Guangdong-Hong Kong-Macao
Pearl River Delta
Regional Air Quality Monitoring Network

A Report of Monitoring Results in 2022

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Approved by	**:**	**Quality Management Committee of Guangdong-Hong Kong-Macao Pearl River Delta Regional Air Quality Monitoring Network**
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Purpose of the Report

This report provides the 2022 monitoring results from the Guangdong-Hong Kong-Macao Pearl River Delta Regional Air Quality Monitoring Network and their statistical analysis.

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1. Foreword

Since the Pearl River Delta (PRD) Regional Air Quality Monitoring Network came into operation on 30 November 2005, a half-yearly and an annual air quality monitoring reports were published every year since 2006.

With the growing concerns of air pollution control and economic development of the region, the environmental protection departments of Guangdong and Hong Kong had worked in collaboration with the environmental protection cum meteorological authorities of Macao to enhance the network by extending the coverage of monitoring area to Guangdong, Hong Kong and Macao in September 2014. The enhancements included the addition of monitoring stations from 16 to 23 to further improve the spatial distribution and the inclusion of two new monitoring parameters, i.e. carbon monoxide (CO) and fine suspended particulates ($PM_{2.5}$), to enrich the air quality monitoring information. At the same time, the network was renamed to "Guangdong-Hong Kong-Macao Pearl River Delta Regional Air Quality Monitoring Network" (the "Network").

With the enhancement of the network, the update of the national ambient air quality standards as well as the need for improving the reporting frequency of monitoring results, starting from 2014, the real-time hourly monitoring data was reported on a new internet platform to replace the daily Regional Air Quality Index (RAQI), the half-yearly report was also replaced by a quarterly report while the annual air quality monitoring report was maintained. The quarterly report is a brief statistical summary of the regional air quality monitoring results in a quarter. The annual report, in addition to the reporting of the monitoring data, provides a more detailed analysis and comparison of the air quality in the year.

2. Introduction to Guangdong-Hong Kong-Macao Pearl River Delta Regional Air Quality Monitoring Network

The PRD Regional Air Quality Monitoring Network was jointly established by Ecological and Environmental Monitoring Centre of Guangdong[1] and the Environmental Protection Department of the Hong Kong Special Administrative Region (HKEPD) from 2003 to 2005. The network came into operation on 30 November 2005 and its data had been used for reporting Regional Air Quality Index (RAQI) to the public. At that time, the network comprised 16 automatic air quality monitoring stations (see Figure 1) across the PRD region in Guangdong and Hong Kong. Thirteen monitoring stations are located within the territory of Guangdong Province, three stations located in Hong Kong. All stations were installed with equipment to measure the ambient concentrations of respirable suspended particulates (PM_{10} or RSP), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and ozone (O_3).

The network was enhanced in September 2014 and renamed "Guangdong-Hong Kong-Macao Pearl River Delta Regional Air Quality Monitoring Network". The number of monitoring stations was increased from 16 to 23. Guangdong, on its original 13 stations, added five stations, including Nanshadawen[2] and Zhudong in Guangzhou, Duanfen and

[1] When the Monitoring Network was established in 2003, the unit was named Guangdong Provincial Environmental Protection Monitoring Centre, which was renamed as Guangdong Provincial Environmental Monitoring Centre in 2008, and was renamed again as Ecological and Environmental Monitoring Centre of Guangdong in December 2020.

[2] Owing to insufficient space after the extensive renovation work at Modiesha monitoring station in Guangzhou, this station closed permanently in 2021, whereas a new Nanshadawen monitoring station in Guangzhou joined the network.

Huaguoshan in Jiangmen, and Xijiao[3] in Huizhou. Hong Kong added Yuen Long monitoring station on the basis of its original three stations and Macao joined in with the monitoring station at Taipa Grande. As regards the monitoring parameters, the Network continued to monitor the original four air pollutants with the addition of two new monitoring parameters, i.e. carbon monoxide (CO) and fine suspended particulates ($PM_{2.5}$ or FSP). Figure 2 shows the latest spatial distribution of the monitoring stations after the enhancement of the network.

Based on the previous "Standard Operating Procedures on Quality Assurance and Quality Control of the PRD Air Quality Monitoring System for Guangdong and Hong Kong", the Network employs a revised "Standard Operating Procedures on Quality Assurance and Quality Control of the PRD Air Quality Monitoring System for Guangdong, Hong Kong and Macau" (QA/QC Operating Procedures) jointly developed by Guangdong, Hong Kong and Macau to ensure that the air quality monitoring results attain a high degree of accuracy and reliability, and meet the respective quality management policies of the three places. The design and operation of the Network comply with the requirements set out in the QA/QC Operating Procedures. In light of the development of the Network, the QA/QC Operating Procedures will be revised as and when necessary.

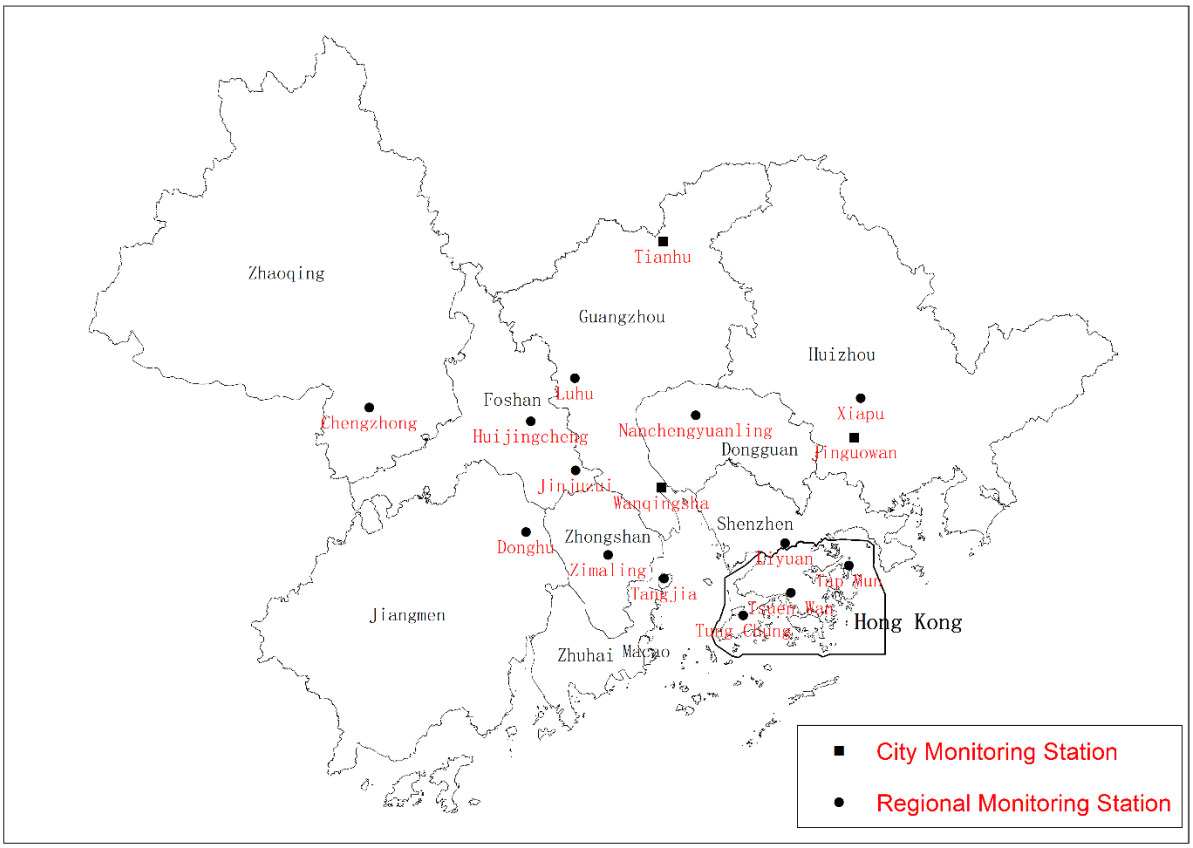

Figure 1：Spatial distribution of monitoring stations (Nov 2005 to Aug 2014)[4]

[3] Xijiao station was relocated to Zhangbei Yaowei She Nationality Primary School, Henghe Town, Boluo County, in the 4th quarter of 2019. Due to potential safety hazards of site load-bearing issue, the station is out of service from 00:00 on August 23, 2022. The new station completed reconstruction and resumed operation on the evening of April 18, 2023, which relocated to Shixia town, Boluo County, and renamed as "Boluo Shixia".

[4] The Figure 1 & 2 were drawn with reference to the China National Standard Map "Map of the Pearl River Delta Region" (approval number: 粵 S (2021) No. 169), and was re-submitted and approved for release. The approval number is GS 粵 (2022) No. 378.

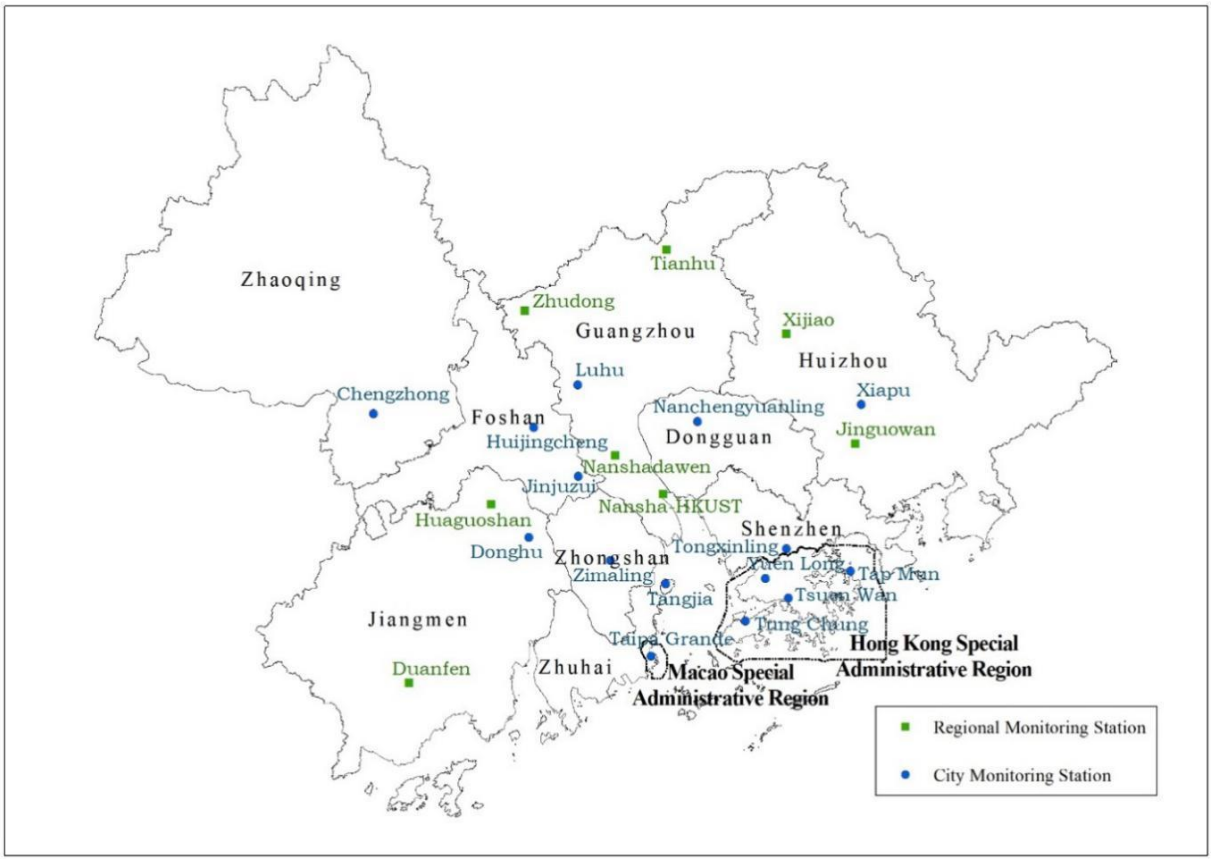

Figure 2：Spatial Distribution of Monitoring Stations in the Network (from Sept 2014)

To cope with the enhancement of the Network and the update of national ambient air quality standards, the internet platform has increased the data reporting frequency by replacing the previous RAQI that was published once a day to hourly dissemination of real time air quality monitoring information of each monitoring station.

The objectives of the Network are to:

- provide accurate air quality data to assist the governments of Guangdong, Hong Kong and Macao in understanding 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 different areas in the region.

