

Pearl River Delta
Regional Air Quality Monitoring Network

**A Report of Monitoring Results
for the Period between January and June 2012**

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Environmental Monitoring
Centre**

**Environmental Protection
Department, HKSAR**

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Management and Monitoring
Special Panel**

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Purpose of the Report

This report provides the monitoring results from the Pearl River Delta Regional Air Quality Monitoring Network measured between January and June 2012 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 it has been providing data for reporting of 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 3 stations located in Hong Kong are managed by the HKEPD. The remaining 3 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 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

Owing to the extensive renovation work at the Guangzhou Nansha Wanqingsha monitoring station, the station had been temporarily suspended from operation since January 2012. In addition, the Dongguan monitoring station was relocated from the original site in Haogong Primary School to a nearby location in the Nanchengyuanling district on 1 January 2012 because the representativeness of the original site had been affected by urban development.

The remaining monitoring stations in the Network were generally in smooth operation during the period from January to June 2011. Excluding the suspended Wanqingsha station, the average data capture rates of all other monitoring stations in the Network was 96%.

In order to provide the public in both Guangdong and HKSAR with daily air quality information in 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 carried out the agreed QA/QC activities, 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 complies continuously 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 and operation of the network and its QA/QC activities. 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.

The results of the performance audit on the accuracy and precision of the Network for 2012 will be discussed in details in the annual report.

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 human respiratory system, SO₂ contributes substantially to acid rain. It can also be oxidized in the air to form sulphate which has a significant impact on the levels of respirable suspended particulates (PM₁₀) and visibility in the region.

The overall averages of SO₂ at various monitoring stations in the Network ranged from 0.005 mg/m³ to 0.035 mg/m³ for the period from January to June 2012. During the period, all monitoring stations in the Network were in compliance with the national hourly air quality standard[#] (0.50 mg/m³) and daily air quality standard (0.15 mg/m³) of SO₂. Details are shown in Figure 2 and Tables 3.1a - 3.1c.

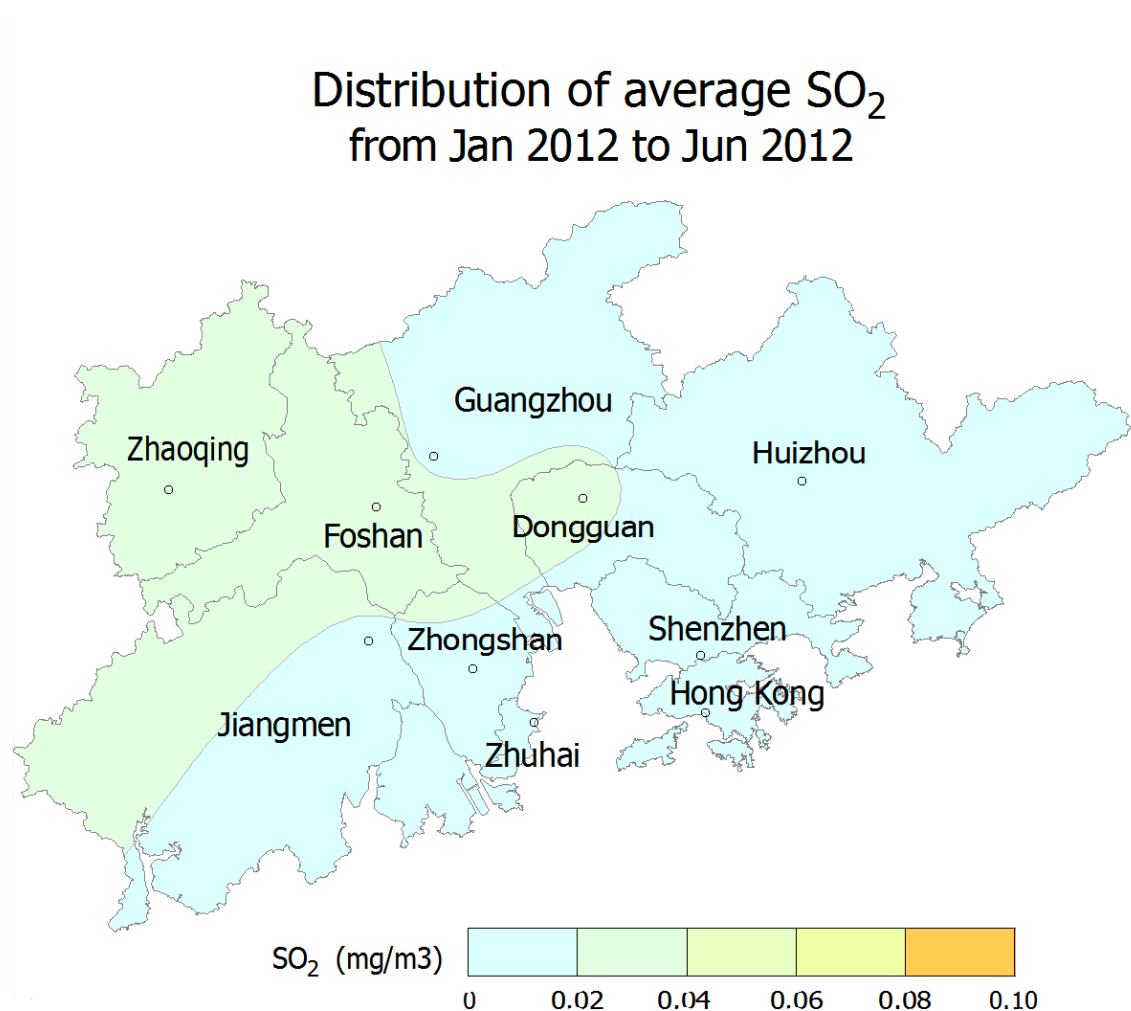


Figure 2 : Spatial distribution of average concentrations of Sulphur Dioxide (SO₂) in the Network

[#] National Standards refer to Class 2 of the “National Ambient Air Quality Standards (GB 3095 – 1996 – revised version)” [NAAQS], which are applicable to residential, mixed commercial/residential, cultural, industrial and village areas.

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

[Class 2 NAAQS (Hourly) : 0.50 mg/m³]

Month	Jan 2012		Feb		Mar		Apr		May		Jun		Exceed- ance Hours	Exceed- ance Rate
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Luhu Park (Guangzhou)	0.000	0.064	0.001	0.112	0.003	0.124	0.001	0.084	0.000	0.078	0.000	0.107	0	0.00%
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.003	0.042	0.004	0.060	0.003	0.082	0.003	0.048	0.003	0.049	0.002	0.060	0	0.00%
Liyuan (Shenzhen)	0.001	0.033	0.000	0.021	0.000	0.054	0.000	0.041	0.001	0.032	0.001	0.074	0	0.00%
Tangjia (Zhuhai)	0.000	0.069	0.000	0.067	0.000	0.042	0.000	0.130	0.002	0.041	0.002	0.043	0	0.00%
Jinjuzui (Foshan)	0.009	0.141	0.010	0.130	0.012	0.154	0.008	0.084	0.010	0.088	0.011	0.080	0	0.00%
Huijingcheng (Foshan)	0.008	0.102	0.015	0.146	0.012	0.209	0.010	0.180	0.009	0.112	0.008	0.125	0	0.00%
Donghu (Jiangmen)	0.003	0.056	0.006	0.099	0.006	0.124	0.002	0.171	0.001	0.064	0.002	0.044	0	0.00%
Chengzhong (Zhaoqing)	0.007	0.182	0.009	0.186	0.003	0.182	0.002	0.234	0.001	0.128	0.002	0.167	0	0.00%
Xiapu (Huizhou)	0.004	0.034	0.004	0.059	0.005	0.080	0.005	0.081	0.003	0.060	0.004	0.073	0	0.00%
Jinguowan (Huizhou)	0.001	0.024	0.000	0.037	0.003	0.024	0.003	0.055	0.004	0.016	0.005	0.041	0	0.00%
Nanchengyuanling (Dongguan)	0.007	0.139	0.010	0.102	0.009	0.168	0.008	0.119	0.009	0.092	0.008	0.121	0	0.00%
Zimaling Park (Zhongshan)	0.004	0.071	0.004	0.168	0.004	0.109	0.004	0.101	0.001	0.044	0.001	0.051	0	0.00%
Tsuen Wan (HKSAR)	0.007	0.074	0.007	0.140	0.005	0.098	0.008	0.087	0.003	0.078	0.004	0.063	0	0.00%
Tap Mun (HKSAR)	0.008	0.030	0.008	0.036	0.006	0.082	0.000	0.061	0.002	0.021	0.003	0.037	0	0.00%
Tung Chung (HKSAR)	0.005	0.061	0.004	0.055	0.006	0.087	0.006	0.081	0.007	0.039	0.006	0.089	0	0.00%

