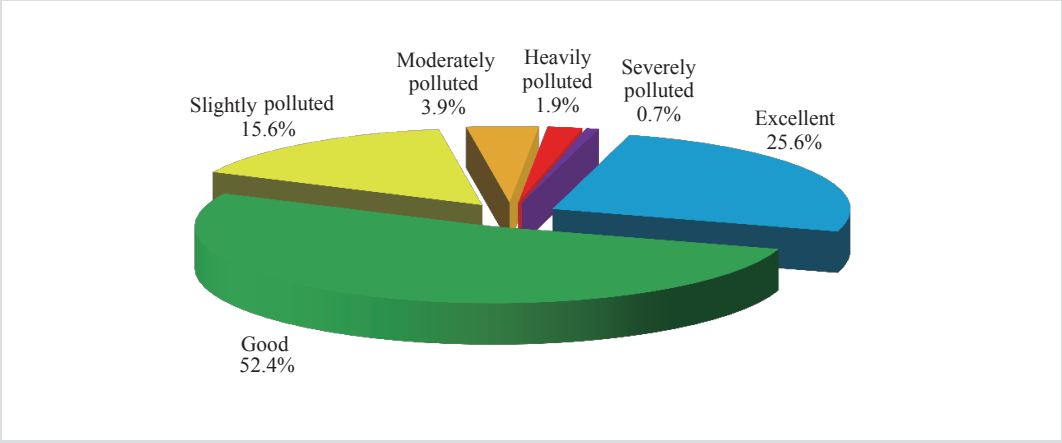
Atmospheric Environment

Air quality

Cities at or above prefecture level In 2017, all 338 APL cities* (hereinafter referred to as the 338 cities) across the country conducted environmental monitoring. The monitoring results showed that 99 cities met national air quality standard**, accounting for 29.3% of the total; 239 cities failed to meet national air quality standard, taking up 70.7%.

The average percent of attainment days on air quality*** of the 338 cities was 78.0%, down by 0.8 percentage points compared with that of 2016. The amount of non-attainment days**** took up 22.0%***** in average. The attainment rate was 100% for 5 cities, 80%~100% for 170 cities, 50%~80% for 137 cities, and less than 50% for 26 cities.



Percentage of 338 Cities with Different Air Quality Levels in 2017

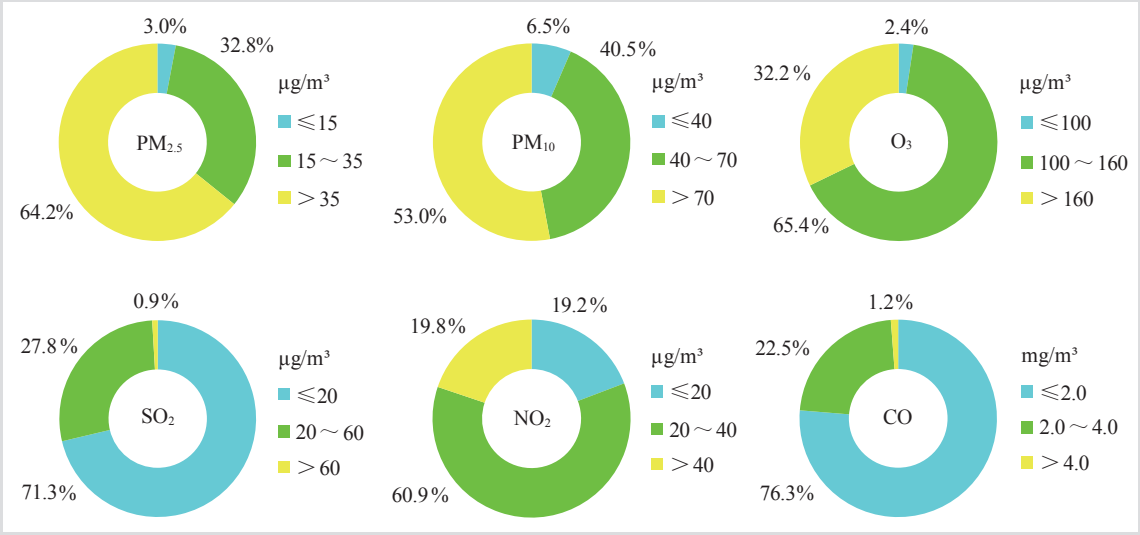
*Cities at or above prefecture level (APL cities): including municipality, cities or regions at prefecture level, autonomous prefectures and league.

**Air quality meeting the standard: the ambient air quality meets the standard when the concentrations of all 6 pollutants under assessment meet the standard, among which, SO_2, NO_2, PM_{10} and $PM_{2.5}$ were evaluated according to the annual average concentration, and CO and O_3 were evaluated according to the percentile concentration.

