

Pearl River Delta

Regional Air Quality Monitoring Network

A Report of Monitoring Results in 2009

Report Number	:	PRDAIR-2009-2
Report Prepared by	:	Guangdong Provincial Environmental Monitoring Centre
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Approved by	:	Pearl River Delta Air Quality Management and Monitoring Special Panel
Security Classification	:	Unrestricted

Purpose of the Report

This report provides the 2009 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) (formerly named as Guangdong Provincial Environmental Protection Monitoring Centre) and the Environmental Protection Department of the Hong Kong Special Administrative Region (HKEPD) from 2003 to 2005. It came into operation on 30 November 2005 and 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 Operational 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 particulate (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 Network was generally in smooth operation in 2009. The data capture rates of all monitoring stations in the Network averaged 94%.

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 of the network, its performance in QA/QC and the operation status 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 findings of the system audit will be reported. The deficiency found and corrective measures suggested will be listed and followed up by the QMC.

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 (PM₁₀) 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 2009, the GDEMC and HKEPD jointly carried out 363 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 -10.8% to 11% 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 (PM₁₀) are $\pm 20\%$ and $\pm 10\%$ respectively. In 2009, the GDEMC and HKEPD jointly carried out 1397 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 -8.5 % and 13.7 % and was within the specified control limits (see Figure 3). Overall, the QA/QC performance of the monitoring network was good in 2009, and met all the requirements specified in the QA/QC Operating Procedures.

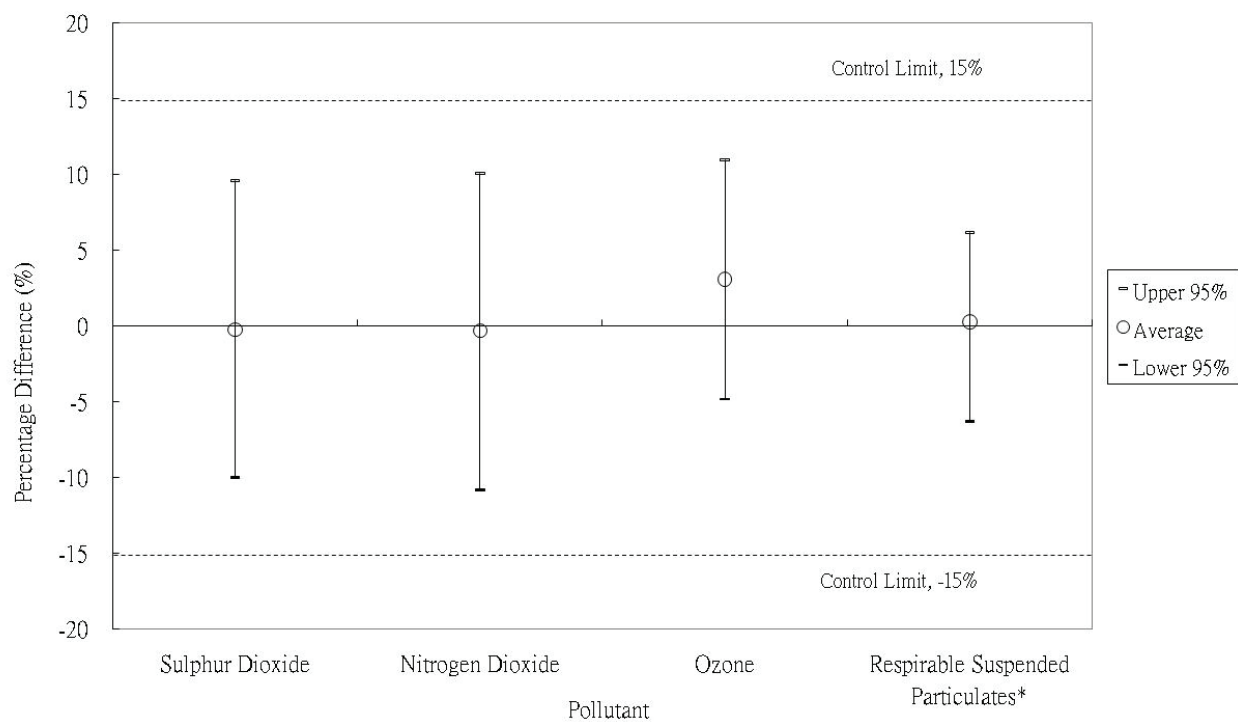


Figure 2 : Accuracy of the PRD Regional Air Quality Monitoring Network in 2009

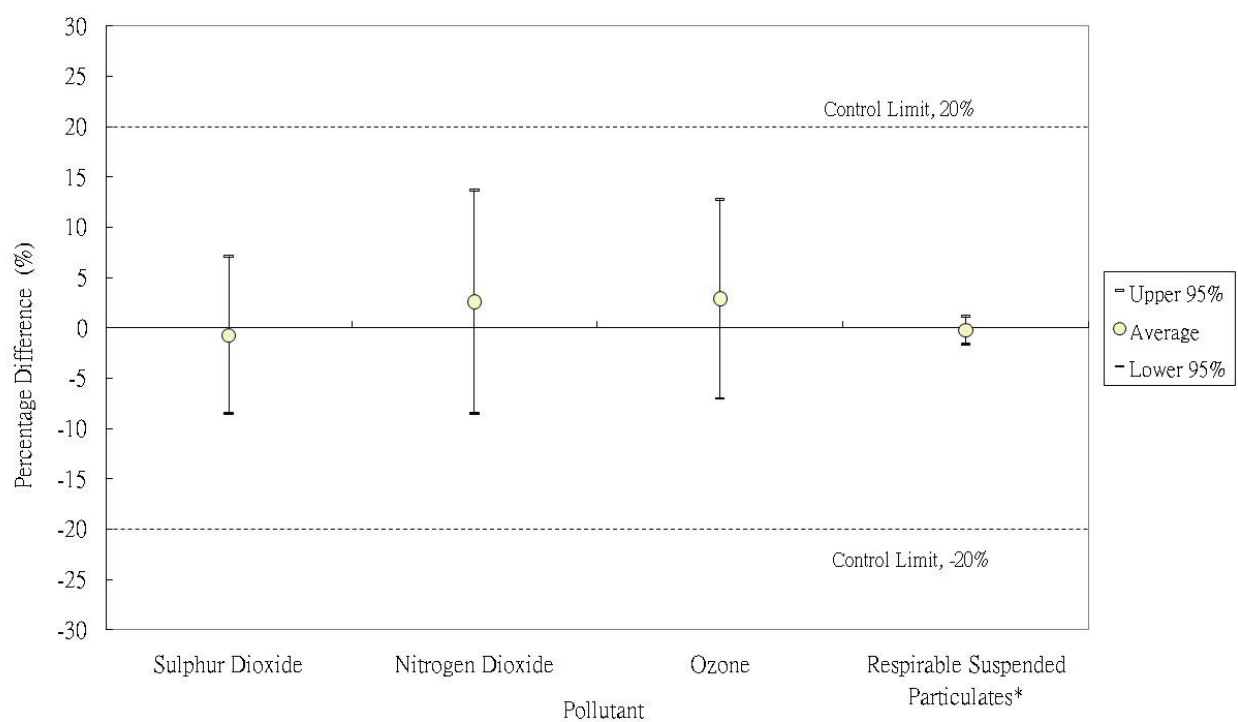


Figure 3 : Precision of the PRD Regional Air Quality Monitoring Network in 2009

* 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 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 annual averages of SO₂ at various monitoring stations in the Network ranged from 0.012 mg/m³ to 0.059 mg/m³ in 2009, all stations are in compliance with the national annual air quality standard[#] (0.06 mg/m³). As shown in Figure 4, the average levels of SO₂ at the north-western part of PRD were in general higher 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, 3 monitoring stations in the Network had recorded exceedance of the national daily air quality standard (0.15 mg/m³) of SO₂, while no station had recorded exceedance of the national hourly standard (0.50 mg/m³). Details are in Table 3.1a and Table 3.1b.

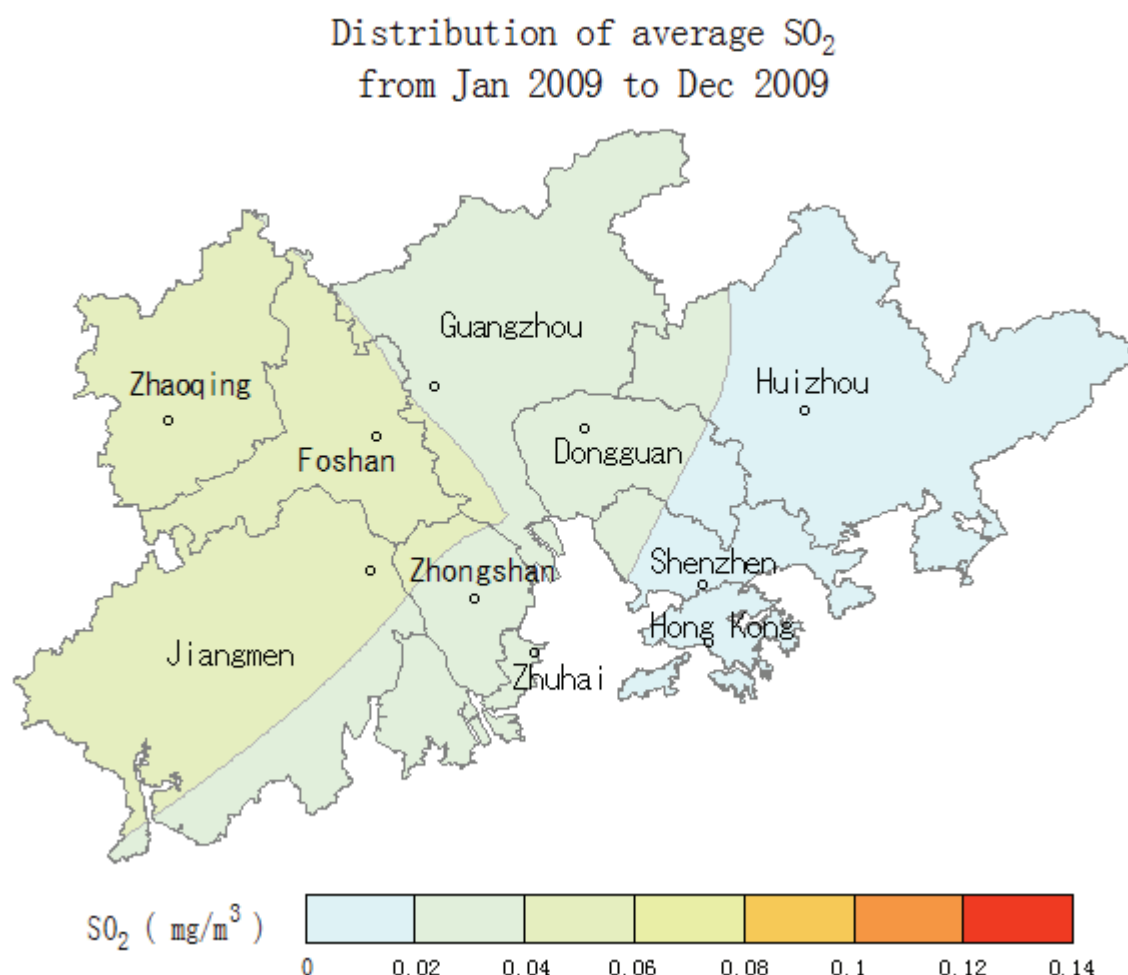


Figure 4 : Spatial distribution of average concentrations of Sulphur Dioxide (SO₂) in the Network