This is an annual report on the monitoring results for 2022. From 2015 onwards, the annual report covers the monitoring results of six monitoring parameters recorded at 23 monitoring stations of the Network.

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

3. Operation of the Network

The overall operation of the Network was smooth in 2022. The average hourly data capture rate for the six air pollutants measured at all monitoring stations was 97.0%.

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

The governments of Guangdong, Hong Kong, and Macao have fully implemented the agreed QC works, which include zero/span checks, precision checks, dynamic calibration, etc. The QA/QC works are carried out 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 is in compliance with the QA/QC requirements, the GDEEMC, HKEPD, Environmental Protection Bureau of Macau SARG and Meteorological and Geophysical Bureau of Macao SARG jointly established the "Quality Management Committee of Guangdong-Hong Kong-Macao Pearl River Delta Regional Air Quality Monitoring Network" (Quality Management Committee, "QMC") to review and evaluate, on a quarterly basis, the performance of equipment, QA/QC works, data transmission system and operation of the Network. The QMC also conducts a system audit every year to evaluate the effectiveness of the quality management system. Based on the audit results, a report will be prepared to summarize any corrective measures and recommendations and the QMC will take appropriate follow-up actions.

3.2 Accuracy and Precision

The accuracy of the Network is evaluated by means of performance audits. The performance goals set for the gaseous pollutants and particulates (PM_{10} and $PM_{2.5}$) are ±20% and ±15% respectively. In 2022, we had carried out 270 audit checks on the analyzers and particulate samplers at the monitoring stations of the Network. The results showed that, based on the 95% probability limits, the accuracy of the Network ranged from -11.9% to 11.1%, which were within the required performance goals (see Figure 3).

Precision is a measure of repeatability and is calculated in accordance with the QA/QC Operating Procedures. The performance goals adopted for the gaseous pollutants and particulates (PM_{10} and $PM_{2.5}$) are ±15%. In 2022, we had carried out 4550 precision checks on the analyzers and samplers at the monitoring stations of the Network. The results showed that, based on the 95% probability limits, the precision of the Network ranged from -8.6% and 13.8%, which were within the required performance goals (see Figure 4). In 2022, the overall QA/QC performance of the Network was satisfactory and met all the requirements specified in the QA/QC Operating Procedures.

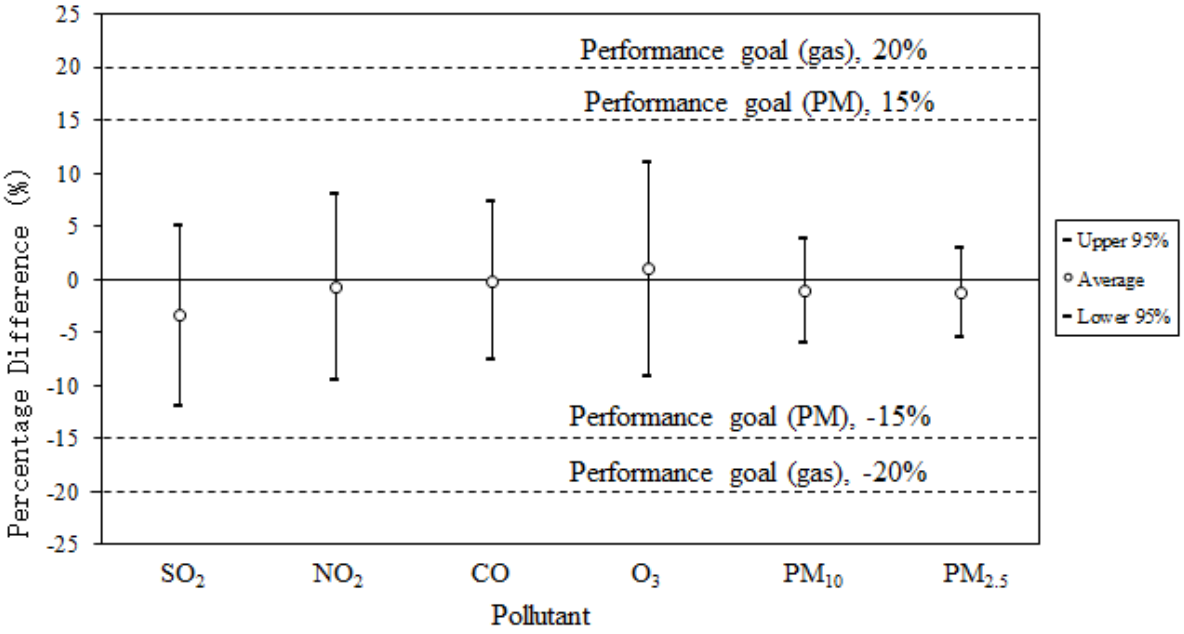

Figure 3：Accuracy of the monitoring network in 2022[5]

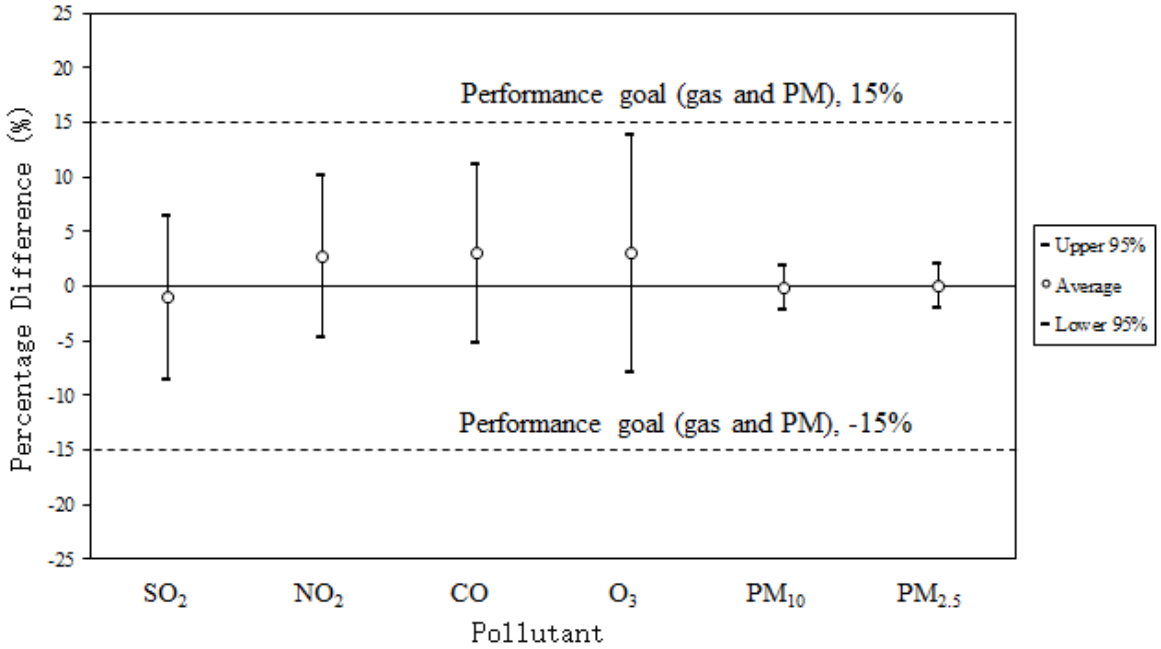

Figure 4：Precision of the monitoring network in 2022[6]

[5]The stations that underwent audit checks in 2022 were Nanshadawen (Guangzhou), Nansha-HKUST (Guangzhou), Tianhu (Guangzhou), Zhudong (Guangzhou), Huijingcheng (Foshan), Donghu (Jiangmen), Duanfen (Jiangmen), Huaguoshan (Jiangmen), Jinguowan (Huizhou), Tap Mun (Hong Kong), Tsuen Wan (Hong Kong), Yuen Long (Hong Kong), Tung Chung (Hong Kong) and Taipa Grande (Macao). However, other stations were unable to undergo audits check due to the epidemic situation.

[6] After its shutdown on August 23, the Xijiao (Huizhou) monitoring station did not undergo the precision check, while other stations completed the required bi-weekly precision check as required.

4. Statistical Analysis of Pollutant Concentrations

Starting from 2014 annual report, the air quality assessment is conducted based on the class II limits of the national "Ambient Air Quality Standards" (NAAQS) (GB3095-2012). Per the amended version of the Standards, starting from 2019, the concentrations of gaseous pollutants are calculated at a reference temperature of 298.15K and a pressure of 101.325 kPa, while the concentrations of PM_{10} and $PM_{2.5}$ are measured at real-time temperature and atmospheric pressure during monitoring.

Owing to the low daily data capture rate in 2022 for the six monitoring parameters at Xijiao station, these data were not used for statistical analysis but for reference only.

4.1 Sulphur Dioxide (SO_2)

Sulphur dioxide (SO_2) comes mainly from the combustion of sulphur-containing fossil fuel. Its major sources of emissions include power plants, fuel combustion plants, vehicles and vessels. Apart from its impact on the human respiratory system, SO_2 can also be oxidized in the air to form sulphate, which has significant impact on the levels of particulate matters, acid rain and visibility in the region.

In 2022, the annual average of SO_2 recorded at each monitoring station in the Network ranged from 3 to 11 μg/m^3, and all stations were in compliance with the national annual average concentration limit (60 μg/m^3). As shown in Figure 5, the annual average concentrations of SO_2 recorded at all the monitoring stations were generally at a low level. During the year, all monitoring stations in the Network could comply with the national 24-hour average concentration limit (150 μg/m^3) and 1-hour average concentration limit (500 μg/m^3) of SO_2.

Tables 4.1a to 4.1c list the monthly maxima of hourly averages, the monthly maxima of daily averages with the 98th percentile of the year, the monthly and annual averages of SO_2 at each station respectively.

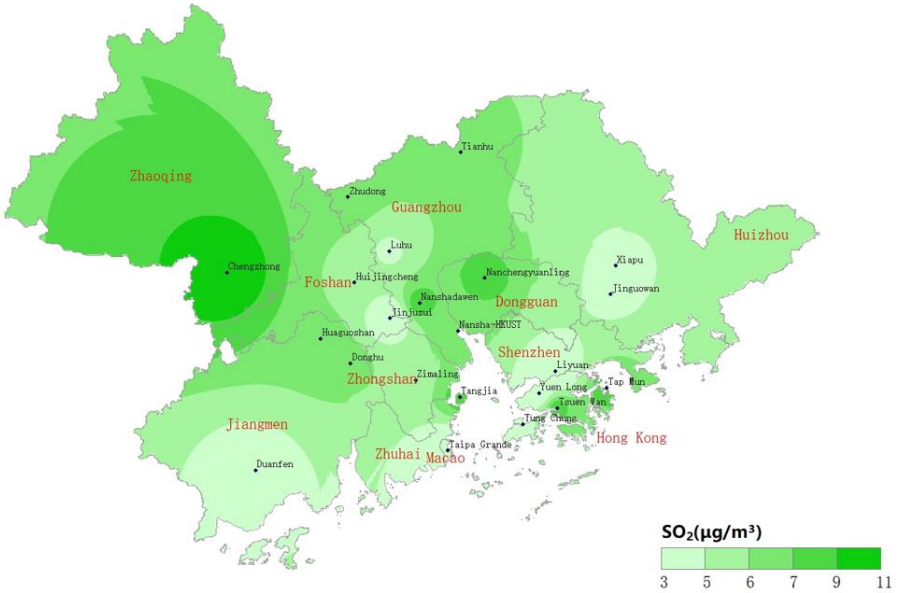

Figure 5：Spatial distribution of annual average concentrations of Sulphur Dioxide (SO_2) [7]

[7] Data at Xijiao station in Huizho are excluded from the concentration spatial distribution figure and the calculation of the monthly variation of pollutant concentrations in 2022 owing to its low data capture rate during the year. The same applies to following.

