	0.137	0	0.00%
	Min	0.010	0.008	0.009	0.009	0.007	0.008	0.008	0.010	0.012	0.011	0.012	0.014		
Zimaling Park (Zhongshan)	Max	0.221	0.095	0.216	0.074	0.020	0.111	0.044	0.014	--	0.088	0.111	0.154	0	0.00%
	Min	0.013	0.003	0.003	0.001	0.006	0.000	0.000	0.009	--	0.003	0.001	0.006		
Tsuen Wan (HKSAR)	Max	0.091	0.142	0.129	0.170	0.092	0.061	0.087	0.092	0.091	0.056	0.077	0.083	0	0.00%
	Min	0.007	0.008	0.002	0.002	0.002	0.002	0.003	0.005	0.003	0.004	0.005	0.010		
Tap Mun (HKSAR)	Max	0.047	0.033	0.034	0.052	0.037	0.021	0.036	0.035	0.040	0.029	0.030	0.063	0	0.00%
	Min	0.000	0.002	0.003	0.002	0.002	0.003	0.003	0.004	0.005	0.006	0.006	0.009		
Tung Chung (HKSAR)	Max	0.098	0.051	0.082	0.049	0.062	0.058	0.090	0.078	0.074	0.031	0.084	0.066	0	0.00%
	Min	0.004	0.002	0.002	0.001	0.001	0.001	0.003	0.004	0.005	0.007	0.005	0.007		

Table 3.1b : The monthly maxima and minima of daily averages of Sulphur Dioxide

[Class 2 NAAQS (Daily) : 0.15 mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Days	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.050	0.061	0.071	0.059	0.045	0.045	0.035	0.043	0.039	0.033	0.041	0.048	0	0.00%
	Min	0.007	0.003	0.006	0.011	0.004	0.005	0.010	0.012	0.002	0.002	0.005	0.010		
Wanqingsha (Guangzhou)	Max	0.083	0.089	0.078	0.056	0.090	0.048	0.053	0.049	0.060	0.072	0.057	0.120	0	0.00%
	Min	0.029	0.009	0.010	0.006	0.004	0.005	0.002	0.007	0.006	0.007	0.015	0.029		
Tianhu (Guangzhou)	Max	0.047	0.057	0.096	0.099	0.068	0.060	0.054	0.035	0.021	0.021	0.019	0.049	0	0.00%
	Min	0.002	0.001	0.005	0.021	0.023	0.034	0.004	0.005	0.005	0.004	0.005	0.010		
Liyuan (Shenzhen)	Max	0.040	0.021	0.019	0.024	0.012	0.021	0.023	0.019	0.015	0.014	0.015	0.035	0	0.00%
	Min	0.005	0.002	0.003	0.002	0.001	0.001	0.002	0.002	0.002	0.003	0.002	0.010		
Tangjia (Zhuhai)	Max	0.082	0.048	0.046	0.036	0.046	0.014	0.026	0.040	0.039	0.041	0.031	0.074	0	0.00%
	Min	0.016	0.008	0.012	0.003	0.000	0.000	0.004	0.002	0.005	0.007	0.008	0.011		
Jinjuzui (Foshan)	Max	0.056	0.066	0.064	0.080	0.068	0.048	0.043	0.045	0.038	0.077	0.078	0.097	0	0.00%
	Min	0.012	0.008	0.011	0.012	0.004	0.009	0.013	0.012	0.012	0.007	0.016	0.022		
Huijingcheng (Foshan)	Max	0.076	0.080	0.091	0.072	0.052	0.054	0.069	0.041	0.063	0.086	0.118	0.120	0	0.00%
	Min	0.018	0.014	0.026	0.026	0.024	0.021	0.022	0.015	0.012	0.011	0.029	0.028		
Donghu (Jiangmen)	Max	0.077	0.063	0.058	0.044	0.054	0.040	0.049	0.046	0.058	0.079	0.073	0.143	0	0.00%
	Min	0.009	0.006	0.015	0.009	0.007	0.008	0.004	0.006	0.010	0.006	0.012	0.008		
Chengzhong (Zhaoqing)	Max	0.065	0.112	0.154	0.080	0.082	0.068	0.050	0.059	0.059	0.076	0.102	0.085	1	0.28%
	Min	0.014	0.009	0.014	0.019	0.011	0.018	0.016	0.009	0.011	0.005	0.007	0.014		
Xiapu (Huizhou)	Max	0.047	0.023	0.034	0.051	0.020	0.019	0.038	0.032	0.018	0.029	0.029	0.041	0	0.00%
	Min	0.011	0.008	0.007	0.008	0.008	0.009	0.007	0.010	0.007	0.008	0.005	0.016		
Jinguowan (Huizhou)	Max	0.044	0.024	0.032	0.037	0.013	0.035	0.033	0.030	0.031	0.030	0.021	0.046	0	0.00%
	Min	0.009	0.005	0.015	0.007	0.005	0.004	0.004	0.002	0.019	0.008	0.004	0.015		
Haogang (Dongguan)	Max	0.086	0.050	0.084	0.102	0.077	0.094	0.057	0.060	0.054	0.088	0.076	0.072	0	0.00%
	Min	0.017	0.014	0.017	0.012	0.008	0.009	0.010	0.017	0.016	0.014	0.015	0.028		
Zimaling Park (Zhongshan)	Max	0.092	0.057	0.068	0.044	0.013	0.093	0.019	0.012	--	0.055	0.046	0.077	0	0.00%
	Min	0.022	0.005	0.008	0.003	0.008	0.003	0.006	0.011	--	0.009	0.005	0.015		
Tsuen Wan (HKSAR)	Max	0.045	0.062	0.068	0.039	0.046	0.035	0.037	0.042	0.037	0.023	0.022	0.037	0	0.00%
	Min	0.009	0.010	0.005	0.003	0.003	0.002	0.004	0.007	0.004	0.005	0.007	0.013		
Tap Mun (HKSAR)	Max	0.033	0.012	0.019	0.012	0.011	0.011	0.018	0.016	0.017	0.019	0.021	0.044	0	0.00%
	Min	0.006	0.005	0.004	0.004	0.004	0.003	0.004	0.006	0.005	0.007	0.007	0.014		
Tung Chung (HKSAR)	Max	0.057	0.025	0.036	0.020	0.033	0.018	0.028	0.037	0.024	0.019	0.020	0.039	0	0.00%
	Min	0.007	0.006	0.006	0.005	0.003	0.002	0.005	0.005	0.007	0.008	0.006	0.012		

Table 3.1c : The monthly and annual averages of Sulphur Dioxide**[Class 2 NAAQS (Annual) : 0.06 mg/m³]**

Monitoring Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Luhu Park (Guangzhou)	0.023	0.023	0.025	0.036	0.017	0.021	0.020	0.026	0.017	0.014	0.017	0.029	0.022
Wanqingsha (Guangzhou)	0.054	0.030	0.043	0.019	0.025	0.009	0.014	0.021	0.024	0.033	0.033	0.054*	0.029
Tianhu (Guangzhou)	0.021	0.019	0.026	0.060	0.049	0.047	0.023	0.021	0.012*	0.008	0.012	0.027	0.028
Liyuan (Shenzhen)	0.018	0.009	0.011	0.009	0.005	0.004	0.005	0.008	0.006	0.008	0.009	0.019	0.009
Tangjia (Zhuhai)	0.037	0.020	0.027	0.010	0.013	0.004	0.009	0.011	0.014	0.021	0.018	0.031	0.018
Jinjuzui (Foshan)	0.029	0.025	0.031	0.047	0.027	0.022	0.026	0.026	0.025	0.033	0.039	0.051	0.032
Huijingcheng (Foshan)	0.036	0.032	0.048	0.042	0.038	0.031	0.036	0.027	0.029	0.042	0.058	0.062	0.040
Donghu (Jiangmen)	0.034	0.024	0.031	0.020	0.018	0.017	0.017	0.019	0.028	0.040	0.041	0.029	0.027
Chengzhong (Zhaoqing)	0.032	0.040	0.048	0.054	0.041	0.033	0.029	0.024	0.033	0.026	0.040	0.050	0.037
Xiapu (Huizhou)	0.024	0.014	0.019	0.020	0.012	0.014	0.016	0.018	0.014	0.017	0.017	0.031	0.018
Jinguowan (Huizhou)	0.021	0.013	0.023	0.020	0.009	0.010	0.011	0.012	0.023	0.020	0.011	0.023	0.016
Haogang (Dongguan)	0.042	0.027	0.038	0.037	0.023	0.017	0.021	0.030	0.029	0.034	0.039	0.047	0.032
Zimaling Park (Zhongshan)	0.055	0.022	0.039	0.012	0.010	0.014	0.009	0.011*	--	0.029*	0.028	0.040	0.025
Tsuen Wan (HKSAR)	0.021	0.023	0.021	0.018	0.016	0.016	0.018	0.021	0.011	0.010	0.014	0.024	0.018
Tap Mun (HKSAR)	0.014	0.007	0.012	0.008	0.008	0.006	0.008	0.010	0.010	0.012	0.015	0.025	0.011
Tung Chung (HKSAR)	0.024	0.013	0.016	0.012	0.010	0.006	0.010	0.012	0.013	0.014	0.015	0.024	0.014

Remark : 1. All concentration units are in milligrams per cubic metre.

2. “*” denotes that the data capture rate does not meet the minimum requirements for determining a representative value.

3.2 Nitrogen Dioxide (NO₂)

Nitrogen Dioxide (NO₂) is mainly formed from oxidization of nitrogen monoxide (NO) emitted in the process of combustion. Its major emission sources include power plants, vehicles, industrial combustion plants, etc. Apart from its impact on human respiratory system, NO₂ can also be oxidized in the air to form nitrate, which has significant impact on the levels of particulates, acid rain and visibility in the region.

The annual averages of NO₂ at various monitoring stations in the Network ranged from 0.013 mg/m³ to 0.070 mg/m³ in 2011, all were in compliance with the national annual air quality standard (0.08 mg/m³). During the year, six monitoring stations in the Network had recorded exceedance of the national hourly standard (0.24 mg/m³) while 11 monitoring stations had recorded exceedance of the national daily air quality standard (0.12 mg/m³) of NO₂. Details are shown on Figures 5 and Tables 3.2a to 3.2c.