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

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	0.143	0.253	0.194	0.250	0.257	0.175	0.075	0.090	0.150	0.139	0.177	0.199	0	0.00%
	Min	0.001	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000		
Wanqingsha (Guangzhou)	Max	0.320	0.290	0.294	0.330	0.201	0.124	0.149	0.250	0.204	0.216	0.313	0.225	0	0.00%
	Min	0.006	0.005	0.005	0.000	0.004	0.004	0.005	0.005	0.005	0.007	0.006	0.010		
Tianhu (Guangzhou)	Max	0.123	0.170	0.162	0.091	0.138	0.146	0.118	0.132	0.108	0.072	0.156	0.048	0	0.00%
	Min	0.010	0.011	0.010	0.011	0.011	0.000	0.007	0.007	0.008	0.002	0.002	0.002		
Liyuan (Shenzhen)	Max	0.101	0.090	0.062	0.069	0.131	0.085	0.102	0.131	0.083	0.056	0.098	0.156	0	0.00%
	Min	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.001	0.001	0.001		
Tangjia (Zhuhai)	Max	0.254	0.215	0.138	0.153	0.166	0.149	0.041	0.109	0.156	0.140	0.215	0.181	0	0.00%
	Min	0.006	0.001	0.004	0.000	0.000	0.001	0.001	0.002	0.001	0.000	0.002	0.004		
Jinjuzei (Foshan)	Max	0.273	0.257	0.325	0.278	0.319	0.206	0.131	0.202	0.192	0.242	0.291	0.347	0	0.00%
	Min	0.006	0.011	0.008	0.005	0.003	0.002	0.003	0.004	0.003	0.006	0.009	0.012		
Huijingcheng (Foshan)	Max	0.417	0.358	0.361	0.250	0.207	0.248	0.303	0.268	0.247	0.285	0.423	0.298	0	0.00%
	Min	0.002	0.010	0.011	0.012	0.004	0.000	0.005	0.015	0.000	0.007	0.016	0.020		
Donghu (Jiangmen)	Max	0.309	0.276	0.288	0.239	0.375	0.149	0.106	0.198	0.189	0.254	0.453	0.336	0	0.00%
	Min	0.008	0.006	0.007	0.009	0.005	0.003	0.004	0.003	0.000	0.008	0.007	0.014		
Chengzhong (Zhaoqing)	Max	0.351	0.225	0.265	0.286	0.198	0.203	0.130	0.162	0.241	0.184	0.258	0.351	0	0.00%
	Min	0.003	0.007	0.006	0.006	0.008	0.002	0.003	0.006	0.000	0.007	0.001	0.008		
Xiapu (Huizhou)	Max	0.101	0.046	0.058	0.046	0.098	0.118	0.127	0.080	0.115	0.057	0.051	0.066	0	0.00%
	Min	0.001	0.004	0.002	0.010	0.006	0.000	0.006	0.009	0.010	0.012	0.001	0.002		
Jinguowan (Huizhou)	Max	0.048	0.052	0.056	0.033	0.036	0.082	0.118	0.067	0.094	0.064	0.052	0.077	0	0.00%
	Min	0.007	0.008	0.009	0.005	0.006	0.007	0.007	0.008	0.008	0.008	0.013	0.010		
Haogang (Dongguan)	Max	0.212	0.194	0.295	0.211	0.409	0.402	0.204	0.099	0.098	0.152	0.177	0.308	0	0.00%
	Min	0.003	0.005	0.001	0.000	0.000	0.002	0.002	0.000	0.002	0.005	0.008	0.010		
Zimaling Park (Zhongshan)	Max	0.272	0.181	0.162	0.193	0.144	0.171	0.049	0.161	0.162	0.176	0.256	0.174	0	0.00%
	Min	0.007	0.000	0.003	0.001	0.001	0.000	0.002	0.002	0.004	0.005	0.005	0.000		
Tsuen Wan (HKSAR)	Max	0.143	0.137	0.118	0.144	0.145	0.094	0.111	0.124	0.183	0.081	0.201	0.114	0	0.00%
	Min	0.004	0.005	0.003	0.003	0.000	0.003	0.004	0.003	0.004	0.004	0.001	0.001		
Tap Mun (HKSAR)	Max	0.095	0.106	0.096	0.116	0.094	0.041	0.091	0.062	0.095	0.052	0.082	0.055	0	0.00%
	Min	0.005	0.005	0.005	0.004	0.005	0.006	0.002	0.003	0.003	0.005	0.005	0.002		
Tung Chung (HKSAR)	Max	0.102	0.158	0.077	0.114	0.173	0.096	0.089	0.131	0.139	0.060	0.173	0.126	0	0.00%
	Min	0.002	0.001	0.000	0.000	0.000	0.002	0.003	0.003	0.003	0.002	0.003	0.001		

Table 3.1 b : 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	0.035	0.066	0.075	0.105	0.067	0.062	0.029	0.034	0.065	0.095	0.076	0.081	0	0.00%
	Min	0.002	0.015	0.005	0.004	0.011	0.016	0.007	0.005	0.004	0.003	0.009	0.001		
Wanqingsha (Guangzhou)	Max	0.115	0.074	0.095	0.102	0.102	0.069	0.061	0.079	0.085	0.085	0.125	0.101	0	0.00%
	Min	0.024	0.011	0.011	0.010	0.007	0.005	0.008	0.011	0.010	0.013	0.018	0.028		
Tianhu (Guangzhou)	Max	0.051	0.110	0.087	0.041	0.059	0.098	0.051	0.047	0.047	0.051	0.032	0.038	0	0.00%
	Min	0.011	0.013	0.011	0.011	0.012	0.004	0.008	0.008	0.010	0.011	0.002	0.003		
Liyuan (Shenzhen)	Max	0.052	0.021	0.022	0.028	0.046	0.026	0.038	0.039	0.029	0.027	0.032	0.031	0	0.00%
	Min	0.002	0.002	0.004	0.003	0.003	0.002	0.003	0.003	0.003	0.003	0.003	0.003		
Tangjia (Zhuhai)	Max	0.096	0.064	0.087	0.051	0.074	0.036	0.019	0.046	0.032	0.063	0.089	0.086	0	0.00%
	Min	0.015	0.004	0.007	0.001	0.001	0.002	0.003	0.003	0.002	0.007	0.004	0.009		
Jinjuzei (Foshan)	Max	0.112	0.113	0.099	0.124	0.083	0.072	0.048	0.083	0.055	0.110	0.178	0.126	3	0.88%
	Min	0.012	0.025	0.019	0.014	0.018	0.014	0.009	0.015	0.010	0.015	0.014	0.021		
Huijingcheng (Foshan)	Max	0.172	0.111	0.160	0.141	0.080	0.093	0.099	0.113	0.107	0.131	0.249	0.131	7	2.08%
	Min	0.009	0.019	0.021	0.031	0.010	0.000	0.015	0.040	0.010	0.020	0.027	0.025		
Donghu (Jiangmen)	Max	0.157	0.117	0.128	0.101	0.098	0.051	0.044	0.085	0.053	0.120	0.176	0.131	2	0.57%
	Min	0.013	0.015	0.028	0.020	0.010	0.004	0.007	0.007	0.007	0.021	0.020	0.032		
Chengzhong (Zhaoqing)	Max	0.150	0.100	0.147	0.113	0.073	0.081	0.055	0.088	0.106	0.105	0.118	0.128	0	0.00%
	Min	0.006	0.016	0.014	0.015	0.022	0.011	0.009	0.015	0.015	0.020	0.004	0.017		
Xiapu (Huizhou)	Max	0.045	0.021	0.037	0.024	0.031	0.047	0.041	0.048	0.053	0.028	0.024	0.029	0	0.00%
	Min	0.002	0.008	0.004	0.013	0.010	0.005	0.010	0.012	0.013	0.015	0.005	0.004		
Jinguowan (Huizhou)	Max	0.031	0.024	0.030	0.020	0.019	0.029	0.040	0.026	0.030	0.034	0.033	0.036	0	0.00%
	Min	0.008	0.009	0.010	0.009	0.008	0.009	0.009	0.010	0.012	0.014	0.015	0.012		
Haogang (Dongguan)	Max	0.082	0.086	0.086	0.065	0.096	0.102	0.054	0.036	0.035	0.054	0.088	0.087	0	0.00%
	Min	0.007	0.012	0.005	0.002	0.003	0.007	0.006	0.006	0.011	0.010	0.014	0.016		
Zimaling Park (Zhongshan)	Max	0.096	0.070	0.101	0.055	0.074	0.037	0.015	0.060	0.063	0.072	0.105	0.101	0	0.00%
	Min	0.014	0.003	0.005	0.002	0.001	0.002	0.002	0.003	0.005	0.008	0.006	0.014		
Tsuen Wan (HKSAR)	Max	0.087	0.062	0.034	0.059	0.068	0.039	0.051	0.064	0.036	0.035	0.037	0.033	0	0.00%
	Min	0.008	0.007	0.004	0.004	0.002	0.004	0.005	0.004	0.006	0.005	0.003	0.004		
Tap Mun (HKSAR)	Max	0.038	0.019	0.031	0.022	0.021	0.024	0.032	0.034	0.020	0.019	0.023	0.021	0	0.00%
	Min	0.009	0.006	0.008	0.006	0.006	0.007	0.004	0.004	0.004	0.007	0.007	0.005		
Tung Chung (HKSAR)	Max	0.056	0.044	0.023	0.041	0.069	0.040	0.028	0.044	0.056	0.030	0.056	0.029	0	0.00%
	Min	0.007	0.003	0.003	0.006	0.004	0.003	0.004	0.006	0.003	0.004	0.004	0.005		

