7.1 Is the climate changing?

To know about climate change, first we need to understand the difference between weather and climate. Weather describes the conditions of the atmosphere within a short period of time, while climate describes the average meteorological conditions over a long period of time.

Weather and climate vary from region to region. After a brief overview of the global climate, this chapter specifically introduces the climates of China and Hong Kong.

To better understand ongoing climate change, we need to examine the scientific evidence such as the rising global surface temperature, increasing ocean heat content, shrinking sea ice, retreating glaciers and ice sheets as well as rising sea level.

1 Weather and climate

Weather describes the conditions of the atmosphere in a place within a short period of time (e.g. several hours, a few days). Climate on the other hand describes the average meteorological conditions in a place over a long period of time. Therefore, climate can be interpreted as the "average weather". The World Meteorological Organization (WMO) calculates climate parameters based on 30–year averages.

1.1 Examples of weather

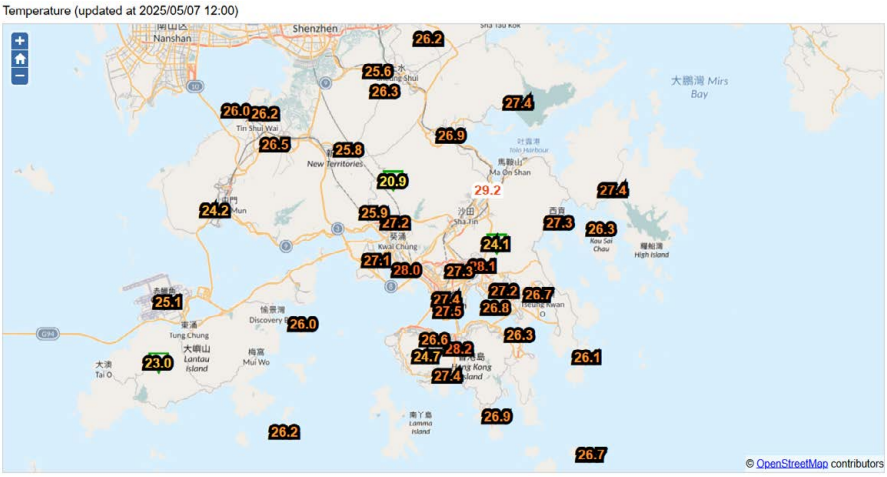


Fig 1a Regional temperatures of Hong Kong (12:00 noon on May 7, 2025)
Source: HKO

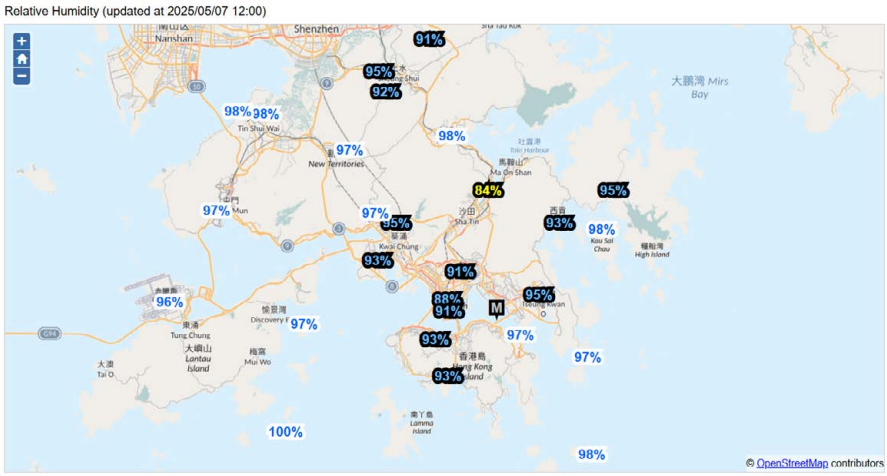


Fig 1b Regional relative humidity of Hong Kong (12:00 noon on May 7, 2025)
Source: HKO

What are the conditions of the atmosphere?

The conditions of the atmosphere refer to the meteorological elements such as temperature, relative humidity, precipitation, air pressure, wind direction and wind speed.

More Information

What is climate?

What is Climatological Normal?