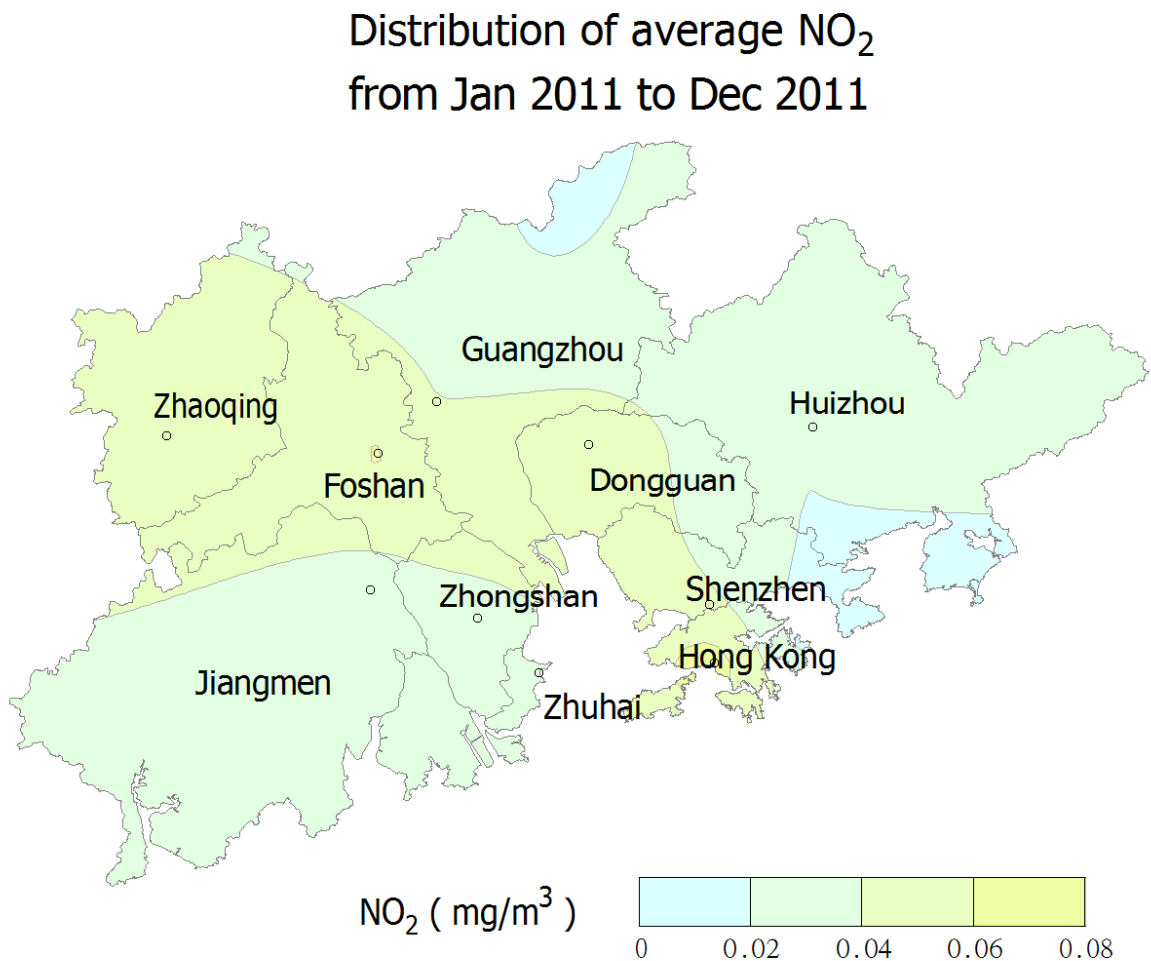


Figure 5 : Spatial distribution of average concentrations of Nitrogen Dioxide (NO₂) in the Network

Table 3.2a : The monthly maxima and minima of hourly averages of Nitrogen Dioxide

[Class 2 NAAQS (Hourly) : 0.24 mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed-ance Hours	Exceed-ance Rate
Luhu Park (Guangzhou)	Max	0.089	0.180	0.280	0.246	0.119	0.146	0.126	0.126	0.106	0.128	0.127	0.118	2	0.02%
	Min	0.010	0.013	0.016	0.017	0.010	0.001	0.006	0.005	0.000	0.000	0.012	0.012		
Wanqingsha (Guangzhou)	Max	0.182	0.170	0.150	0.138	0.131	0.090	0.102	0.118	0.116	0.169	0.165	0.178	0	0.00%
	Min	0.025	0.008	0.008	0.002	0.006	0.000	0.000	0.001	0.003	0.010	0.015	0.023		
Tianhu (Guangzhou)	Max	0.051	0.104	0.108	0.134	0.103	0.117	0.096	0.074	0.029	0.054	0.071	0.043	0	0.00%
	Min	0.006	0.006	0.005	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.008		
Liyuan (Shenzhen)	Max	0.285	0.144	0.178	0.153	0.152	0.096	0.145	0.136	0.147	0.144	0.167	0.208	5	0.06%
	Min	0.013	0.007	0.010	0.006	0.003	0.002	0.006	0.007	0.004	0.004	0.006	0.014		
Tangjia (Zhuhai)	Max	0.157	0.099	0.127	0.095	0.093	0.044	0.097	0.071	0.082	0.090	0.118	0.141	0	0.00%
	Min	0.019	0.012	0.011	0.001	0.000	0.003	0.000	0.000	0.003	0.004	0.001	0.003		
Jinjuzui (Foshan)	Max	0.178	0.205	0.199	0.168	0.124	0.082	0.084	0.101	0.123	0.174	0.210	0.224	0	0.00%
	Min	0.012	0.011	0.008	0.012	0.009	0.005	0.008	0.008	0.009	0.007	0.013	0.015		
Huijingcheng (Foshan)	Max	0.164	0.233	0.236	0.211	0.157	0.140	0.309	0.130	0.167	0.229	0.296	0.221	11	0.13%
	Min	0.009	0.008	0.021	0.001	0.020	0.013	0.007	0.012	0.006	0.006	0.017	0.008		
Donghu (Jiangmen)	Max	0.150	0.122	0.085	0.031	0.035	0.072	0.089	0.070	0.096	0.132	0.147	0.206	0	0.00%
	Min	0.008	0.006	0.000	0.006	0.004	0.003	0.003	0.003	0.008	0.003	0.009	0.010		
Chengzhong (Zhaoqing)	Max	0.136	0.170	0.227	0.171	0.134	0.124	0.095	0.085	0.115	0.162	0.176	0.193	0	0.00%
	Min	0.004	0.003	0.012	0.013	0.003	0.014	0.013	0.007	0.011	0.007	0.015	0.019		
Xiapu (Huizhou)	Max	0.170	0.205	0.169	0.157	0.105	0.076	0.102	0.080	0.079	0.169	0.149	0.187	0	0.00%
	Min	0.016	0.010	0.010	0.006	0.002	0.001	0.008	0.007	0.005	0.012	0.012	0.014		
Jinguowan (Huizhou)	Max	0.079	0.063	0.142	0.081	0.046	0.079	0.091	0.066	0.039	0.028	0.068	0.068	0	0.00%
	Min	0.007	0.004	0.004	0.005	0.002	0.001	0.002	0.002	0.000	0.001	0.001	0.009		
Haogang (Dongguan)	Max	0.200	0.223	0.232	0.179	0.130	0.181	0.125	0.141	0.136	0.136	0.197	0.226	0	0.00%
	Min	0.014	0.014	0.015	0.012	0.001	0.005	0.003	0.000	0.001	0.011	0.001	0.017		
Zimaling Park (Zhongshan)	Max	0.204	0.158	0.170	0.060	0.060	0.068	0.046	0.055	0.036	0.125	0.565	0.227	9	0.11%
	Min	0.018	0.007	0.003	0.001	0.003	0.001	0.000	0.001	0.001	0.007	0.006	0.000		
Tsuen Wan (HKSAR)	Max	0.288	0.194	0.231	0.164	0.183	0.150	0.169	0.266	0.153	0.166	0.169	0.230	9	0.10%
	Min	0.022	0.016	0.021	0.016	0.015	0.012	0.009	0.017	0.007	0.011	0.013	0.018		
Tap Mun (HKSAR)	Max	0.112	0.067	0.074	0.073	0.063	0.037	0.080	0.084	0.065	0.031	0.051	0.042	0	0.00%
	Min	0.008	0.005	0.009	0.003	0.000	0.000	0.001	0.001	0.000	0.002	0.003	0.005		
Tung Chung (HKSAR)	Max	0.216	0.188	0.234	0.153	0.213	0.117	0.123	0.181	0.187	0.218	0.249	0.240	2	0.02%
	Min	0.020	0.012	0.015	0.002	0.002	0.002	0.001	0.003	0.005	0.008	0.011	0.020		