Table 3.1 c : 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)	0.016	0.031	0.035	0.047	0.039	0.037	0.019	0.022	0.034	0.029	0.032	0.031	0.031
Wanqingsha (Guangzhou)	0.058	0.035	0.046	0.035	0.028	0.021	0.023	0.037	0.032	0.047	0.054	0.062	0.040
Tianhu (Guangzhou)	0.025	0.036	0.028	0.019	0.026	0.025	0.023	0.022	0.019	0.020	0.014	0.022	0.023
Liyuan (Shenzhen)	0.020	0.008	0.010	0.010	0.011	0.010	0.008	0.014	0.008	0.012	0.014	0.014	0.012
Tangjia (Zhuhai)	0.032	0.016	0.031	0.016	0.010	0.006	0.006	0.015	0.012	0.024	0.036	0.041	0.021
Jinjuzui (Foshan)	0.048	0.056	0.056	0.047	0.042	0.038	0.026	0.041	0.035	0.046	0.059	0.063	0.046
Huijingcheng (Foshan)	0.054	0.059	0.059	0.074	0.041	0.046	0.043	0.068	0.050	0.062	0.088	0.063	0.059
Donghu (Jiangmen)	0.060	0.057	0.063	0.049	0.039	0.025	0.019	0.030	0.031	0.060	0.064	0.078	0.048
Chengzhong (Zhaoqing)	0.070	0.046	0.054	0.067	0.047	0.036	0.027	0.036	0.043	0.044	0.046	0.062	0.048
Xiapu (Huizhou)	0.021	0.014	0.016	0.019	0.017	0.017	0.019	0.021	0.020	0.023	0.013	0.016	0.018
Jinguowan (Huizhou)	0.020	0.014	0.015	0.014	0.012	0.014	0.015	0.017	0.017	0.020	0.021	0.022	0.017
Haogang (Dongguan)	0.042	0.035	0.030	0.023	0.031	0.027	0.016	0.020	0.018	0.024	0.032	0.038	0.028
Zimaling Park (Zhongshan)	0.048	0.019	0.035	0.020	0.015	0.007	0.005	0.020	0.025	0.034	0.048	0.054	0.028
Tsuen Wan (HKSAR)	0.023	0.020	0.016	0.013	0.014	0.021	0.018	0.022	0.014	0.015	0.014	0.013	0.017
Tap Mun (HKSAR)	0.020	0.010	0.013	0.013	0.010	0.010	0.010	0.012	0.011	0.013	0.014	0.012	0.012
Tung Chung (HKSAR)	0.022	0.012	0.011	0.016	0.015	0.014	0.009	0.016	0.011	0.014	0.019	0.015	0.015

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 the impact on human respiratory system, it 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 0.012 mg/m³ to 0.069 mg/m³ in 2009; all are in compliance with the national annual air quality standard (0.08 mg/m³). During the period, 11 monitoring stations in the Network had recorded exceedance of the national daily air quality standard (0.12 mg/m³) of NO₂ while the corresponding national hourly standard (0.24 mg/m³) was exceeded at 9 monitoring stations. Please refer to Figures 5 and Tables 3.2a to 3.2c for details.

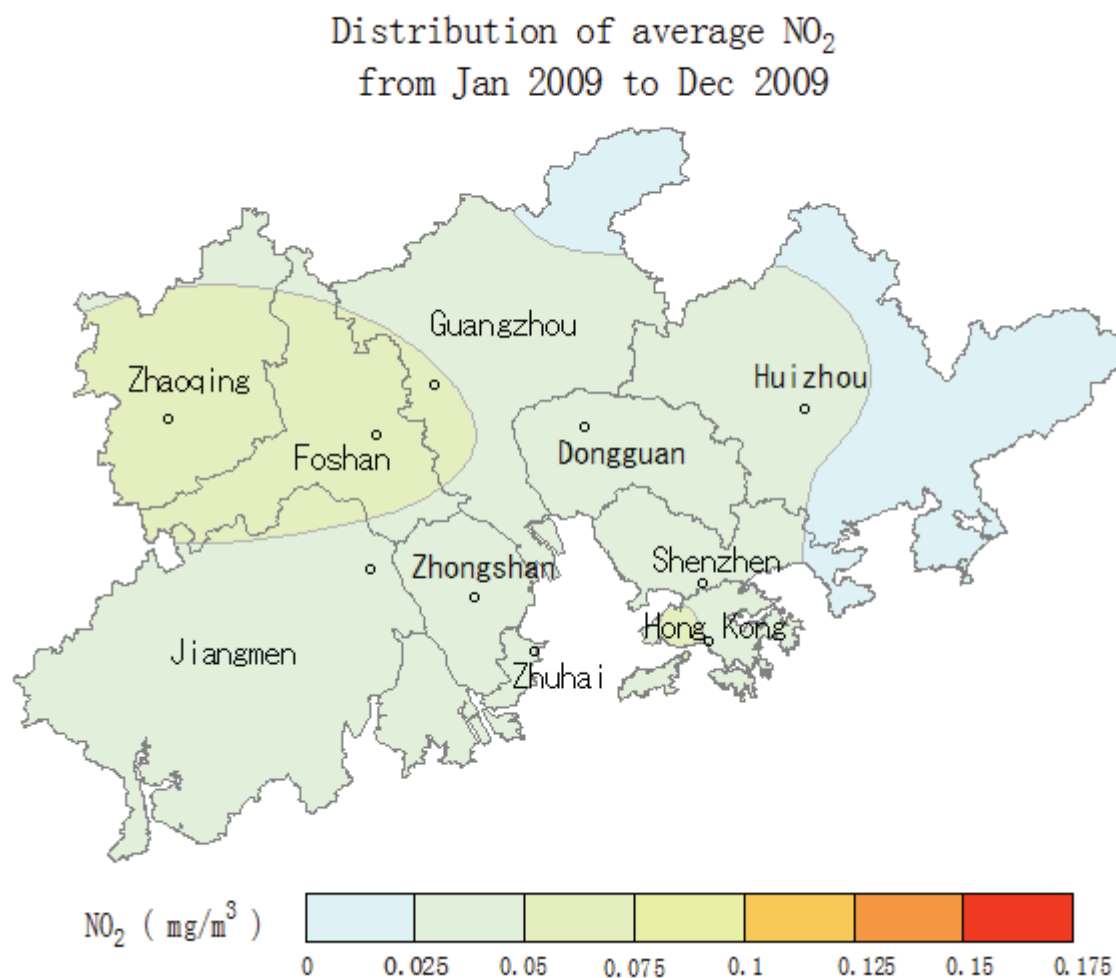


Figure 5 : Spatial distribution of average concentrations of Nitrogen Dioxide (NO₂) in the Network

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

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	0.144	0.138	0.201	0.209	0.167	0.195	0.106	0.115	0.142	0.200	0.246	0.232	1	0.01%
	Min	0.003	0.015	0.014	0.000	0.012	0.006	0.008	0.001	0.000	0.008	0.005	0.017		
Wanqingsha (Guangzhou)	Max	0.196	0.123	0.139	0.144	0.113	0.109	0.059	0.123	0.097	0.150	0.213	0.163	0	0.00%
	Min	0.005	0.000	0.005	0.000	0.000	0.000	0.000	0.002	0.000	0.007	0.006	0.024		
Tianhu (Guangzhou)	Max	0.156	0.135	0.097	0.142	0.097	0.084	0.075	0.113	0.086	0.054	0.098	0.038	0	0.00%
	Min	0.005	0.007	0.004	0.004	0.001	0.000	0.000	0.002	0.000	0.002	0.002	0.002		
Liyuan (Shenzhen)	Max	0.231	0.182	0.165	0.139	0.169	0.233	0.106	0.178	0.149	0.266	0.317	0.257	15	0.18%
	Min	0.009	0.009	0.008	0.008	0.008	0.004	0.005	0.007	0.005	0.012	0.009	0.012		
Tangjia (Zhuhai)	Max	0.141	0.114	0.121	0.118	0.086	0.085	0.051	0.090	0.092	0.106	0.149	0.162	0	0.00%
	Min	0.018	0.004	0.011	0.001	0.000	0.000	0.004	0.005	0.000	0.002	0.000	0.004		
Jinjuzui (Foshan)	Max	0.216	0.201	0.200	0.189	0.123	0.129	0.088	0.134	0.125	0.196	0.265	0.182	4	0.05%
	Min	0.014	0.002	0.012	0.000	0.007	0.000	0.001	0.006	0.006	0.007	0.010	0.015		
Huijingcheng (Foshan)	Max	0.294	0.208	0.205	0.249	0.167	0.176	0.157	0.193	0.163	0.274	0.370	0.261	37	0.45%
	Min	0.007	0.021	0.020	0.017	0.020	0.000	0.011	0.021	0.011	0.016	0.009	0.031		
Donghu (Jiangmen)	Max	0.195	0.112	0.132	0.127	0.114	0.099	0.058	0.104	0.091	0.159	0.285	0.167	2	0.02%
	Min	0.013	0.010	0.013	0.007	0.001	0.000	0.007	0.008	0.005	0.012	0.007	0.022		
Chengzhong (Zhaoqing)	Max	0.245	0.232	0.163	0.142	0.139	0.110	0.107	0.101	0.115	0.184	0.268	0.221	3	0.04%
	Min	0.009	0.014	0.009	0.016	0.017	0.006	0.007	0.008	0.006	0.016	0.017	0.026		
Xiapu (Huizhou)	Max	0.170	0.194	0.142	0.093	0.089	0.089	0.101	0.100	0.151	0.129	0.162	0.153	0	0.00%
	Min	0.006	0.013	0.013	0.010	0.011	0.004	0.001	0.006	0.005	0.007	0.008	0.010		
Jinguowan (Huizhou)	Max	0.059	0.049	0.069	0.037	0.063	0.071	0.103	0.075	0.043	0.105	0.107	0.108	0	0.00%
	Min	0.008	0.008	0.008	0.007	0.005	0.005	0.002	0.002	0.001	0.003	0.005	0.011		
Haogang (Dongguan)	Max	0.211	0.189	0.163	0.133	0.149	0.122	0.153	0.126	0.090	0.167	0.226	0.183	0	0.00%
	Min	0.007	0.011	0.000	0.010	0.009	0.010	0.011	0.014	0.012	0.014	0.015	0.021		
Zimaling Park (Zhongshan)	Max	0.139	0.137	0.126	0.073	0.082	0.105	0.054	0.108	0.102	0.150	0.307	0.202	3	0.04%
	Min	0.012	0.004	0.006	0.005	0.000	0.001	0.001	0.001	0.002	0.007	0.002	0.015		
Tsuen Wan (HKSAR)	Max	0.234	0.153	0.163	0.188	0.204	0.157	0.260	0.225	0.189	0.228	0.253	0.227	2	0.02%
	Min	0.018	0.015	0.014	0.012	0.014	0.013	0.008	0.010	0.002	0.012	0.014	0.014		
Tap Mun (HKSAR)	Max	0.121	0.064	0.072	0.074	0.062	0.066	0.083	0.084	0.049	0.061	0.054	0.058	0	0.00%
	Min	0.003	0.002	0.005	0.003	0.002	0.002	0.001	0.000	0.000	0.001	0.000	0.002		
Tung Chung (HKSAR)	Max	0.241	0.162	0.146	0.172	0.169	0.156	0.145	0.180	0.150	0.219	0.235	0.214	1	0.01%
	Min	0.013	0.006	0.007	0.005	0.003	0.001	0.001	0.001	0.000	0.010	0.000	0.015		

