



Air

Population density, scarcity of land, narrow streets and busy traffic all affect the air quality of Macao. However, this is offset to some extent by the low discharge of industrial pollutants. The air quality is therefore quite good in general.

In 2003, roadside monitors recorded that the air quality was “good” on 74 percent of the days, “acceptable” on 21 percent, and “poor” on only five percent (18 days). In the high-density residential areas of the Macao peninsula, the air quality was “good” on 70 percent of the days, “acceptable” on 24 percent, and “poor” on six percent (21 days). The air quality of the high-density residential areas of Taipa was “good” on 59 percent of the days, “acceptable” on 34 percent, and “poor” on seven percent (14 days). General monitoring stations recorded that the air quality was “good” on 59 percent of the days, “acceptable” on 37 percent and “poor” on four percent (14 days).

Every winter, a comparatively high level of pollutants in the air increases the air pollution index; while in summer the air quality improves as the convective precipitation of the tropical climate dispels the pollutants.

Monitoring stations records indicate that the concentration level of respirable suspended particulates and ozone in 2003 was higher than that of the previous year. Other pollutant concentration levels were comparable to those in 2002. Respirable suspended particulates and ozone remained the main sources of pollution throughout the year. The number of days in which “poor” air quality readings were recorded increased in 2003. However, Macao’s air quality remained good, overall. The annual average content level of every pollutant was normal, and met all relevant standards.



Average Pollutant Concentration in 2003

	Respirable suspended particulates ($\mu\text{g}/\text{m}^3$)	Sulphur dioxide ($\mu\text{g}/\text{m}^3$)	Nitrogen dioxide ($\mu\text{g}/\text{m}^3$)	Ozone ($\mu\text{g}/\text{m}^3$)	Carbon monoxide (mg/m^3)
Roadside stations	72.7	---	61.6	---	2.2
High-density residential areas of Macao peninsula	67.1	25.8	50.5	29.3	0.9
High-density residential areas of Taipa island	57.1	---	59.5	43.3	0.7
Overall average	59.3	25.4	37.3	46.6	---

Comparison between Pollutant Concentration and Daily Air Pollution Index

Air quality index	Respirable suspended particulates 24-hour average ($\mu\text{g}/\text{m}^3$)	Sulphur dioxide 24-hour average ($\mu\text{g}/\text{m}^3$)	Nitrogen dioxide 24-hour average ($\mu\text{g}/\text{m}^3$)	Ozone dioxide 8-hour average ($\mu\text{g}/\text{m}^3$)	Carbon monoxide 8-hour average (mg/m^3)
0	0	0	0	0	0
50	100	60	80	80	5
100	150	150	150	160	10
200	350	800	280	350	17
300	420	1,600	565	600	34
400	500	2,100	750	800	46
500	600	2,620	940	1,000	57

Air Pollution Index

Air pollution index	0~50	51~100	101~200	201~300	301~400	401~500
Air quality level (by Macao standards)	Good	Acceptable	Poor	Bad	Severe	Harmful
Symbol						



Climate

Macao is situated in a subtropical zone, with the Asian continent to the north and a wide tropical sea to the south. In winter, Macao experiences a north wind, cold and dry weather and low rainfall, due to a cold continental high-pressure system at medium and high latitudes. In summer, the MSAR is mainly subject to southwesterly winds, hot and wet weather and heavy rainfall, due to the influence of oceanic tropical weather systems. The reverse of wind directions in winter and summer, together with minimal temperature variation during the day, give Macao a marine monsoon climate.

According to the World Meteorological Organization's 30-year-average standard calculation, between 1971 and 2000, average annual precipitation in the Macao SAR was more than 2,000 mm, with most rainfall occurring between April and October. May had the most precipitation – an average of 361.9 mm – while January had the least – an average of 32.4 mm.

Generally, Macao has an average annual temperature of 22.4°C. The coolest month is January, when it averages 14.8°C. Most years, Macao has a short cold weather period when temperatures fall below 5°C. The average monthly temperature exceeds 22°C during seven months of the year, indicating that Macao has a short winter but a long summer.

The MSAR is frequently hit by typhoons. The typhoon season starts in May and ends in October, with July and August as its peak period.