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

[Class 2 NAAQS (Daily) : 0.15 mg/m³]

Month	Jan 2012		Feb		Mar		Apr		May		Jun		Exceed- ance Days	Exceed- ance Rate
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Luhu Park (Guangzhou)	0.001	0.032	0.004	0.040	0.004	0.038	0.005	0.037	0.003	0.032	0.004	0.031	0	0.00%
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.005	0.026	0.006	0.034	0.005	0.039	0.004	0.025	0.006	0.026	0.005	0.029	0	0.00%
Liyuan (Shenzhen)	0.002	0.013	0.001	0.015	0.001	0.012	0.001	0.019	0.001	0.011	0.002	0.024	0	0.00%
Tangjia (Zhuhai)	0.001	0.052	0.001	0.023	0.001	0.013	0.002	0.043	0.002	0.017	0.006	0.016	0	0.00%
Jinjuzui (Foshan)	0.011	0.059	0.012	0.068	0.016	0.074	0.018	0.043	0.013	0.039	0.014	0.045	0	0.00%
Huijingcheng (Foshan)	0.011	0.058	0.024	0.082	0.022	0.097	0.022	0.067	0.018	0.045	0.015	0.049	0	0.00%
Donghu (Jiangmen)	0.006	0.036	0.008	0.057	0.008	0.047	0.009	0.035	0.005	0.026	0.003	0.022	0	0.00%
Chengzhong (Zhaoqing)	0.008	0.075	0.010	0.085	0.013	0.095	0.009	0.070	0.008	0.038	0.003	0.048	0	0.00%
Xiapu (Huizhou)	0.005	0.021	0.007	0.025	0.009	0.025	0.008	0.029	0.006	0.022	0.007	0.025	0	0.00%
Jinguowan (Huizhou)	0.007	0.019	0.007	0.027	0.004	0.020	0.004	0.026	0.004	0.009	0.005	0.013	0	0.00%
Nanchengyuanling (Dongguan)	0.009	0.047	0.013	0.048	0.013	0.067	0.011	0.058	0.011	0.035	0.010	0.050	0	0.00%
Zimaling Park (Zhongshan)	0.006	0.029	0.006	0.069	0.006	0.059	0.004	0.034	0.003	0.010	0.002	0.016	0	0.00%
Tsuen Wan (HKSAR)	0.008	0.037	0.008	0.072	0.008	0.043	0.009	0.042	0.004	0.035	0.005	0.029	0	0.00%
Tap Mun (HKSAR)	0.010	0.021	0.010	0.023	0.011	0.022	0.001	0.016	0.003	0.009	0.004	0.013	0	0.00%
Tung Chung (HKSAR)	0.007	0.025	0.007	0.023	0.007	0.039	0.007	0.034	0.007	0.019	0.007	0.030	0	0.00%

Table 3.1 c : The monthly and overall averages of Sulphur Dioxide

Month	Jan 2012	Feb	Mar	Apr	May	Jun	Overall Average
Luhu Park (Guangzhou)	0.012	0.019	0.018	0.018	0.018	0.013	0.016
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.012	0.014	0.014	0.011	0.011	0.010	0.012
Liyuan (Shenzhen)	0.006	0.006	0.005	0.005	0.004	0.006	0.005
Tangjia (Zhuhai)	0.020	0.009	0.007	0.009	0.009	0.009	0.011
Jinjuzui (Foshan)	0.025	0.035	0.035	0.029	0.025	0.026	0.029
Huijingcheng (Foshan)	0.027	0.044	0.044	0.038	0.030	0.029	0.035
Donghu (Jiangmen)	0.012	0.023	0.018	0.017	0.013	0.009	0.015
Chengzhong (Zhaoqing)	0.024	0.038	0.048	0.036	0.020	0.022	0.031
Xiapu (Huizhou)	0.011	0.013	0.014	0.013	0.012	0.012	0.012
Jinguowan (Huizhou)	0.011	0.013	0.010	0.008	0.006	0.007	0.009
Nanchengyuanling (Dongguan)	0.024	0.025	0.028	0.022	0.019	0.023	0.024
Zimaling Park (Zhongshan)	0.016	0.030	0.020	0.011	0.005	0.004	0.014
Tsuen Wan (HKSAR)	0.018	0.018	0.016	0.023	0.016	0.014	0.018
Tap Mun (HKSAR)	0.015	0.013	0.013	0.008	0.005	0.006	0.010
Tung Chung (HKSAR)	0.015	0.014	0.014	0.015	0.012	0.011	0.014

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

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 overall averages of NO₂ at various monitoring stations in the Network ranged from 0.013 mg/m³ to 0.066 mg/m³ for the period from January to June 2012. During the period, 5 monitoring stations in the Network had recorded exceedance of the national daily standard (0.12 mg/m³) while 4 monitoring stations had recorded exceedance of the national hourly air quality standard (0.24 mg/m³) of NO₂. Details are shown in Figures 3 and Tables 3.2a to 3.2c.