Table 3.2b : The monthly maxima and minima of daily averages of Nitrogen Dioxide

[Class 2 NAAQS (Daily) : 0.12 mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed-ance Days	Exceed-ance Rate
Luhu Park (Guangzhou)	Max	0.063	0.082	0.169	0.108	0.072	0.061	0.063	0.040	0.045	0.077	0.070	0.082	2	0.59%
	Min	0.019	0.024	0.025	0.035	0.021	0.012	0.019	0.018	0.012	0.005	0.028	0.019		
Wanqingsha (Guangzhou)	Max	0.104	0.100	0.093	0.070	0.069	0.044	0.055	0.072	0.064	0.072	0.082	0.122	1	0.30%
	Min	0.034	0.027	0.027	0.024	0.014	0.008	0.003	0.010	0.016	0.020	0.032	0.032		
Tianhu (Guangzhou)	Max	0.026	0.070	0.064	0.054	0.040	0.032	0.028	0.029	0.011	0.023	0.027	0.034	0	0.00%
	Min	0.008	0.007	0.007	0.009	0.000	0.002	0.004	0.003	0.001	0.001	0.007	0.008		
Liyuan (Shenzhen)	Max	0.157	0.089	0.079	0.092	0.062	0.063	0.074	0.069	0.064	0.062	0.078	0.104	1	0.28%
	Min	0.031	0.025	0.028	0.023	0.019	0.017	0.014	0.023	0.011	0.017	0.025	0.028		
Tangjia (Zhuhai)	Max	0.101	0.073	0.079	0.061	0.064	0.030	0.024	0.036	0.053	0.060	0.050	0.116	0	0.00%
	Min	0.031	0.029	0.041	0.012	0.008	0.008	0.004	0.004	0.010	0.018	0.020	0.026		
Jinjuzui (Foshan)	Max	0.102	0.130	0.127	0.073	0.068	0.047	0.066	0.050	0.065	0.104	0.118	0.156	6	1.70%
	Min	0.027	0.024	0.029	0.029	0.014	0.017	0.016	0.023	0.022	0.019	0.038	0.027		
Huijingcheng (Foshan)	Max	0.102	0.151	0.151	0.105	0.093	0.066	0.105	0.074	0.104	0.114	0.182	0.141	12	3.46%
	Min	0.026	0.024	0.038	0.040	0.028	0.031	0.031	0.029	0.030	0.016	0.044	0.032		
Donghu (Jiangmen)	Max	0.099	0.049	0.050	0.017	0.025	0.040	0.050	0.037	0.060	0.079	0.080	0.124	3	0.84%
	Min	0.012	0.009	0.004	0.007	0.006	0.007	0.010	0.012	0.014	0.017	0.015	0.012		
Chengzhong (Zhaoqing)	Max	0.068	0.110	0.132	0.084	0.087	0.061	0.063	0.057	0.068	0.091	0.119	0.119	1	0.29%
	Min	0.018	0.020	0.026	0.028	0.021	0.025	0.024	0.018	0.022	0.015	0.027	0.029		
Xiapu (Huizhou)	Max	0.075	0.094	0.085	0.063	0.040	0.034	0.047	0.047	0.046	0.063	0.063	0.091	0	0.00%
	Min	0.029	0.029	0.025	0.022	0.017	0.006	0.019	0.024	0.010	0.020	0.023	0.021		
Jinguowan (Huizhou)	Max	0.041	0.026	0.090	0.046	0.025	0.040	0.047	0.035	0.018	0.017	0.025	0.031	0	0.00%
	Min	0.012	0.011	0.010	0.012	0.007	0.007	0.008	0.008	0.003	0.005	0.007	0.015		
Haogang (Dongguan)	Max	0.087	0.158	0.153	0.097	0.072	0.068	0.071	0.076	0.062	0.083	0.094	0.125	4	1.11%
	Min	0.025	0.033	0.029	0.034	0.012	0.017	0.022	0.031	0.013	0.016	0.026	0.023		
Zimaling Park (Zhongshan)	Max	0.115	0.086	0.103	0.040	0.047	0.039	0.016	0.028	0.020	0.062	0.082	0.126	1	0.30%
	Min	0.029	0.022	0.022	0.012	0.012	0.009	0.008	0.006	0.009	0.011	0.031	0.006		
Tsuen Wan (HKSAR)	Max	0.175	0.145	0.133	0.107	0.113	0.091	0.098	0.124	0.092	0.103	0.095	0.140	10	2.79%
	Min	0.058	0.050	0.056	0.059	0.039	0.032	0.033	0.039	0.016	0.040	0.039	0.044		
Tap Mun (HKSAR)	Max	0.040	0.021	0.027	0.032	0.021	0.019	0.037	0.029	0.030	0.017	0.024	0.026	0	0.00%
	Min	0.011	0.010	0.013	0.008	0.003	0.001	0.003	0.005	0.001	0.005	0.009	0.012		
Tung Chung (HKSAR)	Max	0.149	0.130	0.142	0.104	0.108	0.063	0.072	0.093	0.077	0.098	0.095	0.132	4	1.14%
	Min	0.039	0.035	0.039	0.024	0.009	0.008	0.008	0.020	0.009	0.020	0.035	0.040		

Table 3.2c : The monthly and annual averages of Nitrogen Dioxide**[Class 2 NAAQS (Annual) : 0.08 mg/m³]**

Monitoring Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Luhu Park (Guangzhou)	0.039	0.043	0.056	0.062	0.037	0.032	0.033	0.028	0.028	0.030	0.044	0.046	0.040
Wanqingsha (Guangzhou)	0.065	0.052	0.062	0.042	0.041	0.019	0.023	0.030	0.036	0.046	0.060	0.068*	0.045
Tianhu (Guangzhou)	0.018	0.020	0.018	0.032	0.015	0.015	0.017*	0.015	0.005*	0.006	0.011	0.019	0.017
Liyuan (Shenzhen)	0.061	0.048	0.052	0.054	0.037	0.028	0.034	0.038	0.031	0.037	0.045	0.058	0.044
Tangjia (Zhuhai)	0.059	0.044	0.058	0.027	0.030	0.013	0.014*	0.013	0.024	0.035	0.036	0.051	0.034
Jinjuzui (Foshan)	0.059	0.056	0.068	0.052	0.041	0.029	0.032	0.033	0.040	0.056	0.072	0.080	0.051
Huijingcheng (Foshan)	0.061	0.057	0.079	0.064	0.056	0.043	0.052	0.044	0.055	0.064	0.085	0.085	0.062
Donghu (Jiangmen)	0.032	0.018	0.018	0.011	0.011	0.020	0.024	0.022	0.033	0.048	0.052	0.050	0.029
Chengzhong (Zhaoqing)	0.042	0.051	0.059	0.053	0.039	0.038	0.040	0.031	0.040	0.046	0.060	0.064	0.047
Xiapu (Huizhou)	0.047	0.042	0.044	0.039	0.027	0.024	0.032	0.034	0.032	0.035	0.044	0.050	0.038
Jinguowan (Huizhou)	0.028	0.016	0.028	0.023	0.016	0.020	0.025	0.018	0.010	0.011	0.016	0.025	0.020
Haogang (Dongguan)	0.052	0.058	0.059	0.058	0.033	0.034	0.041	0.047	0.035	0.041	0.054	0.063	0.048
Zimaling Park (Zhongshan)	0.068	0.045	0.059	0.023	0.023	0.015	0.011	0.011	0.014	0.034	0.053	0.061	0.034
Tsuen Wan (HKSAR)	0.084	0.088	0.084	0.081	0.069	0.052	0.055	0.057	0.057	0.064	0.068	0.079	0.070
Tap Mun (HKSAR)	0.021	0.015	0.018	0.015	0.009	0.006	0.012	0.013	0.008	0.010	0.013	0.018	0.013
Tung Chung (HKSAR)	0.079	0.076	0.072	0.062	0.047	0.021	0.031	0.040	0.039	0.055	0.062	0.078	0.055

Remark : 1. All concentration units are in milligrams per cubic metre.

2. “**” denotes that the data capture rate does not meet the minimum requirements for determining a representative value.

3.3 Ozone (O₃)

Ozone (O₃) is not directly emitted from emission sources. It is formed by the photochemical reaction of oxygen, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) in the air under sunlight, and is one of the main components of photochemical smog. Ozone can cause irritation to the eyes, nose and throat. At elevated levels, it can increase a person's susceptibility to respiratory diseases and aggravate pre-existing respiratory diseases such as asthma.

The precursors of O₃ (NO_x and VOCs) mainly originate from pollution sources in urban areas. However, as it usually takes several hours for O₃ to be formed and rise to its peak level, O₃ and its precursors can be transported to other areas downwind of their sources during this period. The concentrations of O₃ in rural areas are therefore often higher than those in the urban areas. In 2011, the annual averages of O₃ recorded by the Network ranged from 0.033 mg/m³ to 0.089 mg/m³ with higher average values being recorded in rural areas such as Tianhu of Guangzhou, Tap Mun of Hong Kong and Jinguowan of Huizhou, similar to the situation in previous years. During the year, all 16 monitoring stations in the Network had recorded exceedance of the national hourly standard (0.2 mg/m³) of O₃. Details are shown on Figures 6 and Tables 3.3a to 3.3c.

Distribution of average O₃ from Jan 2011 to Dec 2011

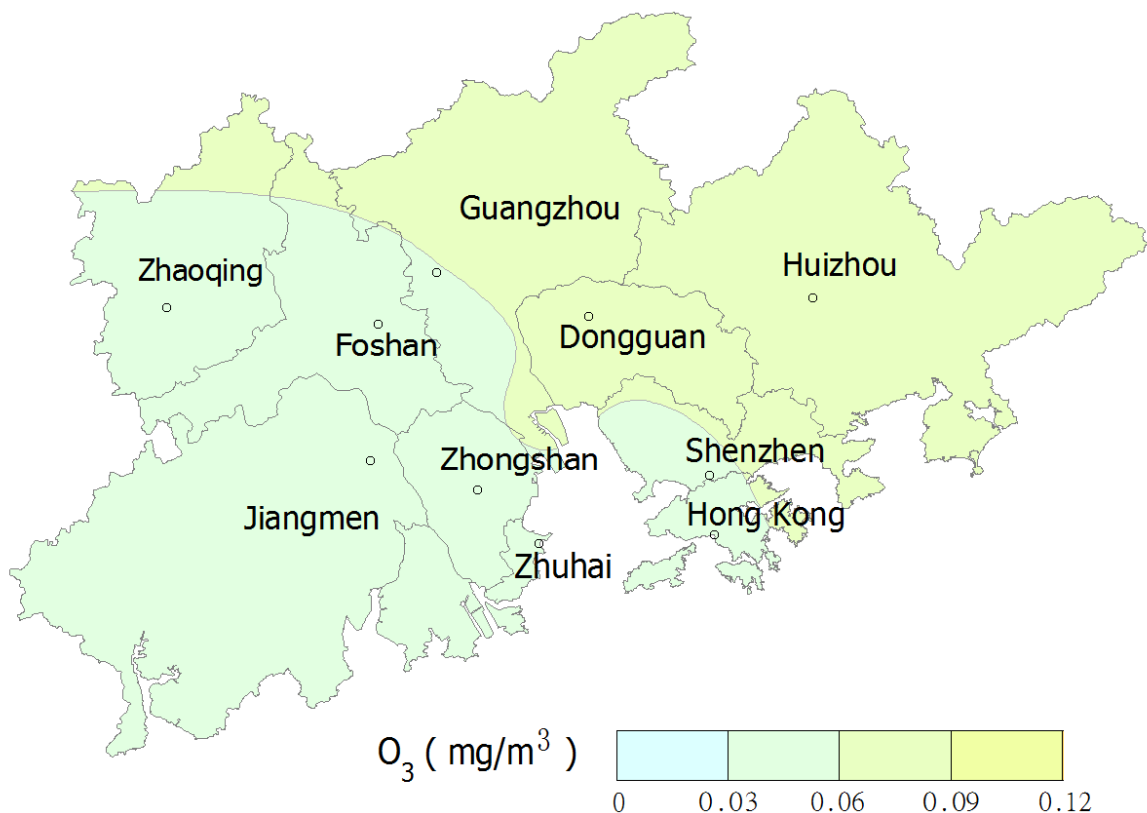


Figure 6 : Spatial distribution of average concentrations of Ozone (O₃) in the Network