Table 4.1a：Hourly averages concentration of Sulphur Dioxide (monthly maxima)[8]

[Class II limit: 500 μg/m^3]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Luhu (Guangzhou)	14	14	16	17	8	7	9	14	11	10	10	12
Nanshadawen (Guangzhou)	18	18	34	17	16	14	15	23	18	30	18	20
Nansha-HKUST (Guangzhou)	20	18	18	14	15	12	15	12	19	20	15	16
Tianhu (Guangzhou)	19	15	14	19	15	11	13	12	20	22	17	18
Zhudong (Guangzhou)	16	17	18	18	21	14	21	14	20	28	19	20
Tongxinling (Shenzhen)	5	6	5	5	6	6	6	7	6	9	5	6
Jinjuzui (Foshan)	7	17	11	10	8	7	7	8	18	13	7	10
Huijingcheng (Foshan)	22	26	17	16	12	14	20	26	48	28	24	21
Tangjia (Zhuhai)	15	22	20	14	12	12	13	12	13	11	12	16
Donghu (Jiangmen)	16	22	16	16	11	11	12	14	20	25	14	14
Duanfen (Jiangmen)	16	17	16	15	18	9	10	12	20	28	18	14
Huaguoshan (Jiangmen)	48	26	45	43	47	50	59	68	80	84	45	29
Chengzhong (Zhaoqing)	72	22	119	134	51	53	70	203	39	116	73	48
Xiapu (Huizhou)	10	6	10	12	19	8	13	9	26	21	16	21
Xijiao (Huizhou)	15	6	9	11	22	9	9	5	--	--	--	--
Jinguowan (Huizhou)	10	8	17	12	11	11	15	13	14	12	16	12
Zimaling (Zhongshan)	16	18	25	11	9	6	14	10	14	21	11	17
Nanchengyuanling (Dongguan)	15	12	13	23	17	10	32	16	29	20	19	17
Tap Mun (Hong Kong)	15	10	11	13	11	13	14	16	14	15	14	11
Tsuen Wan (Hong Kong)	19	27	23	20	16	30	21	28	16	14	17	16
Yuen Long (Hong Kong)	9	10	13	11	13	11	21	8	10	10	8	10
Tung Chung (Hong Kong)	16	18	20	15	10	7	14	12	16	19	11	16
Taipa Grande (Macao)	11	11	14	9	7	7	7	6	11	8	6	11

[8] All pollutants, except for carbon monoxide, are measured in micrograms per cubic meter (μg/m3). The unit for carbon monoxide concentration is milligrams per cubic meter (mg/m3).

* The capture rate of validated daily data per month is below 85%.

-- No monitoring for the corresponding period. This also applies to all the pollutant monitoring mentioned below.

Table 4.1b：Daily averages concentration of Sulphur Dioxide (monthly maxima and the 98th percentile of the year)

[Class II limit: 150 μg/m³]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Compliance	98th percentile
Luhu (Guangzhou)	8	9	9	9	6	5	5	6	5	7	6	9	100.0%	8
Nanshadawen (Guangzhou)	12	11	13	10	10	9	10	13	9	16	8	14	100.0%	13
Nansha-HKUST (Guangzhou)	12	10	10	9	8	7	8	8	12	11	7	12	100.0%	10
Tianhu (Guangzhou)	14	8	11	12	10	8	9	9	13	13	11	13	100.0%	12
Zhudong (Guangzhou)	11	9	10	12	12	9	11	9	12	15	12	11	100.0%	12
Tongxinling (Shenzhen)	4	6	4	4	5	5	4	4	5	7	4	5	100.0%	6
Jinjuzui (Foshan)	6	7	6	8	5	3	3	4	8	7	4	7	100.0%	6
Huijingcheng (Foshan)	10	14	10	9	7	7	10	11	18	12	13	11	100.0%	12
Tangjia (Zhuhai)	11	10	10	11	10	9	10	8	8	9	8	11	100.0%	10
Donghu (Jiangmen)	11	9	10	9	9	8	9	8	11	11	9	9	100.0%	10
Duanfen (Jiangmen)	8	5	6	6	6	4	4	5	8	10	7	10	100.0%	8
Huaguoshan (Jiangmen)	14	12	12	14	16	12	12	16	20	21	13	12	100.0%	16
Chengzhong (Zhaoqing)	20	13	26	32	19	16	21	29	13	33	21	18	100.0%	23
Xiapu (Huizhou)	6	4	6	7	6	3	5	4	10	12	9	11	100.0%	11
Xijiao (Huizhou)	5	3	4	4	5	4	3	3	--	--	--	--	100.0%*	4*
Jinguowan (Huizhou)	6	6	7	7	7	6	7	7	6	8	5	8	100.0%	7
Zimaling (Zhongshan)	10	9	10	6	5	4	7	7	10	11	8	12	100.0%	10
Nanchengyuanling (Dongguan)	12	8	10	11	12	9	13	10	14	12	12	13	100.0%	12
Tap Mun (Hong Kong)	10	8	8	8	8	8	10	10	11	12	10	8	100.0%	11
Tsuen Wan (Hong Kong)	9	8	9	11	9	12	11	13	12	11	10	10	100.0%	11
Yuen Long (Hong Kong)	5	5	6	6	6	5	6	5	6	6	5	7	100.0%	6
Tung Chung (Hong Kong)	9	10	13	11	3	4	6	6	8	9	7	10	100.0%	10
Taipa Grande (Macao)	5	5	5	5	5	5	5	4	6	6	4	8	100.0%	7

Table 4.1c：The monthly and annual averages concentration of Sulphur Dioxide

[Class II limit for annual average: 60 μg/m^3]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Luhu (Guangzhou)	6	6	7	6	4	4	4	4	4	5	3	5	5
Nanshadawen (Guangzhou)	8	7	9	7	7	7	8	8	6	8	6	9	8
Nansha-HKUST (Guangzhou)	8	7	7	7	7	6	7	7	8	8	6	7	7
Tianhu (Guangzhou)	8	7	8	8	8	7	7	7	9	8	4	7	7
Zhudong (Guangzhou)	8	7	8	8	7	7	8	7	8	9	6	7	7
Tongxinling (Shenzhen)	3	4	3	3	3	3	3	3	4	5	3	3	3
Jinjuzui (Foshan)	2	2	4	3	3	2	2	2	3	4	3	4	3
Huijingcheng (Foshan)	6	7	6	6	5	6	6	6	9	9	6	6	6
Tangjia (Zhuhai)	9	7	8	9	8	8	7	6	7	7	7	9	8
Donghu (Jiangmen)	7	6	7	7	7	6	7	6	8	8	7	7	7
Duanfen (Jiangmen)	4	2	4	3	3	2	3	4	5	6	4	7	4
Huaguoshan (Jiangmen)	7	4	7	7	6	6	6	7	10	10	6	8	7
Chengzhong (Zhaoqing)	10	7	11	14	12	12	14	12	9	13	12	11	11
Xiapu (Huizhou)	4	3	5	5	4	3	3	3	6	8	7	8	5
Xijiao (Huizhou)	3	2	3	3	2	2	2	2*	--	--	--	--	2*
Jinguowan (Huizhou)	5	4	6	6	6	6	6	5	5	5	4	6	5
Zimaling (Zhongshan)	6	5	6	4	4	3	5	4	6	8	7	9	6
Nanchengyuanling (Dongguan)	7	6	8	9	9	6	8	8	11	10	10	9	8
Tap Mun (Hong Kong)	8	7	7	7	7	7	8	9	10	10	7	6	8
Tsuen Wan (Hong Kong)	5	5	6	7	7	9	9	9	9	9	9	8	8
Yuen Long (Hong Kong)	4	4	4	5	3	3	4	4	4	4	3	5	4
Tung Chung (Hong Kong)	6	8	9	5	2	3	4	5	6	6	6	8	5
Taipa Grande (Macao)	2	2	3	3	4	4	4	3	3	4	3	6	3

4.2 Nitrogen Dioxide (NO_2)

Nitrogen Dioxide (NO_2) is mainly formed from oxidization of nitric oxide (NO) emitted in the process of combustion. Its major emission sources include power plants, fuel combustion plants, vehicles and vessels. Apart from its impact on human respiratory system, NO_2 can also be oxidized in the air to form nitrate, which has significant impact on the levels of particulate matters, acid rain and visibility in the region.

In 2022, the annual average of NO_2 recorded at each monitoring station in the Network ranged from 7 to 39 μg/m^3, among them, the monitoring station having the highest annual average value of NO_2 was located in the urban area. During the year, 14 monitoring stations in the Network recorded no exceedance of the national 24-hour average concentration limit (80 μg/m^3) while the corresponding compliance rates in the Network ranged from 98.3% to 100.0%; 21 monitoring stations recorded no exceedance of national 1-hour average concentration limit of NO_2 (200 μg/m^3).

Tables 4.2a to 4.2c list the monthly maxima of hourly averages, the monthly maxima of daily averages with the 98th percentile of the year, the monthly and annual averages of NO_2 at each station respectively.

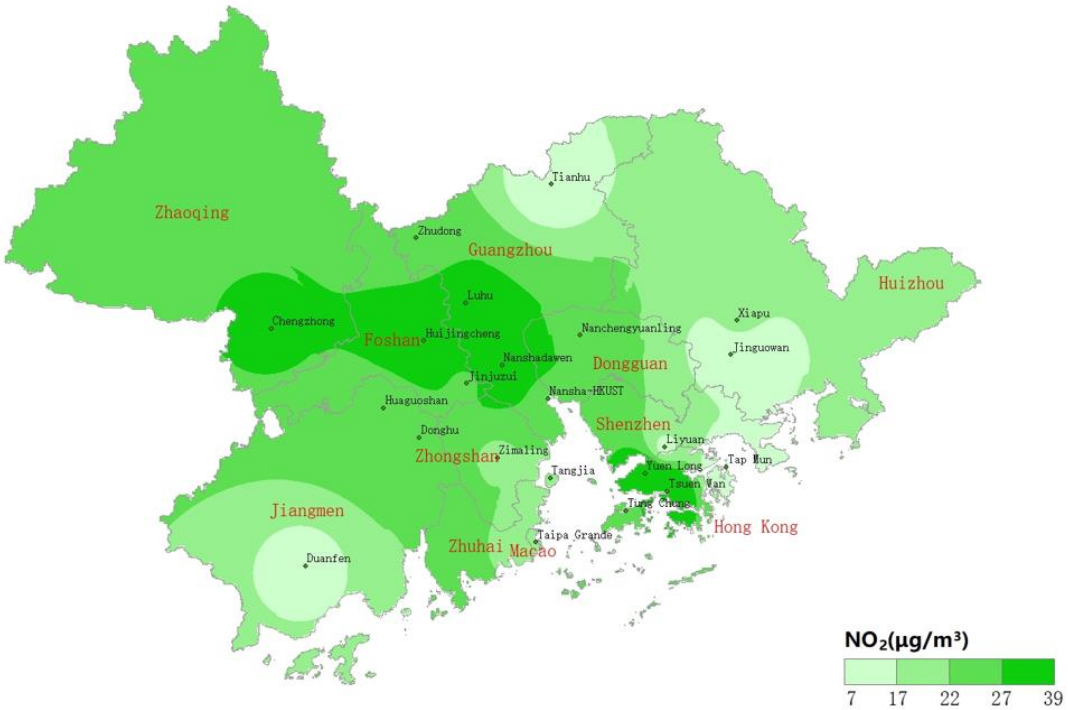

Figure 6：Spatial distribution of annual average concentrations of Nitrogen Dioxide (NO_2)

Table 4.2a：Hourly averages concentration of Nitrogen Dioxide (monthly maxima)

[Class II limit: 200 μg/m^3]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Luhu (Guangzhou)	148	116	136	133	98	49	76	80	105	149	126	102
Nanshadawen (Guangzhou)	211	205	145	102	101	76	95	105	118	127	149	129
Nansha-HKUST (Guangzhou)	135	126	154	103	88	57	70	55	92	74	127	136
Tianhu (Guangzhou)	45	20	41	44	47	31	47	32	22	30	28	30
Zhudong (Guangzhou)	96	75	86	90	63	54	61	53	68	92	74	95
Tongxinling (Shenzhen)	64	80	76	73	46	40	67	52	93	89	66	92
Jinjuzui (Foshan)	135	129	108	104	77	47	58	54	75	107	103	98
Huijingcheng (Foshan)	141	129	114	123	128	61	62	88	101	155	144	140
Tangjia (Zhuhai)	98	66	68	83	62	46	41	54	47	52	80	83
Donghu (Jiangmen)	146	136	79	92	64	38	44	46	54	98	85	121
Duanfen (Jiangmen)	77	44	57	46	31	17	24	21	27	36	46	65
Huaguoshan (Jiangmen)	109	66	63	68	54	32	68	47	66	89	88	120
Chengzhong (Zhaoqing)	158	89	93	136	129	54	65	80	125	146	128	107
Xiapu (Huizhou)	102	104	115	67	60	45	48	58	69	48	80	91
Xijiao (Huizhou)	26	24	27	32	24	34	22	15	--	--	--	--
Jinguowan (Huizhou)	49	31	40	30	26	34	30	30	30	30	31	72
Zimaling (Zhongshan)	142	89	72	68	64	40	62	56	73	81	75	86
Nanchengyuanling (Dongguan)	137	162	131	113	118	55	71	92	89	128	171	126
Tap Mun (Hong Kong)	50	32	57	43	40	18	40	40	44	24	26	62
Tsuen Wan (Hong Kong)	150	151	192	198	108	75	92	123	117	104	171	137
Yuen Long (Hong Kong)	122	126	111	134	101	72	107	91	146	94	134	135
Tung Chung (Hong Kong)	100	119	118	88	77	58	81	75	85	76	91	92
Taipa Grande (Macao)	100	113	90	56	56	36	48	45	159	56	93	77