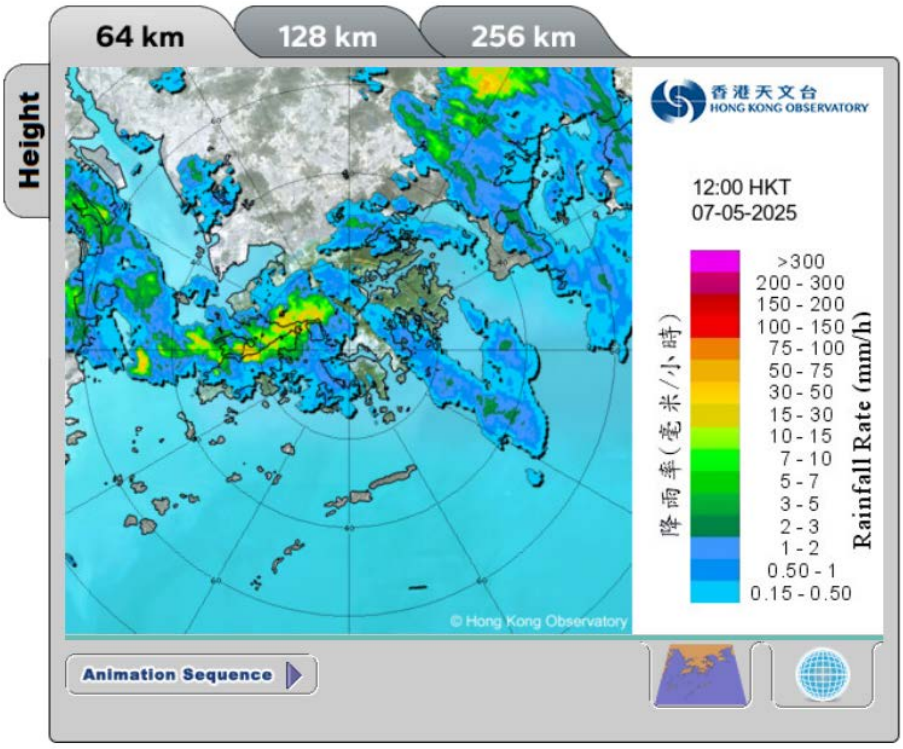


Fig 1c Image of radar echoes (12:00 noon on May 7, 2025)
Source: HKO

More Information

Regional weather in Hong Kong – geographical information system platform

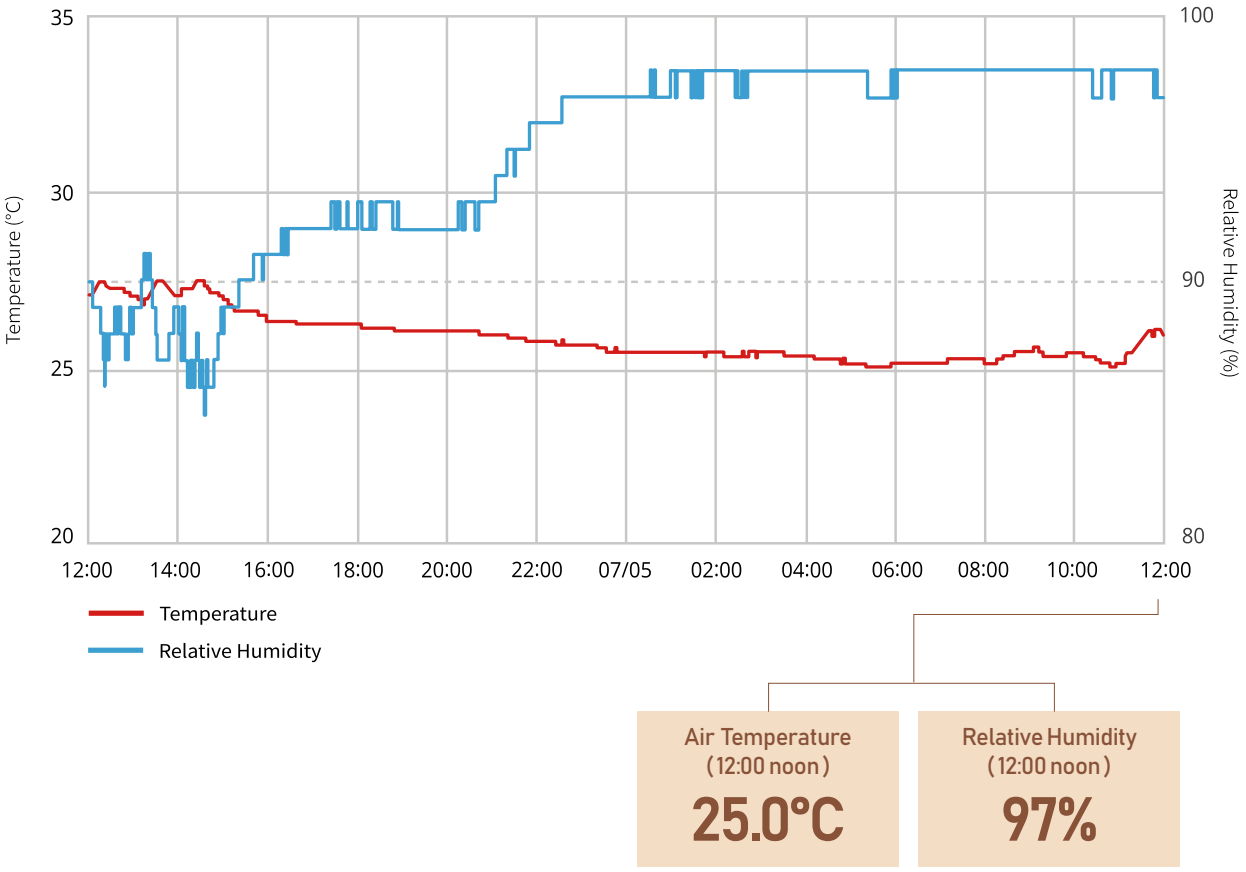


Fig 2 Weather conditions at Tsuen Wan Ho Koon (May 7, 2025)
Source: HKO

1.2 Examples of climate