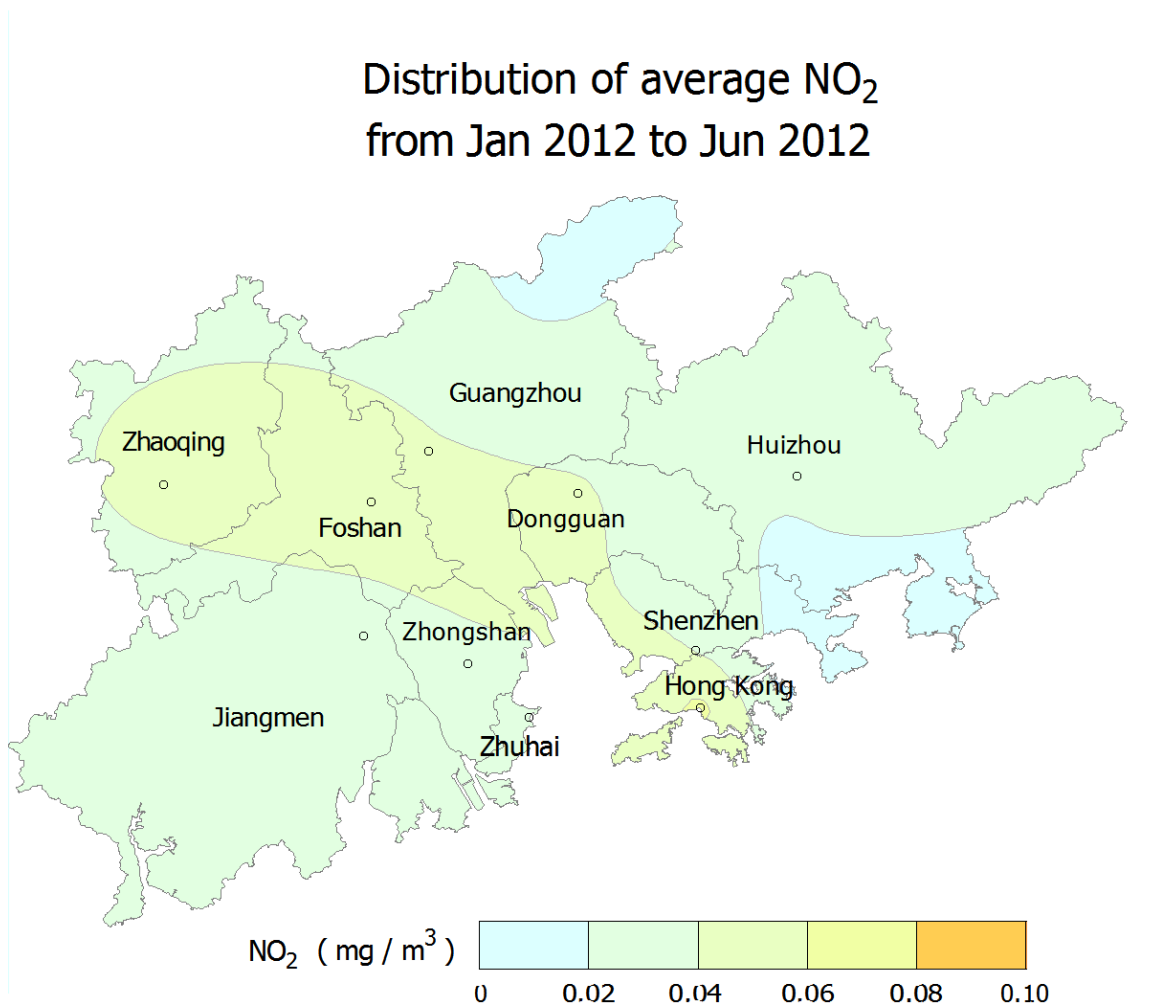


Figure 3 : Spatial distribution of average concentrations of Nitrogen Dioxide (NO₂) in the Network

Table 3.2 a : The monthly maxima and minima of hourly averages of Nitrogen Dioxide**[Class 2 NAAQS (Hourly) : 0.24 mg/m3]**

Month	Jan 2012		Feb		Mar		Apr		May		Jun		Exceed- ance Hours	Exceed- ance Rate
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Luhu Park (Guangzhou)	0.003	0.094	0.002	0.131	0.015	0.187	0.012	0.120	0.010	0.141	0.007	0.144	0	0.00%
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.005	0.054	0.006	0.057	0.003	0.093	0.003	0.071	0.003	0.058	0.000	0.074	0	0.00%
Liyuan (Shenzhen)	0.006	0.147	0.009	0.111	0.009	0.143	0.004	0.222	0.003	0.081	0.004	0.133	0	0.00%
Tangjia (Zhuhai)	0.002	0.118	0.003	0.114	0.000	0.116	0.000	0.121	0.000	0.097	0.002	0.095	0	0.00%
Jinjuzui (Foshan)	0.006	0.156	0.012	0.154	0.014	0.242	0.004	0.135	0.007	0.100	0.005	0.102	2	0.05%
Huijingcheng (Foshan)	0.008	0.154	0.012	0.211	0.006	0.255	0.012	0.205	0.009	0.137	0.011	0.115	1	0.02%
Donghu (Jiangmen)	0.010	0.086	0.010	0.099	0.008	0.124	0.010	0.097	0.006	0.077	0.006	0.071	0	0.00%
Chengzhong (Zhaoqing)	0.013	0.145	0.017	0.166	0.006	0.166	0.003	0.118	0.002	0.079	0.005	0.092	0	0.00%
Xiapu (Huizhou)	0.004	0.116	0.005	0.107	0.000	0.166	0.012	0.135	0.012	0.096	0.007	0.095	0	0.00%
Jinguowan (Huizhou)	0.004	0.048	0.004	0.056	0.003	0.067	0.003	0.063	0.002	0.064	0.001	0.061	0	0.00%
Nanchengyuanling (Dongguan)	0.006	0.153	0.015	0.251	0.009	0.196	0.008	0.150	0.005	0.103	0.005	0.145	1	0.02%
Zimaling Park (Zhongshan)	0.013	0.110	0.016	0.164	0.009	0.239	0.006	0.104	0.004	0.076	0.000	0.069	0	0.00%
Tsuen Wan (HKSAR)	0.013	0.175	0.015	0.192	0.016	0.158	0.017	0.195	0.014	0.161	0.015	0.144	0	0.00%
Tap Mun (HKSAR)	0.004	0.092	0.005	0.042	0.003	0.057	0.004	0.085	0.002	0.040	0.002	0.055	0	0.00%
Tung Chung (HKSAR)	0.012	0.184	0.011	0.166	0.007	0.258	0.005	0.221	0.007	0.099	0.005	0.135	1	0.02%

Table 3.2 b : The monthly maxima and minima of daily averages of Nitrogen Dioxide**[Class 2 NAAQS (Daily) : 0.12 mg/m3]**

Month	Jan 2012		Feb		Mar		Apr		May		Jun		Exceed- ance Days	Exceed- ance Rate
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Luhu Park (Guangzhou)	0.009	0.056	0.019	0.079	0.026	0.099	0.024	0.071	0.025	0.077	0.022	0.055	0	0.00%
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.006	0.030	0.008	0.035	0.007	0.051	0.004	0.028	0.005	0.025	0.001	0.031	0	0.00%
Liyuan (Shenzhen)	0.019	0.074	0.030	0.068	0.025	0.065	0.021	0.108	0.017	0.042	0.016	0.057	0	0.00%
Tangjia (Zhuhai)	0.013	0.084	0.018	0.071	0.023	0.078	0.011	0.067	0.004	0.056	0.005	0.037	0	0.00%
Jinjuzui (Foshan)	0.023	0.096	0.030	0.106	0.028	0.126	0.016	0.075	0.012	0.053	0.017	0.060	3	1.71%
Huijingcheng (Foshan)	0.022	0.098	0.033	0.119	0.040	0.166	0.027	0.114	0.022	0.076	0.023	0.061	1	0.57%
Donghu (Jiangmen)	0.011	0.055	0.013	0.032	0.013	0.047	0.015	0.049	0.012	0.049	0.010	0.041	0	0.00%
Chengzhong (Zhaoqing)	0.021	0.082	0.029	0.128	0.019	0.098	0.017	0.073	0.014	0.043	0.019	0.061	1	0.62%
Xiapu (Huizhou)	0.013	0.045	0.024	0.068	0.021	0.063	0.027	0.067	0.024	0.049	0.018	0.040	0	0.00%
Jinguowan (Huizhou)	0.006	0.030	0.013	0.036	0.012	0.029	0.007	0.023	0.006	0.023	0.003	0.026	0	0.00%
Nanchengyuanling (Dongguan)	0.013	0.074	0.026	0.084	0.029	0.094	0.021	0.075	0.020	0.050	0.017	0.053	0	0.00%
Zimaling Park (Zhongshan)	0.020	0.052	0.029	0.113	0.019	0.114	0.011	0.072	0.011	0.042	0.003	0.034	0	0.00%
Tsuen Wan (HKSAR)	0.036	0.092	0.035	0.126	0.043	0.111	0.050	0.127	0.044	0.086	0.048	0.092	2	1.14%
Tap Mun (HKSAR)	0.006	0.032	0.009	0.021	0.008	0.032	0.005	0.043	0.004	0.021	0.004	0.026	0	0.00%
Tung Chung (HKSAR)	0.033	0.095	0.029	0.089	0.012	0.135	0.010	0.133	0.014	0.065	0.010	0.057	2	1.10%