Table 3.2 b : 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	0.092	0.078	0.128	0.110	0.079	0.087	0.043	0.061	0.059	0.106	0.143	0.120	9	2.70%
	Min	0.011	0.026	0.022	0.040	0.037	0.035	0.023	0.017	0.007	0.025	0.019	0.029		
Wanqingsha (Guangzhou)	Max	0.091	0.076	0.090	0.082	0.064	0.056	0.039	0.070	0.049	0.084	0.122	0.094	1	0.31%
	Min	0.018	0.012	0.016	0.012	0.006	0.009	0.005	0.014	0.009	0.028	0.020	0.042		
Tianhu (Guangzhou)	Max	0.047	0.075	0.057	0.042	0.045	0.038	0.036	0.042	0.032	0.030	0.030	0.022	0	0.00%
	Min	0.006	0.011	0.005	0.006	0.007	0.009	0.001	0.004	0.000	0.004	0.004	0.007		
Liyuan (Shenzhen)	Max	0.132	0.117	0.092	0.083	0.106	0.082	0.055	0.088	0.079	0.106	0.146	0.106	4	1.14%
	Min	0.029	0.030	0.034	0.029	0.023	0.019	0.017	0.024	0.026	0.031	0.025	0.034		
Tangjia (Zhuhai)	Max	0.076	0.059	0.067	0.054	0.040	0.028	0.024	0.040	0.027	0.053	0.089	0.079	0	0.00%
	Min	0.041	0.014	0.022	0.013	0.003	0.002	0.008	0.011	0.003	0.009	0.004	0.031		
Jinjuzui (Foshan)	Max	0.137	0.089	0.104	0.095	0.069	0.068	0.032	0.077	0.054	0.102	0.157	0.101	7	2.11%
	Min	0.025	0.021	0.032	0.035	0.027	0.010	0.012	0.021	0.015	0.028	0.019	0.036		
Huijingcheng (Foshan)	Max	0.172	0.102	0.118	0.130	0.104	0.088	0.068	0.110	0.074	0.159	0.233	0.142	24	7.10%
	Min	0.018	0.038	0.041	0.054	0.047	0.036	0.023	0.033	0.029	0.041	0.036	0.050		
Donghu (Jiangmen)	Max	0.123	0.061	0.097	0.072	0.055	0.040	0.037	0.059	0.054	0.076	0.149	0.095	2	0.57%
	Min	0.019	0.016	0.022	0.023	0.010	0.009	0.014	0.013	0.016	0.026	0.017	0.038		
Chengzhong (Zhaoqing)	Max	0.146	0.116	0.105	0.094	0.070	0.069	0.050	0.065	0.054	0.099	0.154	0.140	13	3.77%
	Min	0.020	0.028	0.027	0.028	0.035	0.022	0.019	0.021	0.021	0.034	0.030	0.040		
Xiapu (Huizhou)	Max	0.088	0.064	0.079	0.045	0.044	0.056	0.046	0.052	0.066	0.041	0.078	0.069	0	0.00%
	Min	0.016	0.027	0.024	0.022	0.022	0.015	0.002	0.018	0.023	0.025	0.021	0.025		
Jinguowan (Huizhou)	Max	0.039	0.027	0.048	0.022	0.025	0.036	0.039	0.036	0.015	0.033	0.037	0.042	0	0.00%
	Min	0.013	0.012	0.013	0.010	0.010	0.009	0.006	0.006	0.001	0.009	0.012	0.017		
Haogang (Dongguan)	Max	0.112	0.082	0.077	0.061	0.063	0.071	0.053	0.070	0.055	0.076	0.132	0.105	1	0.28%
	Min	0.016	0.032	0.024	0.028	0.025	0.022	0.025	0.024	0.025	0.027	0.023	0.032		
Zimaling Park (Zhongshan)	Max	0.078	0.069	0.071	0.044	0.042	0.047	0.025	0.060	0.048	0.080	0.131	0.099	1	0.30%
	Min	0.022	0.012	0.012	0.009	0.009	0.006	0.007	0.007	0.008	0.021	0.011	0.043		
Tsuen Wan (HKSAR)	Max	0.136	0.119	0.108	0.112	0.120	0.102	0.106	0.099	0.087	0.114	0.133	0.125	5	1.43%
	Min	0.042	0.045	0.046	0.050	0.033	0.037	0.031	0.042	0.037	0.055	0.042	0.043		
Tap Mun (HKSAR)	Max	0.056	0.024	0.036	0.022	0.028	0.028	0.032	0.045	0.032	0.014	0.019	0.022	0	0.00%
	Min	0.007	0.005	0.008	0.007	0.005	0.005	0.003	0.002	0.002	0.002	0.006	0.007		
Tung Chung (HKSAR)	Max	0.130	0.122	0.099	0.105	0.102	0.070	0.063	0.092	0.067	0.111	0.120	0.115	3	0.83%
	Min	0.044	0.015	0.015	0.014	0.008	0.007	0.010	0.005	0.003	0.027	0.012	0.043		

Table 3.2 c : 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)	0.043	0.048	0.059	0.071	0.058	0.051	0.033	0.037	0.027	0.060	0.061	0.066	0.051
Wanqingsha (Guangzhou)	0.056	0.037	0.042	0.044	0.032	0.026	0.019	0.031	0.032*	0.048	0.060	0.064	0.042
Tianhu (Guangzhou)	0.018	0.030	0.019	0.017	0.022	0.02*	0.015	0.015	0.010	0.008	0.013	0.013	0.017
Liyuan (Shenzhen)	0.068	0.051	0.055	0.042	0.039	0.048	0.032	0.055	0.041	0.052	0.060	0.061	0.050
Tangjia (Zhuhai)	0.055*	0.029	0.044	0.032	0.016	0.014	0.013	0.020	0.017	0.028	0.039	0.052	0.029
Jinjuzui (Foshan)	0.072	0.050	0.056	0.054	0.040	0.037	0.022	0.039	0.034	0.053	0.068	0.067	0.049
Huijingcheng (Foshan)	0.077	0.061	0.064	0.078	0.065	0.060	0.045	0.060	0.055	0.085	0.093	0.094	0.069
Donghu (Jiangmen)	0.059	0.037	0.041	0.044	0.024	0.023	0.020	0.028	0.031	0.049	0.059	0.058	0.040
Chengzhong (Zhaoqing)	0.068	0.061	0.054	0.063	0.046	0.039	0.030	0.036	0.037	0.061	0.069	0.079	0.054
Xiapu (Huizhou)	0.048	0.039	0.043	0.034	0.031	0.034	0.025	0.033	0.034	0.034	0.036	0.039	0.036
Jinguowan (Huizhou)	0.022	0.018	0.021	0.016	0.015	0.018	0.017	0.019	0.008	0.018	0.024	0.028	0.019
Haogang (Dongguan)	0.056	0.053	0.047	0.041	0.041	0.048	0.035	0.046	0.040	0.049	0.059	0.061	0.048
Zimaling Park (Zhongshan)	0.049	0.032	0.039	0.027	0.021	0.018	0.013	0.026	0.030	0.044	0.056	0.067	0.035
Tsuen Wan (HKSAR)	0.079	0.069	0.067	0.066	0.058	0.062	0.047	0.066	0.058	0.079	0.073	0.076	0.067
Tap Mun (HKSAR)	0.016	0.010	0.016	0.012	0.010	0.013	0.011	0.015	0.009	0.008	0.011	0.013	0.012
Tung Chung (HKSAR)	0.073	0.053	0.052	0.048	0.036	0.034	0.024	0.045	0.034	0.060	0.062	0.069	0.049

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 the main component of photochemical smog. Ozone can cause irritation to the eye, nose and throat. At elevated levels, O₃ 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, and O₃ and its precursors can be transported to rural areas downwind of their sources during this period, the concentrations of O₃ in rural areas are therefore often higher than that in the urban areas. The annual averages of O₃ recorded by the Network ranged from 0.035 mg/m³ to 0.088 mg/m³ in 2009, with higher average values measured in rural areas such as Tianhu of Guangzhou, Tap Mun of Hong Kong and Jinguowan of Huizhou. During the year, all 16 monitoring stations in the Network had recorded exceedance of the national hourly standard (0.2 mg/m³) of ozone. Please refer to Figures 6 and Tables 3.3a to 3.3c for details.

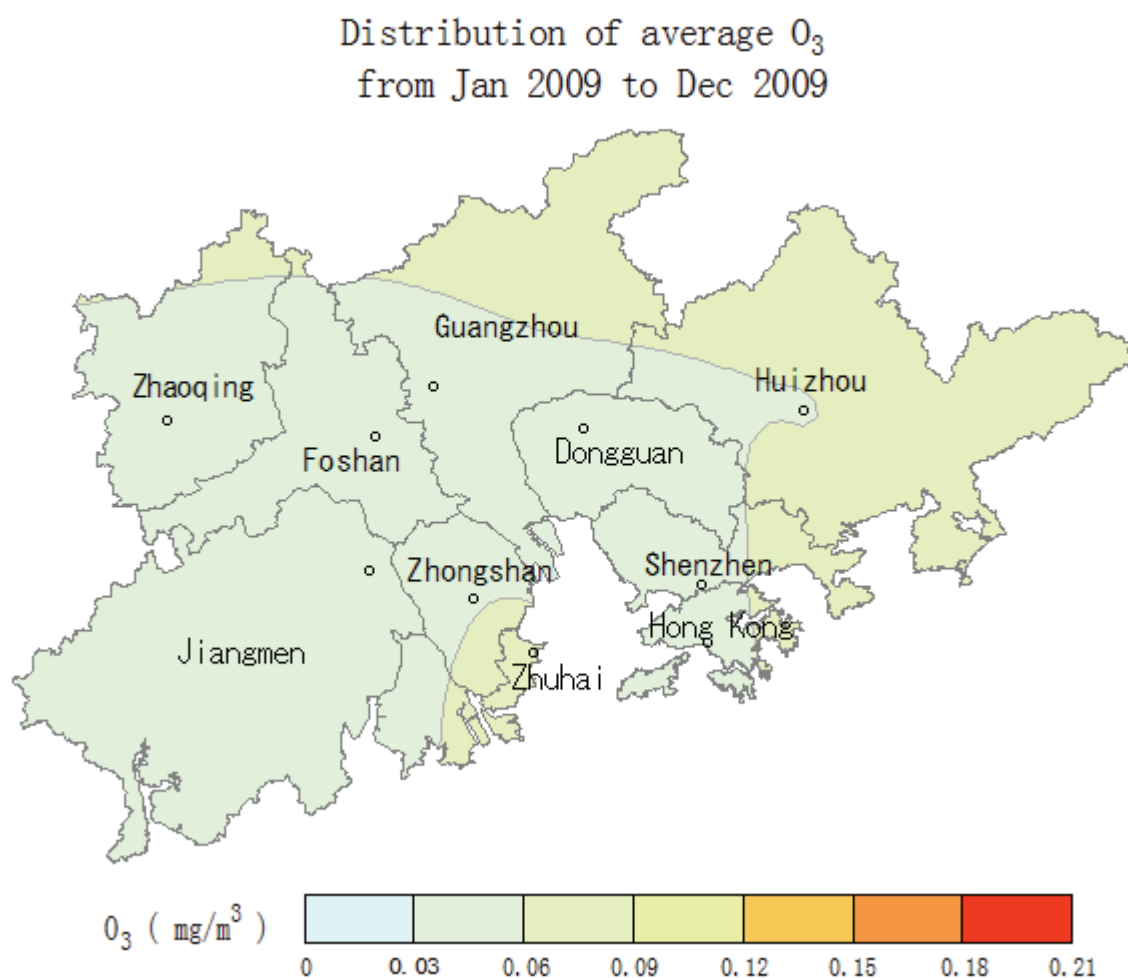


Figure 6 : Spatial distribution of average concentrations of Ozone (O₃) in the Network