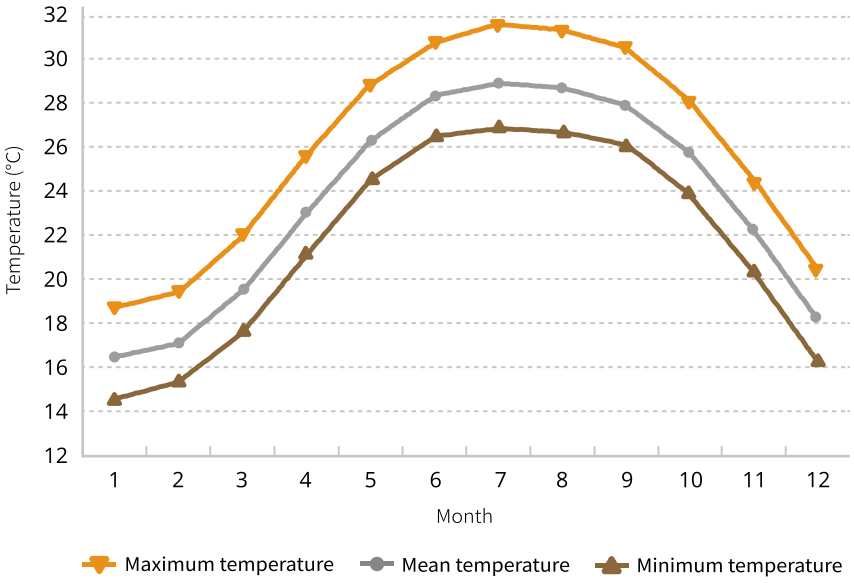


Fig 3 Monthly means of daily maximum, mean and minimum temperatures recorded at the Hong Kong Observatory (HKO) between 1991–2020
Source: HKO

More Information

The ABCs of Climate

Climatological Information from HKO

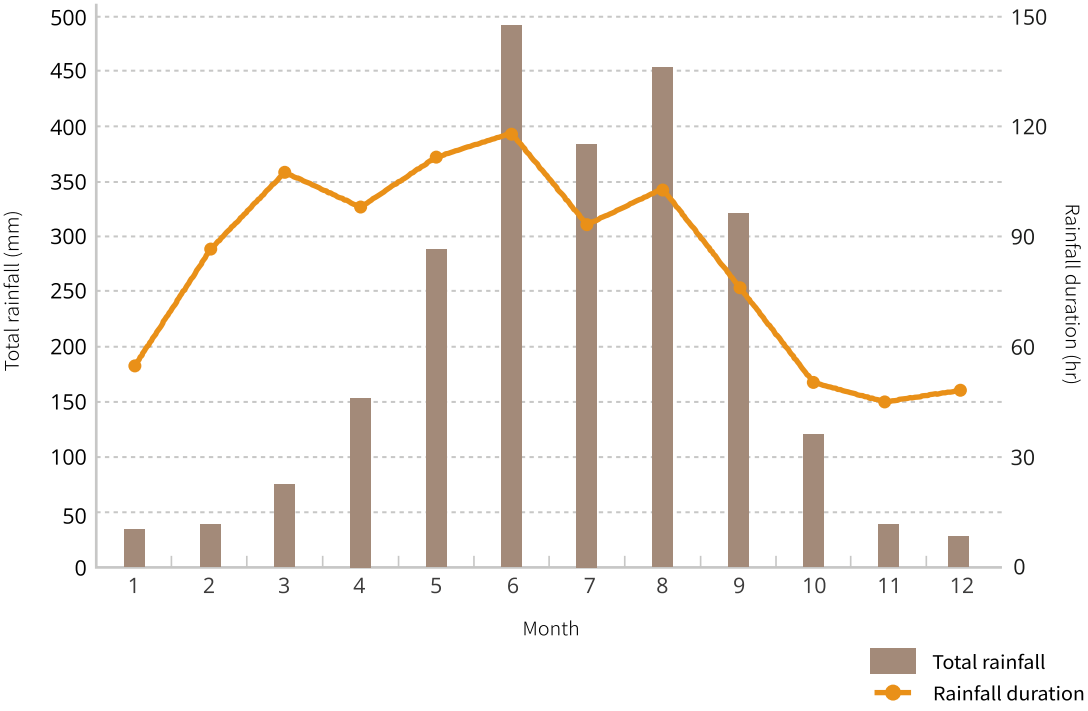
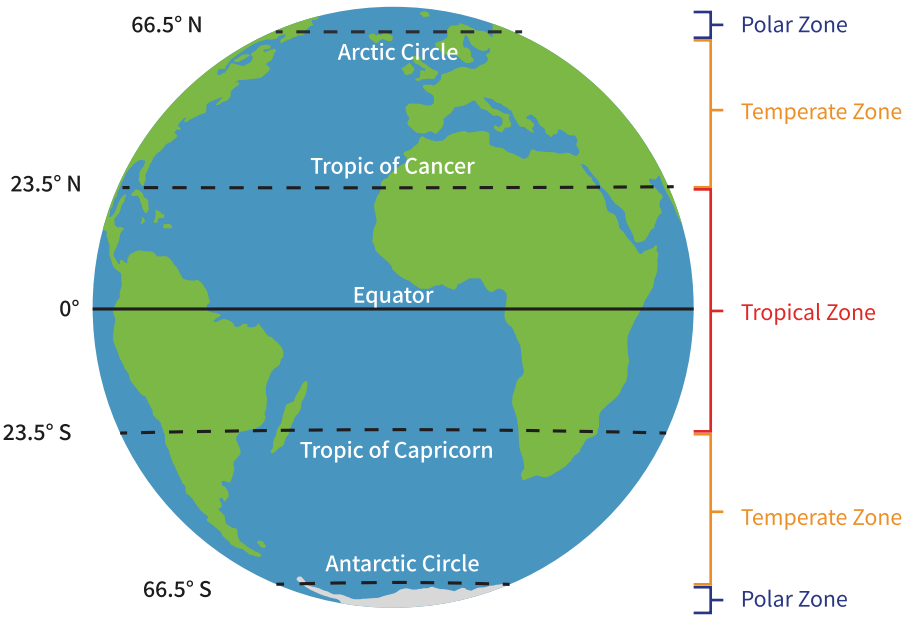