Table 3.2 c : The monthly and overall averages of Nitrogen Dioxide

Month	Jan 2012	Feb	Mar	Apr	May	Jun	Overall Average
Luhu Park (Guangzhou)	0.031	0.041	0.047	0.046	0.050	0.036	0.042
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.014	0.018	0.021	0.013	0.012	0.011	0.015
Liyuan (Shenzhen)	0.045	0.043	0.042	0.043	0.029	0.032	0.039
Tangjia (Zhuhai)	0.039	0.038	0.037	0.037	0.026	0.018	0.033
Jinjuzui (Foshan)	0.050	0.056	0.059	0.048	0.035	0.033	0.047
Huijingcheng (Foshan)	0.048	0.065	0.067	0.066	0.050	0.041	0.056
Donghu (Jiangmen)	0.021	0.019	0.025	0.029	0.025	0.023	0.024
Chengzhong (Zhaoqing)	0.044	0.056	0.047	0.047	0.029	0.029	0.042
Xiapu (Huizhou)	0.032	0.038	0.042	0.040	0.032	0.029	0.035
Jinguowan (Huizhou)	0.020	0.021	0.019	0.014	0.010	0.009	0.016
Nanchengyuanling (Dongguan)	0.040	0.048	0.055	0.045	0.033	0.033	0.042
Zimaling Park (Zhongshan)	0.037	0.058	0.050	0.035	0.027	0.016	0.037
Tsuen Wan (HKSAR)	0.067	0.067	0.067	0.071	0.057	0.065	0.066
Tap Mun (HKSAR)	0.017	0.015	0.014	0.014	0.008	0.010	0.013
Tung Chung (HKSAR)	0.065	0.055	0.054	0.048	0.034	0.031	0.048

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

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. The overall averages of O₃ recorded by the Network ranged from 0.029 mg/m³ to 0.069 mg/m³ for the period from January to June 2012, with higher average values recorded in rural areas such as Tianhu of Guangzhou, Tap Mun of Hong Kong and Jinguowan of Huizhou, similar to the corresponding period in previous years. During the period, all monitoring stations in the Network had recorded exceedance of the national hourly standard (0.20 mg/m³) of O₃. Details are shown on Figures 4 and Tables 3.3a to 3.3c.

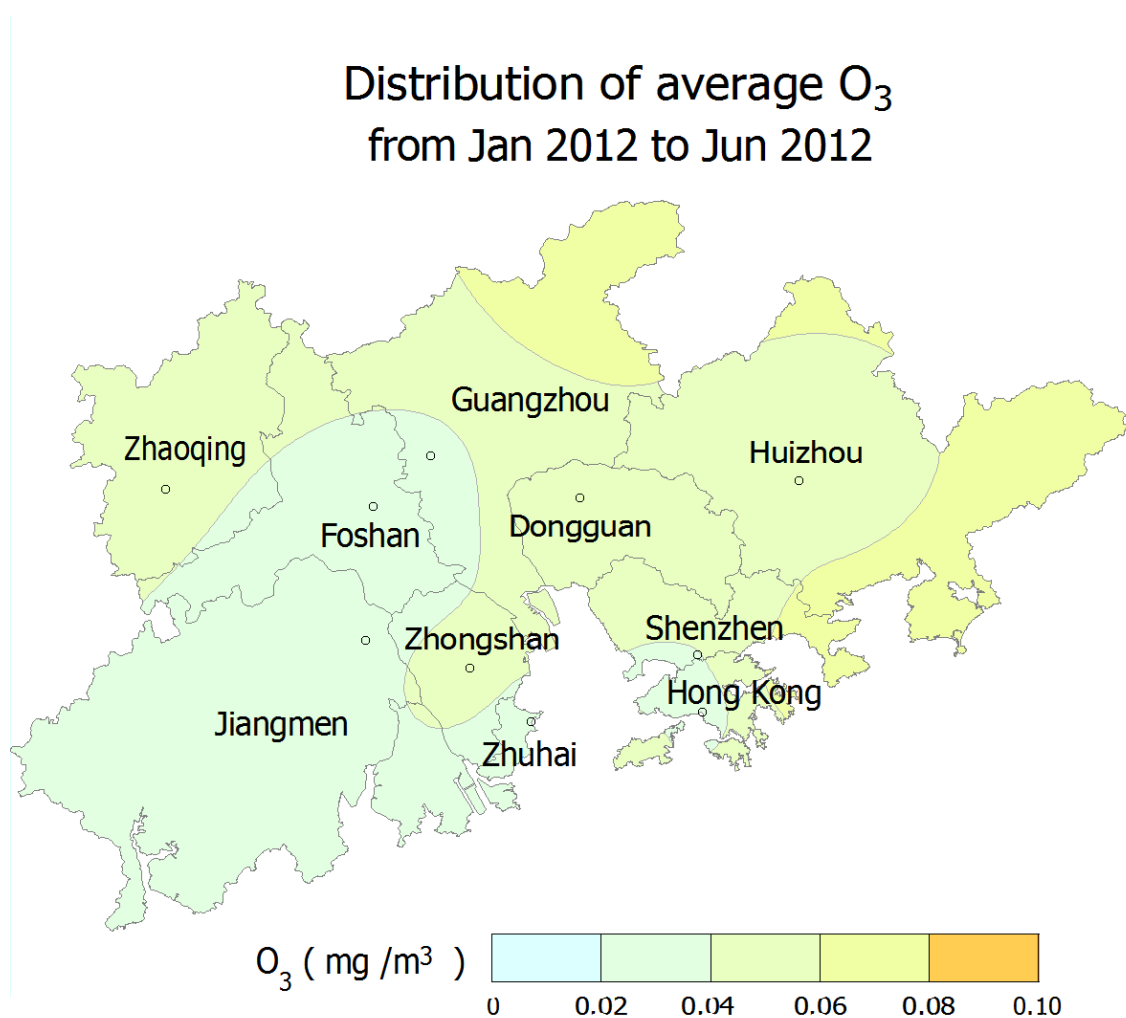


Figure 4 : Spatial distribution of average concentrations of Ozone (O₃) in the Network

Table 3.3 a : The monthly maxima and minima of hourly averages of Ozone**[Class 2 NAAQS (Hourly) : 0.20mg/m³]**