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

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	0.195	0.216	0.193	0.304	0.304	0.367	0.110	0.118	0.279	0.303	0.254	0.164	159	1.95%
	Min	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.001	0.000		
Wanqingsha (Guangzhou)	Max	0.258	0.350	0.218	0.305	0.277	0.300	0.379	0.282	0.335	0.343	0.424	0.260	265	3.24%
	Min	0.000	0.000	0.000	0.001	0.000	0.002	0.001	0.001	0.000	0.001	0.001	0.000		
Tianhu (Guangzhou)	Max	0.223	0.226	0.189	0.287	0.254	0.340	0.322	0.291	0.265	0.284	0.245	0.210	209	2.56%
	Min	0.010	0.005	0.005	0.002	0.003	0.009	0.001	0.004	0.009	0.016	0.005	0.007		
Liyuan (Shenzhen)	Max	0.127	0.172	0.205	0.190	0.193	0.220	0.230	0.241	0.204	0.215	0.250	0.174	12	0.14%
	Min	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.001		
Tangjia (Zhuhai)	Max	0.183	0.177	0.201	0.423	0.279	0.303	0.313	0.394	0.376	0.404	0.266	0.240	271	3.34%
	Min	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000		
Jinjuzui (Foshan)	Max	0.205	0.234	0.222	0.314	0.354	0.300	0.322	0.347	0.353	0.375	0.314	0.197	323	3.87%
	Min	0.002	0.003	0.000	0.001	0.001	0.006	0.000	0.006	0.007	0.006	0.005	0.005		
Huijingcheng (Foshan)	Max	0.178	0.257	0.219	0.300	0.291	0.265	0.232	0.243	0.320	0.282	0.348	0.196	188	2.26%
	Min	0.001	0.003	0.003	0.000	0.003	0.000	0.003	0.000	0.012	0.013	0.011	0.014		
Donghu (Jiangmen)	Max	0.116	0.197	0.179	0.177	0.247	0.272	0.246	0.358	0.306	0.396	0.374	0.181	219	2.55%
	Min	0.003	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.005	0.004	0.003	0.002		
Chengzhong (Zhaoqing)	Max	0.159	0.232	0.159	0.305	0.303	0.220	0.332	0.226	0.229	0.296	0.225	0.144	137	1.61%
	Min	0.001	0.001	0.000	0.004	0.008	0.006	0.004	0.003	0.004	0.003	0.003	0.004		
Xiapu (Huizhou)	Max	0.163	0.208	0.205	0.187	0.240	0.318	0.214	0.360	0.268	0.195	0.193	0.161	60	0.75%
	Min	0.007	0.005	0.005	0.006	0.004	0.000	0.000	0.000	0.000	0.000	0.003	0.002		
Jinguowan (Huizhou)	Max	0.219	0.253	0.213	0.166	0.236	0.343	0.229	0.281	0.287	0.222	0.198	0.173	76	0.94%
	Min	0.002	0.005	0.005	0.010	0.002	0.001	0.001	0.004	0.006	0.010	0.006	0.004		
Haogang (Dongguan)	Max	0.189	0.272	0.198	0.255	0.305	0.327	0.094	0.132	0.116	0.165	0.198	0.180	61	0.72%
	Min	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.003	0.000	0.003		
Zimaling Park (Zhongshan)	Max	0.243	0.318	0.171	0.284	0.286	0.363	0.323	0.397	0.366	0.330	0.305	0.174	306	3.75%
	Min	0.000	0.001	0.001	0.000	0.001	0.001	0.003	0.003	0.004	0.003	0.003	0.003		
Tsuen Wan (HKSAR)	Max	0.137	0.092	0.117	0.163	0.151	0.170	0.226	0.193	0.214	0.205	0.251	0.127	7	0.08%
	Min	0.000	0.002	0.003	0.004	0.004	0.004	0.004	0.003	0.003	0.002	0.002	0.002		
Tap Mun (HKSAR)	Max	0.210	0.168	0.177	0.219	0.240	0.238	0.354	0.281	0.341	0.232	0.182	0.192	94	1.11%
	Min	0.003	0.002	0.003	0.004	0.002	0.003	0.002	0.003	0.003	0.027	0.005	0.005		
Tung Chung (HKSAR)	Max	0.149	0.135	0.171	0.194	0.248	0.279	0.356	0.319	0.308	0.273	0.284	0.184	73	0.86%
	Min	0.004	0.003	0.003	0.003	0.005	0.008	0.006	0.002	0.003	0.002	0.001	0.005		

Table 3.3 b : 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	0.080	0.078	0.050	0.094	0.115	0.145	0.035	0.036	0.094	0.123	0.106	0.055
	Min	0.004	0.004	0.005	0.006	0.005	0.011	0.004	0.001	0.011	0.030	0.009	0.001
Wanqingsha (Guangzhou)	Max	0.085	0.133	0.088	0.156	0.120	0.143	0.155	0.112	0.115	0.152	0.137	0.072
	Min	0.007	0.012	0.005	0.024	0.015	0.020	0.021	0.003	0.016	0.064	0.012	0.001
Tianhu (Guangzhou)	Max	0.144	0.142	0.134	0.132	0.141	0.185	0.143	0.164	0.149	0.167	0.137	0.140
	Min	0.033	0.025	0.025	0.048	0.026	0.019	0.039	0.049	0.052	0.092	0.027	0.051
Liyuan (Shenzhen)	Max	0.075	0.085	0.067	0.105	0.089	0.065	0.080	0.068	0.075	0.116	0.074	0.068
	Min	0.025	0.017	0.010	0.007	0.005	0.002	0.005	0.002	0.007	0.035	0.002	0.008
Tangjia (Zhuhai)	Max	0.075	0.147	0.100	0.168	0.148	0.155	0.129	0.193	0.130	0.161	0.122	0.101
	Min	0.003	0.018	0.004	0.043	0.023	0.020	0.033	0.032	0.025	0.067	0.003	0.001
Jinjuzui (Foshan)	Max	0.100	0.115	0.069	0.140	0.141	0.141	0.130	0.127	0.123	0.142	0.105	0.061
	Min	0.011	0.009	0.002	0.024	0.017	0.017	0.025	0.022	0.024	0.049	0.008	0.008
Huijingcheng (Foshan)	Max	0.076	0.105	0.082	0.136	0.118	0.124	0.077	0.098	0.136	0.127	0.103	0.061
	Min	0.005	0.011	0.010	0.010	0.011	0.010	0.013	0.017	0.028	0.041	0.015	0.016
Donghu (Jiangmen)	Max	0.054	0.067	0.067	0.093	0.105	0.120	0.093	0.123	0.112	0.127	0.099	0.058
	Min	0.007	0.006	0.003	0.008	0.012	0.019	0.018	0.023	0.022	0.009	0.005	0.004
Chengzhong (Zhaoqing)	Max	0.068	0.110	0.067	0.161	0.151	0.106	0.092	0.101	0.112	0.128	0.097	0.067
	Min	0.007	0.011	0.003	0.010	0.028	0.026	0.022	0.023	0.026	0.052	0.011	0.005
Xiapu (Huizhou)	Max	0.098	0.102	0.103	0.140	0.128	0.129	0.063	0.123	0.093	0.109	0.070	0.076
	Min	0.030	0.017	0.014	0.046	0.025	0.011	0.019	0.026	0.013	0.037	0.011	0.013
Jinguowan (Huizhou)	Max	0.122	0.135	0.114	0.135	0.137	0.137	0.108	0.118	0.120	0.135	0.105	0.092
	Min	0.039	0.024	0.020	0.020	0.024	0.017	0.018	0.029	0.031	0.055	0.020	0.020
Haogang (Dongguan)	Max	0.080	0.101	0.078	0.142	0.132	0.133	0.038	0.044	0.052	0.079	0.085	0.057
	Min	0.022	0.021	0.008	0.025	0.014	0.005	0.010	0.006	0.011	0.026	0.012	0.010
Zimaling Park (Zhongshan)	Max	0.123	0.166	0.074	0.143	0.148	0.160	0.138	0.140	0.118	0.134	0.094	0.059
	Min	0.009	0.014	0.003	0.025	0.024	0.016	0.028	0.009	0.014	0.052	0.005	0.006
Tsuen Wan (HKSAR)	Max	0.075	0.056	0.067	0.121	0.095	0.075	0.063	0.060	0.071	0.106	0.072	0.070
	Min	0.011	0.004	0.006	0.012	0.008	0.009	0.008	0.006	0.011	0.025	0.006	0.005
Tap Mun (HKSAR)	Max	0.144	0.113	0.127	0.192	0.175	0.125	0.140	0.114	0.129	0.185	0.122	0.131
	Min	0.037	0.020	0.023	0.061	0.025	0.028	0.025	0.025	0.034	0.063	0.030	0.022
Tung Chung (HKSAR)	Max	0.106	0.081	0.090	0.161	0.132	0.113	0.114	0.105	0.105	0.148	0.092	0.083
	Min	0.008	0.019	0.004	0.020	0.019	0.016	0.017	0.013	0.013	0.039	0.003	0.006

Table 3.3 c : 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)	0.043	0.028	0.019	0.044	0.060	0.050	0.014	0.016	0.054	0.079	0.048	0.026	0.040
Wanqingsha (Guangzhou)	0.057	0.062	0.029	0.076	0.057	0.056	0.051	0.024	0.058	0.106	0.052	0.033	0.055
Tianhu (Guangzhou)	0.106	0.079	0.063	0.091	0.093	0.063	0.069	0.094	0.089	0.133	0.084	0.106	0.088
Liyuan (Shenzhen)	0.051	0.056	0.033	0.055	0.046	0.021	0.015	0.023	0.039	0.074	0.036	0.039	0.041
Tangjia (Zhuhai)	0.027	0.061	0.038	0.093	0.085	0.068	0.052	0.080	0.080	0.119	0.056	0.039	0.067
Jinjuzui (Foshan)	0.048	0.053	0.021	0.060	0.068	0.055	0.049	0.064	0.074	0.092	0.042	0.032	0.055
Huijingcheng (Foshan)	0.040	0.037	0.026	0.055	0.065	0.043	0.038	0.053	0.070	0.085	0.055	0.037	0.050
Donghu (Jiangmen)	0.030	0.033	0.018	0.040	0.045	0.046	0.037	0.058	0.074	0.090	0.045	0.030	0.045
Chengzhong (Zhaoqing)	0.043	0.048	0.028	0.060	0.074	0.054	0.050	0.058	0.078	0.090	0.048	0.034	0.055
Xiapu (Huizhou)	0.064	0.060	0.043	0.078	0.077	0.052	0.036	0.061	0.058	0.084	0.042	0.045	0.058
Jinguowan (Huizhou)	0.085	0.079	0.060	0.081	0.072	0.058	0.038	0.059	0.065	0.101	0.060	0.055	0.068
Haogang (Dongguan)	0.051	0.059	0.032	0.078	0.078	0.036	0.019	0.024	0.034	0.058	0.039	0.034	0.045
Zimaling Park (Zhongshan)	0.055	0.075	0.025	0.070	0.078	0.065	0.052	0.047	0.075	0.099	0.041	0.029	0.059
Tsuen Wan (HKSAR)	0.035	0.028	0.028	0.060	0.043	0.023	0.018	0.022	0.035	0.064	0.031	0.029	0.035
Tap Mun (HKSAR)	0.095	0.082	0.071	0.116	0.095	0.061	0.046	0.062	0.082	0.131	0.079	0.078	0.083
Tung Chung (HKSAR)	0.047	0.047	0.039	0.080	0.065	0.052	0.041	0.042	0.055	0.085	0.039	0.035	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.