Fig 4 Monthly mean of rainfall recorded at Hong Kong Observatory (HKO) between 1991–2020
Source: HKO

2 What is the world's climate like?



More Information

Climatic zones and the Köppen climate classification

Fig 5

Climatic zones classified by the amount of insolation received

One of the most important factors affecting regional climate is the solar radiation, known as insolation, received. Therefore, one way of climatic classifications is to divide the Earth into climatic zones by the Arctic Circle, the Tropic of Cancer, the Tropic of Capricorn and the Antarctic Circle. Tropical zone refers to the region between the Tropic of Cancer and the Tropic of Capricorn; temperate zone refers to the region between the Arctic Circle (the Antarctic Circle) and the Tropic of Cancer (the Tropic of Capricorn); polar zones are the areas within the Arctic and Antarctic Circles. (Fig.5) Among these climatic zones, the tropical zone receives the greatest amount of insolation, and the polar zones receive the least.

Other climatic classifications may take into account parameters such as temperature, precipitation, duration of precipitation and types of vegetation. Regions with similar parameter characteristics are grouped into the same climatic zone. For example, the Köppen Climate Classification divides the world into five major climatic zones based on three factors: vegetation, temperature and precipitation.

In addition to latitude, other factors such as altitude, topography, distance from the sea, ocean currents and prevailing wind directions, also affect the regional climate.

Altitude	As altitude increases, temperature and air pressure decrease. Generally, the temperature decreases with height by about 6.5° C per 1,000 m.
Topography	Wind is stronger on the windward slope of a mountain, air is forced to rise and cool because of the terrain, resulting in more precipitation. Wind is weaker on the leeward slope of a mountain, air descends and becomes warmer and drier, leading to the foehn effect and a rain shadow, with less precipitation.
Distance from the sea	Water bodies help moderate temperatures, resulting in more stable temperatures in coastal areas. Coastal regions are affected by land and sea breezes.
Ocean currents	Warm currents (e.g. the Gulf Stream) bring warmer and more humid climates to nearby coastal areas, while cold currents (e.g. the California Current) lower coastal temperatures and increase atmospheric stability.
Prevailing wind directions	Onshore winds contain more moisture and brings more precipitation, while offshore winds are drier.

3 What are the climates of China and Hong Kong like?

3.1 Climate of China

In terms of climate types, there are five main types in China: temperate monsoon climate, temperate continental climate, subtropical monsoon climate, tropical monsoon climate, and highland/plateau mountain climate (refer to the Education Bureau's Our Country's Climate and Life Augmented Reality Thematic Map [electronic version]).

3.1.1 Temperate monsoon climate

Features: Hot and rainy summers, cold and dry winters, with four distinctive seasons.

Major distribution: Mainly located to the north of the Qinling Mountains—Huaihe River line in eastern China, as well as to the east of the temperate semi-arid and arid zones.

3.1.2 Temperate continental climate

Features: Dry with little rainfall, extreme continental climate, with the largest annual and diurnal temperature ranges among all climate types.