***The amount of attainment days: It refers to the amount of days with AQI at 0~100.

****The amount of non-attainment days: the amount of days with AQI>100. Among them, AQI within the range of 101~150 indicates slight pollution, 151~200 indicates intermediate pollution, 201~300 indicates heavy pollution and >300 very serious pollution.

*****Calculation of the proportion of all categories and grades in this report is based on the number of a certain item divided by the total number. The results are revised according to the *Representation and Judgment of Numerical Rounding Rules and Limit Values (GB/T 8170-2008)*. It may happen that the combined proportion of two or more categories does not equal the sum of the proportions of the various categories, that the sum of the proportions of all categories does not equal 100%, or that the sum of the year-on-year percentage changes does not equal 0.



Percentage of 338 Cities with Different Concentrations of Six Major Pollutants in 2017

In 338 cities, 2,311 days were under heavy pollution and 802 days were under severe pollution. Among them, days with $PM_{2.5}$ as the primary pollutant* took up 74.2%; those with PM_{10} as the primary pollutant took up 20.4%; and those with O_3 as the primary pollutant took up 5.9%. There were 48 cities suffering from more than 20 days of heavy or severe pollution, distributed in 12 provinces like Xinjiang, Hebei, and Henan (some cities were influenced by sandstorm).

The range of annual average $PM_{2.5}$ concentration was 10~86 μg/m^3 with the average level of 43 μg/m^3, down by 6.5% compared with that of 2016. The number of days with daily average concentration failing to meet relevant standard took up 12.4% of the total, down by 1.7 percentage points compared with that of 2016. The range of annual average PM_{10} concentration was 23~154 μg/m^3 with the average of 75 μg/m^3, down by 5.1% compared with that of 2016. The number of days with daily average concentration failing to meet relevant standard took up 7.1% of the total, down by 2.3 percentage points compared with that of 2016. The range of 90th percentile concentration of O_3 daily maximum 8-hour average** was 78~218 μg/m^3 with the average at 149 μg/m^3, up by 8.0% compared with that of 2016. The number of days with daily average failing to meet the standard took up 7.6% of the total, up by 2.4 percentage points compared with that of 2016. The range of annual average SO_2 concentration was 2~84 μg/m^3 with the average at 18 μg/m^3, down by 18.2% compared with that of 2016. The number of days with daily average failing to meet the standard took up 0.3% of the total, down by 0.2 percentage points compared with that of 2016. The range of annual average NO_2 concentration was 9~59 μg/m^3 with the average at 31 μg/m^3, up by 3.3% compared with that of 2016. The number of days with daily average failing to meet the standard took up 1.5% of the total, down by 0.1 percentage point compared with that of 2016. The range of the 95th percentile concentration of daily CO average was 0.5~5.1 mg/m^3 with the average at 1.7 mg/m^3, down by 10.5% compared with that of 2016. The number of days with daily average failing to meet the standard took up 0.3% of the total, down by 0.1 percentage point compared with that of 2016.

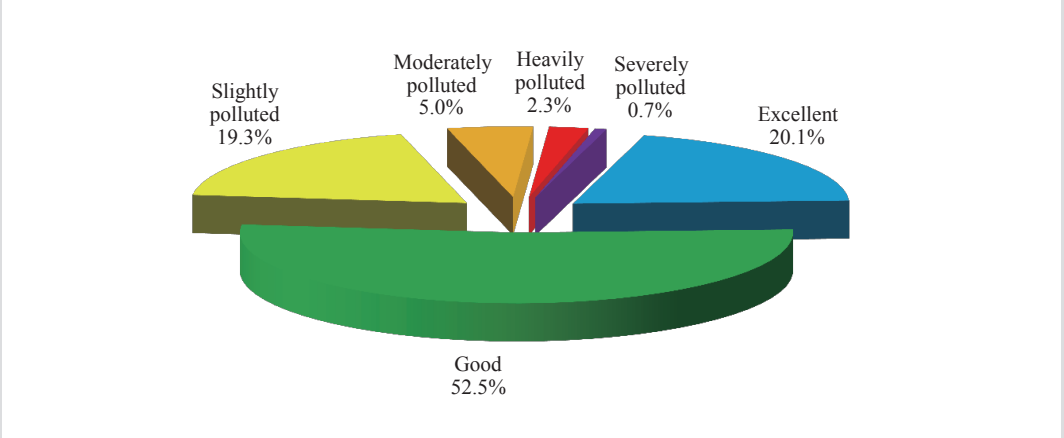
* Primary pollutant: When AQI >50, the pollutant with the biggest individual AQI is the primary pollutant.