Table 4.2b：Daily averages concentration of Nitrogen Dioxide (monthly maxima and the 98th percentile of the year) **[Class II limit: 80 μg/m³]**

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Compliance	98th percentile
Luhu (Guangzhou)	89	71	64	61	54	35	31	35	65	72	61	61	99.7%	69
Nanshadawen (Guangzhou)	109	110	72	56	50	41	44	42	62	61	70	73	98.3%	74
Nansha-HKUST (Guangzhou)	75	68	63	44	49	36	32	39	41	36	48	54	100.0%	55
Tianhu (Guangzhou)	26	10	22	22	18	14	18	13	12	17	17	14	100.0%	18
Zhudong (Guangzhou)	51	35	54	42	34	31	26	27	28	46	44	39	100.0%	44
Tongxinling (Shenzhen)	35	40	41	23	26	19	41	30	33	33	32	58	100.0%	36
Jinjuzui (Foshan)	94	80	52	54	41	30	27	33	44	50	56	59	99.7%	66
Huijingcheng (Foshan)	99	86	78	67	62	40	32	43	49	67	78	81	98.9%	77
Tangjia (Zhuhai)	58	31	43	38	31	17	20	28	24	26	35	52	100.0%	42
Donghu (Jiangmen)	96	66	50	53	37	22	23	23	30	40	44	63	99.4%	63
Duanfen (Jiangmen)	51	23	38	27	20	9	9	10	14	24	33	47	100.0%	38
Huaguoshan (Jiangmen)	75	40	40	39	32	21	29	23	34	53	49	71	100.0%	59
Chengzhong (Zhaoqing)	81	45	56	60	59	33	35	35	48	64	63	63	99.4%	63
Xiapu (Huizhou)	49	50	49	28	27	23	25	26	31	24	32	46	100.0%	39
Xijiao (Huizhou)	15	10	16	17	14	17	8	6	--	--	--	--	100.0%*	15*
Jinguowan (Huizhou)	22	15	20	14	14	16	17	14	14	11	14	24	100.0%	18
Zimaling (Zhongshan)	74	46	38	43	31	19	29	30	35	38	37	60	100.0%	50
Nanchengyuanling (Dongguan)	69	75	55	47	41	39	33	39	39	51	78	60	100.0%	61
Tap Mun (Hong Kong)	19	11	18	14	11	7	18	16	14	12	14	20	100.0%	17
Tsuen Wan (Hong Kong)	73	77	85	61	56	53	57	51	59	48	60	61	99.4%	66
Yuen Long (Hong Kong)	69	72	61	60	54	46	62	53	69	51	67	85	99.7%	68
Tung Chung (Hong Kong)	57	46	58	52	40	23	34	32	44	41	43	53	100.0%	52
Taipa Grande (Macao)	54	58	41	36	23	23	21	31	42	34	39	49	100.0%	48

Table 4.2c：The monthly and annual averages concentration of Nitrogen Dioxide

[Class II limit for annual average: 40 μg/m^3]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Luhu (Guangzhou)	46	28	40	31	30	20	19	23	34	28	34	31	30
Nanshadawen (Guangzhou)	56	35	42	36	34	24	22	26	35	38	44	44	36
Nansha-HKUST (Guangzhou)	40	26	38	28	25	18	15	18	21	17	27	28	25
Tianhu (Guangzhou)	12	6	14	12	10	10	10	7	8	9	10	9	10
Zhudong (Guangzhou)	29	17	32	25	22	21	18	17	21	24	27	24	23
Tongxinling (Shenzhen)	20	13	15	14	12	11	12	13	15	15	18	28	15
Jinjuzui (Foshan)	50	28	34	26	22	12	13	17	24	24	33	31	26
Huijingcheng (Foshan)	48	27	37	30	31	22	19	24	29	30	42	40	32
Tangjia (Zhuhai)	33	19	21	18	14	7	7	10	16	15	22	29	18
Donghu (Jiangmen)	46	25	26	24	20	13	12	16	20	24	32	37	25
Duanfen (Jiangmen)	27	14	14	11	10	4	5	6	11	16	19	29	14
Huaguoshan (Jiangmen)	39	21	24	21	18	9	11	14	23	27	36	41	24
Chengzhong (Zhaoqing)	41	24	35	29	30	17	22	22	31	29	31	27	28
Xiapu (Huizhou)	28	16	23	19	16	16	16	15	17	16	20	20	19
Xijiao (Huizhou)	9	5	10	10	9	10	5	4*	--	--	--	--	8*
Jinguowan (Huizhou)	14	6	11	10	8	9	9	8	9	8	10	12	10
Zimaling (Zhongshan)	38	21	21	19	17	8	10	14	21	20	26	35	21
Nanchengyuanling (Dongguan)	37	23	31	26	24	18	20	24	25	24	35	29	26
Tap Mun (Hong Kong)	11	7	9	7	5	4	6	6	8	7	8	13	7
Tsuen Wan (Hong Kong)	48	37	43	42	38	39	34	33	38	34	35	42	39
Yuen Long (Hong Kong)	51	36	39	38	34	27	28	26*	34	32	42	56	37
Tung Chung (Hong Kong)	38	27	27	25	20	11	14	17	25	24	25	36	24
Taipa Grande (Macao)	34	25	24	17	13	8	7	12	19	20	25	36	20

4.3 Ozone (O_3)

Ozone (O_3) is not directly emitted from emission sources. It is formed by the photochemical reaction of oxygen, nitrogen oxides (NOx) 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.

In 2022, the annual average of O_3 recorded at each monitoring station in the Network ranged from 46 to 81 μg/m^3 with higher average values being recorded in rural areas such as Tianhu in Guangzhou and Tap Mun in Hong Kong, the situation was similar to the one in previous years. During the year, the compliance rates of the daily maximum 8-hour averages of O_3 in the Network ranged from 76.6% to 98.1%. All monitoring stations recorded exceedance of the national 1-hour average concentration limit (200 μg/m^3).

Tables 4.3a to 4.3c list the monthly maxima of hourly averages, the monthly maxima of daily maximum 8-hour averages with the 90th percentile of the year, the monthly and annual averages of O_3 at each station respectively.

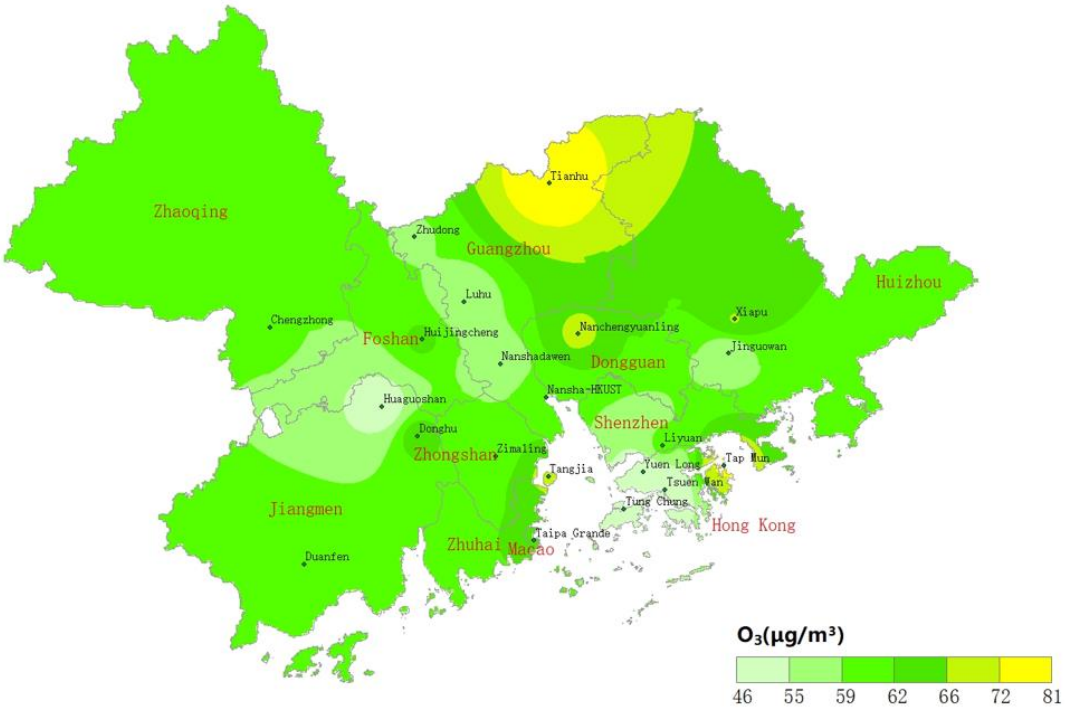

Figure 7：Spatial distribution of annual average concentrations of Ozone (O_3)

Table 4.3a：Hourly averages concentration of Ozone (monthly maxima)

[Class II limit: 200 μg/m^3]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Luhu (Guangzhou)	186	248	243	297	260	211	268	225	280	269	238	115
Nanshadawen (Guangzhou)	300	214	245	320	261	207	288	221	290	301	265	170
Nansha-HKUST (Guangzhou)	286	281	303	323	282	179	349	222	296	262	285	168
Tianhu (Guangzhou)	151	134	233	248	207	161	230	193	209	210	210	122
Zhudong (Guangzhou)	223	245	342	281	305	191	224	216	268	248	261	147
Tongxinling (Shenzhen)	148	247	195	241	211	102	261	208	292	198	135	163
Jinjuzui (Foshan)	230	184	243	241	258	180	228	199	262	271	206	121
Huijingcheng (Foshan)	250	268	284	278	274	166	247	235	294	297	263	111
Tangjia (Zhuhai)	223	234	264	300	237	128	243	270	379	261	296	170
Donghu (Jiangmen)	231	243	292	282	288	158	209	211	296	325	316	170
Duanfen (Jiangmen)	153	207	221	196	191	124	165	134	256	306	220	158
Huaguoshan (Jiangmen)	222	184	250	274	234	146	170	185	244	309	266	133
Chengzhong (Zhaoqing)	259	188	201	245	258	186	172	196	270	254	228	158
Xiapu (Huizhou)	147	138	220	222	259	149	239	205	237	177	161	119
Xijiao (Huizhou)	170	179	234	259	201	195	232	189	--	--	--	--
Jinguowan (Huizhou)^	165	152	237	189	330	156	255	183	240	156	137	116
Zimaling (Zhongshan)	212	254	211	281	245	124	251	243	330	306	233	165
Nanchengyuanling (Dongguan)	210	306	277	301	305	159	265	243	305	219	214	148
Tap Mun (Hong Kong)	161	160	174	186	184	96	278	272	309	194	155	151
Tsuen Wan (Hong Kong)	97	134	154	183	126	51	210	205	294	168	114	105
Yuen Long (Hong Kong)	129	211	155	243	152	74	201	255	357	198	157	131
Tung Chung (Hong Kong)	140	157	229	228	173	57	213	259	325	223	268	132
Taipa Grande (Macao)	160	167	258	186	167	78	170	252	341	267	292	169

Table 4.3b：Daily maximum 8-hour averages concentration of Ozone (monthly maxima and the 90th percentile of the year) **[Class II limit: 160 μg/m³]**