Major distribution: The area to the west of the Daxinganling—Yinshan—Helan Mountains—Qilian Mountains—Bayan Har Mountains line, and to the north of the Kunlun Mountains—Altun Mountains—Qilian Mountains—Hengduan Mountains line.

3.1.3 Subtropical monsoon climate

Features: Warm winters, hot summers, with four distinctive seasons. The annual precipitation generally ranges from 1,000 to 1,500 mm, with most rainfall occurring in summer, with no distinct dry season.

Major distribution: The area to the south of the Qinling Mountains—Huaihe River line and to the north of the tropical monsoon climate zone in eastern China.

3.1.4 Tropical monsoon climate

Features: High temperatures throughout the year, long summers with brief winters. Distinct wet and dry seasons. The year can be divided into three seasons—dry season, rainy season, and hot season. Precipitation mainly comes in summer and relatively scarce in winter.

Major distribution: At eastern coastal regions between latitudes 10° and 20° N, mainly in the Leizhou Peninsula, Hainan Island, the South China Sea, and the southern part of Taiwan Island.

3.1.5 Highland climate/plateau mountain climate

Features: Long, dry, and cold winters with frequent strong winds, cool and rainy summers with frequent hailstorms, indistinct seasonal changes. Abundant sunshine, temperature decreases with increasing altitude and latitude, distinct wet and dry seasons, with frequent nighttime rain.

Major distribution: The Qinghai—Tibet Plateau.

More Information

What are the major climatic features in our country?

PowerPoint Series on Geography of China (3) – Climate of Our Country

Climate and Life of Our Country

The seasonal characteristics of precipitation in China are as follows. In the south, the rainy season starts early, ends late, lasts for a longer period, and is concentrated between May and October. In the north, the rainy season starts late, ends early, lasts for a shorter period, and is concentrated in July and August. Most regions experience more rainfall in summer and autumn and less in winter and spring. The only region in the country dominated by winter rainfall (winter–rain type) is northeastern Taiwan, where winter precipitation accounts for about 35% of the annual total precipitation.

China's precipitation mainly comes from moisture brought by the southeast monsoon from the Pacific Ocean and the southwest monsoon from the Indian Ocean. Annual precipitation varies greatly across regions, following a general pattern as follows. More along the coast than inland, more in the south than in the north, more in mountains than in plains, and more on the windward slopes of the mountains where warm moist air rises than on the leeward slopes.

What is a monsoon?

A monsoon is a seasonal shift in winds that brings either a very rainy or a very dry season to a region. The winds shift because the temperature of the land and the temperature of the water are different as seasons change. Monsoons are usually associated with parts of Asia, and they can happen in many tropical and subtropical regions.

More Information

What is a monsoon?

3.2 Climate of Hong Kong

Hong Kong's climate is sub–tropical, tending towards temperate for nearly half the year. During November and December there are pleasant breezes, plenty of sunshine and comfortable temperatures. Many people regard these as the best months of the year. January and February are cloudier, with occasional cold fronts followed by dry northerly winds. It is not uncommon for temperatures to drop below 10 °C in urban areas. Sub–zero temperatures and frost also occur at times on high ground and in the New Territories.

March and April are milder although there are occasional spells of high humidity. Air traffic and ferry services are occasionally disrupted because of reduced visibility under drizzle and foggy weather.

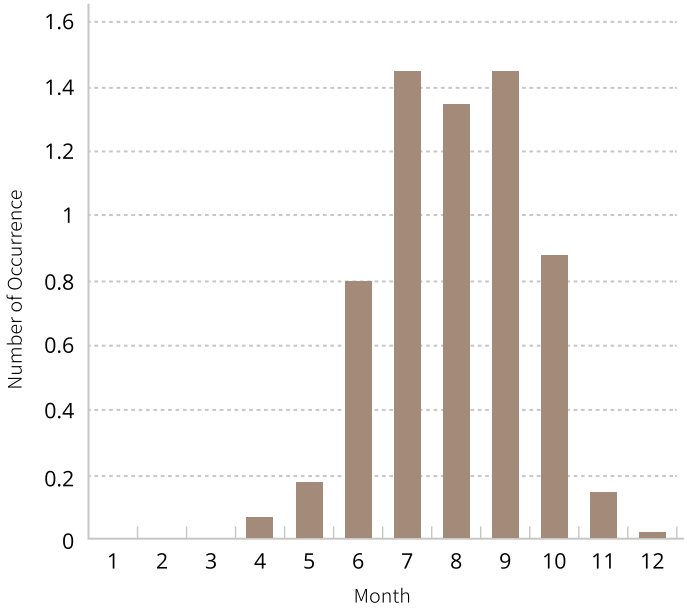


Fig 6 Monthly mean number of occurrences of tropical cyclones affecting Hong Kong (1961–2020)
Source: HKO

May to August are hot and humid with occasional showers and thunderstorms, particularly during the mornings. Afternoon temperatures often exceed 31 °C whereas at night, temperatures generally remain around 26 °C with high humidity. There is usually a fine dry spell in July which may possibly last for one to two weeks, or for even longer in some years.