Table 3.3a : The monthly maxima and minima of hourly averages of Ozone

[Class 2 NAAQS (Hourly) : 0.20mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed- ance Hours	Exceed- ance Rate
Luhu Park (Guangzhou)	Max	0.148	0.313	0.314	0.407	0.348	0.386	0.289	0.299	0.283	0.276	0.207	0.171	310	3.73%
	Min	0.000	0.006	0.005	0.001	0.000	0.001	0.000	0.001	0.001	0.000	0.000	0.001		
Wanqingsha (Guangzhou)	Max	0.184	0.226	0.285	0.356	0.430	0.423	0.352	0.332	0.346	0.332	0.314	0.143	383	4.70%
	Min	0.001	0.000	0.000	0.001	0.002	0.001	0.003	0.004	0.000	0.004	0.001	0.001		
Tianhu (Guangzhou)	Max	0.148	0.222	0.326	0.356	0.268	0.278	0.288	0.304	0.231	0.231	0.217	0.160	363	4.55%
	Min	0.025	0.013	0.016	0.005	0.002	0.002	0.003	0.001	0.024	0.023	0.024	0.007		
Liyuan (Shenzhen)	Max	0.179	0.144	0.181	0.190	0.278	0.264	0.215	0.309	0.299	0.320	0.271	0.268	153	1.78%
	Min	0.000	0.000	0.001	0.001	0.006	0.000	0.000	0.001	0.001	0.001	0.000	0.001		
Tangjia (Zhuhai)	Max	0.208	0.171	0.214	0.232	0.416	0.282	0.393	0.302	0.279	0.286	0.312	0.343	195	2.35%
	Min	0.000	0.000	0.000	0.002	0.001	0.002	0.000	0.002	0.001	0.000	0.001	0.000		
Jinjuzui (Foshan)	Max	0.142	0.203	0.224	0.350	0.392	0.365	0.267	0.294	0.285	0.268	0.249	0.234	243	2.85%
	Min	0.004	0.004	0.004	0.002	0.002	0.002	0.003	0.003	0.001	0.001	0.000	0.001		
Huijingcheng (Foshan)	Max	0.120	0.213	0.261	0.288	0.331	0.247	0.206	0.260	0.236	0.270	0.194	0.143	135	1.59%
	Min	0.003	0.003	0.005	0.002	0.002	0.003	0.003	0.002	0.002	0.002	0.002	0.003		
Donghu (Jiangmen)	Max	0.177	0.201	0.278	0.281	0.399	0.320	0.337	0.307	0.290	0.306	0.293	0.224	270	3.21%
	Min	0.005	0.003	0.000	0.001	0.002	0.001	0.000	0.001	0.002	0.002	0.002	0.002		
Chengzhong (Zhaoqing)	Max	0.130	0.193	0.243	0.240	0.286	0.311	0.191	0.325	0.304	0.310	0.150	0.147	102	1.20%
	Min	0.003	0.000	0.000	0.003	0.003	0.003	0.000	0.005	0.008	0.005	0.005	0.004		
Xiapu (Huizhou)	Max	0.134	0.208	0.215	0.351	0.231	0.279	0.295	0.314	0.151	0.241	0.155	0.146	158	1.83%
	Min	0.003	0.003	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.001	0.002		
Jinguowan (Huizhou)	Max	0.151	0.193	0.200	0.348	0.246	0.304	0.332	0.316	0.191	0.212	0.165	0.158	123	1.45%
	Min	0.008	0.010	0.011	0.007	0.006	0.008	0.005	0.003	0.007	0.006	0.004	0.008		
Haogang (Dongguan)	Max	0.194	0.297	0.321	0.343	0.335	0.297	0.280	0.340	0.296	0.274	0.206	0.239	306	3.53%
	Min	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.002		
Zimaling Park (Zhongshan)	Max	0.194	0.182	0.267	0.126	0.068	0.081	0.068	0.049	--	0.320	0.274	0.227	73	1.14%
	Min	0.010	0.011	0.008	0.001	0.023	0.001	0.009	0.027	--	0.000	0.000	0.000		
Tsuen Wan (HKSAR)	Max	0.108	0.118	0.147	0.158	0.230	0.128	0.196	0.243	0.158	0.168	0.162	0.131	11	0.13%
	Min	0.002	0.002	0.001	0.002	0.002	0.002	0.003	0.002	0.003	0.003	0.002	0.003		
Tap Mun (HKSAR)	Max	0.163	0.168	0.193	0.243	0.293	0.260	0.346	0.267	0.173	0.244	0.241	0.180	80	0.95%
	Min	0.003	0.003	0.004	0.001	0.007	0.005	0.003	0.003	0.006	0.023	0.003	0.013		
Tung Chung (HKSAR)	Max	0.178	0.134	0.250	0.201	0.341	0.326	0.263	0.340	0.319	0.288	0.297	0.152	107	1.26%
	Min	0.002	0.002	0.001	0.000	0.001	0.004	0.003	0.003	0.003	0.003	0.003	0.003		

Table 3.3b : The monthly maxima and minima of daily averages of Ozone

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Luhu Park (Guangzhou)	Max	0.077	0.136	0.151	0.211	0.137	0.146	0.103	0.116	0.103	0.093	0.073	0.076
	Min	0.017	0.021	0.031	0.026	0.004	0.013	0.008	0.015	0.020	0.006	0.003	0.014
Wanqingsha (Guangzhou)	Max	0.076	0.138	0.124	0.159	0.168	0.167	0.104	0.124	0.129	0.156	0.102	0.062
	Min	0.006	0.004	0.024	0.029	0.015	0.017	0.008	0.036	0.029	0.014	0.009	0.019
Tianhu (Guangzhou)	Max	0.121	0.124	0.176	0.209	0.165	0.176	0.207	0.158	0.129	0.155	0.162	0.129
	Min	0.037	0.030	0.038	0.036	0.003	0.040	0.043	0.051	0.050	0.035	0.040	0.024
Liyuan (Shenzhen)	Max	0.072	0.091	0.115	0.145	0.126	0.087	0.064	0.113	0.124	0.159	0.153	0.101
	Min	0.006	0.003	0.011	0.012	0.022	0.008	0.009	0.014	0.020	0.013	0.005	0.030
Tangjia (Zhuhai)	Max	0.082	0.099	0.114	0.125	0.144	0.104	0.109	0.109	0.113	0.114	0.116	0.079
	Min	0.014	0.003	0.025	0.025	0.014	0.025	0.029	0.025	0.029	0.006	0.010	0.018
Jinjuzui (Foshan)	Max	0.075	0.123	0.086	0.140	0.178	0.161	0.082	0.093	0.105	0.106	0.079	0.075
	Min	0.006	0.005	0.010	0.016	0.011	0.013	0.013	0.015	0.014	0.006	0.005	0.013
Huijingcheng (Foshan)	Max	0.073	0.085	0.093	0.121	0.141	0.120	0.067	0.087	0.108	0.088	0.073	0.067
	Min	0.004	0.005	0.021	0.010	0.006	0.010	0.013	0.017	0.014	0.005	0.004	0.009
Donghu (Jiangmen)	Max	0.083	0.098	0.070	0.121	0.142	0.161	0.118	0.116	0.125	0.123	0.090	0.087
	Min	0.016	0.013	0.010	0.010	0.017	0.011	0.023	0.022	0.026	0.008	0.012	0.015
Chengzhong (Zhaoqing)	Max	0.074	0.085	0.084	0.117	0.152	0.111	0.087	0.131	0.122	0.132	0.103	0.098
	Min	0.009	0.004	0.008	0.026	0.011	0.015	0.018	0.034	0.025	0.014	0.008	0.009
Xiapu (Huizhou)	Max	0.085	0.113	0.115	0.161	0.149	0.148	0.150	0.121	0.082	0.122	0.093	0.104
	Min	0.011	0.010	0.029	0.042	0.017	0.017	0.020	0.026	0.015	0.015	0.014	0.035
Jinguowan (Huizhou)	Max	0.091	0.127	0.150	0.164	0.160	0.159	0.159	0.113	0.099	0.120	0.108	0.106
	Min	0.025	0.022	0.042	0.040	0.025	0.032	0.029	0.029	0.035	0.025	0.026	0.043
Haogang (Dongguan)	Max	0.093	0.139	0.120	0.156	0.158	0.133	0.110	0.103	0.108	0.102	0.093	0.090
	Min	0.006	0.004	0.020	0.016	0.013	0.006	0.024	0.017	0.027	0.014	0.013	0.028
Zimaling Park (Zhongshan)	Max	0.079	0.113	0.113	0.060	0.048	0.047	0.035	0.035	--	0.132	0.115	0.076
	Min	0.014	0.013	0.025	0.008	0.036	0.013	0.021	0.032	--	0.028	0.011	0.010
Tsuen Wan (HKSAR)	Max	0.052	0.057	0.098	0.123	0.098	0.047	0.052	0.086	0.062	0.090	0.094	0.059
	Min	0.008	0.003	0.004	0.005	0.006	0.006	0.006	0.006	0.011	0.009	0.010	0.008
Tap Mun (HKSAR)	Max	0.101	0.123	0.159	0.182	0.172	0.125	0.134	0.124	0.133	0.173	0.163	0.114
	Min	0.021	0.020	0.044	0.021	0.024	0.028	0.031	0.026	0.047	0.048	0.033	0.043
Tung Chung (HKSAR)	Max	0.069	0.089	0.135	0.157	0.122	0.092	0.084	0.112	0.101	0.114	0.133	0.072
	Min	0.005	0.003	0.008	0.012	0.008	0.021	0.015	0.012	0.027	0.017	0.011	0.020

Table 3.3c : The monthly and annual averages of Ozone

Monitoring Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Luhu Park (Guangzhou)	0.039	0.068	0.069	0.119	0.054	0.043	0.051	0.065	0.065	0.049	0.039	0.043	0.059
Wanqingsha (Guangzhou)	0.035	0.061	0.061	0.093	0.067	0.052	0.057	0.071	0.092	0.077	0.061	0.037*	0.064
Tianhu (Guangzhou)	0.070	0.083	0.092	0.130	0.080	0.073	0.087	0.096	0.09*	0.078	0.090	0.096	0.089
Liyuan (Shenzhen)	0.037	0.048	0.056	0.066	0.058	0.024	0.028	0.039	0.071	0.086	0.071	0.059	0.053
Tangjia (Zhuhai)	0.043	0.053	0.061	0.076	0.063	0.048	0.056	0.054	0.068	0.068	0.066	0.048	0.059
Jinjuzui (Foshan)	0.035	0.051	0.046	0.084	0.054	0.035	0.044	0.052	0.070	0.051	0.046	0.042	0.051
Huijingcheng (Foshan)	0.028	0.045	0.046	0.068	0.050	0.033	0.037	0.055	0.064	0.046	0.040	0.036	0.045
Donghu (Jiangmen)	0.043	0.051	0.038	0.064	0.059	0.056	0.061	0.058	0.079	0.064	0.057	0.046	0.056
Chengzhong (Zhaoqing)	0.040	0.046	0.043	0.070	0.062	0.047	0.049	0.064	0.086	0.062	0.045	0.044	0.055
Xiapu (Huizhou)	0.045	0.067	0.065	0.101	0.064	0.044	0.053	0.065	0.050	0.065	0.055	0.057	0.061
Jinguowan (Huizhou)	0.062	0.082	0.084	0.108	0.075	0.053	0.067	0.063	0.071	0.072	0.067	0.074	0.073
Haogang (Dongguan)	0.046	0.064	0.061	0.091	0.062	0.043	0.056	0.062	0.076	0.063	0.055	0.058	0.061
Zimaling Park (Zhongshan)	0.043	0.060	0.059	0.037	0.043	0.039	0.031	0.034*	--	0.077*	0.059	0.041	0.047
Tsuen Wan (HKSAR)	0.028	0.028	0.043	0.044	0.036	0.016	0.018	0.023	0.039	0.046	0.043	0.038	0.033
Tap Mun (HKSAR)	0.068	0.085	0.089	0.094	0.081	0.048	0.054	0.051	0.085	0.100	0.091	0.086	0.078
Tung Chung (HKSAR)	0.032	0.036	0.054	0.061	0.054	0.040	0.041	0.040	0.059	0.063	0.054	0.041	0.048

Remark : 1. All concentration units are in milligrams per cubic metre.