** Percentile concentration: Based on the Technical Regulation for Ambient Air Quality Assessment (Trial) (HJ 663-2013), effective daily maximum 8-hour average values of O_3 concentrations and 24-hour average values of CO concentration in the calendar year are ranked from low to high respectively. We will compare the 90th percentile value with the daily maximum 8-hour average of O_3 concentration of national standard date to judge if O_3 concentration meets the standard; and the standard 24-hour CO concentration limit is compared to the 95th percentile value with the 24-hour average of CO concentration to judge if CO concentration meets the standard. The O_3 and CO concentrations in this publication refer to percentile concentrations.

If the impact of dust was not excluded, among the 338 cities, 27.2% cities met national air quality standard while 72.8% cities failed to meet national air quality standard; the average concentrations of $PM_{2.5}$ and PM_{10} were 44 μg/m^3 and 80 μg/m^3 respectively, down by 6.4% and 2.4% compared with that of 2016.

Cities under Stage I monitoring based on the newly amended ambient air quality standard In 2017, the monitoring results of 74 cities under Stage I monitoring based on the newly amended ambient air quality standard (including APL cities in key regions such as Beijing-Tianjin-Hebei, the Yangtze River delta and Pearl River delta, municipalities, provincial capital cities and cities under separate plan of the State Council, hereinafter referred to as the 74 cities) showed that the percentage of days of the 74 cities meeting air quality standard was 72.7%, down by 1.5 percentage points compared with that of 2016. The average number of days failing to meet the standard took up 27.3%. The attainment rate was 80%~100% for 22 cities, 50%~80% for 42 cities and less than 50% for 10 cities. The number of days with $PM_{2.5}$ as the primary pollutant took up 47.0% of the total non-attainment days, the number of days with O_3 as the primary pollutant took up 43.1%, the number of days with PM_{10} as the primary pollutant took up 7.8%, the number of days with NO_2 as primary pollutant took up 2.4%, and the number of days with SO_2 as primary pollutant took up less than 0.1%.

The evaluation results of air quality comprehensive index* showed that the top 10 cities with relatively poor air quality (from No.74 to No. 65) were Shijiazhuang, Handan, Xingtai, Baoding, Tangshan, Taiyuan, Xi'an, Hengshui, Zhengzhou, and Jinan. The top 10 cities with relatively good air quality (from No.1 to No.10) were Haikou, Lhasa, Zhoushan, Xiamen, Fuzhou, Huizhou, Shenzhen, Lishui, Guiyang and Zhuhai.

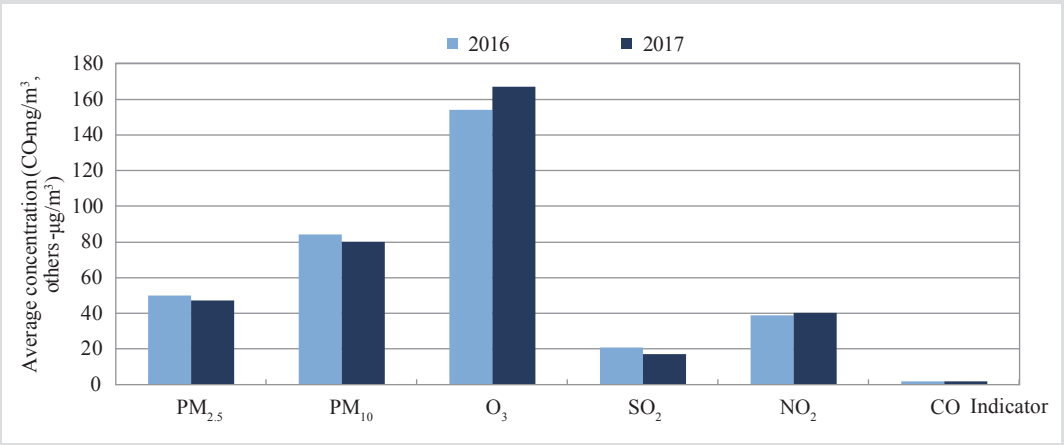


Percentage of Air Quality Levels of 74 Cities in 2017

* Air quality comprehensive index: The sum of the quotients of concentration of the 6 air pollutants against corresponding Grade II limit of assessment period is the air quality comprehensive index of the current city in that period, which is employed for ranking of air quality.