Weather in 2003

General Situation

The average temperature and the total amount of sunshine in 2003 were higher than the standard level; while the relative humidity, total rainfall and evaporation level were lower. Average temperatures in 10 months of the year exceeded the 30-year average. February was the most conspicuous month, with the average temperature higher than the corresponding 30-year average by over 2.6°C. In addition, the total rainfall in July was a mere 33 mm, 256.8 mm less than the norm. This was the lowest figure recorded in any July since 1952. It is noteworthy that the total amount of sunshine in July reached 316.8 hours, 90.6 hours more than the norm for this month



and the highest figure recorded in any July since 1952.

Four tropical cyclones approached Macao during 2003. Typhoons Imbudo and Dujuan had a big impact on Macao, requiring the hoisting of signal No. 8. Severe tropical storm Koni and typhoon Krovanh required the hoisting of signals No. 1 and No. 3, respectively. Tropical cyclones did not cause any serious damage in Macao in 2003.

Two red rainstorm warnings and two black rainstorm warnings were issued in 2002.

A total of 29 thunderstorm warnings were issued in the course of the year. The first was on 8 April. Most thunderstorms occurred during May, June, August and September; and these four months accounted for 97 percent of the year's total.

Summary of Severe Weather Warnings issued in 2003

Warning/Signal Type		Hoisted/Issued Frequency	No. of Warning Reports Issued
Tropical Cyclone Warning	No. 1 Alert Signal	4	19
	No. 3 Strong Wind Signal	5	18
	No. 8 Gale Signal	4	29
	All Signals Lowered	4	4
Strong Monsoon Signal (Black Ball)		10	39
Rainstorm Warning	Red	6	13
	Black	2	4
Thunderstorm warnings		29	91

Temperature

Macao had an average annual temperature of 23°C during 2003. This was 0.6°C higher than the 30- year average. The maximum monthly average temperature during the year was 29°C recorded in July, and the minimum average was 15.3°C recorded in January. The hottest day was 23 July, when the temperature shot up to 35.4°C; while the coldest day was 7 January, when the temperature fell to just 6.2°C.



Relative Humidity

Average relative humidity during 2003 was 78 percent, which was one percent lower than the 30-year average. April saw the highest humidity, which averaged 87 percent, while December was the lowest, with humidity averaging 62 percent.

Rainfall

Total rainfall during 2003 was 1,490 mm, 632.9 mm below the 30-year average. June was the rainiest month, with 420.4 mm, which was 80.7 mm more than the 30-year June average. December was the driest, with just 2.8 mm of rain, 32.4 mm lower than the 30-year average for that month.

Evaporation

Total evaporation levels reached 944.6 mm in 2003, 126.6 mm less than the 30-year average. In December, the evaporation level was 122.2 mm, the highest figure during the year, while April was the lowest, with 44.3 mm.

Sunshine

Macao had 2,007.2 hours of sunshine during 2003, 179.4 hours more than the 30-year average.

Wind

Macao was subject to mainly northerly winds in January, February, and October to December 2003. Southeasterly winds prevailed from March to May and during September, while southerly winds prevailed between June and August. Wind speeds averaged 16.1 kilometres per hour.

Weather Services

Meteorological and Geophysical Bureau

The Meteorological and Geophysical Bureau (SMG) is under the supervision of the Secretary for Transport and Public Works. It provides weather reports, monitors air quality, and conducts research into climate, climate change and earthquakes.

The SMG's work has a direct influence on Macao's everyday life. Apart from hourly real-time weather information, the SMG issues various types of daily weather forecasts for the public, Government departments and private institutions. These



include five weather reports and forecasts, and two marine and weather forecasts for the South China coastal area that are broadcast daily. In 2003, it provided 1,825 weather reports and 730 marine and weather forecasts for the South China coastal area.

The SMG releases four-day forecasts every day. Each day, its officers explain the day's weather conditions and the forecast for the following day in telephone reports that are broadcast on TDM's (Macau Broadcasting Company) morning TV programme. These presentations explain forthcoming weather conditions and teach viewers about meteorology.

The SMG also provides various extreme weather warnings, which include tropical cyclone, rainstorm, thunderstorm and strong monsoon (black ball) warnings.

A round-the-clock, automatic air-quality monitoring network and ultraviolet (UV) monitoring system enable the SMG to summarise air quality and UV indexes for the day and report them to the public, together with an air quality forecast for the following day. Residents can access this information by dialling 1311 - the "Hotline Weather Report" and 1313 - the "Weather Report Fax", or by visiting the SMG's website at <http://www.smg.gov.mo/>.