2. “*” denotes that the data capture rate does not meet the minimum requirements for determining a representative value.

3.4 Respirable Suspended Particulates (PM₁₀)

Respirable suspended particulates (PM₁₀ or RSP) in the atmosphere come from a great variety of emission sources, such as power plants, vehicles, cement and pottery manufacturing, fugitive dust etc, while some are products of oxidization of gaseous pollutants in the air (e.g. sulphate formed from oxidation of SO₂) or formed from photochemical reactions. PM₁₀ can penetrate deeply into human lungs and cause impact on human respiratory system. Furthermore, finer particles in PM₁₀ have significant effect on visibility.

In 2011, the annual averages of PM₁₀ at various monitoring stations in the Network ranged from 0.051 mg/m³ to 0.100 mg/m³. As shown in Figure 7, the average levels of PM₁₀ in the central to north-western part of PRD were relatively higher than those in the coastal areas in the south. During the year, all monitoring stations in the Network were in compliance with the national annual air quality standard (0.10 mg/m³) of PM₁₀ while 14 monitoring stations had recorded exceedance of the national daily standard (0.15mg/m³) of PM₁₀. Details are shown on Tables 3.4a to 3.4c.

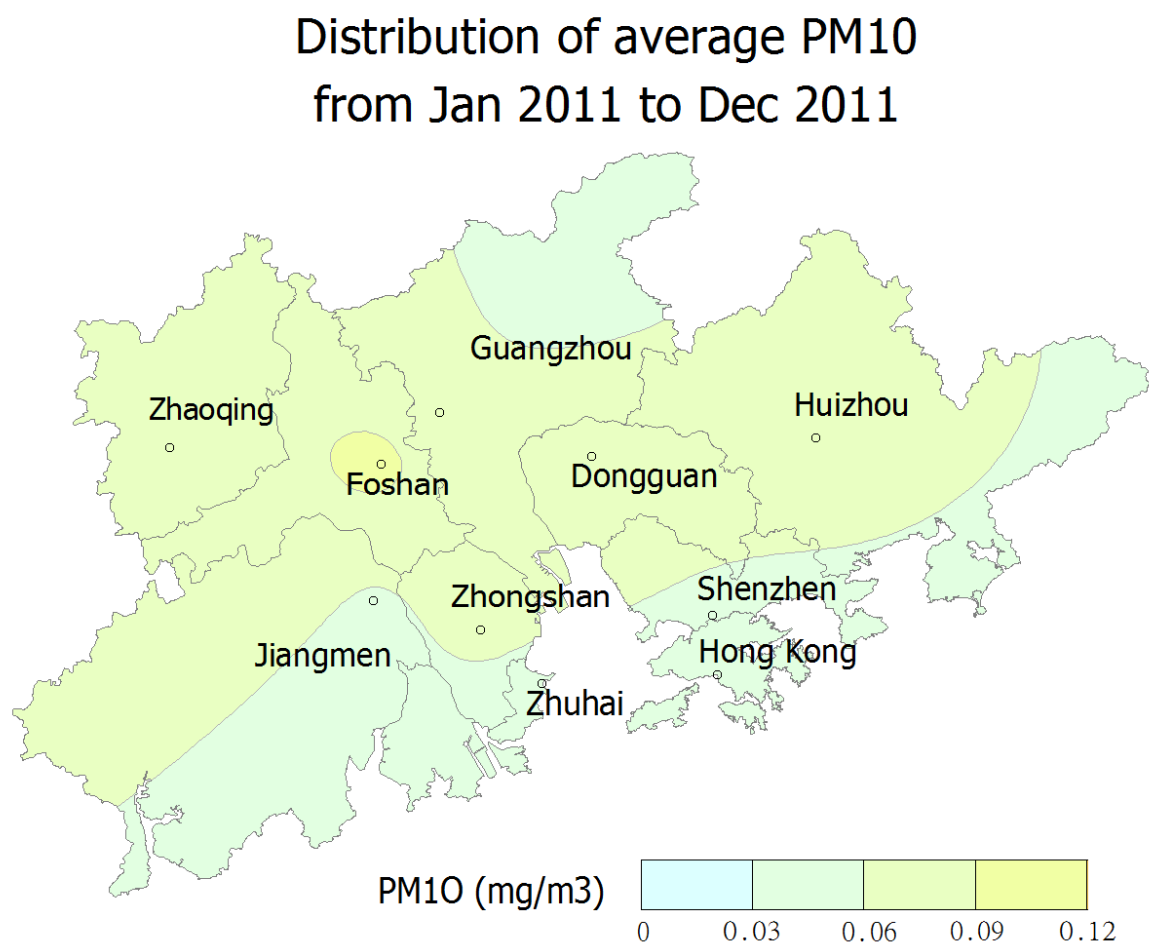


Figure 7 : Spatial distribution of average concentrations of Respirable Suspended Particulates (PM₁₀) in the Network

Table 3.4a : The monthly maxima and minima of hourly averages of Respirable Suspended Particulates

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Luhu Park (Guangzhou)	Max	0.199	0.242	0.324	0.165	0.147	0.121	0.125	0.131	0.120	0.138	0.206	0.281
	Min	0.029	0.003	0.005	0.024	0.004	0.001	0.025	0.022	0.024	0.019	0.010	0.034
Wanqingsha (Guangzhou)	Max	0.273	0.297	0.335	0.198	0.252	0.163	0.144	0.126	0.152	0.294	0.211	0.273
	Min	0.022	0.004	0.005	0.004	0.001	0.000	0.001	0.002	0.008	0.003	0.002	0.022
Tianhu (Guangzhou)	Max	0.132	0.177	0.212	0.257	0.300	0.183	0.160	0.129	0.108	0.124	0.179	0.155
	Min	0.002	0.000	0.003	0.000	0.000	0.001	0.000	0.002	0.001	0.000	0.000	0.001
Liyuan (Shenzhen)	Max	0.327	0.258	0.214	0.171	0.196	0.201	0.162	0.148	0.200	0.209	0.216	0.262
	Min	0.008	0.002	0.001	0.004	0.001	0.001	0.002	0.002	0.001	0.001	0.000	0.008
Tangjia (Zhuhai)	Max	0.237	0.133	0.192	0.213	0.174	0.144	0.162	0.145	0.116	0.171	0.178	0.200
	Min	0.010	0.004	0.005	0.008	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.011
Jinjuzui (Foshan)	Max	0.174	0.259	0.260	0.233	0.226	0.236	0.156	0.156	0.139	0.255	0.232	0.328
	Min	0.021	0.004	0.008	0.009	0.005	0.002	0.002	0.004	0.003	0.004	0.000	0.016
Huijingcheng (Foshan)	Max	0.250	0.372	0.443	0.349	0.435	0.256	0.243	0.162	0.220	0.288	0.446	0.280
	Min	0.037	0.018	0.016	0.048	0.030	0.018	0.017	0.018	0.019	0.014	0.023	0.031
Donghu (Jiangmen)	Max	0.224	0.301	0.240	0.148	0.192	0.116	0.152	0.106	0.249	0.224	0.162	0.201
	Min	0.011	0.000	0.010	0.007	0.001	0.001	0.000	0.002	0.008	0.004	0.000	0.007
Chengzhong (Zhaoqing)	Max	0.239	0.527	0.395	0.218	0.221	0.175	0.149	0.229	0.184	0.281	0.288	0.264
	Min	0.012	0.002	0.005	0.013	0.000	0.002	0.005	0.010	0.005	0.002	0.001	0.010
Xiapu (Huizhou)	Max	0.280	0.256	0.213	0.292	0.139	0.126	0.164	0.119	0.124	0.266	0.200	0.281
	Min	0.006	0.006	0.002	0.015	0.006	0.001	0.001	0.007	0.012	0.005	0.006	0.011
Jinguowan (Huizhou)	Max	0.193	0.179	0.223	0.344	0.185	0.193	0.213	0.171	0.249	0.203	0.168	0.173
	Min	0.013	0.003	0.002	0.005	0.000	0.000	0.001	0.000	0.000	0.002	0.000	0.003
Haogang (Dongguan)	Max	0.194	0.290	0.324	0.259	0.204	0.281	0.276	0.223	0.192	0.234	0.230	0.281
	Min	0.016	0.001	0.006	0.008	0.000	0.000	0.000	0.000	0.004	0.002	0.001	0.010
Zimaling Park (Zhongshan)	Max	0.280	0.227	0.349	0.186	0.228	0.200	0.205	0.169	0.205	0.224	0.261	0.329
	Min	0.014	0.001	0.005	0.012	0.002	0.001	0.000	0.001	0.004	0.000	0.000	0.017
Tsuen Wan (HKSAR)	Max	0.210	0.186	0.177	0.141	0.174	0.126	0.141	0.146	0.099	0.170	0.127	0.207
	Min	0.016	0.008	0.012	0.015	0.008	0.005	0.005	0.005	0.007	0.003	0.003	0.025
Tap Mun (HKSAR)	Max	0.145	0.138	0.183	0.156	0.183	0.086	0.161	0.114	0.096	0.127	0.123	0.142
	Min	0.022	0.003	0.004	0.000	0.008	0.004	0.005	0.006	0.010	0.006	0.004	0.021
Tung Chung (HKSAR)	Max	0.231	0.191	0.273	0.129	0.180	0.153	0.121	0.142	0.136	0.144	0.152	0.207
	Min	0.019	0.012	0.014	0.017	0.001	0.001	0.004	0.001	0.006	0.003	0.003	0.021