3.4 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 annual averages of PM₁₀ at various monitoring stations in the Network ranged from 0.048 mg/m³ to 0.116 mg/m³ in 2009, only Huijingcheng station exceeding the national annual air quality standard (0.10 mg/m³). As shown in Figure 7, the average levels of PM₁₀ in the north western part of PRD were generally higher than those in the coastal areas in the south. All monitoring stations except Jinguowan station had recorded exceedance of the national daily standard (0.15mg/m³) of PM₁₀. Please refer to Tables 3.4a to 3.4c for details.

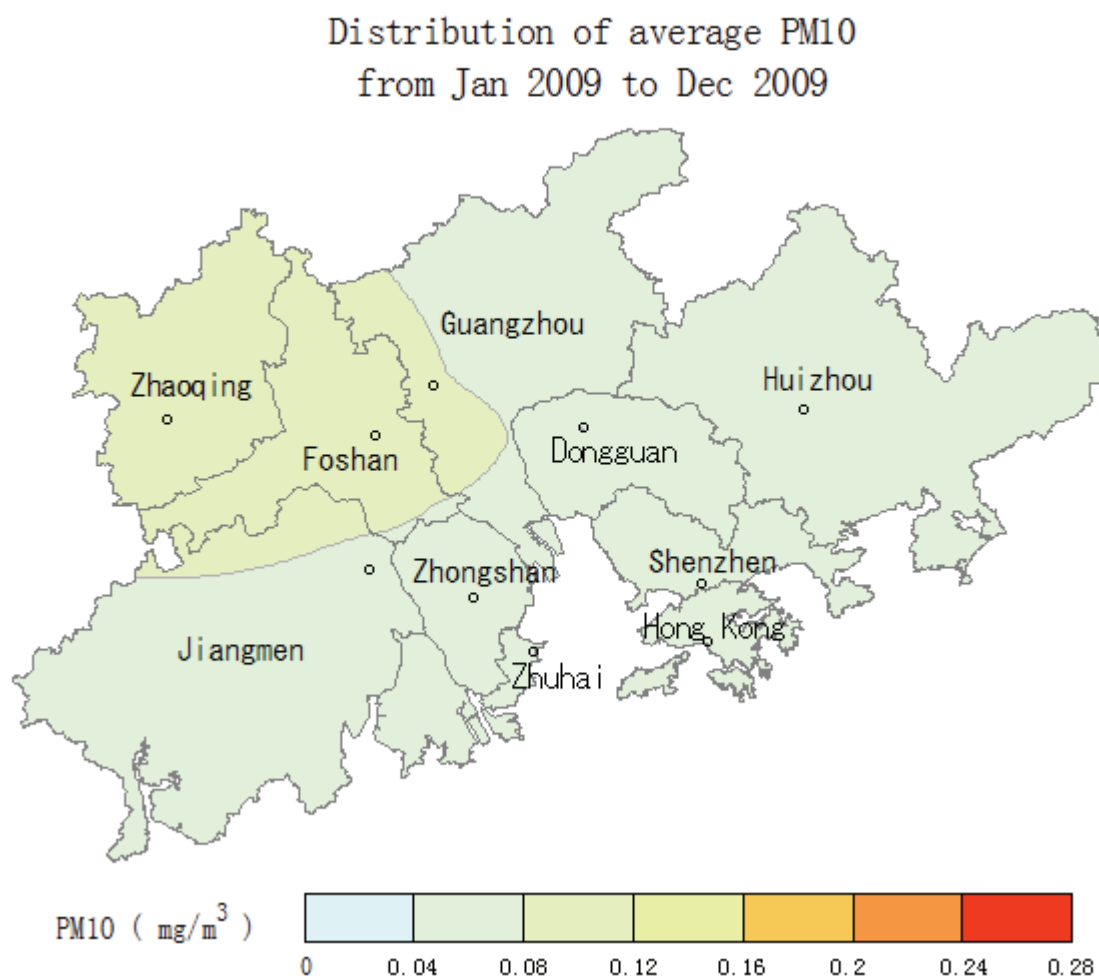


Figure 7 : Spatial distribution of average concentrations of Respirable Suspended Particulates (PM₁₀) in the Network

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

Monitoring Stations	Mth	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Luhu Park (Guangzhou)	Max	0.274	0.291	0.224	0.658	0.166	0.173	0.114	0.158	0.190	0.263	0.276	0.328
	Min	0.002	0.004	0.001	0.000	0.020	0.020	0.017	0.017	0.014	0.030	0.010	0.021
Wanqingsha (Guangzhou)	Max	0.338	0.241	0.262	0.415	0.250	0.213	0.205	0.315	0.215	0.368	0.448	0.346
	Min	0.014	0.007	0.001	0.000	0.000	0.000	0.001	0.000	0.002	0.008	0.001	0.001
Tianhu (Guangzhou)	Max	0.216	0.220	0.198	0.494	0.161	0.165	0.174	0.158	0.170	0.202	0.240	0.184
	Min	0.002	0.003	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.011	0.001	0.000
Liyuan (Shenzhen)	Max	0.265	0.167	0.183	0.204	0.242	0.132	0.206	0.159	0.233	0.341	0.272	0.265
	Min	0.004	0.001	0.000	0.001	0.000	0.002	0.000	0.000	0.002	0.004	0.002	0.000
Tangjia (Zhuhai)	Max	0.212	0.187	0.172	0.256	0.168	0.173	0.182	0.206	0.178	0.238	0.384	0.298
	Min	0.005	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.005	0.002	0.004
Jinjuzui (Foshan)	Max	0.381	0.285	0.293	0.478	0.167	0.204	0.219	0.225	0.303	0.324	0.466	0.418
	Min	0.006	0.000	0.002	0.005	0.001	0.001	0.005	0.001	0.010	0.023	0.006	0.013
Huijingcheng (Foshan)	Max	0.513	0.467	0.348	0.751	0.320	0.319	0.251	0.272	0.241	0.317	0.705	0.442
	Min	0.005	0.016	0.003	0.003	0.016	0.003	0.007	0.013	0.027	0.056	0.030	0.049
Donghu (Jiangmen)	Max	0.264	0.199	0.292	0.505	0.181	0.275	0.249	0.356	0.240	0.258	0.306	0.333
	Min	0.002	0.004	0.001	0.006	0.000	0.000	0.000	0.001	0.001	0.008	0.001	0.000
Chengzhong (Zhaoqing)	Max	0.399	0.362	0.300	0.521	0.228	0.159	0.197	0.182	0.167	0.287	0.574	0.365
	Min	0.002	0.009	0.001	0.000	0.001	0.000	0.000	0.000	0.005	0.023	0.001	0.001
Xiapu (Huizhou)	Max	0.347	0.242	0.258	0.374	0.170	0.175	0.185	0.201	0.256	0.182	0.349	0.312
	Min	0.003	0.001	0.007	0.016	0.000	0.000	0.000	0.010	0.002	0.013	0.001	0.002
Jinguowan (Huizhou)	Max	0.141	0.074	0.074	0.144	0.156	0.196	0.247	0.259	0.199	0.406	0.507	0.302
	Min	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.010	0.002	0.002
Haogang (Dongguan)	Max	0.303	0.223	0.191	0.495	0.259	0.226	0.277	0.315	0.218	0.462	0.546	0.523
	Min	0.005	0.013	0.004	0.000	0.002	0.000	0.001	0.000	0.001	0.004	0.001	0.001
Zimaling Park (Zhongshan)	Max	0.347	0.398	0.262	0.346	0.181	0.188	0.213	0.267	0.244	0.336	0.521	0.287
	Min	0.011	0.002	0.001	0.002	0.002	0.000	0.001	0.003	0.004	0.011	0.000	0.002
Tsuen Wan (HKSAR)	Max	0.247	0.152	0.143	0.200	0.175	0.097	0.182	0.145	0.189	0.195	0.189	0.195
	Min	0.018	0.010	0.004	0.007	0.009	0.004	0.003	0.007	0.008	0.019	0.003	0.005
Tap Mun (HKSAR)	Max	0.213	0.187	0.134	0.200	0.131	0.090	0.164	0.121	0.142	0.194	0.153	0.173
	Min	0.009	0.012	0.007	0.007	0.009	0.008	0.006	0.005	0.005	0.021	0.004	0.003
Tung Chung (HKSAR)	Max	0.223	0.149	0.149	0.203	0.192	0.087	0.183	0.229	0.211	0.189	0.167	0.217
	Min	0.012	0.008	0.007	0.005	0.004	0.006	0.005	0.005	0.004	0.018	0.008	0.006