Month	Jan 2012		Feb		Mar		Apr		May		Jun		Exceed- ance Hours	Exceed- ance Rate
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Luhu Park (Guangzhou)	0.000	0.139	0.000	0.155	0.000	0.273	0.000	0.247	0.001	0.346	0.001	0.354	64	1.49%
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.003	0.127	0.003	0.151	0.002	0.208	0.002	0.247	0.003	0.210	0.004	0.269	31	0.76%
Liyuan (Shenzhen)	0.001	0.168	0.000	0.143	0.000	0.195	0.000	0.213	0.000	0.190	0.000	0.221	4	0.09%
Tangjia (Zhuhai)	0.000	0.197	0.000	0.161	0.000	0.185	0.000	0.154	0.006	0.257	0.006	0.217	6	0.15%
Jinjuzui (Foshan)	0.001	0.140	0.001	0.162	0.001	0.286	0.002	0.233	0.005	0.256	0.002	0.264	33	0.78%
Huijingcheng (Foshan)	0.002	0.116	0.000	0.144	0.003	0.245	0.004	0.246	0.003	0.232	0.003	0.263	45	1.07%
Donghu (Jiangmen)	0.002	0.139	0.003	0.180	0.003	0.264	0.002	0.200	0.003	0.335	0.003	0.261	29	0.68%
Chengzhong (Zhaoqing)	0.002	0.114	0.003	0.132	0.005	0.223	0.003	0.300	0.002	0.256	0.005	0.255	26	0.63%
Xiapu (Huizhou)	0.001	0.123	0.003	0.101	0.003	0.209	0.002	0.251	0.002	0.267	0.003	0.202	16	0.38%
Jinguowan (Huizhou)	0.002	0.138	0.003	0.137	0.001	0.191	0.003	0.231	0.006	0.177	0.006	0.224	5	0.12%
Nanchengyuanling (Dongguan)	0.004	0.184	0.001	0.220	0.001	0.247	0.002	0.272	0.002	0.291	0.003	0.354	96	2.29%
Zimaling Park (Zhongshan)	0.005	0.119	0.005	0.151	0.004	0.222	0.009	0.290	0.001	0.290	0.001	0.277	34	0.82%
Tsuen Wan (HKSAR)	0.002	0.102	0.000	0.080	0.003	0.143	0.002	0.173	0.003	0.120	0.003	0.201	1	0.02%
Tap Mun (HKSAR)	0.003	0.158	0.005	0.146	0.003	0.177	0.002	0.248	0.003	0.196	0.004	0.258	7	0.17%
Tung Chung (HKSAR)	0.002	0.113	0.003	0.111	0.004	0.178	0.006	0.283	0.004	0.292	0.004	0.307	18	0.42%

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

Month	Jan 2012		Feb		Mar		Apr		May		Jun	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Luhu Park (Guangzhou)	0.001	0.066	0.001	0.064	0.001	0.084	0.004	0.085	0.008	0.124	0.007	0.106
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.009	0.094	0.012	0.093	0.009	0.191	0.043	0.141	0.049	0.128	0.032	0.117
Liyuan (Shenzhen)	0.003	0.087	0.001	0.086	0.002	0.110	0.005	0.095	0.009	0.099	0.010	0.084
Tangjia (Zhuhai)	0.002	0.077	0.001	0.066	0.003	0.070	0.009	0.090	0.024	0.105	0.031	0.071
Jinjuzui (Foshan)	0.002	0.056	0.003	0.064	0.003	0.108	0.008	0.085	0.018	0.093	0.015	0.115
Huijingcheng (Foshan)	0.003	0.047	0.004	0.053	0.004	0.096	0.006	0.092	0.012	0.108	0.010	0.100
Donghu (Jiangmen)	0.005	0.054	0.005	0.071	0.005	0.089	0.011	0.093	0.016	0.130	0.021	0.095
Chengzhong (Zhaoqing)	0.004	0.057	0.007	0.077	0.009	0.109	0.022	0.106	0.024	0.113	0.016	0.112
Xiapu (Huizhou)	0.004	0.068	0.013	0.062	0.013	0.104	0.018	0.110	0.035	0.129	0.028	0.104
Jinguowan (Huizhou)	0.015	0.082	0.020	0.082	0.016	0.123	0.028	0.117	0.030	0.108	0.040	0.103
Nanchengyuanling (Dongguan)	0.007	0.088	0.008	0.082	0.004	0.115	0.016	0.107	0.027	0.136	0.022	0.120
Zimaling Park (Zhongshan)	0.007	0.052	0.007	0.073	0.007	0.111	0.027	0.134	0.027	0.112	0.032	0.095
Tsuen Wan (HKSAR)	0.003	0.063	0.004	0.052	0.006	0.093	0.006	0.096	0.008	0.094	0.016	0.080
Tap Mun (HKSAR)	0.017	0.117	0.015	0.098	0.019	0.145	0.023	0.137	0.031	0.141	0.044	0.124
Tung Chung (HKSAR)	0.003	0.077	0.006	0.077	0.006	0.132	0.021	0.135	0.014	0.116	0.032	0.102

Table 3.3 c : The monthly and overall averages of Ozone

Month	Jan 2012	Feb	Mar	Apr	May	Jun	Overall Average
Luhu Park (Guangzhou)	0.022	0.019	0.024	0.029	0.054	0.052	0.033
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.052	0.056	0.073	0.080	0.083	0.073	0.069
Liyuan (Shenzhen)	0.029	0.030	0.048	0.041	0.045	0.041	0.039
Tangjia (Zhuhai)	0.025	0.026	0.031	0.037	0.050	0.049	0.036
Jinjuzui (Foshan)	0.020	0.021	0.031	0.038	0.051	0.053	0.036
Huijingcheng (Foshan)	0.019	0.020	0.034	0.037	0.056	0.054	0.036
Donghu (Jiangmen)	0.023	0.025	0.034	0.041	0.055	0.049	0.038
Chengzhong (Zhaoqing)	0.027	0.030	0.043	0.045	0.061	0.050	0.042
Xiapu (Huizhou)	0.025	0.031	0.055	0.055	0.070	0.063	0.050
Jinguowan (Huizhou)	0.043	0.047	0.068	0.062	0.062	0.064	0.057
Nanchengyuanling (Dongguan)	0.041	0.037	0.048	0.054	0.076	0.069	0.054
Zimaling Park (Zhongshan)	0.016	0.028	0.045	0.065	0.056	0.056	0.044
Tsuen Wan (HKSAR)	0.020	0.021	0.037	0.034	0.033	0.032	0.029
Tap Mun (HKSAR)	0.054	0.057	0.070	0.076	0.082	0.077	0.069
Tung Chung (HKSAR)	0.021	0.031	0.049	0.058	0.053	0.059	0.045

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

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 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.

The overall averages of PM₁₀ at various monitoring stations in the Network ranged from 0.040 mg/m³ to 0.081 mg/m³ for the period from January to June 2012. During the period, 13 monitoring stations had recorded exceedance of the national daily standard (0.15mg/m³) of PM₁₀. Details are shown in Figure 5 and Tables 3.4a to 3.4c.