May to November are the months during which tropical cyclones of different intensities may strike Hong Kong, while July to September are the most likely months with tropical cyclones affecting Hong Kong. (Fig.6)

On average, about 30 tropical cyclones form in the western North Pacific or China Seas every year, and about half of them reach typhoon strength (maximum winds of 118 km per hour or more). When a tropical cyclone is

about 700 to 1,000 km southeast of Hong Kong, the weather is usually fine and exceptionally hot, but isolated thunderstorms sometimes occur in the evenings. If the centre comes closer to Hong Kong, winds will increase and rain can become heavy and widespread. Heavy rain from tropical cyclones may last for a few days and subsequent landslips and flooding sometimes cause considerably more damage than the winds.

The mean annual rainfall ranges from about 1,400 mm at Ping Chau to more than 3,000 millimetres in the vicinity of Tai Mo Shan. (Fig.7) About 80% of the rain falls between May and September. June and August are usually the wettest months while January and December are usually the driest months. (Fig.8)

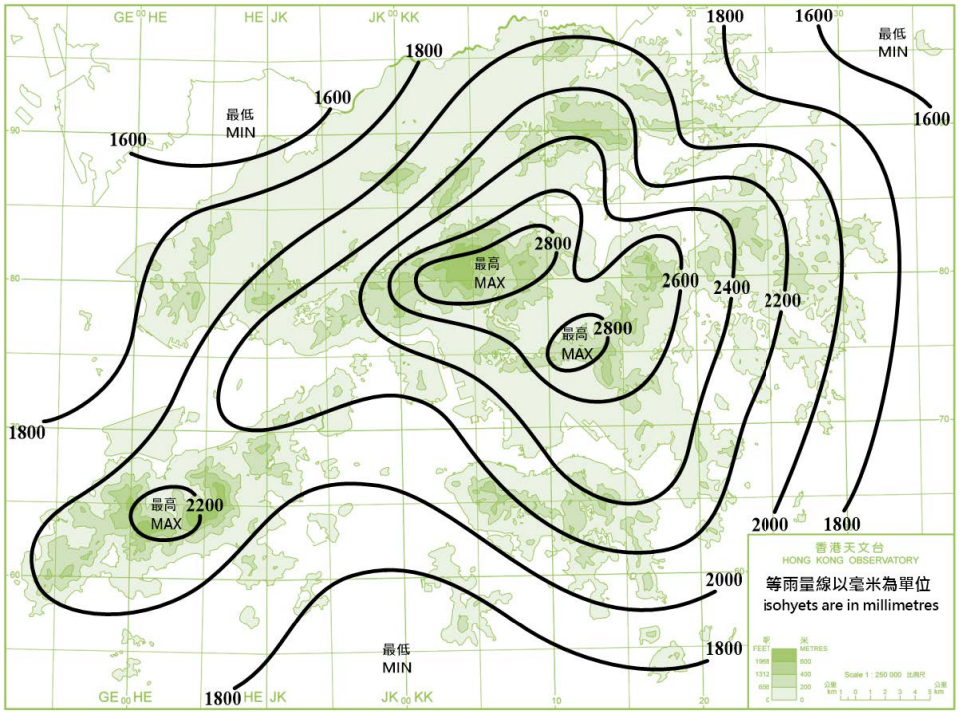


Fig 7 Average annual rainfall distribution in Hong Kong (1991–2020)
Source: HKO

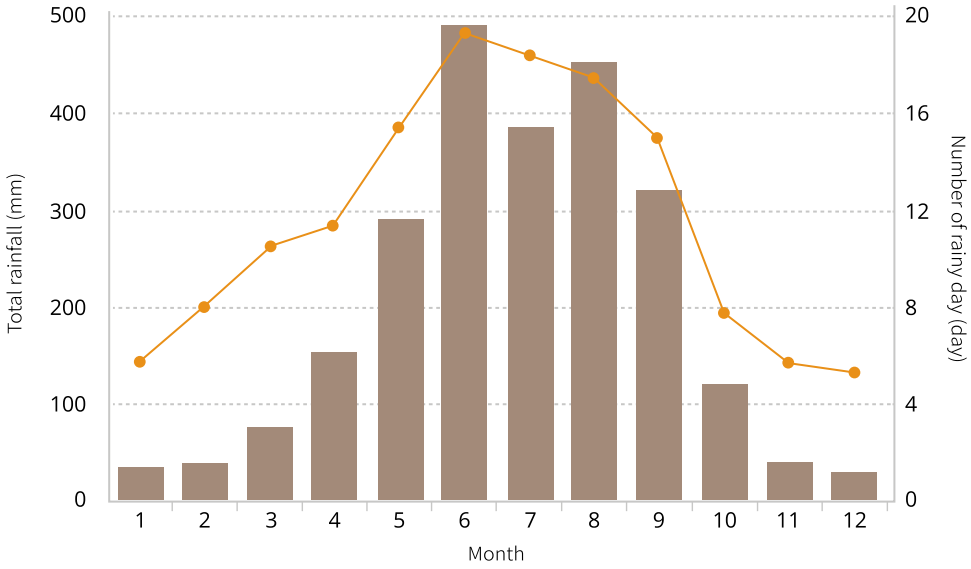


Fig 8 Monthly means of total rainfall and number of rainy day recorded at the Hong Kong Observatory (HKO) between 1991 and 2020
Source: HKO