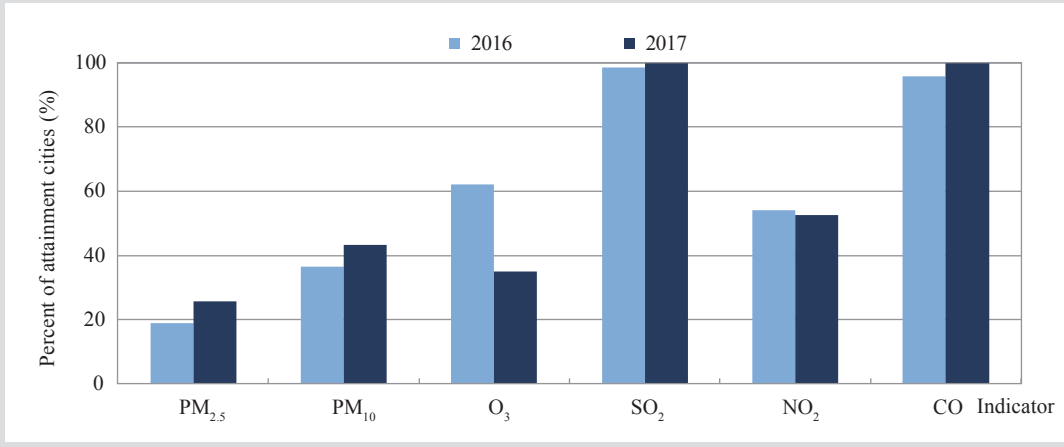
Air Quality Comprehensive Index and Primary Pollutants of 74 Cities in 2017

No.	City	Compre-hensive index	Maximum index	Primary pollutant	No.	City	Compre-hensive index	Maximum index	Primary pollutant
1	Haikou	2.49	0.79	O_3	38	Hangzhou	5.02	1.29	$PM_{2.5}$
2	Lhasa	3.13	0.80	O_3	39	Chongqing	5.04	1.29	$PM_{2.5}$
3	Zhoushan	3.18	0.95	O_3	40	Xining	5.11	1.19	PM_{10}
4	Xiamen	3.37	0.80	NO_2	41	Nanjing	5.18	1.18	NO_2
5	Fuzhou	3.42	0.88	O_3	42	Huai'an	5.18	1.43	$PM_{2.5}$
6	Huizhou	3.48	0.89	O_3	43	Taizhou	5.22	1.46	$PM_{2.5}$
7	Shenzhen	3.49	0.92	O_3	44	Changchun	5.22	1.31	$PM_{2.5}$
8	Lishui	3.54	0.94	$PM_{2.5}$	45	Wuxi	5.28	1.26	$PM_{2.5}$
9	Guiyang	3.61	0.91	$PM_{2.5}$	46	Suqian	5.34	1.57	$PM_{2.5}$
10	Zhuhai	3.64	1.00	O_3	47	Changzhou	5.41	1.37	$PM_{2.5}$
11	Taizhou	3.65	0.94	$PM_{2.5}$	48	Wuhan	5.46	1.49	$PM_{2.5}$
12	Kunming	3.76	0.83	PM_{10}	49	Zhenjiang	5.63	1.57	$PM_{2.5}$
13	Nanning	3.95	1.00	$PM_{2.5}$	50	Hefei	5.65	1.60	$PM_{2.5}$
14	Dalian	4.15	1.02	O_3	51	Harbin	5.71	1.66	$PM_{2.5}$
15	Zhongshan	4.16	1.13	O_3	52	Yangzhou	5.72	1.54	$PM_{2.5}$
16	Zhangjiakou	4.18	1.08	O_3	53	Shenyang	5.78	1.43	$PM_{2.5}$
17	Ningbo	4.31	1.06	$PM_{2.5}$	54	Chengdu	5.85	1.60	$PM_{2.5}$
18	Quzhou	4.37	1.20	$PM_{2.5}$	55	Qinhuangdao	5.86	1.26	$PM_{2.5}$
19	Dongguan	4.37	1.06	O_3、$PM_{2.5}$	56	Beijing	5.87	1.66	$PM_{2.5}$
20	Wenzhou	4.40	1.09	$PM_{2.5}$	57	Hohhot	5.93	1.36	PM_{10}
21	Jinhua	4.44	1.20	$PM_{2.5}$	58	Yinchuan	6.41	1.51	PM_{10}
22	Zhaoqing	4.47	1.17	$PM_{2.5}$	59	Lanzhou	6.45	1.59	PM_{10}
23	Yancheng	4.58	1.23	$PM_{2.5}$	60	Tianjin	6.53	1.77	$PM_{2.5}$
24	Jiangmen	4.60	1.21	O_3	61	Urumchi	6.55	2.00	$PM_{2.5}$
25	Guangzhou	4.61	1.30	NO_2	62	Langfang	6.61	1.71	$PM_{2.5}$
26	Shanghai	4.63	1.13	O_3	63	Xuzhou	6.78	1.94	$PM_{2.5}$
27	Jiaxing	4.72	1.20	$PM_{2.5}$	64	Cangzhou	6.89	1.89	$PM_{2.5}$
28	Shaoxing	4.73	1.29	$PM_{2.5}$	65	Jinan	7.04	1.86	$PM_{2.5}$
29	Foshan	4.75	1.14	$PM_{2.5}$	66	Zhengzhou	7.07	1.89	$PM_{2.5}$
30	Nanchang	4.75	1.17	$PM_{2.5}$	67	Hengshui	7.29	2.20	$PM_{2.5}$
31	Qingdao	4.78	1.11	PM_{10}、$PM_{2.5}$	68	Xi'an	7.72	2.17	$PM_{2.5}$
32	Lianyungang	4.79	1.29	$PM_{2.5}$	69	TaiYuan	7.79	1.89	$PM_{2.5}$
32	Nantong	4.79	1.12	O_3	70	Tangshan	7.97	1.89	$PM_{2.5}$
34	Huzhou	4.80	1.20	$PM_{2.5}$	71	Baoding	8.32	2.40	$PM_{2.5}$
35	Chengde	4.86	1.17	PM_{10}	72	Xingtai	8.57	2.29	$PM_{2.5}$
36	Suzhou	4.97	1.20	NO_2、$PM_{2.5}$	73	Handan	8.64	2.46	$PM_{2.5}$
37	Changsha	4.98	1.49	$PM_{2.5}$	74	Shijiazhuang	8.72	2.46	$PM_{2.5}$