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Compliance	90th percentile
Luhu (Guangzhou)	144	191	189	226	229	145	236	196	226	228	179	102	80.1%	183
Nanshadawen (Guangzhou)	213	180	187	234	243	133	255	169	245	255	224	136	78.1%	187
Nansha-HKUST (Guangzhou)	181	213	184	251	239	115	268	199	252	229	244	132	81.2%	191
Tianhu (Guangzhou)	132	122	190	218	194	148	219	180	188	188	181	115	89.9%	158
Zhudong (Guangzhou)	184	187	255	233	276	153	210	188	226	208	222	128	82.2%	176
Tongxinling (Shenzhen)	118	172	131	200	160	81	229	190	234	172	121	104	90.8%	150
Jinjuzui (Foshan)	157	140	179	214	235	111	184	169	245	238	170	99	84.0%	175
Huijingcheng (Foshan)	199	202	244	246	247	143	223	193	244	244	217	97	76.6%	203
Tangjia (Zhuhai)	174	191	195	212	202	79	158	217	311	204	231	135	85.0%	172
Donghu (Jiangmen)	181	192	217	242	261	133	186	174	260	282	247	146	79.2%	198
Duanfen (Jiangmen)	130	183	174	174	180	87	136	113	222	228	175	133	89.9%	155
Huaguoshan (Jiangmen)	183	160	214	220	210	125	143	147	218	257	226	106	89.3%	161
Chengzhong (Zhaoqing)	218	163	174	219	237	141	163	152	229	227	189	127	85.8%	169
Xiapu (Huizhou)	121	123	176	183	237	129	225	168	205	165	141	109	91.2%	156
Xijiao (Huizhou)	149	145	189	188	185	160	197	168	--	--	--	--	95.3%*	143*
Jinguowan (Huizhou)^	140	124	193	172	267	123	231	157	206	148	115	105	95.4%	141
Zimaling (Zhongshan)	149	194	171	229	206	89	204	191	288	240	210	135	83.6%	181
Nanchengyuanling (Dongguan)	171	215	233	256	261	133	236	206	250	203	183	126	78.5%	189
Tap Mun (Hong Kong)	152	147	164	176	174	71	215	224	275	181	141	135	92.1%	152
Tsuen Wan (Hong Kong)	83	101	115	118	115	42	155	118	253	135	94	84	98.1%	109
Yuen Long (Hong Kong)	100	154	121	191	125	59	147	221	304	172	120	109	94.2%	139
Tung Chung (Hong Kong)	108	118	124	190	121	52	154	173	277	166	165	107	95.4%	128
Taipa Grande (Macao)	122	126	157	171	143	56	126	229	277	226	199	131	92.2%	149

Table 4.3c：The monthly and annual averages concentration of Ozone

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Luhu (Guangzhou)	31	38	53	63	56	41	70	54	93	92	40	44	56
Nanshadawen (Guangzhou)	33	37	55	61	59	36	67	51	97	92	42	44	56
Nansha-HKUST (Guangzhou)	48	46	56	67	65	34	61	52	109	95	49	47	61
Tianhu (Guangzhou)	64	58	86	84	81	60	89	68	119	111	68	75	81
Zhudong (Guangzhou)	36	40	55	65	62	45	66	54	91	94	47	48	59
Tongxinling (Shenzhen)	56	51	64	71	68	36	56	48	106	88	50	42	61
Jinjuzui (Foshan)	28	33	51	61	57	36	56	49	104	90	49*	49*	56
Huijingcheng (Foshan)	33	36	61	73	67	42	72	61	114	105	43	42	63
Tangjia (Zhuhai)	54	48	68	74	76	45	59	58	125	95	54	52	68
Donghu (Jiangmen)	38	42	65	73	71	41	63	55	122	104	47	47	64
Duanfen (Jiangmen)	48	55	67	69	71	44	51	47	92	98	48	52	62
Huaguoshan (Jiangmen)	36	39	50	58	52	34	50	41	92	82	35	35	50
Chengzhong (Zhaoqing)	39	40	53	67	63	43	58	55	99	99	52	53	60
Xiapu (Huizhou)	50	49	68	74	72	43	70	56	102	95	55	53	66
Xijiao (Huizhou)	48	48	60	62	46	41	57	42*	--	--	--	--	51*
Jinguowan (Huizhou)	48	47	61	63	63	36	55	42	86	80	43	50	56
Zimaling (Zhongshan)	40	43	59	66	63	44	60	57	119	96	42	41	61
Nanchengyuanling (Dongguan)	53	52	77*	76	73	42	69	55	111	98	53	53	67
Tap Mun (Hong Kong)	81	66	80	81	81	42	55	56	118	99	69	62	74
Tsuen Wan (Hong Kong)	42	39	49	47	49	17	32	28	97	73	44	36	46
Yuen Long (Hong Kong)	39	39	50	56	53	27	38	36	104	85	45	39	51
Tung Chung (Hong Kong)	40	36	48	56	54	34	41	38	96	76	48	31	50
Taipa Grande (Macao)	51	42	59	64	65	39	50	49	125	104	62	52	64

4.4 Carbon Monoxide (CO)

Carbon Monoxide (CO) is formed when the fuel is not completely burned. Except for methane conversion, plant emissions, forest fires and other natural sources, deforestation, grassland and waste incineration, and the use of fossil fuels and civilian fuel are the main anthropogenic sources of CO. In most urban areas, the major emission source of CO is automobiles.

In 2022, the annual average of CO recorded at each monitoring station in the Network ranged from 0.4 to 0.7 mg/m^3. During the year, all monitoring stations in the Network were in compliance with the national 1-hour and 24-hour average concentration limits (10 mg/m^3 and 4 mg/m^3).

Tables 4.4a to 4.4c list the monthly maxima of hourly and daily averages, the maxima of daily averages with the 95th percentile of the year, the monthly and annual averages of CO at each station respectively.

Figure 8：Spatial distribution of annual average concentrations of Carbon Monoxide (CO)

Table 4.4a：Hourly averages concentration of Carbon Monoxide (monthly maxima)

[Class II limit: 10 mg/m^3]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Luhu (Guangzhou)	1.6	1.5	1.7	1.4	1.6	1.0	1.1	1.3	1.6	1.1	1.6	0.9
Nanshadawen (Guangzhou)	1.9	2.2	1.9	1.5	1.1	0.9	1.0	1.0	1.6	1.1	1.3	1.2
Nansha-HKUST (Guangzhou)	1.5	1.1	1.0	1.0	1.1	0.6	0.8	1.1	0.9	0.8	1.0	1.1
Tianhu (Guangzhou)	1.9	1.6	1.0	0.8	1.1	1.3	1.1	1.0	0.8	1.0	1.2	1.2
Zhudong (Guangzhou)	1.3	1.3	1.3	1.1	1.1	0.8	0.8	1.0	1.2	1.0	1.3	1.6
Tongxinling (Shenzhen)	1.1	1.3	1.1	0.8	1.1	1.1	1.3	1.2	1.1	0.9	0.9	1.4
Jinjuzui (Foshan)	1.6	1.4	1.5	1.4	1.2	0.8	0.8	0.9	1.1	1.2	1.7	0.8
Huijingcheng (Foshan)	2.5	2.3	2.0	1.5	1.4	0.8	0.8	0.9	1.2	1.8	1.8	1.7
Tangjia (Zhuhai)	1.2	1.0	1.0	0.8	0.9	0.5	0.7	0.7	0.8	0.7	0.9	1.0
Donghu (Jiangmen)	2.9	2.2	1.7	1.3	1.2	1.1	1.3	1.0	1.1	1.6	2.2	1.8
Duanfen (Jiangmen)	1.4	1.2	1.1	1.0	0.9	0.8	1.0	0.7	0.8	1.0	1.2	1.0
Huaguoshan (Jiangmen)	1.8	1.2	1.2	1.0	1.1	0.8	1.0	1.0	1.2	1.4	1.7	1.1
Chengzhong (Zhaoqing)	1.5	1.4	1.6	1.2	1.3	1.5	1.2	1.0	1.0	1.0	1.3	1.0
Xiapu (Huizhou)	1.3	1.7	1.6	0.8	0.9	0.7	0.7	0.8	1.0	0.8	1.1	1.5
Xijiao (Huizhou)	1.1	1.0	1.0	1.0	0.8	1.2	0.8	0.8	--	--	--	--
Jinguowan (Huizhou)	1.1	1.1	1.0	1.0	0.8	0.7	0.9	0.9	0.6	0.6	0.7	0.8
Zimaling (Zhongshan)	1.2	0.9	1.3	1.0	1.2	1.1	1.1	1.5	0.9	0.8	1.0	1.0
Nanchengyuanling (Dongguan)	1.6	1.9	1.7	1.1	1.3	1.1	1.2	1.2	1.3	1.2	1.7	1.5
Tap Mun (Hong Kong)	1.3	0.6	0.8	0.8	1.0	0.5	0.8	0.9	1.1	0.7	0.9	0.9
Tsuen Wan (Hong Kong)	1.4	1.2	1.2	1.0	0.7	0.9	1.0	0.9	1.3	0.8	1.0	1.2
Yuen Long (Hong Kong)	1.7	1.4	1.3	0.9	1.0	1.0	1.2	1.0	1.2	1.0	1.1	1.4
Tung Chung (Hong Kong)	1.2	1.0	1.0	0.9	0.6	0.6	0.8	0.8	0.9	0.7	0.7	0.7
Taipa Grande (Macao)	1.3	1.1	1.1	0.9	0.9	0.7	0.9	1.2	1.3	0.8	0.9	0.9

Table 4.4b：Daily averages concentration of Carbon Monoxide (monthly maxima and the 95th percentile of the year) **[Class II limit: 4 mg/m³]**

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Compliance	95th percentile
Luhu (Guangzhou)	1.2	0.9	1.1	1.1	1.1	0.8	0.8	1.0	1.0	0.8	0.9	0.8	100.0%	1.0
Nanshadawen (Guangzhou)	1.3	1.5	0.9	0.9	0.9	0.8	0.7	0.8	1.1	0.9	1.0	1.1	100.0%	1.0
Nansha-HKUST (Guangzhou)	1.4	1.0	0.9	0.8	0.9	0.5	0.7	0.8	0.8	0.6	0.8	1.0	100.0%	0.9
Tianhu (Guangzhou)	1.2	0.8	0.9	0.7	0.9	1.2	1.0	0.8	0.7	0.8	1.1	1.1	100.0%	1.0
Zhudong (Guangzhou)	1.2	1.0	1.0	0.9	0.9	0.5	0.7	0.8	0.9	0.8	1.0	1.0	100.0%	0.9
Tongxinling (Shenzhen)	0.9	0.9	0.8	0.7	0.9	0.7	0.9	0.7	0.9	0.8	0.7	0.8	100.0%	0.8
Jinjuzui (Foshan)	1.2	0.9	0.9	0.9	0.9	0.6	0.6	0.6	0.9	0.8	0.9	0.6	100.0%	0.9
Huijingcheng (Foshan)	1.3	1.3	1.2	1.0	0.9	0.6	0.7	0.8	0.8	1.0	1.3	1.1	100.0%	1.1
Tangjia (Zhuhai)	1.1	0.9	0.7	0.7	0.8	0.5	0.6	0.5	0.7	0.5	0.6	0.9	100.0%	0.8
Donghu (Jiangmen)	1.3	1.0	0.9	0.8	0.9	0.7	0.6	0.7	0.8	0.7	1.1	0.8	100.0%	1.0
Duanfen (Jiangmen)	1.4	0.9	0.9	0.7	0.8	0.5	0.5	0.5	0.7	0.7	1.0	0.9	100.0%	0.9
Huaguoshan (Jiangmen)	1.2	1.0	1.0	0.8	0.8	0.7	0.8	0.8	0.9	0.8	1.0	0.7	100.0%	1.0
Chengzhong (Zhaoqing)	1.2	0.9	1.0	0.9	1.0	0.7	0.8	0.7	0.8	0.8	1.0	0.8	100.0%	0.9
Xiapu (Huizhou)	0.9	0.7	0.8	0.7	0.8	0.5	0.6	0.7	0.9	0.8	0.7	0.8	100.0%	0.8
Xijiao (Huizhou)	1.1	0.8	0.9	0.8	0.6	0.6	0.5	0.5	--	--	--	--	100.0%*	0.8*
Jinguowan (Huizhou)	1.0	0.9	0.9	0.9	0.7	0.6	0.8	0.7	0.5	0.5	0.5	0.6	100.0%	0.8
Zimaling (Zhongshan)	1.0	0.8	0.8	0.8	1.0	0.9	1.0	0.9	0.7	0.6	0.8	0.9	100.0%	0.8
Nanchengyuanling (Dongguan)	1.2	1.2	1.1	0.9	1.0	0.9	1.0	0.8	1.0	0.9	1.1	1.0	100.0%	1.0
Tap Mun (Hong Kong)	1.0	0.5	0.7	0.7	0.8	0.4	0.8	0.7	1.0	0.6	0.7	0.8	100.0%	0.8
Tsuen Wan (Hong Kong)	1.2	1.1	0.9	0.8	0.6	0.7	0.9	0.8	1.1	0.7	0.7	0.9	100.0%	0.9
Yuen Long (Hong Kong)	1.2	1.1	1.1	0.7	0.8	0.8	0.8	0.9	1.0	0.7	0.8	0.8	100.0%	1.0
Tung Chung (Hong Kong)	1.0	0.9	0.9	0.8	0.4	0.4	0.5	0.7	0.8	0.6	0.6	0.6	100.0%	0.7
Taipa Grande (Macao)	1.1	1.1	0.9	0.8	0.8	0.6	0.6	0.8	1.1	0.7	0.9	0.8	100.0%	0.9