More Information

Climate of Hong Kong

Monthly Weather Summary

Climate Statistics

Severe weather phenomena that can affect Hong Kong include tropical cyclones, strong winter and summer monsoon, monsoon troughs, and thunderstorms with associated squalls that are most frequent from April to September. Waterspouts and hailstorms occur infrequently, while snow and tornadoes are rare.

4 Scientific evidence of climate change

Numerous studies have shown overwhelming scientific evidence for climate change, with a clear scientific consensus among climate scientists. The scientific evidence of climate change is outlined in the following.

More Information

Vital indicators of climate change — Global temperature

4.1 Rising global surface temperature

The analyses of global temperature data from various meteorological institutions and research centers have reached the same conclusion that the average global surface temperature has been increasing significantly over the past hundred years. In January 2025, the World Meteorological Organization (WMO) confirmed that 2024 was the warmest year on record, based on six international datasets. The past ten years (2015–2024) were also the ten warmest years on record. The global mean surface temperature in 2024 was about 1.55° C above pre-industrial levels (Fig.9)

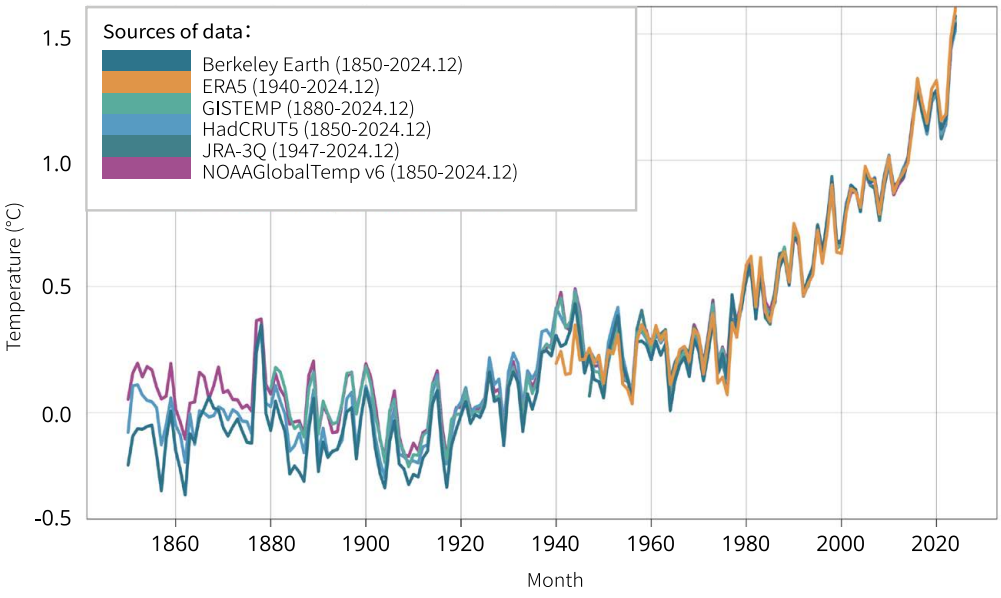


Fig 9 Annual global mean temperature anomalies (1850–2024) relative to a pre-industrial (1850–1900) baseline
Source: WMO

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) also confirmed that global warming has significantly intensified during the last fourty years between 1981 and 2020, with both the scale and intensity of warming greatly increasing when compared to the first eighty years of the 20th century (1900–1980). Warming accerlerated after the 1970s, but not all regions are warming equally. (Fig.10)