Comparison of the Average Concentration of Six Pollutants of the 74 Cities between 2016 and 2017

The annual $PM_{2.5}$ concentration was 20~86 μg/m^3 with the average at 47 μg/m^3, down by 6.0% compared with that of 2016. The number of days failing to meet national air quality standard was 14.1%, down by 2.5 percentage points compared with that of 2016. 19 cities reached Grade II national air quality standard, taking up 25.7% of the total. 55 cities failed to meet Grade II national air quality standard, taking up 74.3%. The annual range of average PM_{10} concentration was 37~154 μg/m^3 with the average at 80 μg/m^3, down by 4.8% compared with that of 2016. The number of days failing to meet national standard was 8.4%, down by 2.7 percentage points compared with that of 2016. The annual average PM_{10} concentration of 1 city reached Grade I national air quality standard, taking up 1.4%. 31 cities reached Grade II national air quality standard, taking up 41.9%. 42 cities failed to meet Grade II national air quality standard, taking up 56.8%. The 90th percentile concentration of O_3 daily maximum 8-hour average was 117~218 μg/m^3 with the average at 167 μg/m^3,



Comparison of the Percentage of Cities with the Six Pollutants Meeting National Air Quality Standard in 74 Cities between 2016 and 2017

up by 8.4% compared with that of 2016. The number of days failing to meet the standard was 12.2%, up by 3.6 percentage points compared with that of 2016. The O_3 concentration of 26 cities reached Grade II national air quality standard, taking up 35.1%. 48 cities failed to meet Grade II national air quality standard, taking up 64.9%. The range of the annual average SO_2 concentration was 6~54 μg/m^3 with the average at 17 μg/m^3, down by 19.0% compared with that of 2016. The number of days failing to meet the standard was 0.2%, down by 0.1 percentage point compared with that of 2016. The annual average SO_2 concentration of 56 cities reached Grade I national air quality standard, taking up 75.7%. 18 cities reached Grade II national air quality standard, taking up 24.3%. The range of annual average NO_2 concentration was 12~59 μg/m^3 with the average at 40 μg/m^3, up by 2.6% than that of 2016. The number of days failing to meet the standard was 4.0%, down by 0.2 percentage point compared with that of 2016. The annual average NO_2 concentration of 39 cities reached Grade I national air quality standard (same as Grade II national air quality standard), taking up 52.7%. 35 cities failed to meet Grade II national air quality standard, taking up 47.3%. The 95th percentile concentration of daily average CO was 0.8~3.8 mg/m^3 with the average at 1.7 mg/m^3, down by 10.5 percentage points compared with that of 2016. The number of days failing to meet the national air quality standard was 0.4%, down by 0.2 percentage point compared with that of 2016. The average CO concentration of all 74 cities reached Grade I national air quality standard (same as Grade II national air quality standard).

If the impact of dust was not excluded, the average concentrations of $PM_{2.5}$ and PM_{10} of the 74 cities were 47 μg/m^3 and 83 μg/m^3 respectively, down by 6.0% and 2.4% compared with that of 2016.