Table 4.4c：The monthly and annual averages concentration of Carbon Monoxide

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Luhu (Guangzhou)	1.0	0.7	0.9	0.8	0.8	0.7	0.7	0.8	0.8	0.6	0.7	0.6	0.7
Nanshadawen (Guangzhou)	1.0	0.9	0.8	0.6	0.7	0.6	0.6	0.6	0.8	0.7	0.8	0.8	0.7
Nansha-HKUST (Guangzhou)	1.0	0.8	0.6	0.5	0.6	0.4	0.4	0.5	0.5	0.4	0.6	0.7	0.6
Tianhu (Guangzhou)	0.9	0.6	0.6	0.5	0.6	0.8	0.7	0.6	0.5	0.6	0.6	0.9	0.7
Zhudong (Guangzhou)	1.0	0.8	0.7	0.6	0.6	0.4	0.5	0.6	0.8	0.6	0.8	0.8	0.7
Tongxinling (Shenzhen)	0.7	0.7	0.6	0.5	0.4	0.5	0.5	0.6	0.7	0.6	0.5	0.7	0.6
Jinjuzui (Foshan)	0.9	0.7	0.6	0.6	0.6	0.5	0.5	0.4	0.6	0.6	0.6*	0.5*	0.6
Huijingcheng (Foshan)	1.0	0.7	0.7	0.6	0.7	0.5	0.6	0.6	0.7	0.8	0.9	0.8	0.7
Tangjia (Zhuhai)	0.7	0.6	0.5	0.4	0.5	0.3	0.4	0.3	0.5	0.3	0.4	0.5	0.5
Donghu (Jiangmen)	1.0	0.7	0.6	0.5	0.6	0.5	0.4	0.5	0.7	0.6	0.8	0.7	0.6
Duanfen (Jiangmen)	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.4	0.6	0.6	0.7	0.7	0.6
Huaguoshan (Jiangmen)	1.0	0.8	0.7	0.6*	0.6	0.6	0.5	0.6	0.7	0.6	0.8	0.5	0.7
Chengzhong (Zhaoqing)	0.9	0.7	0.6	0.6	0.7	0.6	0.6	0.6	0.7	0.6	0.8	0.6	0.7
Xiapu (Huizhou)	0.7	0.5	0.6	0.5	0.6	0.4	0.5	0.4	0.7	0.5	0.5	0.5	0.5
Xijiao (Huizhou)	0.8	0.7	0.7	0.6	0.4	0.4	0.4	0.4*	--	--	--	--	0.6*
Jinguowan (Huizhou)	0.8	0.6	0.7	0.7	0.6	0.4	0.5	0.5	0.4	0.3	0.4	0.3	0.5
Zimaling (Zhongshan)	0.8	0.6	0.6	0.5	0.5	0.7	0.6	0.6	0.5	0.5	0.5	0.6	0.6
Nanchengyuanling (Dongguan)	1.0	0.9	0.8	0.6	0.7	0.6	0.7	0.7	0.8	0.7	0.9	0.6	0.7
Tap Mun (Hong Kong)	0.6	0.4	0.5	0.5	0.6	0.3	0.6	0.5	0.8	0.4	0.4	0.6	0.5
Tsuen Wan (Hong Kong)	0.9	0.7	0.7	0.5	0.5	0.6	0.6	0.5	0.7	0.5	0.6	0.7	0.6
Yuen Long (Hong Kong)	0.9	0.9	0.9	0.5	0.7	0.6	0.6	0.6	0.8	0.7	0.6	0.6	0.7
Tung Chung (Hong Kong)	0.7	0.6	0.6	0.5	0.3	0.2	0.3	0.4	0.6	0.5	0.4	0.4	0.4
Taipa Grande (Macao)	0.8	0.8	0.6	0.6	0.6	0.5	0.5	0.5	0.7	0.6	0.7	0.6	0.6

4.5 Respirable Suspended Particulates (PM_{10})

Respirable suspended particulates (PM_{10} or RSP) in the atmosphere come from a great variety of emission sources, such as power plants, vehicles, vessels, 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 SO_2) or formed from photochemical reactions. PM_{10} can penetrate deeply into human lungs and cause impact on human respiratory system. Furthermore, finer particles in PM_{10} have significant effect on visibility.

In 2022, the annual average of PM_{10} recorded at each monitoring station in the Network ranged from 20 to 44 μg/m^3, and all monitoring stations met the national annual average concentration limit (70 μg/m^3). During the year, 19 monitoring stations in the Network recorded no exceedance of the national 24-hour average concentration limit (150 μg/m^3) while the corresponding compliance rates in the Network ranged from 99.4% to 100.0%.

Table 4.5a and Table 4.5b list the monthly maxima of daily averages with the 95th percentile of the year, the monthly and annual averages of PM_{10} at each station respectively.

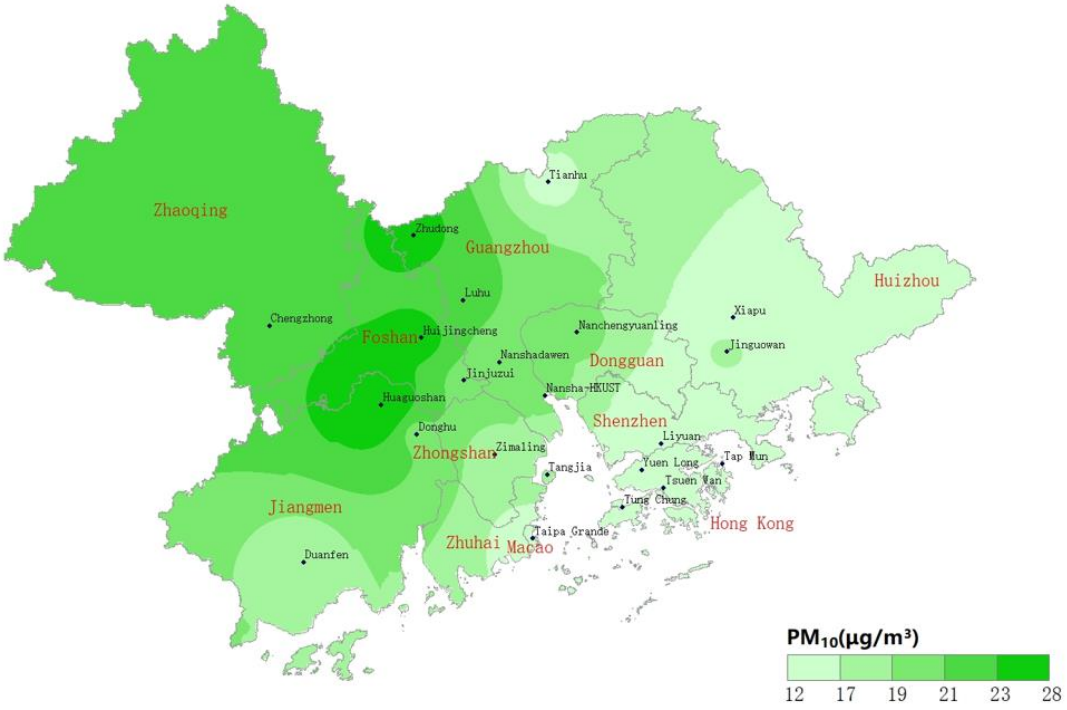

Figure 9：Spatial distribution of annual average concentrations of Respirable Suspended Particulates (PM_{10})

Table 4.5a：Daily averages concentration of PM_{10} (monthly maxima and the 95th percentile of the year) **[Class II limit: 150 μg/m^3]**

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Compliance	95th percentile
Luhu (Guangzhou)	117	95	80	84	64	30	55	50	91	69	89	76	100.0%	72
Nanshadawen (Guangzhou)	137	128	79	96	62	27	51	48	83	85	91	80	100.0%	80
Nansha-HKUST (Guangzhou)	88	58	61	62	54	22	50	38	77	58	67	60	100.0%	60
Tianhu (Guangzhou)	70	41	61	63	51	27	58	47	69	64	70	53	100.0%	54
Zhudong (Guangzhou)	134	69	139	102	81	40	56	51	69	73	111	80	100.0%	76
Tongxinling (Shenzhen)	65	52	53	55	39	22	53	38	69	59	39	88	100.0%	53
Jinjuzui (Foshan)	143	91	73	69	53	27	49	40	84	70	98	81	100.0%	73
Huijingcheng (Foshan)	151	124	123	111	76	29	60	54	104	89	113	89	99.7%	100
Tangjia (Zhuhai)	89	65	68	47	46	19	40	34	76	57	50	76	100.0%	59
Donghu (Jiangmen)	153	88	76	84	73	28	54	45	77	86	94	89	99.7%	79
Duanfen (Jiangmen)	72	48	39	42	44	21	34	29	58	57	43	64	100.0%	51
Huaguoshan (Jiangmen)	157	78	83	93	73	34	62	48	93	114	116	94	99.4%	85
Chengzhong (Zhaoqing)	149	56	68	77	79	30	53	49	74	80	102	85	100.0%	76
Xiapu (Huizhou)	76	61	65	61	53	33	63	52	84	63	60	71	100.0%	61
Xijiao (Huizhou)	47	32	54	46	42	26	47	40	--	--	--	--	100.0%*	42*
Jinguowan (Huizhou)	56	37	53	47	44	28	58	44	71	49	45	56	100.0%	48
Zimaling (Zhongshan)	107	74	69	62	49	27	57	50	88	62	58	66	100.0%	64
Nanchengyuanling (Dongguan)	100	93	72	74	64	27	61	44	86	73	130	75	100.0%	74
Tap Mun (Hong Kong)	60	38	47	44	28	14	38	31	50	41	30	72	100.0%	43
Tsuen Wan (Hong Kong)	64	46	55	43	30	24	43	35	69	40	36	68	100.0%	43
Yuen Long (Hong Kong)	80	70	53	49	31	17	28	41	70	46	43	81	100.0%	53
Tung Chung (Hong Kong)	76	54	68	45	32	15	42	43	66	48	39	68	100.0%	49
Taipa Grande (Macao)	84	58	66	52	35	20	48	54	80	63	61	91	100.0%	61

Table 4.5b：The monthly and annual averages concentration of PM_{10}

[Class II limit for annual average: 70 μg/m^3]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Luhu (Guangzhou)	49	23	43	38	31	24	29	26	51	45	37	43	37
Nanshadawen (Guangzhou)	57	31	46	42	30	21	26	23	51	52	39	43	38
Nansha-HKUST (Guangzhou)	43	22	32	34	25	16	24	21	49	42	32	36	32
Tianhu (Guangzhou)	28	11	32	31	23	19	27	19	37	37	25	28	27
Zhudong (Guangzhou)	52	21	55	46	37	26	30	24	40	38	35	37	37
Tongxinling (Shenzhen)	36	21	28	30	20	15	21	18	42	37	24	38	28
Jinjuzui (Foshan)	56	28	42	38	29	20	25	20	49	46	34	47	36
Huijingcheng (Foshan)	69	30	52	46	36	21	29	21	59	56	49	55	44
Tangjia (Zhuhai)	45	26	31	28	20	12	16	14	43	37	27	43	28
Donghu (Jiangmen)	66	31	44	42	33	22	26	22	53	50	40	51	40
Duanfen (Jiangmen)	39	19	26	25	17	13	18	13	37	36	24	38	25
Huaguoshan (Jiangmen)	67	32	45	44	35	22	28	24	58	59	46	53	43
Chengzhong (Zhaoqing)	51	20	41	36	35	22	29	25	48	45	39	44	37
Xiapu (Huizhou)	42	20	38	35	27	21	31	24	49	43	34	36	33
Xijiao (Huizhou)	25	14	28	27	21	19	26	19*	--	--	--	--	23*
Jinguowan (Huizhou)	32	16	30	30	22	18	24	21	41	34	25	29	27
Zimaling (Zhongshan)	50	27	37	35	25	18	24	20	50	44	31	43	34
Nanchengyuanling (Dongguan)	47	24	36	39	32	20	31	26	54	46	43	40	36
Tap Mun (Hong Kong)	30	15	21	20	14	9	12	13	32	29	18	27	20
Tsuen Wan (Hong Kong)	31	22	23	24	19	15	15	15	36	28	19	28	23
Yuen Long (Hong Kong)	40	22	25	27	17	11	16	14	37	30	22	35	25
Tung Chung (Hong Kong)	39	21	23	24	15	9	14	13	36	31	19	31	23
Taipa Grande (Macao)	41	22	31	29	20	12	15	13	49	46	29	51	30

4.6 Fine Suspended Particulates ($PM_{2.5}$)

Fine suspended particulates ($PM_{2.5}$) in the atmosphere come from a great variety of combustion sources, such as the emissions from power plants and diesel vehicles exhaust while some are products of oxidization of gaseous pollutants in the air (e.g. sulphate formed from oxidation of SO_2) or formed from photochemical reactions. $PM_{2.5}$ have significant effect on visibility.