Table 3.4b : The monthly maxima and minima of daily averages of Respirable Suspended Particulates [Class 2 NAAQS (Daily) : 0.15 mg/m³]

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Exceed-ance Days	Exceed-ance Rate
Luhu Park (Guangzhou)	Max	0.129	0.172	0.219	0.113	0.069	0.078	0.083	0.080	0.086	0.095	0.135	0.180	5	1.43%
	Min	0.048	0.027	0.037	0.048	0.023	0.026	0.040	0.040	0.031	0.028	0.025	0.053		
Wanqingsha (Guangzhou)	Max	0.182	0.141	0.191	0.128	0.157	0.093	0.098	0.094	0.108	0.136	0.141	0.172	8	2.41%
	Min	0.052	0.032	0.041	0.051	0.022	0.012	0.021	0.015	0.030	0.025	0.012	0.037		
Tianhu (Guangzhou)	Max	0.101	0.101	0.142	0.150	0.199	0.143	0.112	0.082	0.080	0.098	0.087	0.121	1	0.32%
	Min	0.023	0.009	0.031	0.032	0.007	0.007	0.001	0.008	0.009	0.005	0.006	0.012		
Liyuan (Shenzhen)	Max	0.194	0.102	0.129	0.090	0.107	0.096	0.092	0.087	0.080	0.104	0.093	0.141	2	0.56%
	Min	0.026	0.017	0.026	0.023	0.019	0.012	0.012	0.013	0.022	0.025	0.007	0.036		
Tangjia (Zhuhai)	Max	0.156	0.081	0.117	0.091	0.097	0.059	0.070	0.095	0.085	0.098	0.086	0.141	1	0.32%
	Min	0.039	0.035	0.036	0.030	0.009	0.004	0.012	0.010	0.024	0.012	0.007	0.033		
Jinjuzui (Foshan)	Max	0.132	0.162	0.148	0.130	0.125	0.136	0.108	0.106	0.098	0.144	0.152	0.236	8	2.29%
	Min	0.037	0.025	0.032	0.062	0.027	0.016	0.023	0.022	0.024	0.028	0.015	0.037		
Huijingcheng (Foshan)	Max	0.180	0.300	0.241	0.208	0.204	0.162	0.131	0.109	0.164	0.195	0.289	0.227	48	14.12%
	Min	0.053	0.044	0.057	0.079	0.051	0.031	0.049	0.039	0.042	0.036	0.033	0.045		
Donghu (Jiangmen)	Max	0.157	0.184	0.150	0.083	0.111	0.064	0.073	0.085	0.143	0.120	0.100	0.126	2	0.56%
	Min	0.030	0.025	0.032	0.032	0.016	0.010	0.016	0.016	0.026	0.026	0.007	0.022		
Chengzhong (Zhaoqing)	Max	0.179	0.245	0.205	0.141	0.126	0.074	0.104	0.097	0.122	0.169	0.224	0.166	20	5.78%
	Min	0.028	0.024	0.037	0.045	0.020	0.020	0.026	0.028	0.035	0.019	0.007	0.027		
Xiapu (Huizhou)	Max	0.139	0.124	0.167	0.127	0.111	0.087	0.102	0.072	0.092	0.125	0.130	0.146	1	0.28%
	Min	0.040	0.021	0.019	0.047	0.018	0.013	0.020	0.019	0.028	0.021	0.010	0.035		
Jinguowan (Huizhou)	Max	0.134	0.101	0.127	0.225	0.119	0.116	0.126	0.085	0.125	0.103	0.105	0.120	1	0.31%
	Min	0.039	0.018	0.021	0.055	0.014	0.019	0.021	0.015	0.036	0.019	0.011	0.038		
Haogang (Dongguan)	Max	0.131	0.170	0.177	0.122	0.118	0.112	0.114	0.074	0.087	0.160	0.125	0.187	7	1.95%
	Min	0.040	0.022	0.033	0.053	0.025	0.023	0.031	0.023	0.034	0.021	0.011	0.028		
Zimaling Park (Zhongshan)	Max	0.176	0.102	0.138	0.106	0.134	0.093	0.099	0.124	0.117	0.136	0.137	0.175	7	2.08%
	Min	0.042	0.023	0.028	0.043	0.013	0.012	0.008	0.022	0.029	0.020	0.003	0.050		
Tsuen Wan (HKSAR)	Max	0.131	0.103	0.124	0.112	0.108	0.069	0.074	0.109	0.077	0.109	0.100	0.123	0	0.00%
	Min	0.032	0.017	0.022	0.039	0.018	0.015	0.018	0.017	0.021	0.012	0.007	0.043		
Tap Mun (HKSAR)	Max	0.111	0.094	0.133	0.118	0.098	0.053	0.087	0.075	0.082	0.094	0.097	0.112	0	0.00%
	Min	0.033	0.016	0.010	0.030	0.014	0.013	0.013	0.011	0.023	0.017	0.008	0.032		
Tung Chung (HKSAR)	Max	0.155	0.112	0.130	0.112	0.107	0.068	0.066	0.096	0.077	0.101	0.075	0.137	2	0.58%
	Min	0.040	0.023	0.023	0.030	0.013	0.009	0.010	0.010	0.016	0.010	0.007	0.035		

Table 3.4c : The monthly and annual averages of Respirable Suspended Particulates**[Class 2 NAAQS (Annual) : 0.10 mg/m³]**

Monitoring Stations	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Annual Average
Luhu Park (Guangzhou)	0.082	0.068	0.084	0.078	0.040	0.047	0.052	0.051	0.059	0.052	0.065	0.095	0.064
Wanqingsha (Guangzhou)	0.109	0.082	0.101	0.081	0.066	0.026	0.035	0.039	0.061	0.076	0.086	0.095*	0.070
Tianhu (Guangzhou)	0.060	0.057	0.058	0.093	0.044	0.033	0.032	0.042	0.044*	0.037	0.046	0.066	0.052
Liyuan (Shenzhen)	0.091	0.061	0.075	0.053	0.047	0.029	0.031	0.034	0.049	0.058	0.058	0.087	0.056
Tangjia (Zhuhai)	0.088	0.053*	0.075*	0.053	0.042	0.024	0.030	0.031	0.048	0.056	0.058	0.089	0.052
Jinjuzui (Foshan)	0.078	0.064	0.080	0.097	0.066	0.040	0.047	0.046	0.061	0.075	0.092	0.113	0.072
Huijingcheng (Foshan)	0.106	0.111	0.138	0.126	0.094	0.059	0.075	0.062	0.091	0.089	0.124	0.124	0.100
Donghu (Jiangmen)	0.073	0.068	0.082	0.053	0.043	0.025	0.036	0.036	0.056	0.061	0.062	0.066	0.056
Chengzhong (Zhaoqing)	0.089	0.098	0.102	0.083	0.060	0.043	0.055	0.054	0.077	0.069	0.090	0.102	0.077
Xiapu (Huizhou)	0.079	0.074	0.086	0.089	0.049	0.036	0.047	0.051	0.060	0.065	0.075	0.092	0.067
Jinguowan (Huizhou)	0.084	0.064	0.079	0.094	0.056	0.042	0.050	0.046	0.064	0.064	0.068	0.084*	0.066
Haogang (Dongguan)	0.081	0.080	0.095	0.090	0.058	0.044	0.052	0.043	0.059	0.062	0.075	0.090	0.069
Zimaling Park (Zhongshan)	0.099	0.061	0.088	0.071	0.048	0.025	0.033	0.047	0.062	0.067	0.078	0.114	0.066
Tsuen Wan (HKSAR)	0.076	0.060	0.072	0.064	0.045	0.031	0.032	0.036	0.049	0.055	0.052	0.083	0.055
Tap Mun (HKSAR)	0.069	0.057	0.070	0.066	0.040	0.024	0.028	0.027	0.048	0.057	0.052	0.078	0.051
Tung Chung (HKSAR)	0.091	0.062	0.079	0.057	0.044	0.020	0.024	0.030	0.042	0.049	0.043	0.076	0.052

Remark : 1. All concentration units are in milligrams per cubic metre.

2. “*”denotes that the data capture rate does not meet the minimum requirements for determining a representative value.

3.5 Monthly Variations of Pollutant Concentrations

Figure 8 shows the monthly variations of the major pollutants (SO_2 , NO_2 , O_3 , and PM_{10}) recorded by the Network in 2011. The overall concentrations of SO_2 , NO_2 and PM_{10} were generally higher during the winter season (first and fourth quarters of year) and relatively lower in the summer months. The lower pollutants levels in summer were mainly due to the relatively clean maritime air stream prevailed in the PRD region under the influence of southern monsoon together with heavier rainfall and higher mixing layer height that favoured the dispersion of pollutants. As for ozone, the highest monthly averages occurred in April, September and October because of more days in the period with meteorological conditions that favoured photochemical reactions (such as strong solar radiation, less amount of clouds, weak wind speed etc.), hence causing more ozone formation.