Table 3.4 b : 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	0.191	0.195	0.164	0.454	0.111	0.109	0.069	0.102	0.109	0.166	0.186	0.188	26	7.56%
	Min	0.026	0.041	0.022	0.029	0.037	0.032	0.026	0.036	0.034	0.044	0.019	0.043		
Wanqingsha (Guangzhou)	Max	0.200	0.118	0.135	0.216	0.166	0.106	0.088	0.149	0.124	0.203	0.230	0.170	18	5.54%
	Min	0.028	0.024	0.025	0.031	0.018	0.023	0.016	0.012	0.024	0.059	0.019	0.039		
Tianhu (Guangzhou)	Max	0.137	0.146	0.107	0.326	0.090	0.129	0.105	0.093	0.095	0.158	0.122	0.116	3	0.91%
	Min	0.007	0.031	0.009	0.029	0.006	0.008	0.015	0.015	0.012	0.032	0.008	0.015		
Liyuan (Shenzhen)	Max	0.167	0.098	0.095	0.143	0.112	0.072	0.089	0.089	0.094	0.143	0.148	0.117	1	0.29%
	Min	0.019	0.015	0.018	0.021	0.015	0.020	0.011	0.009	0.017	0.026	0.021	0.030		
Tangjia (Zhuhai)	Max	0.144	0.079	0.108	0.151	0.116	0.074	0.067	0.134	0.078	0.159	0.184	0.137	5	1.55%
	Min	0.016	0.016	0.026	0.023	0.012	0.016	0.016	0.014	0.028	0.029	0.018	0.037		
Jinjuzui (Foshan)	Max	0.201	0.166	0.178	0.285	0.109	0.111	0.089	0.114	0.108	0.233	0.292	0.177	27	8.39%
	Min	0.026	0.039	0.026	0.026	0.036	0.026	0.019	0.017	0.021	0.041	0.021	0.040		
Huijingcheng (Foshan)	Max	0.351	0.293	0.234	0.554	0.164	0.156	0.134	0.141	0.125	0.204	0.441	0.219	69	21.84%
	Min	0.031	0.055	0.041	0.078	0.048	0.025	0.033	0.039	0.046	0.072	0.055	0.094		
Donghu (Jiangmen)	Max	0.153	0.120	0.140	0.300	0.093	0.107	0.075	0.125	0.104	0.164	0.197	0.128	8	2.27%
	Min	0.016	0.028	0.032	0.046	0.018	0.021	0.025	0.032	0.031	0.038	0.016	0.028		
Chengzhong (Zhaoqing)	Max	0.265	0.227	0.188	0.390	0.120	0.105	0.096	0.109	0.109	0.202	0.295	0.241	45	12.86%
	Min	0.015	0.035	0.017	0.035	0.028	0.015	0.017	0.010	0.020	0.039	0.010	0.032		
Xiapu (Huizhou)	Max	0.234	0.129	0.189	0.227	0.093	0.107	0.095	0.119	0.151	0.109	0.169	0.146	13	4.06%
	Min	0.027	0.039	0.035	0.048	0.022	0.022	0.017	0.042	0.031	0.040	0.011	0.016		
Jinguowan (Huizhou)	Max	0.103	0.053	0.042	0.084	0.091	0.094	0.093	0.108	0.108	0.128	0.114	0.117	0	0.00%
	Min	0.006	0.010	0.005	0.011	0.018	0.016	0.017	0.021	0.021	0.035	0.014	0.018		
Haogang (Dongguan)	Max	0.192	0.143	0.118	0.253	0.134	0.103	0.104	0.109	0.099	0.183	0.314	0.215	27	7.74%
	Min	0.021	0.034	0.018	0.031	0.026	0.027	0.025	0.033	0.026	0.040	0.018	0.037		
Zimaling Park (Zhongshan)	Max	0.172	0.157	0.121	0.172	0.133	0.105	0.082	0.140	0.114	0.214	0.219	0.173	16	4.73%
	Min	0.031	0.028	0.020	0.024	0.021	0.011	0.013	0.019	0.025	0.036	0.019	0.027		
Tsuen Wan (HKSAR)	Max	0.200	0.100	0.089	0.168	0.100	0.068	0.076	0.103	0.082	0.165	0.108	0.112	3	0.83%
	Min	0.033	0.027	0.019	0.028	0.021	0.021	0.017	0.022	0.025	0.034	0.021	0.024		
Tap Mun (HKSAR)	Max	0.152	0.155	0.093	0.161	0.076	0.063	0.063	0.069	0.061	0.152	0.103	0.110	4	1.11%
	Min	0.020	0.019	0.014	0.023	0.015	0.016	0.013	0.011	0.018	0.030	0.013	0.011		
Tung Chung (HKSAR)	Max	0.176	0.097	0.098	0.172	0.120	0.066	0.074	0.132	0.096	0.158	0.111	0.108	3	0.83%
	Min	0.031	0.018	0.020	0.023	0.013	0.017	0.012	0.012	0.018	0.028	0.014	0.034		

Table 3.4 c : 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)	0.089	0.094	0.082	0.107	0.064	0.065	0.046	0.069	0.068	0.096	0.084	0.112	0.082
Wanqingsha (Guangzhou)	0.110	0.061	0.066	0.074	0.057	0.050	0.031	0.052	0.067	0.113	0.089	0.096	0.072
Tianhu (Guangzhou)	0.066	0.064	0.047	0.073	0.048	0.045	0.041	0.051	0.052	0.072	0.051	0.062	0.056
Liyuan (Shenzhen)	0.083	0.044	0.058	0.053	0.042	0.037	0.022	0.042	0.048	0.080	0.067	0.074	0.054
Tangjia (Zhuhai)	0.067	0.038	0.060	0.061	0.040	0.032	0.027	0.044	0.048	0.089	0.071	0.084	0.056
Jinjuzui (Foshan)	0.112	0.086	0.080	0.084	0.056*	0.051	0.037	0.061	0.069	0.111	0.107	0.117	0.081
Huijingcheng (Foshan)	0.143	0.134	0.103	0.173	0.108	0.068	0.059	0.098	0.090	0.129	0.165	0.155	0.116
Donghu (Jiangmen)	0.081	0.053	0.071	0.094	0.053	0.051	0.040	0.070	0.073	0.096	0.070	0.078	0.069
Chengzhong (Zhaoqing)	0.122	0.100	0.083	0.119	0.067	0.055	0.041	0.055	0.071	0.119	0.108	0.113	0.088
Xiapu (Huizhou)	0.117	0.073	0.101	0.094	0.063	0.053	0.055	0.081	0.064	0.077	0.071	0.082	0.078
Jinguowan (Huizhou)	0.052	0.027	0.024	0.027	0.045	0.040	0.036	0.052	0.049	0.087	0.069	0.069	0.048
Haogang (Dongguan)	0.106	0.073	0.061	0.084	0.068	0.059	0.044	0.067	0.067	0.112	0.106	0.118	0.080
Zimaling Park (Zhongshan)	0.099	0.065	0.061	0.070	0.052	0.044	0.030	0.057	0.064	0.107	0.093	0.097	0.070
Tsuen Wan (HKSAR)	0.080	0.054	0.052	0.058	0.043	0.037	0.029	0.041	0.045	0.082	0.056	0.063	0.053
Tap Mun (HKSAR)	0.073	0.052	0.050	0.058	0.041	0.028	0.022	0.033	0.040	0.074	0.048	0.056	0.048
Tung Chung (HKSAR)	0.078	0.043	0.045	0.053	0.040	0.031	0.021	0.038	0.041	0.081	0.060	0.065	0.050

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 2009. The overall concentrations of SO_2 , NO_2 and PM_{10} were generally higher during the periods in the first quarter and forth quarter. Levels of these pollutants were lower from June to August due to the heavier rainfall and higher mixing layer height in these summer months, which favoured the dispersion of pollutants. The relatively clean maritime air stream prevailed in the PRD region under the influence of southern monsoon also accounts for a lower level of pollution in summer time. As for ozone, the highest monthly average occurred in October because it was relatively sunny and calm that favoured the formation and accumulation of ozone in the month. That notwithstanding, the monthly variations in concentrations of pollutants may change from year to year. Long-term monitoring is thus required before a general pattern can be established.

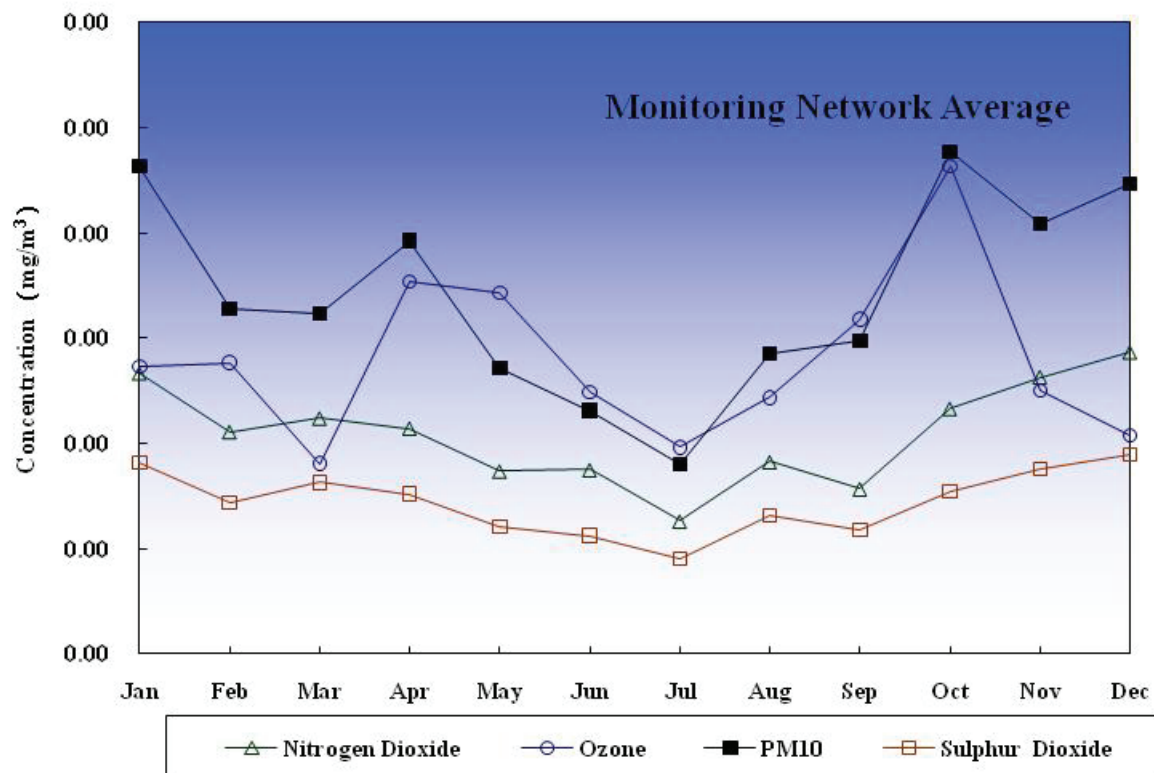


Figure 8 : Monthly variations of average pollutant concentrations measured by the Network

3.6 Annual Variations of Pollutant Concentrations (2006-2009)

Table 3.6 a shows the annual averages variations of the major pollutants (SO₂, NO₂, O₃, and PM₁₀) recorded by the Network from 2006 to 2009. As compared to 2008, the overall air quality in PRD region has shown improvement in 2009. The overall annual averages of SO₂ and NO₂ decreased by 26% and 7% respectively in 2009 as compared with 2008. The overall annual average of PM₁₀ in 2009 was similar to last year. The overall annual average of O₃ increased by 10%, the reason might be due to more sunshine and less rainfall in 2009, which favour the formation of photochemical smog. The Hong Kong and Guangdong governments will continue to implement control measures to further improve the air quality in the region.

Table 3.6 a : 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

Remark : 1. 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 reporting 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, PM₁₀ and O₃. 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 4.1a summarise the statistics on the RAQI grades and effective days of RAQI for all monitoring stations in the Network from January to December 2009.