In 2022, the annual average of $PM_{2.5}$ recorded at each monitoring station in the Network ranged from 12 to 28 μg/m^3, and all monitoring stations met the national annual average concentration limit (35 μg/m^3). During the year, 17 monitoring stations in the Network recorded no exceedance of the national 24-hour average concentration limit (75 μg/m^3) while the corresponding compliance rates in the Network ranged from 98.6% to 100.0%.

Tables 4.6a and 4.6b list the monthly maxima of daily averages with the 95th percentile of the year, the monthly and annual averages of $PM_{2.5}$ at each station respectively.

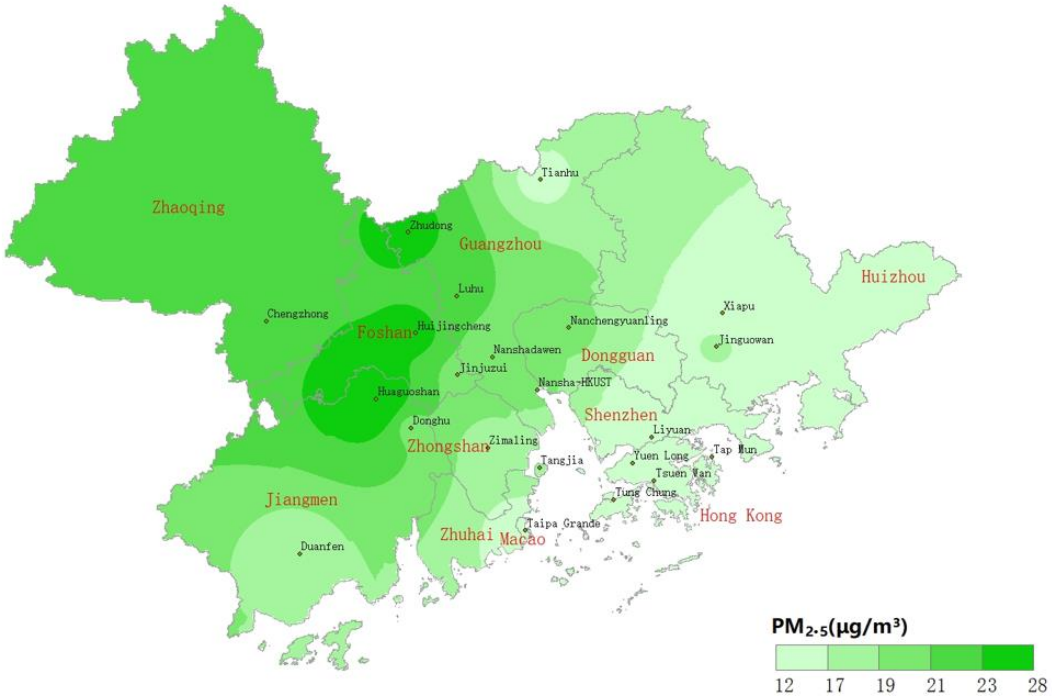

Figure 10：Spatial distribution of annual average concentrations of Fine Suspended Particulates ($PM_{2.5}$)

Table 4.6a：Daily averages concentration of $PM_{2.5}$ (monthly maxima and the 95th percentile of the year) **[Class II limit: 75 μg/m³]**

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Compliance	95th percentile
Luhu (Guangzhou)	66	56	42	42	34	16	35	29	56	41	59	53	100.0%	42
Nanshadawen (Guangzhou)	62	68	41	36	31	15	35	24	57	45	44	37	100.0%	43
Nansha-HKUST (Guangzhou)	55	43	40	35	35	19	29	22	50	37	51	46	100.0%	37
Tianhu (Guangzhou)	63	33	43	35	33	12	35	28	43	36	49	39	100.0%	35
Zhudong (Guangzhou)	93	49	96	73	49	23	41	34	51	36	72	54	99.2%	48
Tongxinling (Shenzhen)	44	31	33	26	21	9	36	25	50	33	26	64	100.0%	34
Jinjuzui (Foshan)	89	63	42	39	31	11	28	21	47	44	53	53	99.7%	43
Huijingcheng (Foshan)	92	50	71	70	50	13	38	32	61	55	91	47	98.6%	59
Tangjia (Zhuhai)	56	49	52	29	32	12	30	25	61	34	37	54	100.0%	41
Donghu (Jiangmen)	72	53	43	43	33	16	31	24	51	43	48	51	100.0%	43
Duanfen (Jiangmen)	51	38	31	26	30	15	27	20	44	39	34	49	100.0%	37
Huaguoshan (Jiangmen)	108	58	60	59	48	22	41	35	68	72	70	65	98.6%	62
Chengzhong (Zhaoqing)	106	40	41	47	55	18	32	30	49	44	67	59	99.5%	48
Xiapu (Huizhou)	52	31	37	30	30	11	27	22	46	34	30	71	100.0%	33
Xijiao (Huizhou) ^	26	14	23	21	20	10	26	14	--	--	--	--	100.0%*	20*
Jinguowan (Huizhou)	38	28	35	29	26	13	42	28	53	34	28	45	100.0%	34
Zimaling (Zhongshan)	53	38	34	30	28	16	33	28	54	39	32	41	100.0%	36
Nanchengyuanling (Dongguan)	58	56	44	42	31	19	33	23	50	40	75	49	100.0%	42
Tap Mun (Hong Kong)	40	21	34	27	18	6	28	22	41	23	21	57	100.0%	28
Tsuen Wan (Hong Kong)	50	36	40	21	21	14	29	27	54	29	28	54	100.0%	33
Yuen Long (Hong Kong)	59	58	38	36	23	9	23	30	51	24	27	64	100.0%	38
Tung Chung (Hong Kong)	64	43	49	29	20	7	32	32	49	25	24	50	100.0%	36
Taipa Grande (Macao)	53	38	42	29	22	6	29	32	57	33	48	53	100.0%	37

Table 4.6b：The monthly and annual averages concentration of $PM_{2.5}$

[Class II limit for annual average: 35 μg/m³]

Monitoring Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
Luhu (Guangzhou)	30	15	22	19	17	12	16	14	31	25	23	26	21
Nanshadawen (Guangzhou)	27	15	19	17	18	11	15	14	36	22	17	19	19
Nansha-HKUST (Guangzhou)	29	16	19	19	15	9	13	11	28	22	21	23	19
Tianhu (Guangzhou)	23	9	20	17	14	7	14	9	23	20	16	17	16
Zhudong (Guangzhou)	35	16	34	27	25	16	22	16	29	20	21	23	24
Tongxinling (Shenzhen)	24	13	16	15	11	6	10	8	26	18	14	21	15
Jinjuzui (Foshan)	34	19	22	20	16	9	12	10	27	23	19	27	20
Huijingcheng (Foshan)	42	16	23	28	23	9	15	14	32	29	34	26	24
Tangjia (Zhuhai)	29	18	21	17	13	6	10	8	27	20	18	26	18
Donghu (Jiangmen)	31	18	22	20	16	9	12	10	29	24	21	28	20
Duanfen (Jiangmen)	28	15	18	15	11	7	10	7	26	21	16	26	17
Huaguoshan (Jiangmen)	48	23	29	27	22	11	17	15	40	34	29	35	28
Chengzhong (Zhaoqing)	34	14	24	21	23	12	16	14	30	25	26	26	22
Xiapu (Huizhou)	26	12	18	15	13	8	12	9	23	19	17	22	16
Xijiao (Huizhou) ^	12	8	11	10	9	7	12	8*	--	--	--	--	10*
Jinguowan (Huizhou)	22	12	19	15	14	10	15	13	27	21	17	20	17
Zimaling (Zhongshan)	25	15	18	16	13	8	12	10	28	22	16	22	17
Nanchengyuanling (Dongguan)	29	16	20	19	16	9	14	12	28	21	25	23	19
Tap Mun (Hong Kong)	20	10	13	12	7	4	7	6	20	14	11	17	12
Tsuen Wan (Hong Kong)	22	15	14	10	12	8	7	10	25	17	15	20	15
Yuen Long (Hong Kong)	29	16	17	17	12	6	8	9	24	15	15	23	16
Tung Chung (Hong Kong)	30	15	15	14	10	5	9	9	23	15	12	19	14
Taipa Grande (Macao)	22	11	16	13	8	3	7	5	29	23	20	24	15

4.7 Monthly Variations of Pollutant Concentrations

Figure 11 shows the monthly variations of the major pollutants (Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O_3), Respirable Suspended Particulates (PM_{10}), Fine Suspended Particulates ($PM_{2.5}$), and Carbon Monoxide (CO)) recorded by the Network in 2022. In general, the monthly average concentrations of SO_2, NO_2, PM_{10}, $PM_{2.5}$, and CO were higher during the winter season (first and fourth quarters of the year) and relatively lower in the summer months. The lower pollutant levels in summer were mainly due to the cleaner maritime air stream prevailed in the PRD region under the influence of southern monsoon, together with heavier rainfall and higher mixing layer that favoured the dispersion of pollutants. The ozone concentration was higher in September and October mainly due to the fact that there were more days with meteorological conditions that favoured photochemical reactions (such as strong solar radiation and less amount of clouds) and resulted in more ozone formation during the period.

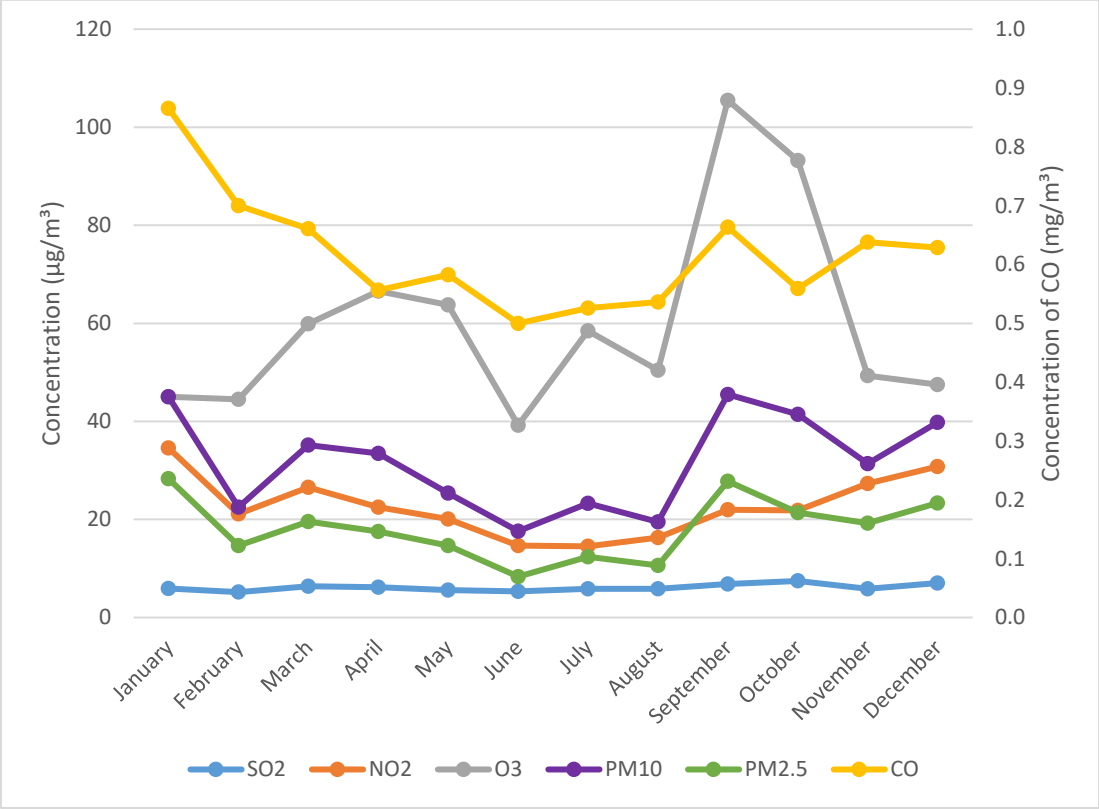

Figure 11：Monitoring network monthly variations of air pollutant concentrations

4.8 Annual Variations of Pollutant Concentrations (2006-2022)

Table 4.8 shows the annual average concentrations of air pollutants recorded by the Network from 2006 to 2022, while Figure 12 shows the trend of rate of changes in the annual pollutant concentrations.