Beijing-Tianjin-Hebei region In 2017, the number of days of 13 APL cities in Beijing-Tianjin-Hebei of the whole year meeting air quality standard was within the range of 38.9%~79.7% with the average at 56.0%, down by 0.8 percentage point compared with that of 2016. The average number of non-attainment days accounts for 44.0% of the total, of which 25.9% was slight pollution, 10.0% moderate pollution, 6.1% heavy pollution and 2.0% severe pollution. The number of days meeting air quality standard accounted for 50%~80% for 8 cities and less than 50% for 5 cities. Among the non-attainment days, the number of days with $PM_{2.5}$, O_3, PM_{10}, and NO_2 as the primary pollutant took up 50.3%, 41.0%, 8.9% and 0.3% respectively. There was no occurrence of non-attainment days with CO and SO_2 as the primary pollutant.

The number of days with excellent and good air quality in Beijing reached 61.9%, up by 7.8 percentage points compared with that of 2016. The city experienced 19 days of heavy pollution and 5 days of very heavy pollution, 15 days less than that of 2016.

Average Concentration of Primary Pollutants in Beijing–Tianjin–Hebei Region in 2017

Region	Indicator	Average concentration (CO: mg/m^3, others: μg/m^3)	Increase from 2016 (%)
Beijing-Tianjin-Hebei	$PM_{2.5}$	64	-9.9
	PM_{10}	113	-4.2
	O_3	193	12.2
	SO_2	25	-19.4
	NO_2	47	-4.1
	CO	2.8	-12.5
Beijing	$PM_{2.5}$	58	-20.5
	PM_{10}	84	-5.6
	O_3	193	-3.0
	SO_2	8	-20.0
	NO_2	46	-4.2
	CO	2.1	-34.4

Average Concentration of Primary Pollutants in the Yangtze River Delta in 2017

Region	Indicator	Average concentration (CO: mg/m^3, others: μg/m^3)	Increase from 2016 (%)
The Yangtze River Delta	$PM_{2.5}$	44	-4.3
	PM_{10}	71	-5.3
	O_3	170	6.9
	SO_2	14	-17.6
	NO_2	37	2.8
	CO	1.3	-13.3
Shanghai	$PM_{2.5}$	39	-13.3
	PM_{10}	55	-6.8
	O_3	181	10.4
	SO_2	12	-20.0
	NO_2	44	2.3
	CO	1.2	-7.7

The Yangtze River delta The number of days with excellent and good air quality in 25 cities ranged from 48.2% to 94.2%, with the average at 74.8%, down by 1.3 percentage points compared with that of 2016. The average number of days failing to meet air quality standard took up 25.2%; of which the number of days with slight pollution was 19.9%, the number of days with moderate pollution 4.4%, the number of days with heavy pollution 0.9%, and the number of days with severe pollution 0.1%. The attainment rate was within the range of 80%~100% for 6 cities, 50%~80% for 18 cities, and less than 50% for 1 city. Of all days failing to meet national air quality standard, the number of days with $PM_{2.5}$, O_3, PM_{10} and NO_2 as the primary took up 44.5%, 50.4%, 2.3% and 3.0% respectively. There was no occurrence of non-attainment days with SO_2 and CO as the primary pollutants.

The number of days meeting air quality standard was 75.3% for Shanghai around the year, down by 0.1 percentage point compared with that of 2016. There were 2 days of heavy pollution and no occurrence of very heavy pollution, the same as that of 2016.

The Pearl River Delta The number of days of 9 APL cities in the Pearl River Delta meeting air quality standard was within the range of 77.3%~94.8% with the average at 84.5%, down by 5.0 percentage points compared with that of 2016. The average proportion of non-attainment days was 15.5%; 12.5% of which were of slight pollution, 2.4% of moderate pollution and 0.6% of heavy pollution. There was no occurrence of severe pollution. The attainment rate was within the range of 80%~100% for 6 cities and 50~80% for 3 cities. Among the non-attainment days, the number of days with O_3, $PM_{2.5}$ and NO_2 as the primary pollutants took up 70.6%, 20.4% and 9.2% respectively. There was no occurrence of non-attainment days with PM_{10}, SO_2 and CO as the primary pollutant.

