



Air

A dense population, scarcity of land, narrow streets and busy traffic all affect the air quality of Macao. However, this is to some extent offset by a low discharge of industrial pollutants. So, the air quality is quite good.

On average, from 1999 to 2001, roadside monitors showed that the air quality was “good” for 61 percent of days, “acceptable” for 36 percent and “poor” for only 3 percent, i.e. fewer than 10 days a year on average. In high-density residential areas, the air quality was “good” for 73 percent of days, “acceptable” for 24 percent and “poor” for 3 percent. The ambient stations recorded that the air quality was “good” for 67 percent of days, “acceptable” for 30 percent and “poor” for 3 percent. It has been concluded, therefore, that the air quality in Macao is generally good. The main pollutants were respirable suspended particulates and ozone.

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

Records by monitoring stations show that the air quality in 2001 was similar to that of previous years, with no obvious incremental trend. The annual average pollutant level was normal and met all relevant standards.

Average Pollutant Concentration in 2001

	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	72.1	---	68.0	---	2.4
High density residential areas	68.9	26.7	48.0	26.7	0.7
Overall average	56.4	27.5	32.9	42.7	---



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 (under Macao standards)	Good	Acceptable	Poor	Bad	Severe	Harmful
Symbol						

Climate

Macao is situated in the 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 wind in winter and summer together with minimal temperature variation during the day give Macao a marine monsoon climate.



Average annual precipitation in the MSAR is more than 2,000 mm, with most rainfall from April to October. According to statistics from 1952 to 2001, June has the most precipitation – an average of 360.8 mm, and December the least - at 29.6 mm on average.

Macao has an average temperature of 22.4°C over the year and 14.8°C in January, the coldest month. In most years, Macao has a short cold weather period when temperatures fall below 5°C. There are seven months per year in which the average monthly temperature exceeds 22°C, indicating that Macao has a short winter and a long summer.

The MSAR is frequently hit by typhoons. The typhoon season starts in May and ends in October, with July and August hit by most of the typhoons.

The Weather in 2001

The average temperature in 2001 was 0.5°C higher than the 30-year average. Specifically, there were nine months with a monthly temperature higher than the 30-year average. The first three months were particularly warm with temperatures higher by 1°C or more.

Precipitation in 2001 was 432.9 mm higher than the 30-year average. Particularly wet were June, July and September, when the variation was +383.7 mm, +515.6 mm and +158.9 mm respectively. The abundant rainfall resulted in relatively less sunshine; annual total sunshine duration was 117.2 hours shorter than the 30-year average. This was particularly the case in July, when sunshine duration was 72.8 hours shorter.

Macao was influenced by five tropical cyclones in 2001. Typhoon Civet Durian was the first to justify the hoisting of tropical cyclone signal No.1, which was raised on 30 June and later upgraded to signal No.3. Typhoon Utor had the biggest impact on Macao, requiring the hoisting of signal No.8 for seven hours on 6 July. The remaining three tropical cyclones occurred in late July, August and September respectively, each requiring the No.3 signal.

More storm warnings were issued as a result of high rainfall during the year. Two black rainstorm warnings (rainfall over 100 mm within three hours) were hoisted on 6 and 13 July respectively, while seven red rainstorm warnings (rainfall over 50 mm



within two hours) were hoisted - one in March, four in June and two in September.

A total of 46 thunderstorm warnings were issued during the year - one in March, two in April, nine in May, 14 in June, nine in July, seven in August and four in September. The thunderstorms were concentrated in the second half of year, especially in the high rainfall months of May, June and July.

Overall, temperatures were slightly above average in Macao during 2001, especially in winter and early spring. Although the number of typhoons affecting Macao in 2001 was normal, the rainfall due to these typhoons was high, leading to a generally higher level of precipitation over the year.

Weather Service

Meteorological and Geophysical Bureau

The Meteorological and Geophysical Bureau (SMG) was officially established in 1952. Before then, meteorological observations were conducted by the Portuguese Navy garrisoned in Macao, with meteorological records dating back to 1861. The Meteorological and Geophysical Observatory was renamed the Meteorological and Geophysical Bureau on 20 December 1999. The SMG provides weather reports, monitors air quality and conducts research into climate, climate change and earthquakes.

The work of the bureau impinges directly on daily life. The Meteorological Monitoring Centre operates 24 hours a day, providing five daily weather reports and two forecasts for the press, radio, television and public and telecommunications bodies at 7am, 9am, 2pm, 5.30pm and 9pm. In extreme weather, the centre issues tropical cyclone, rainstorm, thunderstorm or strong monsoon warnings.

A round-the-clock, automatic air-quality monitoring network and ultraviolet (UV) monitoring system enable the SMG to summarise the air quality and UV indexes for the day and report them to the public along with an air quality forecast for the next day. Residents can access the information by dialling 1311 - the “Hotline Weather Report”, 1313 - the “Weather Report Fax”, visiting the SMG’s Web site at <http://www.smg.gov.mo/>, or via mobile phone.



The SMG reports to the Secretary for Transport and Public Works. Its headquarters at Taipa Grande is supported by three divisions – the Meteorology Division, the Computer Division and the Instruments and Maintenance Division; four centres – the Meteorological Monitoring Centre, the Climate and Atmospheric Environment Centre, the Telecommunications and Processing Centre, and the Seismological Monitoring Centre; and the Administration Department. The Aeronautic Meteorological Centre at Macau International Airport provides hourly weather observations and special observations in extreme weather conditions for its aviation operations, with all weather messages sent in the METAR and SPECI international code formats.

Monitoring Network

The SMG has 10 weather observation stations at key points in Macao, forming an “Automatic Weather Observation Network”. Three of the stations automatically send information every 15 minutes under the international code SYNOP to Guangzhou and Hong Kong via a Global Telecommunications System (GTS). This creates the “Pearl River Delta Real-time Automatic Weather Observation Network” jointly operated by the Guangdong Provincial Meteorological Bureau, the Hong Kong Observatory and the Macao Meteorological and Geophysical Bureau.

Air Quality Monitoring Network: The SMG started the Air Quality Monitoring Project jointly with other Government departments in 1987. The SMG now uses a fully automatic mobile monitoring network to measure major pollutants in Macao. It runs three automatic air-quality monitoring stations on Taipa island and the Macao peninsula.

Seismological Monitoring: The Seismological Monitoring Station on Coloane island sends earthquake information to the SMG by wireless transmission, where the signals are amplified and recorded. The new digital seismological monitoring station enables more efficient and accurate monitoring.

Environmental Radiation Monitoring Station: The SMG headquarters is equipped with an environmental radiation monitoring workstation, largely for detecting harmful Gamma radiation in the atmosphere.