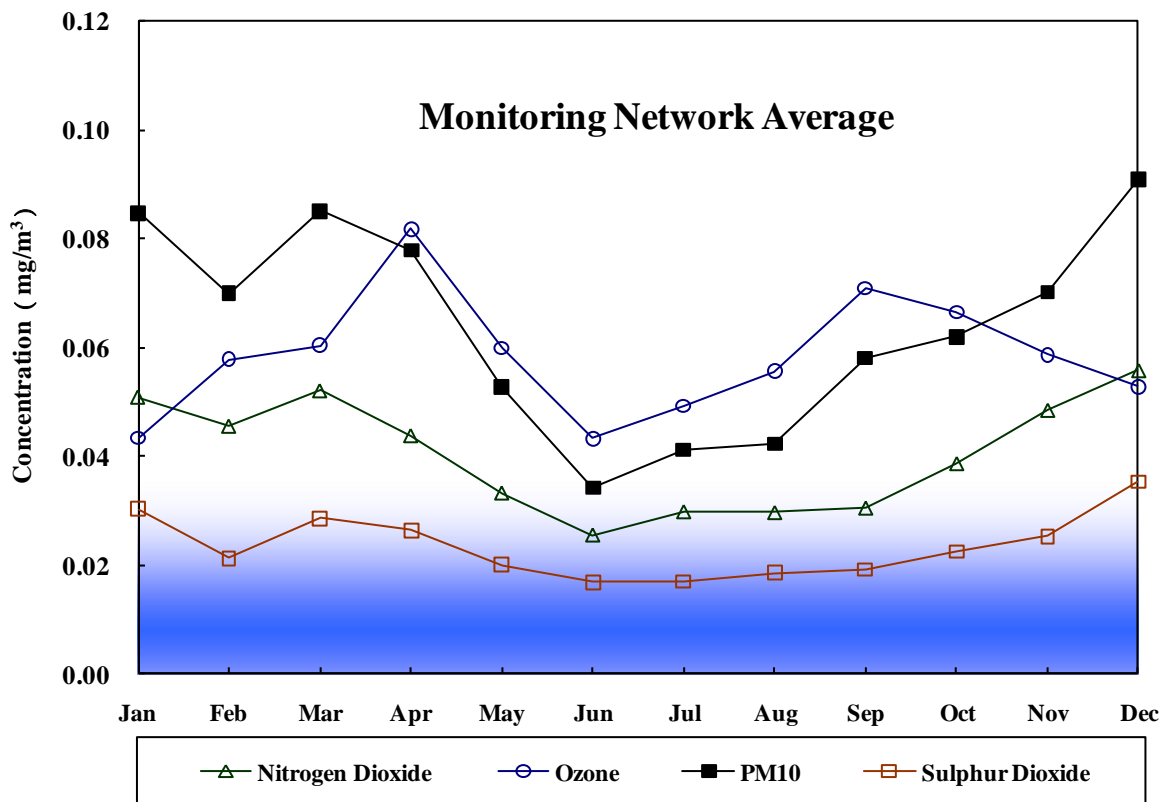


Figure 8 : Monthly variations of average pollutant concentrations measured by the Network

3.6 Annual Variations of Pollutant Concentrations (2006-2011)

Table 3.6 shows the annual mean concentrations of the major pollutants (SO₂, NO₂, O₃, and PM₁₀) recorded by the Network from 2006 to 2011.

From 2006 to 2011, the annual averages recorded by the Network for SO₂, NO₂, and PM₁₀ decreased by 49%, 13% and 14% respectively. These reductions indicated that the measures implemented in recent years by Guangdong and Hong Kong, including the retrofitting of power plants with flue-gas desulphurization facilities, tightening the vehicle emission standards and fuel specifications, phasing out the more polluting industrial facilities in the PRD, etc., had brought improvements in the overall air quality in the Pearl River Delta region. However, the Network had recorded an increase of 21% in the annual ozone average in the same period, reflecting that the photochemical smog pollution in the region has not yet improved. The Guangdong and Hong Kong governments will continue to implement emission reduction measures to further improve the air quality in the region and tackle the photochemical pollution problem.

Table 3.6 : Annual averages of the pollutants from the monitoring network

	Sulphur Dioxide	Nitrogen Dioxide	Ozone	Respirable Suspended Particulates
2006	0.047	0.046	0.048	0.074
2007	0.048	0.045	0.051	0.079
2008	0.039	0.045	0.051	0.070
2009	0.029	0.042	0.056	0.069
2010	0.025	0.043	0.053	0.064
2011	0.024	0.040	0.058	0.064

Remark : All concentration units are in milligrams per cubic metre.

4. Statistical Analysis of the Regional Air Quality Index (RAQI)

The two governments of Guangdong and HKSAR jointly started the daily reporting of the RAQI since 30 November 2005 to provide the public with information about the air quality in different parts of the PRD region.

The RAQI is a composite indicator of the aggregate level of the four major regional air pollutants, namely sulphur dioxide (SO₂), nitrogen dioxide (NO₂), ozone (O₃) and respirable suspended particulates (PM₁₀). The higher the index value, the higher the regional air pollution levels. The RAQI is divided into the following five grades:

Grade	Regional Air Quality Index (RAQI) value [#]	Air Quality Condition in the Monitored Area
I	0 – 1	Concentrations of all pollutants are well within Class 2 of the National Ambient Air Quality Standards (NAAQS)
II	1 – 2	Concentrations of all pollutants are generally within Class 2 NAAQS
III	2 – 3	Concentrations of individual pollutants may approach or exceed Class 2 NAAQS
IV	3 – 4	Class 2 NAAQS are generally exceeded
V	>4	Class 2 NAAQS are significantly exceeded

The formula for calculating the RAQI is as follows:

$$I_c = \sum_{i=1}^4 \frac{C_i}{R_i}$$

where I_c stands for the RAQI, an indicator of the aggregate pollution level of four pollutants, namely, SO₂, NO₂, O₃ and PM₁₀. For SO₂, NO₂ and PM₁₀, C_i is the daily average concentration while R_i represents the daily average concentration limits of the corresponding pollutants as specified in Class 2 NAAQS. For O₃, C_i is the highest hourly average of a day while R_i represents the hourly average concentration limit in Class 2 NAAQS (refer to Class 2 NAAQS (GB 3095 – 1996) revised version).

[#] The upper limits of the range of Grades I, II, III and IV of the RAQI are inclusive.

4.1 Statistics on RAQI Grades

Table 4.1 summarise the statistics on the RAQI grades and effective days of RAQI for all monitoring stations in the Network from January to December 2011.

Table 4.1 : Statistics on RAQI grades of individual monitoring stations

Monitoring Stations	District	Days with valid RAQI	Ratio of valid RAQI	Distribution of RAQI grades in 2011 (%)				
				Grade I	Grade II	Grade III	Grade IV	Grade V
Luhu Park	Guangzhou	347	95%	14.12	61.10	21.61	2.88	0.29
Wanqingsha	Guangzhou	340	93%	15.88	40.88	39.12	3.82	0.29
Tianhu	Guangzhou	302	83%	32.45	54.97	10.60	1.99	0.00
Liyuan	Shenzhen	351	96%	31.05	53.56	15.10	0.28	0.00
Tangjia	Zhuhai	338	93%	28.70	50.59	20.12	0.59	0.00
Jinjuzui	Foshan	347	95%	13.26	48.13	31.99	6.34	0.29
Huijingcheng	Foshan	342	94%	4.09	45.03	38.60	9.65	2.63
Donghu	Jiangmen	361	99%	25.48	53.74	18.56	2.22	0.00
Chengzhong	Zhaoqing	356	98%	14.61	54.49	27.25	3.09	0.56
Xiapu	Huizhou	355	97%	22.25	60.56	16.90	0.28	0.00
Jinguowan	Huizhou	348	95%	25.00	66.95	7.76	0.29	0.00
Haogang	Dongguan	358	98%	11.45	53.35	29.89	5.03	0.28
Zimaling Park	Zhongshan	340	93%	46.76	31.47	19.71	2.06	0.00
Tsuen Wan	HKSAR	356	98%	29.21	61.24	9.27	0.28	0.00
Tap Mun	HKSAR	356	98%	40.73	57.30	1.97	0.00	0.00
Tung Chung	HKSAR	354	97%	30.79	49.44	18.08	1.69	0.00

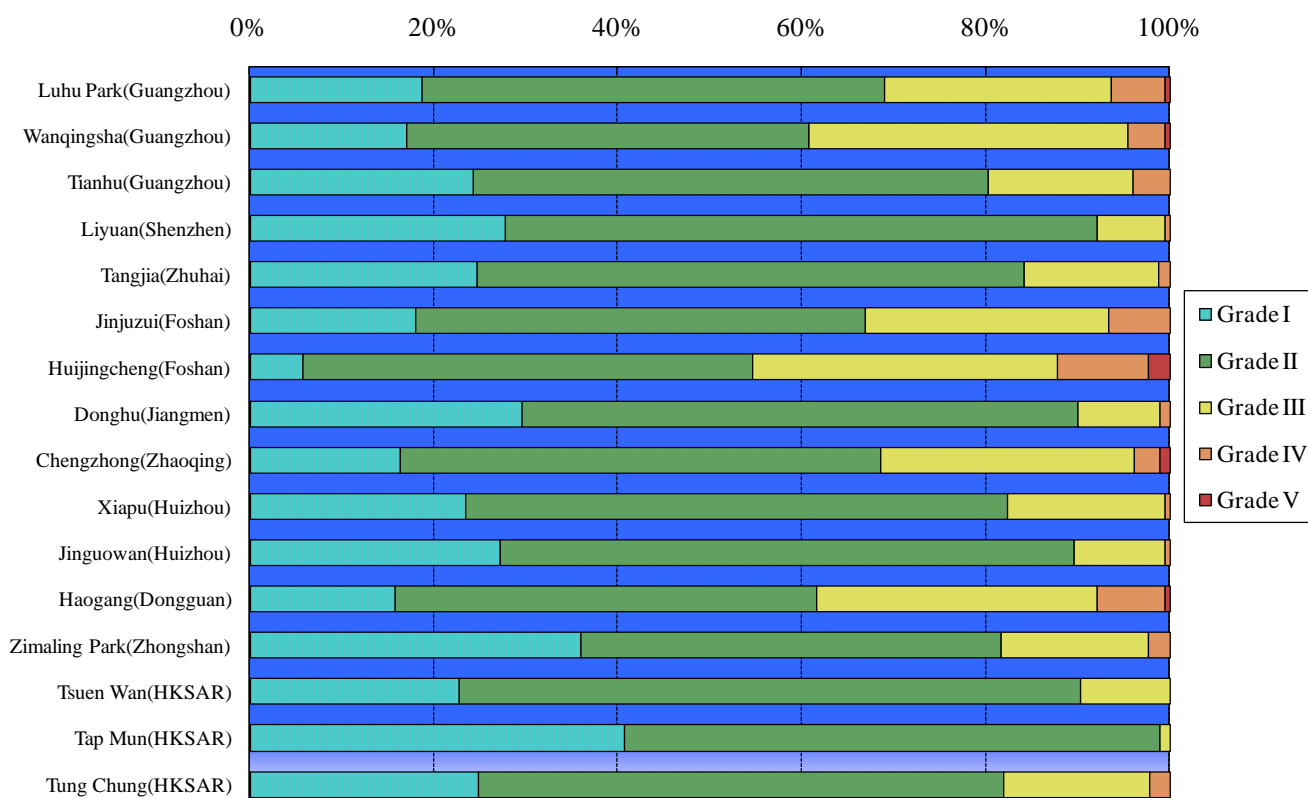


Figure 9 : Stacked column chart of RAQI grades of individual monitoring stations

Figure 10 shows the overall distribution of different RAQI grades recorded by the Network in 2011. As a whole, 76.7% of the RAQI values are at Grade I to II, meaning the pollutant concentrations are generally within Class 2 of the NAAQS, followed by 20.4% at Grade III, 2.5% at Grade IV and 0.3% at Grade V.