From 2006 to 2022, the annual averages recorded by the Network for SO_2, NO_2, and PM_{10} decreased by 86%, 45% and 52% respectively, which exhibited a discernible downward trend with a descending rate of about 2.3, 1.2 and 2.2 $\mu g/m^3$ per year respectively. As for CO and $PM_{2.5}$, these two parameters had been added to the Network in September 2014 and their annual averages decreased by 16% and 38% respectively between 2015 and 2022. These reductions indicate that the measures implemented in recent years by concerted or individual effort of Guangdong, Hong Kong and Macao, including requiring power plants to implement ultra-low emission upgrades, continuously raising atmospheric pollutant emission standards for key industries, conducting volatile organic compound treatment, phasing out coal-fired boilers and highly polluting vehicles, improving motor vehicle emission standards, improving fuel quality, and regulating non-road mobile machinery , etc., have improved the overall air quality in the PRD region. Compared with 2006, the annual average of O_3 in 2022 increased by 39%, reflecting the photochemical smog problem in the region has not yet been resolved. The Guangdong, Hong Kong and Macao governments will continue to implement emission reduction measures to further improve the air quality in the region and tackle the photochemical pollution problem.

Table 4.8：Annual averages of the pollutants in the monitoring network [9]

Year	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	CO (mg/m^3)
2006	43	42	44	67	-	-
2007	44	41	46	72	-	-
2008	36	40	46	65	-	-
2009	26	38	51	64	-	-
2010	23	39	49	59	-	-
2011	21	37	53	59	-	-
2012	17	35	49	52	-	-
2013	17	37	49	59	-	-

[9] All Tap Mun's pollutants data are excluded from the calculation of the annual averages of pollutants in 2016 owing to its low hourly data capture rate in 2016.
Taipa Grande's PM_{10} and $PM_{2.5}$, Tap Mun's PM_{10} and Xijiao's $PM_{2.5}$ data are excluded from the calculation of the annual averages of pollutants in 2017 owing to its low daily data capture rate in 2017.
All Tap Mun's pollutants and Jinguowan's O_3 data are excluded from the calculation of the annual averages of pollutants in 2018 owing to its low daily data capture rate in 2018.
Zhudong's $PM_{2.5}$ data is excluded from the calculation of the annual averages of pollutants in 2019 owing to its low daily data capture rate in 2019.
All Modiesha, Zhudong, Xijiao and Nanchengyuanling's pollutants data and Duanfen's SO_2, NO_2, O_3 and PM_{10} data are excluded from the calculation of the annual averages of pollutants in 2020 owing to its low daily data capture rate in 2020.
Ozone data at Xijiao station in Huizhou, and $PM_{2.5}$ data at Xijiao station in Huizhou are excluded from the calculation of the annual averages of pollutants in 2021 owing to its low daily data capture rate in 2021.
Data at Xijiao station in Huizhou are excluded from the calculation of the annual averages of pollutants in 2022 owing to its low data capture rate in 2022.

Year	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	O_3 ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	CO (mg/m^3)
2014	14	34	52	50	-	-
2015	12	30	47	44	29	0.730
2016	11	32	44	41	26	0.728
2017	10	31	52	45	28	0.665
2018	9	29	53	42	25	0.611
2019	7	30	60	42	25	0.700
2020	6	24	56	34	20	0.611
2021	7	25	59	37	21	0.600
2022	6	23	61	32	18	0.614

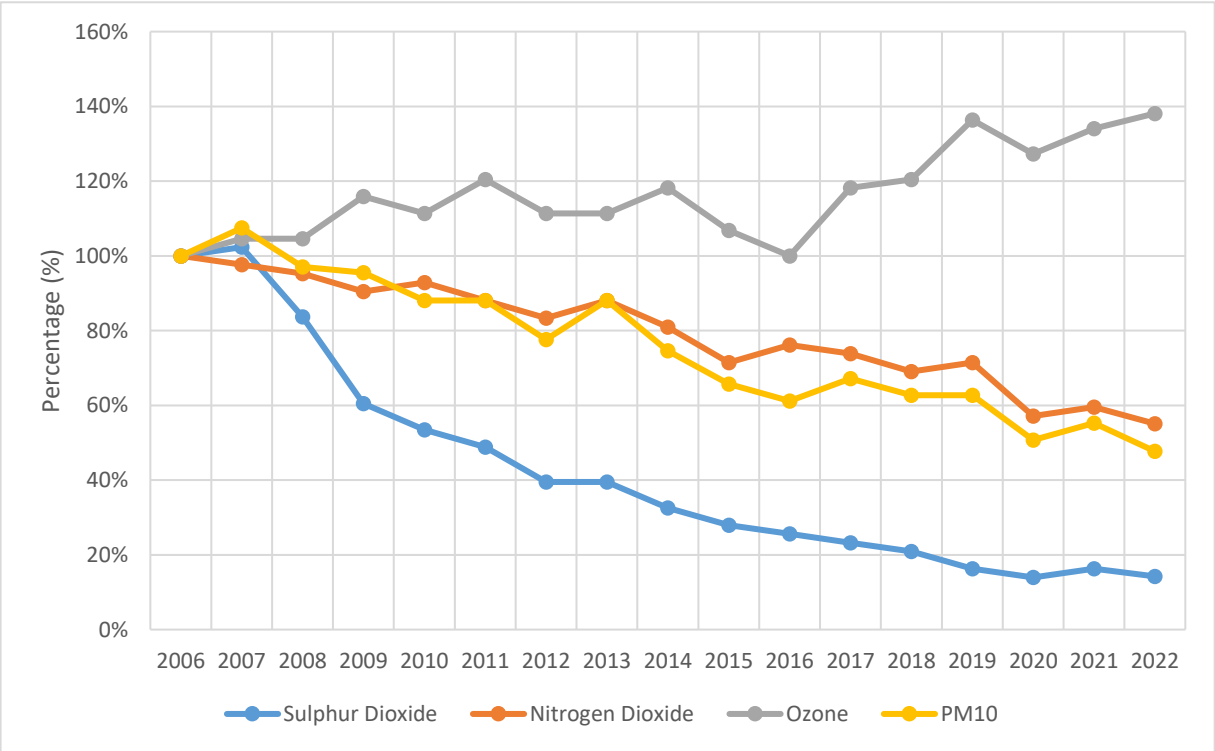

Figure 12：Trend of rates of changes in pollutant's annual averages in the monitoring network[10]

[10] All Tap Mun's pollutants data are excluded from the calculation of the annual averages of pollutants in 2016 owing to its low hourly data capture rate in 2016.
Taipa Grande's PM_{10} and Tap Mun's PM_{10} data are excluded from the calculation of the annual averages of pollutants in 2017 owing to its low daily data capture rate in 2017.
All Tap Mun's pollutants and Jinguowan's O_3 data are excluded from the calculation of the annual averages of pollutants in 2018 owing to its low daily data capture rate in 2018.
All Modiesha, Zhudong, Duanfenm Xijiao and Nanchengyuanling's pollutants data are excluded from the calculation of the annual averages of pollutants in 2020 owing to its low daily data capture rate in 2020.
Ozone data at Xijiao station in Huizhou, and $PM_{2.5}$ data at Xijiao station in Huizhou are excluded from the calculation of the annual averages of pollutants in 2021 owing to its low daily data capture rate in 2021
Data at Xijiao station in Huizhou are excluded from the calculation of the annual averages of pollutants in 2022 owing to its low data capture rate in 2022.

Annex A：Site Information of Monitoring Stations

Monitoring Stations	Address	Area Type	Sampling Height (Above P.D.)	Above Ground	Date Commenced Operation
Luhu (Guangzhou)	Jufong Garden of Luhu Park (Big yard, No. 11 Luhu Park)	City	30m	9m	1993
Nanshadawen[11] (Guangzhou)	Shinan Road, Dongchong Town, Nansha	City	23m	10m	Jan 2021
Nansha-HKUST[12] (Guangzhou)	HKUST Fok Ying Tung Research Institute, Nansha	Mixed educational/ commercial and residential/industrial	54m	28m	Oct 2004
Tianhu (Guangzhou)	Tianhu Park, Conghua	Background : rural	251m	13m	Oct 2004
Zhudong (Guangzhou)	Zhudong Village Committee, Chini Town, Huadu District	Rural	19m	10m	Dec 2011
Tongxinling[13] (Shenzhen)	Shennan Zhong Road, Futian District	City	38m	12m	Sep 1997
Jinjuzui (Foshan)	Foshan City Communist Party School, Jinjuzui, Shunde District	Tourist and cultural /educational	27m	17m	Oct 1999
Huijingcheng (Foshan)	No. 127, Fenjiang Nan Road, Chancheng District	Urban: mixed residential/commercial/ industrial	24m	14m	Feb 2000
Tangjia (Zhuhai)	Qiao Island Mangrove Monitoring Station, Tangjia Town	Mixed educational/ commercial and residential/industrial	13m	13m	Jan 2010
Donghu (Jiangmen)	Donghu Park, Jiangmen	City	17.5m	5m	Nov 2001
Duanfen (Jiangmen)	Duanfen Middle School, Taishan	Rural	15m	12m	Dec 2011
Huaguoshan (Jiangmen)	Huaguoshan, Taoyuan, Heshan	Rural	25m	15m	Feb 2012
Chengzhong (Zhaoqing)	No. 63, Zhengdong Road, Duanzhou District	Urban: mixed residential/commercial	38m	16m	Jun 2001
Xiapu (Huizhou)	No. 4 Xiabuhengjiang Road No. 3, Huicheng District	Urban: commercial	49m	20m	Dec 1999

[11] Modiesha station closed permanently owing to insufficient space after the extensive renovation work at station, whereas Nanshadawen station joined the network in the 1st quarter of 2021.
[12] Wanqingsha station was renamed as Nansha-HKUST station in the 1st quarter of 2019.
[13] Liyuan station was renamed as Tongxinling station in the 1st quarter of 2019.

Xijiao (Huizhou)	Zhangbei Yaowei She Nationality Primary School, Henghe Town	Rural	44m	10m	Dec 2011
Jinguowan (Huizhou)	Jinguowan Ecological Farm, Huizhou	Residential	77m	8m	Oct 2004
Zimaling (Zhongshan)	Zimaling Park, Zhongshan	Mixed residential/ commercial	45m	7m	Aug 2002
Nancheng-yuanling[14] (Dongguan)	Dongguan administration center	Mixed residential/ commercial/industrial	40m	19m	May 2021
Tap Mun (Hong Kong)	Tap Mun Police Station	Background: rural	26m	11m	Apr 1998
Tsuen Wan (Hong Kong)	60 Tai Ho Road, Tsuen Wan	Urban: mixed residential/commercial/ industrial	21m	17m	Aug 1988
Yuen Long (Hong Kong)	Yuen Long District Office, 269 Castle Peak Road, Yuen Long	New Town: residential	31m	25m	Jul 1995
Tung Chung (Hong Kong)	6 Fu Tung Street, Tung Chung	New Town: residential	34.5m	27.5m	Apr 1999
Taipa Grande[15] (Macao)	Rampa do Observatorio, Taipa Grande	Rural	120m	10m	Mar 1999

[14] Nancheng-yuanling station was relocated to Dongguan administration center in May 2021. The distance between the old and new sites is about 600 metres.
[15] Taipa Grande station was relocated to SMG observing station in September 2022. The distance between the old and new sites is about 100 meters.

Annex B: Measurement Methods of Air Pollutant Concentration

Pollutants	**Measuring Principles**
Sulphur dioxide (SO_2)	UV fluorescence / Differential Optical Absorption Spectroscopy
Nitrogen dioxide (NO_2)	Chemiluminescence / Differential Optical Absorption Spectroscopy
Ozone (O_3)	UV absorption / Differential Optical Absorption Spectroscopy
Respirable suspended particulates (PM_{10})	Oscillating microbalance (TEOM) / Beta particulate monitor
Fine suspended particulates ($PM_{2.5}$)	Oscillating microbalance (TEOM) / Beta particulate monitor / Hybrid nephelometric / radiometric particulate mass monitor
Carbon monoxide (CO)	Gas filter correlation infrared absorption method / Non-dispersive infrared absorption method