Real-time weather conditions, weather forecasts, and extreme weather warning information have been available via SMS for the registered customers of three mobile phone service providers since March 2003. The SMG has also teamed up with the Companhia de Telecomunicacoes de Macau (CTM) for cell broadcasting of relevant information to its mobile phone subscribers three times a day.

The SMG Aeronautic Meteorological Centre at Macau International Airport provides hourly weather observations and special reports to aviation organisations and flight crews. Every six hours, the centre issues a 24-hour weather forecast for them. It is also responsible for issuing thunderstorm and typhoon warnings for the airport, and providing updated aeronautical meteorological documents for departing flights. The latter include meteorological maps for every route, as well as high-altitude air temperatures, wind maps, and weather forecasts. The centre issued about 15,000 such documents in 2003.



In 2003, the centre provided meteorological information and airport meteorological warnings for air traffic control centres and airport-related agencies via an intranet webpage.

To offer the public an accurate and convenient time service, the SMG acquired a caesium beam atomic clock and time device in 2003. Residents may synchronise the clocks of their computers with the time provided by the bureau via the Internet. The SMG also makes standard time signals available to telecommunication companies in Macao. Residents can learn the Macao standard time through time services offered by these companies.

Monitoring Network

To collect weather data 24 hours a day, the SMG maintains the Automatic Weather Observation Network of 11 weather observation stations located at key locations in Macao. Three stations automatically send information every 15 minutes to Guangzhou and Hong Kong, using the international SYNOP code and a Global Telecommunications System (GTS). This forms part of the Pearl River Delta Real-time Automatic Weather Observation Network, which is jointly operated by the Guangdong Provincial Meteorological Bureau, the Hong Kong Observatory, and the Macao SMG. The SMG has equipped the Macau Tower with Automatic Weather Observation Network installations at altitudes of 100, 150, 241, 294 and 324 metres, to facilitate round-the-clock collection of weather information.

Air Quality Monitoring

The SMG established the Air Quality Monitoring Project in partnership with other Government departments in 1987. It now employs a fully automatic air-monitoring network to measure major pollutants that jeopardise Macao's air quality. In 2003, with the assistance of the SMG, two automatic air-quality-monitoring stations were set up in Concordia Industrial Park on Coloane and the Westin Resort Macau golf course. To date, Macao has six such stations.

Seismological Monitoring

The SMG has two seismological monitoring stations, one in Ka Ho Lighthouse on Coloane, and the other in the Taipa Grande headquarters on Taipa. A simulated seismograph and digital seismograph are installed inside the Ka Ho Lighthouse. The Taipa Grande headquarters is equipped with a deep-shaft (30 metres from ground)



digital seismograph.

Environmental Radiation Monitoring

The SMG headquarters is equipped with an environmental radiation monitoring and measuring workstation, largely for detecting harmful Gamma radiation in the atmosphere.

Regional and International Cooperation

The SMG is a member of the World Meteorological Organization (WMO). It actively participates in promoting technology, research, training and applications relating to meteorology. Every year, it sends delegations to meetings and training programmes arranged by the WMO. In 2003, it sent eight delegates to attend and deliver four reports at seven WMO sessions and training activities.

The SMG is keen to exchange technology and professional knowledge with its mainland and Hong Kong counterparts. Every year, the Guangzhou-Hong Kong-Macao Seminar on Meteorological Science and Technology, the Guangzhou-Hong Kong-Macao Meteorological Cooperation Meeting, and the Seminar on Urban Air Quality in Pearl River Delta Region are held alternately in the three regions. Their aim is to exchange opinions and explore issues related to scientific research outcomes, technical developments and applications, and air-quality monitoring. The first two of these meetings for 2003 were hosted by Macao, and the SMG presented two theses. The third meeting was held in Zhuhai, and the SMG delivered one thesis.

In 2003, the bureau continued to cooperate with the Guangzhou Institute of Geochemistry, Chinese Academy of Sciences. Together they inaugurated research into the timing and geographical distribution of volatile organic compounds (VOCs), and analysis of their content and composition. The SMG began to study the daytime changes and vertical distribution of VOCs, in an attempt to understand their patterns of change, in terms of timing and geographical distribution.

The SMG also participated in the European Cooperation in the field of Scientific and Technical Research (COST), a cooperative research project on science and technology for member-states of the European Union. During 2003, the bureau sent two delegates to attend its two meetings.