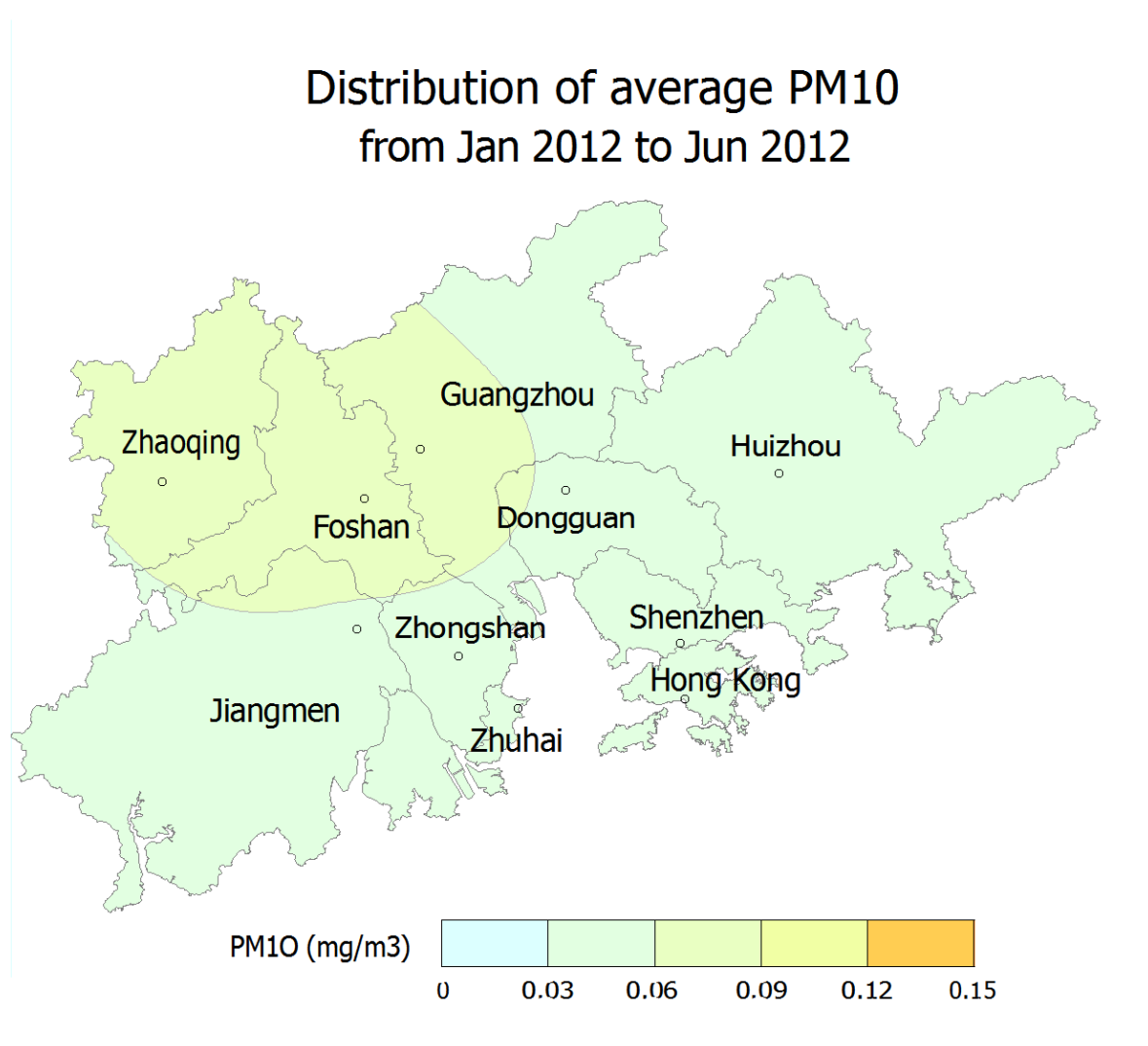


Figure 5 : Spatial distribution of average concentrations of Respirable Suspended Particulates (PM₁₀) in the Network

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

Month	Jan 2012		Feb		Mar		Apr		May		Jun	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Luhu Park (Guangzhou)	0.017	0.213	0.016	0.224	0.025	0.360	0.024	0.219	0.033	0.194	0.024	0.178
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.000	0.126	0.000	0.187	0.002	0.230	0.001	0.204	0.003	0.107	0.002	0.136
Liyuan (Shenzhen)	0.001	0.179	0.002	0.187	0.000	0.235	0.000	0.192	0.001	0.096	0.001	0.111
Tangjia (Zhuhai)	0.000	0.196	0.002	0.196	0.003	0.246	0.000	0.167	0.004	0.125	0.008	0.120
Jinjuzui (Foshan)	0.001	0.236	0.006	0.297	0.004	0.448	0.000	0.246	0.001	0.121	0.003	0.158
Huijingcheng (Foshan)	0.009	0.270	0.017	0.272	0.021	0.484	0.007	0.422	0.006	0.174	0.006	0.157
Donghu (Jiangmen)	0.000	0.121	0.002	0.244	0.011	0.247	0.000	0.270	0.001	0.176	0.001	0.170
Chengzhong (Zhaoqing)	0.000	0.247	0.003	0.311	0.003	0.407	0.002	0.200	0.001	0.178	0.003	0.114
Xiapu (Huizhou)	0.004	0.155	0.001	0.176	0.006	0.240	0.004	0.207	0.005	0.107	0.004	0.127
Jinguowan (Huizhou)	0.002	0.132	0.001	0.178	0.002	0.199	0.000	0.155	0.004	0.189	0.001	0.183
Nanchengyuanling (Dongguan)	0.003	0.191	0.008	0.262	0.005	0.316	0.003	0.172	0.006	0.099	0.006	0.126
Zimaling Park (Zhongshan)	0.000	0.248	0.004	0.314	0.000	0.370	0.003	0.153	0.001	0.119	0.002	0.144
Tsuen Wan (HKSAR)	0.008	0.180	0.006	0.142	0.005	0.244	0.003	0.142	0.004	0.089	0.003	0.122
Tap Mun (HKSAR)	0.003	0.117	0.004	0.114	0.008	0.224	0.007	0.146	0.005	0.070	0.004	0.099
Tung Chung (HKSAR)	0.008	0.221	0.003	0.207	0.009	0.299	0.002	0.252	0.006	0.115	0.005	0.174

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

Month	Jan 2012		Feb		Mar		Apr		May		Jun		Exceed- ance Days	Exceed- ance Rate
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
Luhu Park (Guangzhou)	0.024	0.141	0.032	0.165	0.037	0.248	0.058	0.153	0.055	0.111	0.039	0.109	7	3.91%
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.002	0.079	0.010	0.134	0.010	0.148	0.015	0.125	0.017	0.065	0.012	0.081	0	0.00%
Liyuan (Shenzhen)	0.010	0.100	0.016	0.098	0.022	0.171	0.009	0.092	0.015	0.068	0.013	0.064	1	0.56%
Tangjia (Zhuhai)	0.011	0.105	0.016	0.094	0.019	0.169	0.008	0.096	0.018	0.053	0.022	0.061	1	0.61%
Jinjuzui (Foshan)	0.014	0.133	0.035	0.169	0.032	0.315	0.024	0.115	0.027	0.058	0.021	0.072	7	4.05%
Huijingcheng (Foshan)	0.018	0.156	0.038	0.188	0.048	0.303	0.040	0.157	0.037	0.090	0.025	0.100	15	8.62%
Donghu (Jiangmen)	0.008	0.079	0.023	0.143	0.027	0.168	0.026	0.143	0.022	0.097	0.021	0.090	2	1.14%
Chengzhong (Zhaoqing)	0.011	0.154	0.020	0.192	0.027	0.262	0.025	0.121	0.016	0.093	0.016	0.065	6	3.53%
Xiapu (Huizhou)	0.017	0.117	0.016	0.111	0.016	0.137	0.019	0.100	0.017	0.065	0.021	0.076	0	0.00%
Jinguowan (Huizhou)	0.010	0.105	0.015	0.110	0.025	0.154	0.024	0.094	0.029	0.068	0.023	0.074	1	0.59%
Nanchengyuanling (Dongguan)	0.012	0.125	0.027	0.144	0.021	0.156	0.022	0.102	0.026	0.058	0.019	0.074	1	0.56%
Zimaling Park (Zhongshan)	0.007	0.143	0.020	0.148	0.010	0.196	0.017	0.105	0.012	0.047	0.016	0.078	1	0.56%
Tsuen Wan (HKSAR)	0.018	0.108	0.022	0.098	0.022	0.186	0.021	0.096	0.017	0.057	0.016	0.066	1	0.55%
Tap Mun (HKSAR)	0.017	0.101	0.014	0.095	0.019	0.165	0.017	0.086	0.010	0.056	0.014	0.064	1	0.55%
Tung Chung (HKSAR)	0.023	0.153	0.019	0.110	0.024	0.177	0.014	0.113	0.012	0.044	0.013	0.063	3	1.69%

Table 3.4 c : The monthly and overall averages of Respirable Suspended Particulates