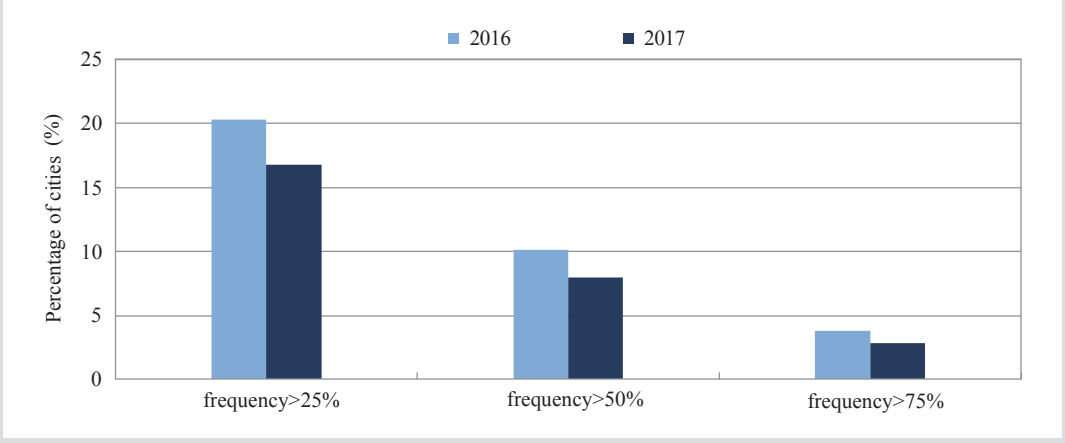
The attainment rate of Guangzhou was 80.5%, down by 4.2 percentage points compared with that of 2016. There were 2 days of heavy pollution and no occurrence of very heavy pollution, 1 day more than that of 2016.

Average Concentration of Primary Pollutants in the Pearl River Delta in 2017

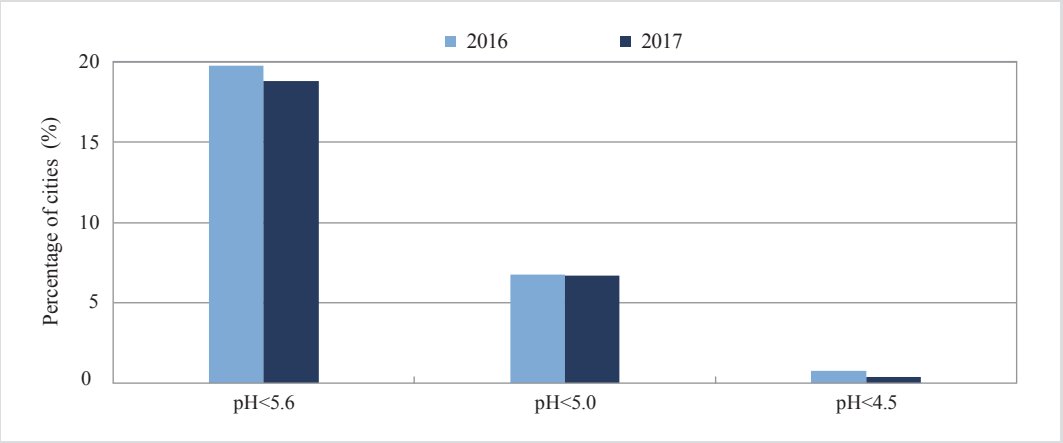
Region	Indicator	Average concentration (CO: mg/m^3, others: μg/m^3)	Increase from 2016 (%)
The Pearl River Delta	$PM_{2.5}$	34	6.2
	PM_{10}	53	8.2
	O_3	165	9.3
	SO_2	11	0
	NO_2	37	5.7
	CO	1.2	-7.7
Guangzhou	$PM_{2.5}$	35	-2.8
	PM_{10}	56	0
	O_3	162	4.5
	SO_2	12	0
	NO_2	52	13.0
	CO	1.2	-7.7

Acid Rain

Acid rain frequency In 2017, the average acid rain frequency of 463 cities, districts or counties under precipitation monitoring was 10.8%, down by 1.9 percentage points compared with that of 2016. The rate of cities with acid rain occurrence was 36.1%, down by 2.7 percentage points compared with that of 2016. 16.8% of the cities had acid rain frequency over 25%, down by 3.5 percentage points compared with that of 2016. 8.0% cities had acid rain frequency over 50%, down by 2.1 percentage points compared with that of 2016. 2.8% cities had acid rain frequency over 75%, down by 1.0 percentage point compared with that of 2016.



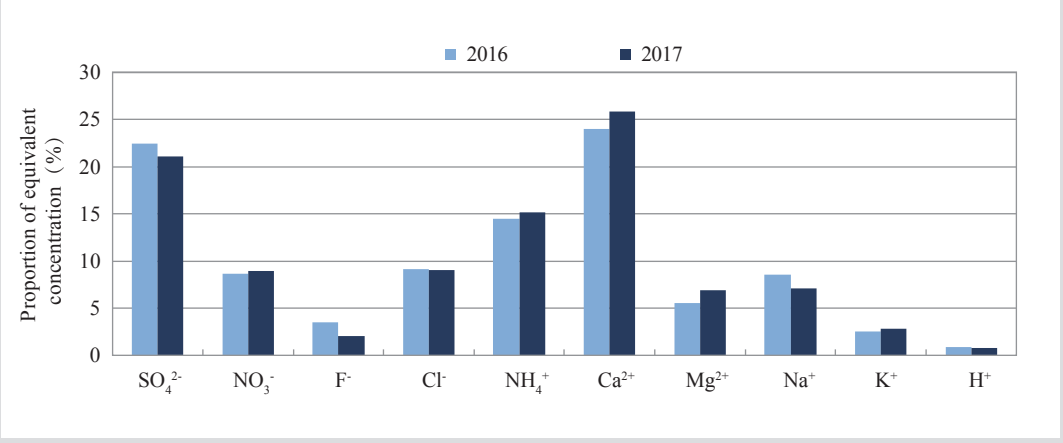
Comparison of the Percentage of Cities with Different Acid Rain Frequency between 2016 and 2017