Table 4.1 a : Statistics on RAQI grades of individual monitoring stations

Monitoring Stations	District	Days with valid RAQI	Ratio of valid RAQI	Distribution of RAQI grades in 2009 (%)				
				Grade I	Grade II	Grade III	Grade IV	Grade V
Luhu Park	Guangzhou	337	92%	20.47	45.10	28.19	6.23	0.00
Wanqingsha	Guangzhou	341	93%	22.29	43.70	26.69	6.16	1.17
Tianhu	Guangzhou	315	86%	37.46	47.94	13.65	0.95	0.00
Liyuan	Shenzhen	348	95%	38.22	51.15	9.48	1.15	0.00
Tangjia	Zhuhai	329	90%	31.00	49.24	17.63	2.13	0.00
Jinjuzui	Foshan	335	92%	14.33	41.19	32.24	10.15	2.09
Huijingcheng	Foshan	331	91%	4.23	37.16	34.14	18.43	6.04
Donghu	Jiangmen	349	96%	25.21	42.98	26.65	3.72	1.43
Chengzhong	Zhaoqing	348	95%	14.37	44.54	28.74	9.20	3.16
Xiapu	Huizhou	318	87%	18.55	62.89	17.92	0.63	0.00
Jinguowan	Huizhou	322	88%	42.24	52.80	4.97	0.00	0.00
Haogang	Dongguan	342	94%	20.18	52.34	22.51	4.39	0.58
Zimaling Park	Zhongshan	311	85%	28.62	43.09	23.47	4.18	0.64
Tsuen Wan	HKSAR	349	96%	26.65	61.60	11.17	0.57	0.00
Tap Mun	HKSAR	352	96%	41.48	55.68	2.84	0.00	0.00
Tung Chung	HKSAR	346	95%	35.84	48.84	13.58	1.73	0.00

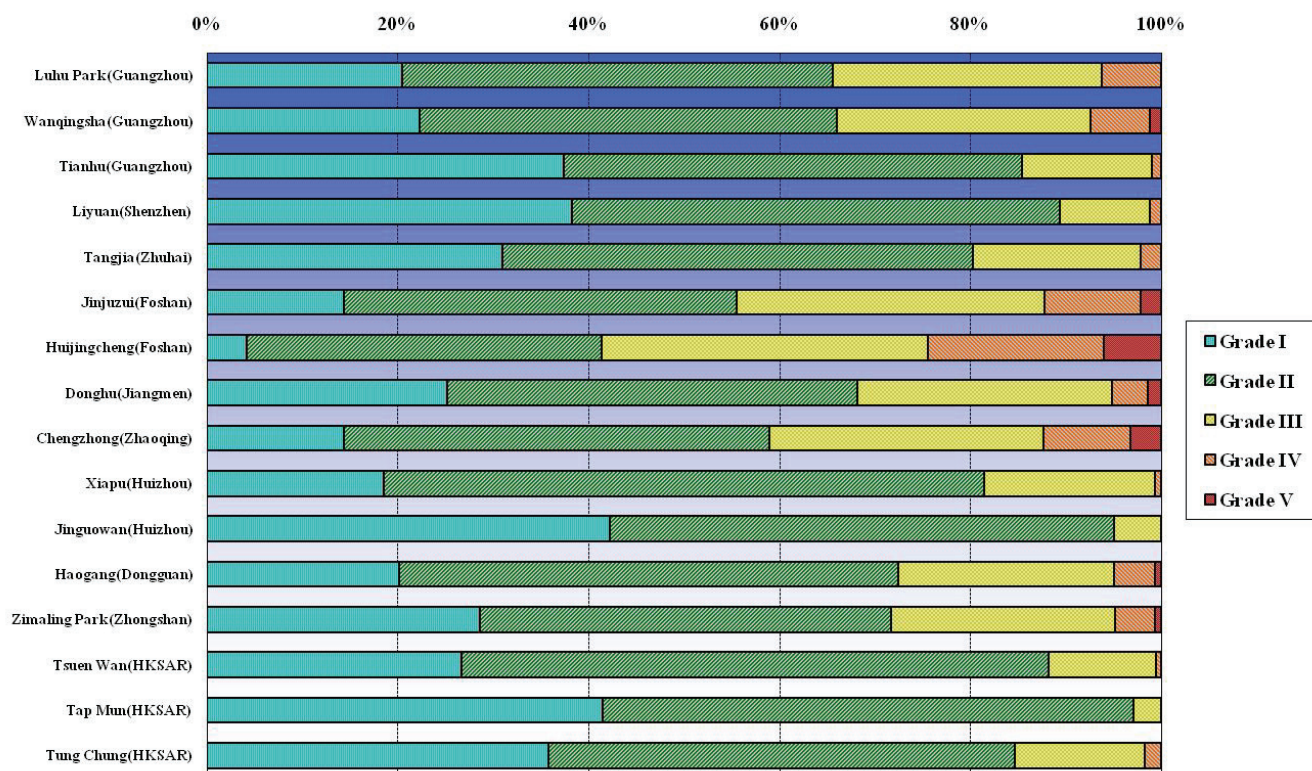


Figure 9 : Stacked column chart of RAQI grades of individual monitoring stations

Distribution of RAQI Grades
(Jan - Dec 2009)

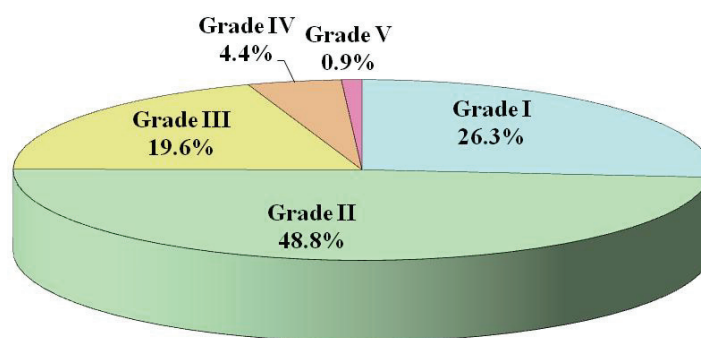


Figure 10 : Distribution of RAQI grades in the Network

Figure 10 shows the overall distribution of different RAQI grades recorded by the Network in 2009. As a whole, 75.1% of the RAQI values are at Grade I or II, meaning the pollutant concentrations are within Class 2 NAAQS, followed by 19.6% in Grade III, 4.4% at Grade IV and 0.9% in Grade V.

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

Distribution of average RAQI
from Jan 2009 to Dec 2009

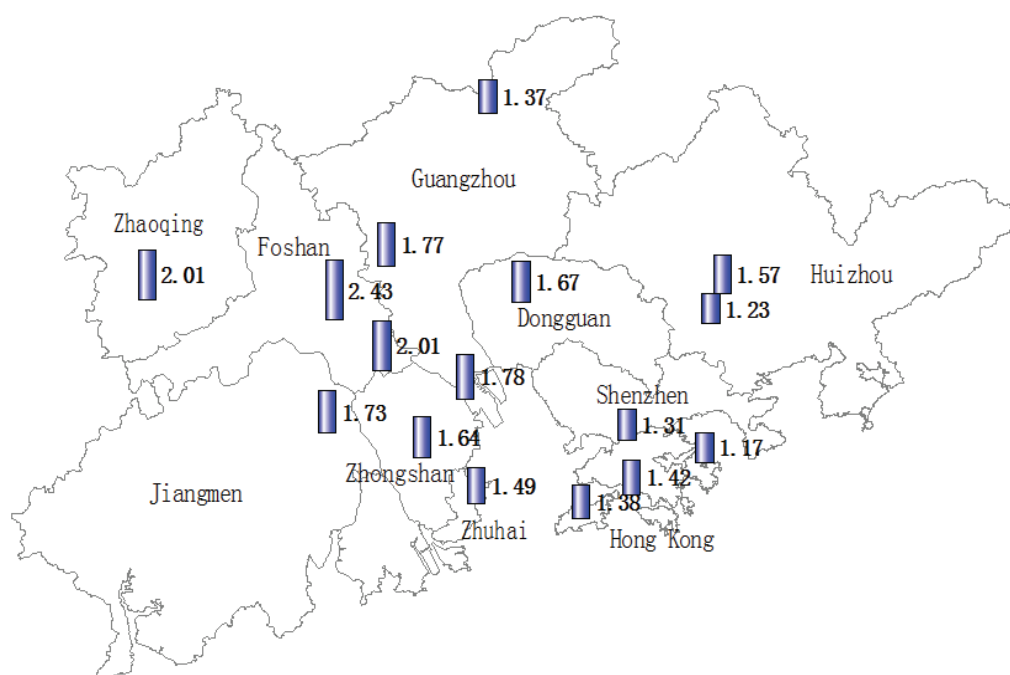


Figure 11 : Spatial distribution of average RAQI at Monitoring Stations in the Network

Figure 11 shows the spatial distribution of RAQI annual average in 2009 at monitoring stations in the network. The average values ranged from Grade II to Grade III.

4.3 Monthly Variations of Average RAQI

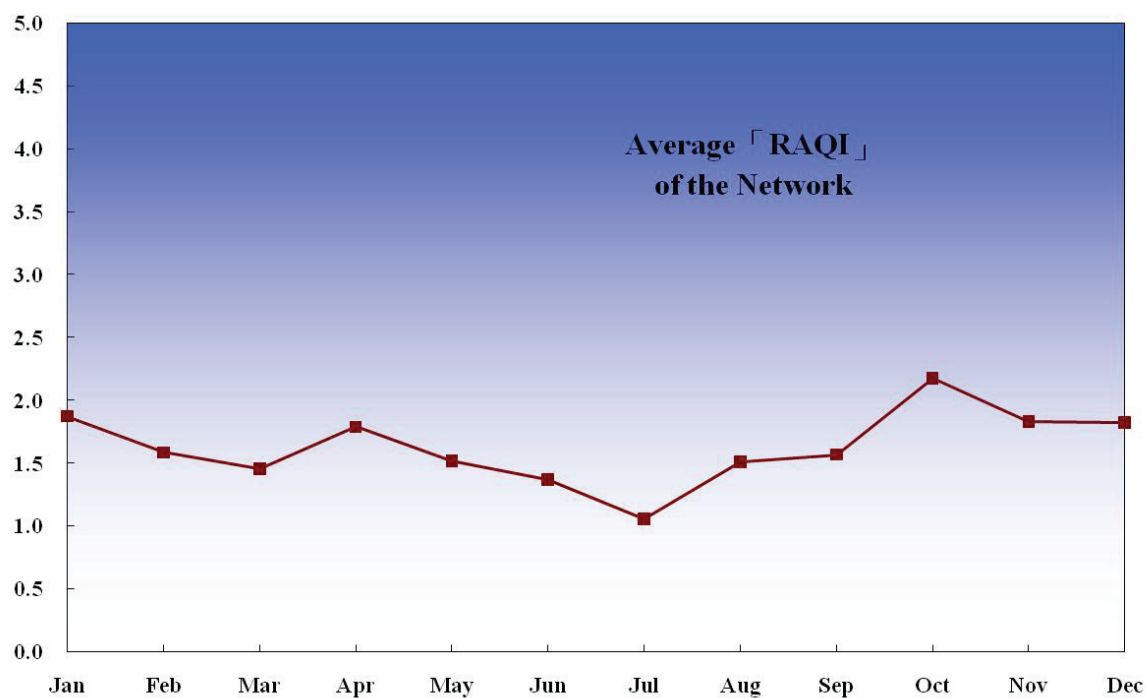


Figure 12 : Monthly variations in average RAQI

Figure 12 shows the monthly variations in the average RAQI values of the Network from January to December 2009. Except for October where the average RAQI values reached the Grade III level, the values in other months were within the Grade II category. The maximum and minimum RAQI values were recorded in October and July respectively.

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