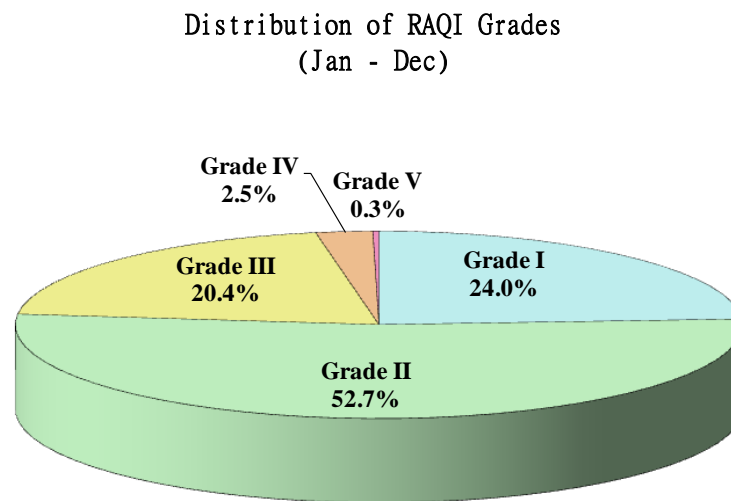


Figure 10 : Distribution of RAQI grades in the Network

4.2 Spatial Distribution of Average RAQI at Monitoring Stations in the Network

Distribution of average RAQI from Jan 2011 to Dec 2011

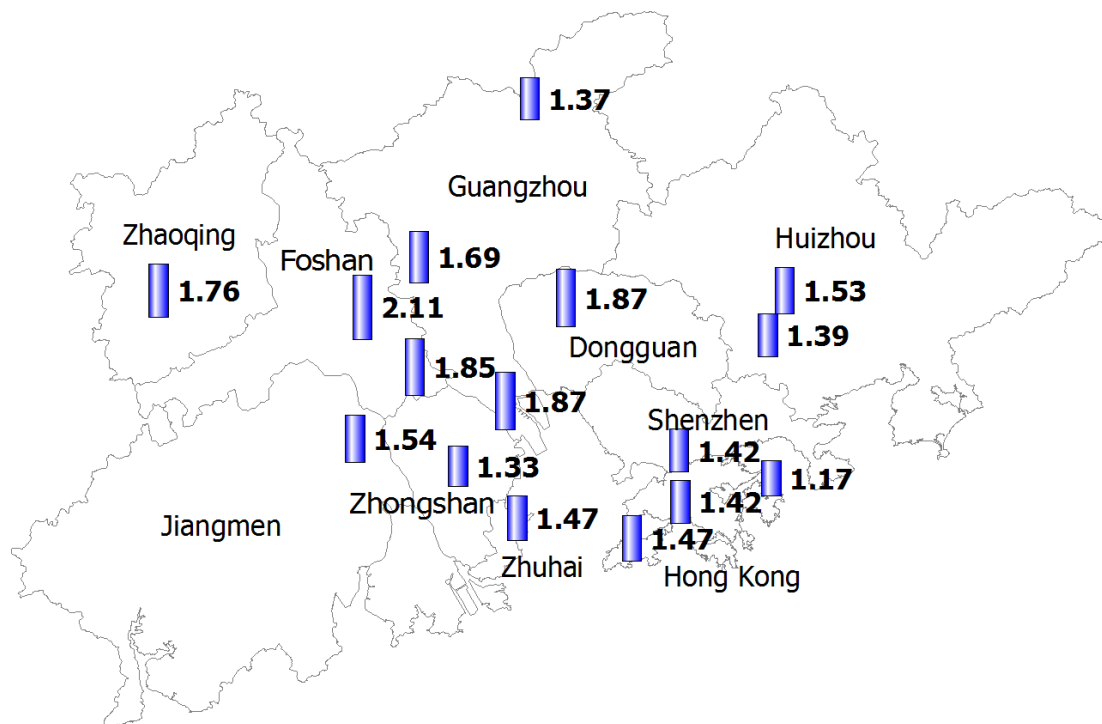


Figure 11 : Spatial distribution of average RAQI at Monitoring Stations in the Network

Figure 11 shows the spatial distribution of RAQI annual average in 2011 at monitoring stations in the network. The average values ranged from Grade II to Grade III.

4.3 Monthly Variations of Average RAQI

Figure 12 shows the monthly variations in the average RAQI values of the Network from January to December 2011. During the year, all monthly average RAQI were within the Grade II category. The maximum and minimum RAQI values were recorded in April and June respectively.

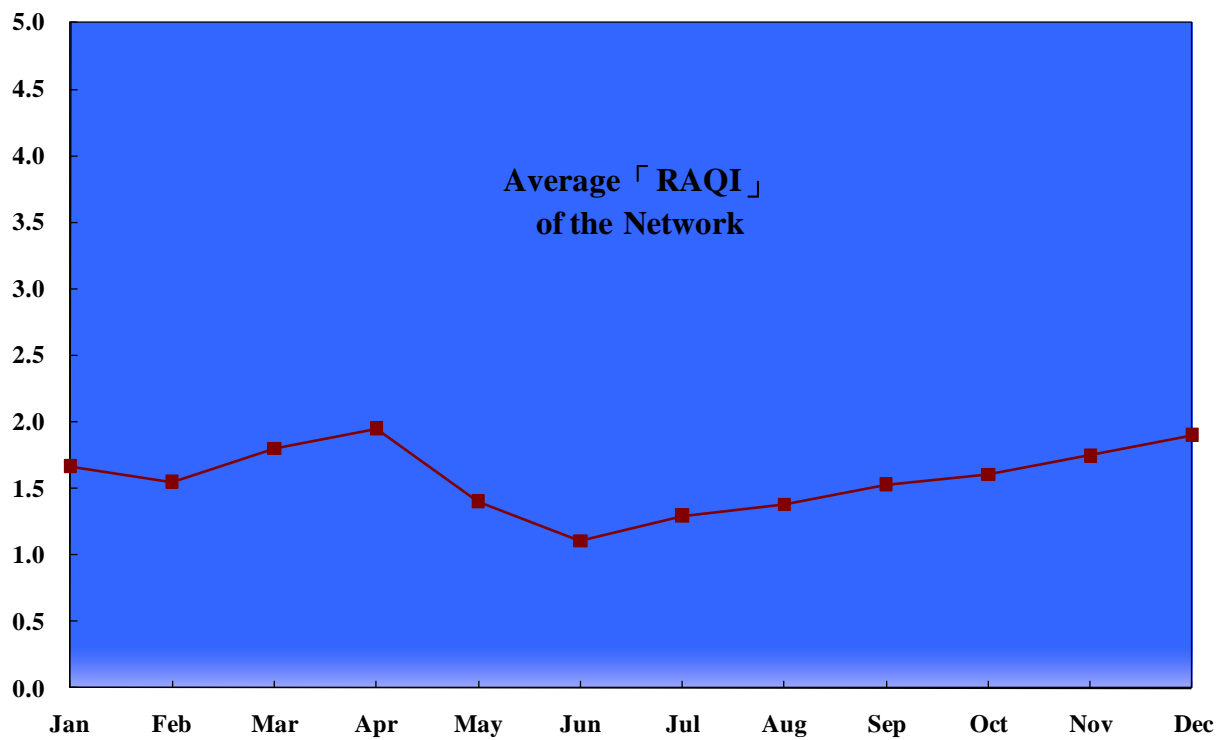


Figure 12 : Monthly variations in average RAQI

Annex A : Site Information of Monitoring Stations

Monitoring Stations	Address	Area Type	Sampling Height (Above P.D.)	Above Ground	Date Commenced Operation
Luhu Park (Guangzhou)	Inside Jufong Garden of Luhu Park (Big yard, No. 11 Luhu Park)	City	30m	9m	1993
Wanqingsha (Guangzhou)	Wanqingsha Secondary School, Nansha	Mixed educational/commercial and residential/industrial	13m	12m	Oct 2004
Tianhu (Guangzhou)	Tianhu Park, Conghua City	Background : rural	251m	13m	Oct 2004
Liyuan (Shenzhen)	Shennan Zhong Road, Shenzhen City	City	38m	12m	Sep 1997
Tangjia (Zhuhai)	Building No. 1, Rong Yuan, Zhongshan University, Tangjia, Zhuhai City	Mixed educational/commercial and residential/industrial	24m	19m	Jan 2003
Jinjuzui (Foshan)	Roof-top of Educational Building, Foshan City Communist Party Shunde Jinjuzui	Tourist and cultural /educational	27m	17m	Oct 1999
Huijingcheng (Foshan)	No. 127, Fenjiang Nan Road, Chancheng Area	Urban: mixed residential/commercial /industrial	24m	14m	Feb 2000
Donghu (Jiangmen)	Inside Donghu Park, Jiangmen City	City	17.5m	5m	Nov 2001
Chengzhong (Zhaoqing)	No. 17, Qintian Road, Zhaoqing City	Urban: mixed residential/commercial	21m	16m	Jun 2001
Xiapu (Huizhou)	No. 4 Xiabuhengjiang Road No. 3, Huicheng Area	Urban: commercial	49m	20m	Dec 1999
Jinguowan (Huizhou)	Jinguowan Ecological Farm, Huizhou City	Residential	77m	8m	Oct 2004
Haogang (Dongguan)	Haogang Primary School, NanchengQu, Dongguan City	Mixed residential/commercial/industrial	18 m	14m	1998
Zimaling Park (Zhongshan)	Zimaling Park, Zhongshan City	Mixed residential/commercial	45 m	7m	Aug 2002
Tsuen Wan (HKSAR)	60 Tai Ho Road, Tsuen Wan	Urban: mixed residential/commercial /industrial	21m	17m	Aug 1988
Tap Mun (HKSAR)	Tap Mun Police Station	Background: rural	26m	11m	Apr 1998
Tung Chung (HKSAR)	6 Fu Tung Street, Tung Chung	New Town: residential	34.5m	27.5m	Apr 1999

Annex B : Measurement Methods of Air Pollutant Concentration

Pollutants	Measuring Principles
Sulphur Dioxide	UV fluorescence / Differential Optical Absorption Spectroscopy
Nitrogen Dioxide	Chemiluminescence / Differential Optical Absorption Spectroscopy
Ozone	UV absorption / Differential Optical Absorption Spectroscopy
Respirable Suspended Particulates	Oscillating microbalance (TEOM) Beta particulate monitor