Month	Jan 2012	Feb	Mar	Apr	May	Jun	Overall Average
Luhu Park (Guangzhou)	0.061	0.078	0.113	0.089	0.079	0.067	0.081
Wanqingsha (Guangzhou)	--	--	--	--	--	--	--
Tianhu (Guangzhou)	0.034	0.047	0.057	0.044	0.041	0.041	0.044
Liyuan (Shenzhen)	0.045	0.046	0.052	0.044	0.034	0.031	0.042
Tangjia (Zhuhai)	0.058	0.049	0.059	0.042	0.029	0.036	0.046
Jinjuzui (Foshan)	0.070	0.079	0.101	0.058	0.042	0.043	0.065
Huijingcheng (Foshan)	0.070	0.092	0.124	0.080	0.059	0.056	0.080
Donghu (Jiangmen)	0.042	0.053	0.078	0.063	0.048	0.046	0.055
Chengzhong (Zhaoqing)	0.062	0.085	0.092	0.060	0.046	0.031	0.062
Xiapu (Huizhou)	0.057	0.054	0.065	0.046	0.037	0.041	0.050
Jinguowan (Huizhou)	0.046	0.050	0.062	0.054	0.045	0.050	0.051
Nanchengyuanling (Dongguan)	0.058	0.069	0.080	0.047	0.042	0.042	0.056
Zimaling Park (Zhongshan)	0.064	0.070	0.068	0.042	0.029	0.035	0.051
Tsuen Wan (HKSAR)	0.057	0.048	0.053	0.047	0.032	0.035	0.046
Tap Mun (HKSAR)	0.046	0.040	0.051	0.042	0.029	0.030	0.040
Tung Chung (HKSAR)	0.074	0.054	0.062	0.045	0.026	0.031	0.049

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

3.5 Monthly Variations of Pollutant Concentrations

Figure 6 shows the monthly variations of the major pollutants (SO_2 , NO_2 , O_3 , and PM_{10}) recorded by the Network during the period from January to June 2012. The overall concentrations of SO_2 , NO_2 and PM_{10} were generally higher in the first quarter and lower in June as summer approached, similar to the corresponding period in previous years. 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.



Figure 6 : Monthly variations of average pollutant concentrations measured by the Network

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 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 and Figure 7 summarise the statistics on the RAQI grades of all monitoring stations in the Network from January to June 2012. The percentages of days with valid RAQI at various monitoring stations averaged 95%.

Table 4.1 : Statistics on RAQI grades of individual monitoring stations

Monitoring Stations	District	Days with valid RAQI	Distribution of RAQI grades (%) (January – June 2012)				
			Grade I	Grade II	Grade III	Grade IV	Grade V
Luhu Park	Guangzhou	177	23.73	50.85	24.86	0.56	0.00
Wanqingsha	Guangzhou	--	--	--	--	--	--
Tianhu	Guangzhou	164	54.27	43.90	1.83	0.00	0.00
Liyuan	Shenzhen	179	52.51	46.37	1.12	0.00	0.00
Tangjia	Zhuhai	168	51.79	47.02	1.19	0.00	0.00
Jinjuzui	Foshan	174	24.71	56.90	16.67	1.72	0.00
Huijingcheng	Foshan	170	14.12	54.12	28.24	3.53	0.00
Donghu	Jiangmen	176	44.32	47.73	7.95	0.00	0.00
Chengzhong	Zhaoqing	165	33.94	48.48	15.15	2.42	0.00
Xiapu	Huizhou	178	38.76	57.87	3.37	0.00	0.00
Jinguowan	Huizhou	174	60.34	39.66	0.00	0.00	0.00
Nanchengyuanling	Dongguan	168	22.02	57.74	19.64	0.60	0.00
Zimaling Park	Zhongshan	171	42.69	48.54	7.60	1.17	0.00
Tsuen Wan	HKSAR	175	32.57	64.57	2.86	0.00	0.00
Tap Mun	HKSAR	175	60.57	39.43	0.00	0.00	0.00
Tung Chung	HKSAR	175	39.43	53.14	7.43	0.00	0.00

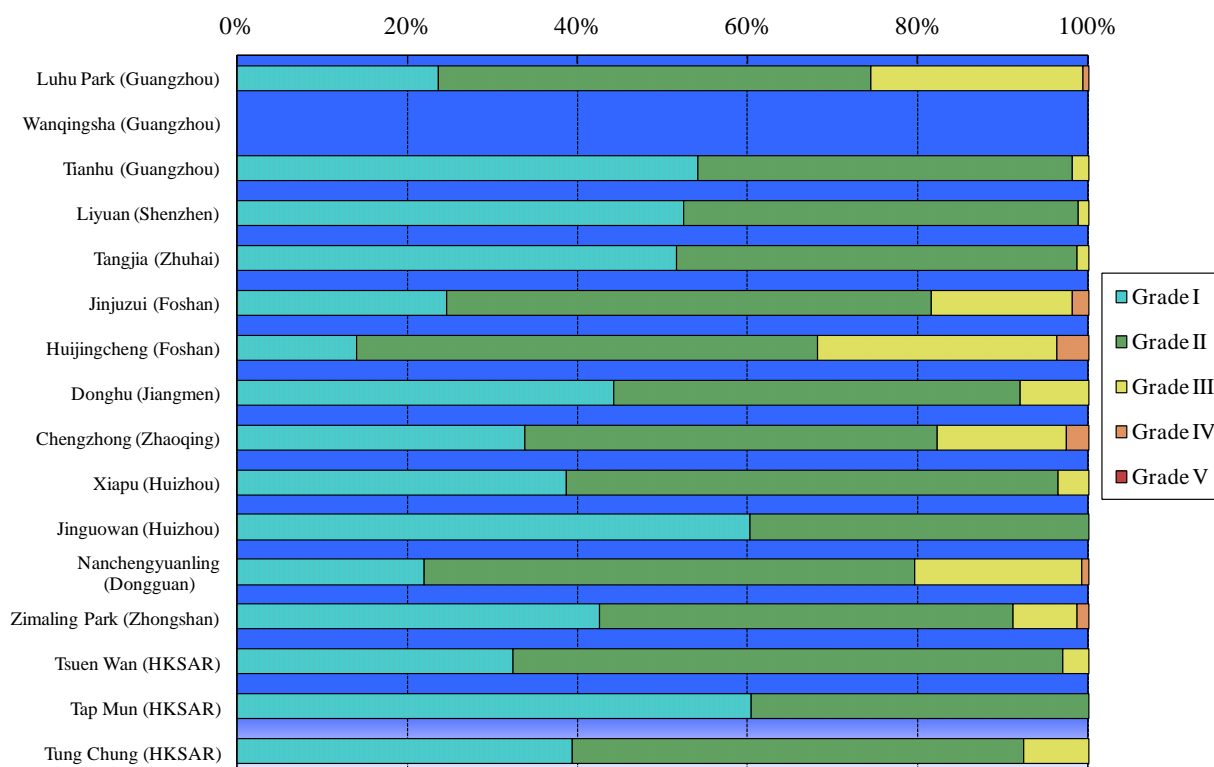


Figure 7 : Stacked column chart of RAQI grades of individual monitoring stations

Figure 8 shows the overall distribution of different RAQI grades recorded by the Network during the period from January to June 2012. As a whole, 90.19% of the RAQI values are at Grade I to II, meaning the pollutant concentrations are generally within Class 2 of the NAAQS, followed by 9.15% at Grade III and 0.66% at Grade IV while none at Grade V.