Comparison of the Percentage of Cities with Different Annual pH Value of Precipitation between 2016 and 2017

Precipitation acidity In 2017, the annual average pH value of precipitation across the country was 4.42 (Dazu county in Chongqing) ~8.18 (Bayan Nur City in Inner Mongolia Autonomous Region). Among them, the proportions of cities with acid rain (annual average pH value of precipitation < 5.6), relatively serious acid rain (annual average pH value of precipitation < 5.0) and serious acid rain (annual average pH value of precipitation < 4.5) was 18.8%, 6.7% and 0.4% respectively, down by 1.0, 0.1 and 0.4 percentage points respectively compared with that of 2016.

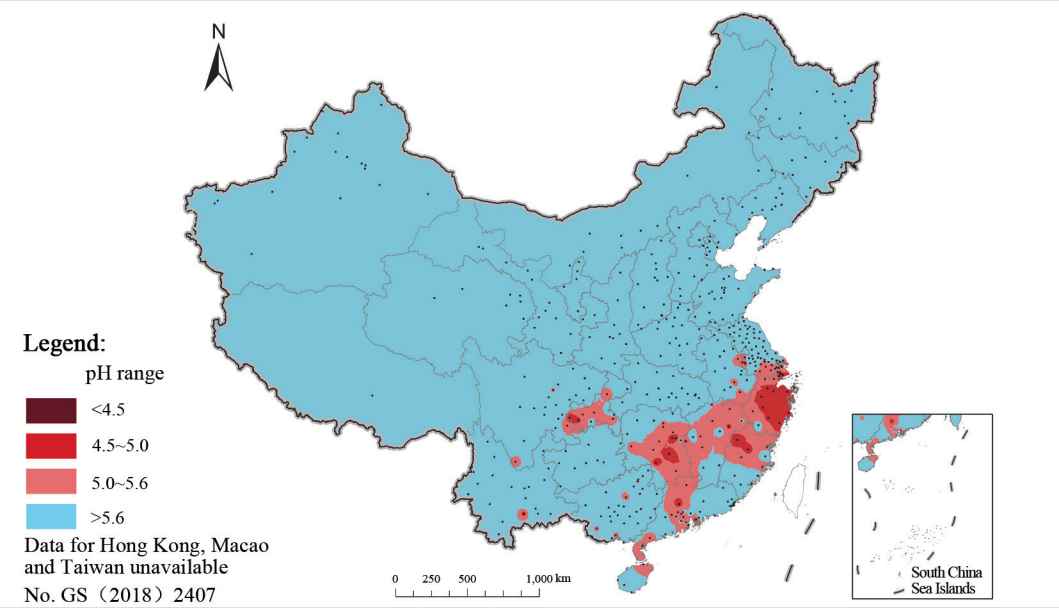
Chemical composition In 2017, the main cations in precipitation were calcium and ammonium, taking up 25.9% and 15.2% respectively of total ion equivalent. The key anion was sulfate radical, taking up 21.1% of the total ion equivalent, while nitrate radical took up 9.0% of the total ion equivalent. In general, the type of acid rain was still sulphuric acid. Compared with that of 2016, the percentage of concentration of sulfate radical, fluoride ion and sodium ion went down; the percentage of concentration of ammonium ion, calcium ion and magnesium ion went up; slightly and the



Comparison of Main Ion Equivalent Concentration Ratio of Precipitation between 2016 and 2017

percentage of concentration of other ion equivalents kept at a stable level.

Acid rain distribution The total area affected by acid rain was about 620,000 km^2, taking up 6.4% of the national territory, down by 0.8 percentage point compared with that of 2016. Among them, the percentage of land area with relatively serious acid rain was 0.9%. Acid rain was mainly distributed south to the Yangtze River and east to Yunnan-Guizhou Plateau, including most of Zhejiang and Shanghai, central and northern part of Jiangxi, central and northern part of Fujian, central and eastern part of Hunan, central part of Guangdong, southern part of Chongqing, southern part of Jiangsu and a small part of southern part of Anhui.



The Isoline of Annual Average pH Value of Precipitation in China in 2017