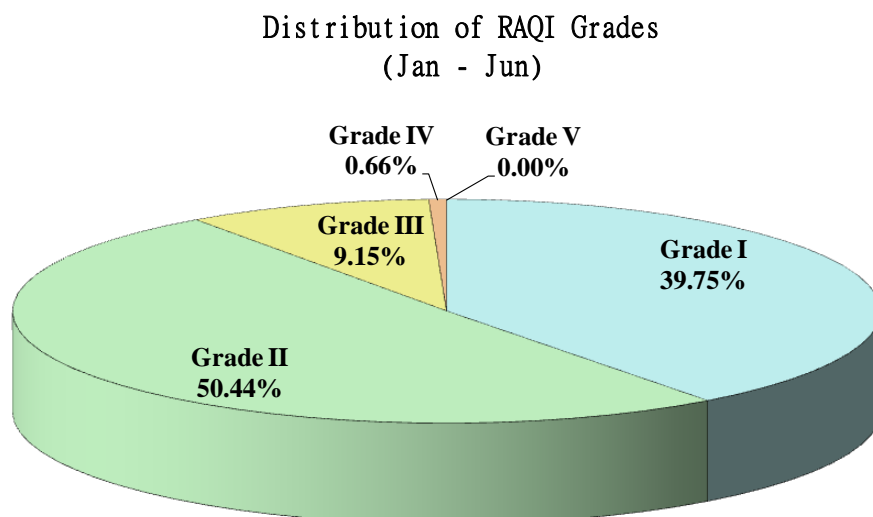


Figure 8 : Distribution of RAQI grades in the Network

4.2 Spatial Distribution of Average RAQI Grades

Distribution of average RAQI from Jan 2012 to Jun 2012

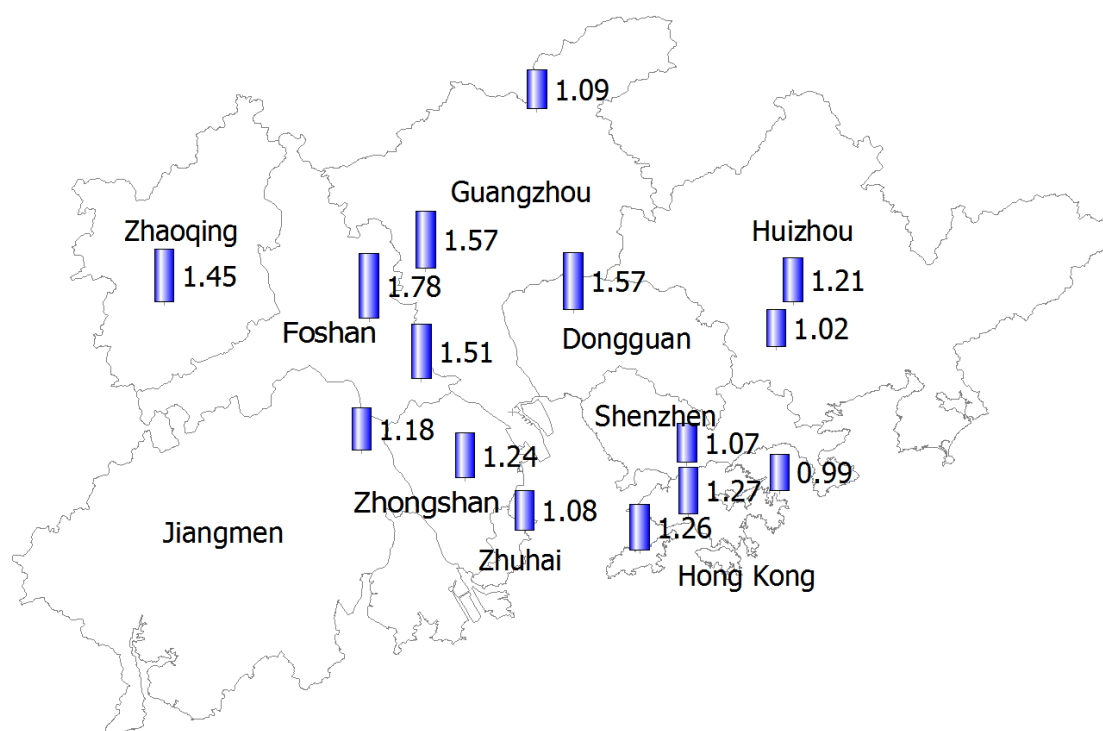


Figure 9 : Spatial distribution of average RAQI at Monitoring Stations in the Network

Figure 9 shows the spatial distribution of half-yearly average RAQI during the period from January to June 2012. The half-yearly average RAQI values measured in the PRD monitoring network ranged from Grade I to Grade II.

4.3 Monthly Variations of Average RAQI

Figure 10 shows the monthly variations in the average RAQI values of the Network from January to June 2012. The average RAQI values in all six months were within the Grade II category.

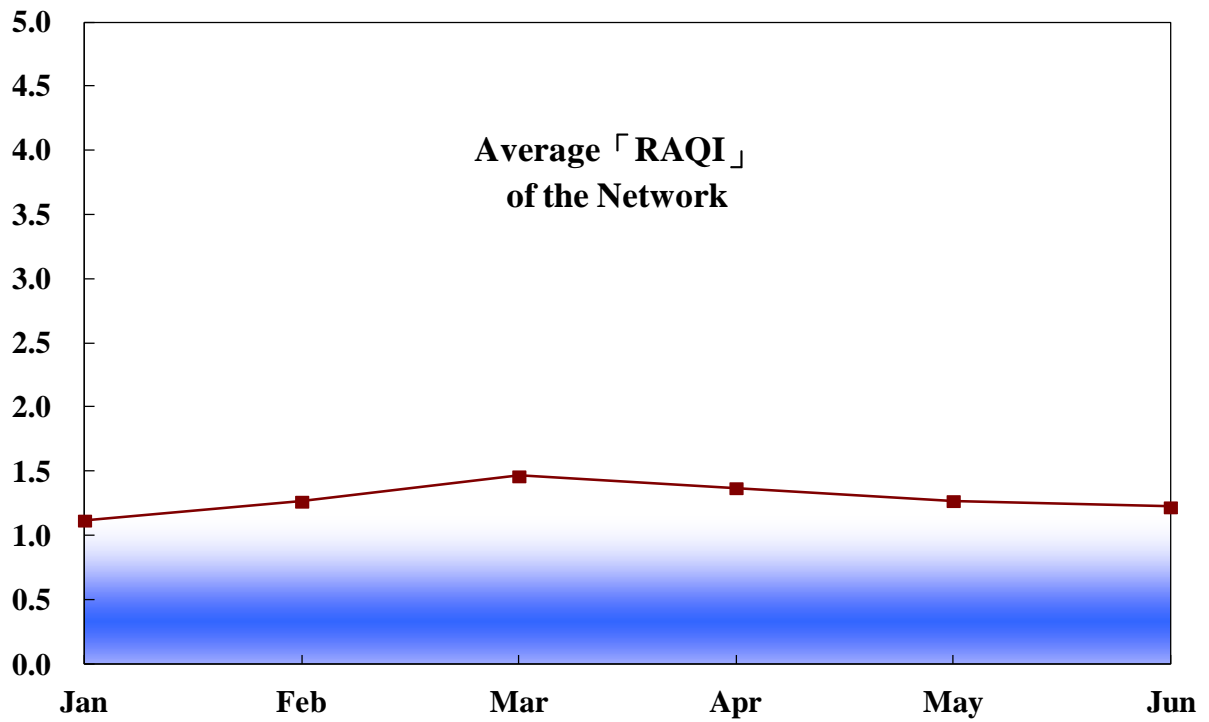


Figure 10 : Monthly variations in average RAQI

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
Nanchengyuanling (Dongguan) *	Nanchengyuanling Community, Dongguan City	Mixed residential/commercial/industrial	15 m	18m	September 2010
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

Note *: The original station in Dongguan was sited in the Dongguan Haogang Primary School. As the representativeness of the original site had been affected by urban development, the station was relocated to a nearby location in the Nanchengyuanling district in Dongguan on 1 January 2012.

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