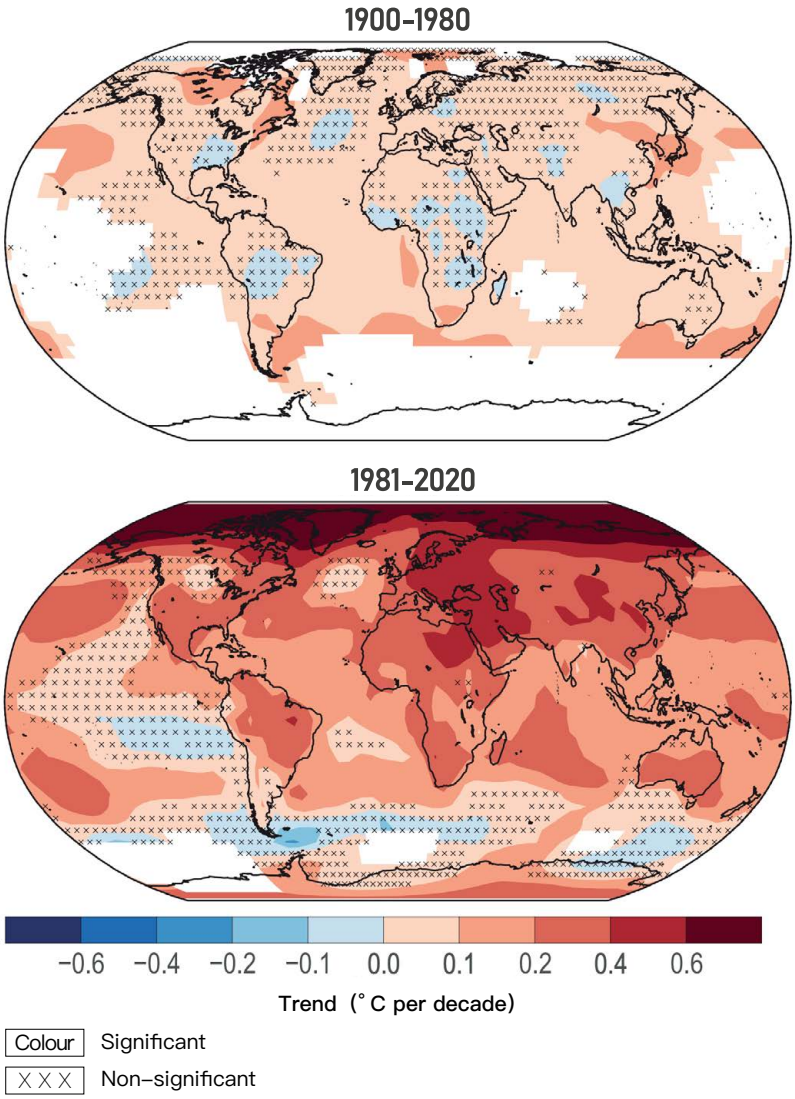


Fig 10 Changes in surface temperature (°C per decade) during 1900–1980 (upper diagram) and 1981–2020 (lower diagram)
Source: IPCC Sixth Assessment Report

More Information

Latest global temperature

Why do snowstorms and extremely cold weather still occasionally occur in some regions under global warming?

Cold events occurring in a specific place at a specific time are just weather, and do not necessarily reflect climate. Against the backdrop of natural climate variability, global warming refers to the increase in global average temperature since the 20th century as a result of human activities. Snowstorms and extremely cold weather are parts of the natural climate variability and are not precluded by global warming. However, global warming has reduced the frequency of extremely cold events over the last few decades. The frequency of extremely cold events is expected to decrease further if global temperature keeps rising in the future.

More Information

Is global warming really at work?

4.2 Increase in sea surface temperature and ocean heat content

The ocean covers more than 70% of the Earth's surface. The heat capacity of ocean is much higher than that of land. Fig.11 and 12 clearly show the long–term increasing trend of sea surface temperature and ocean heat content.

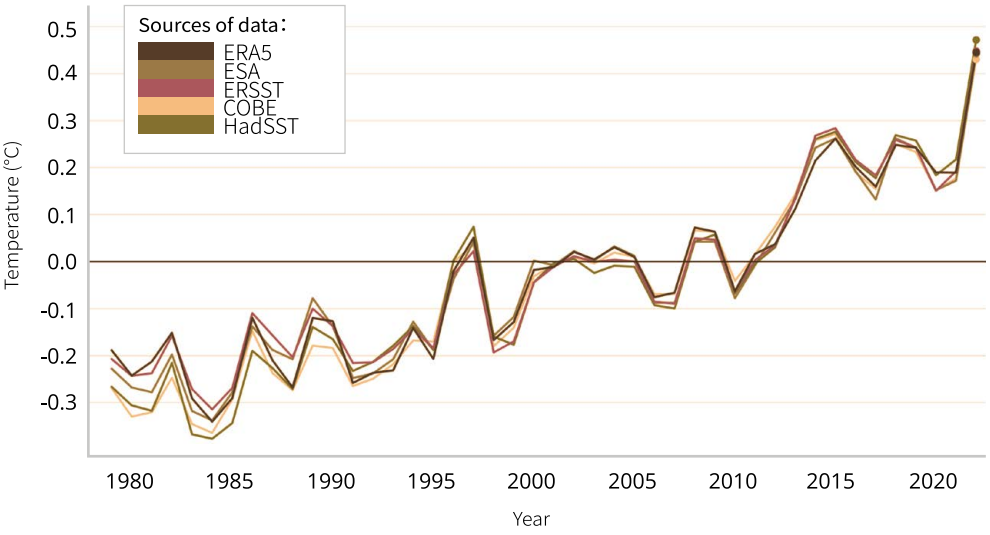


Fig 11 Anomalies in annual sea surface temperature for 60° S — 60° N (relative to the average for the 1991–2020 reference period)
Source : EU Copernicus European Earth Observation Programme

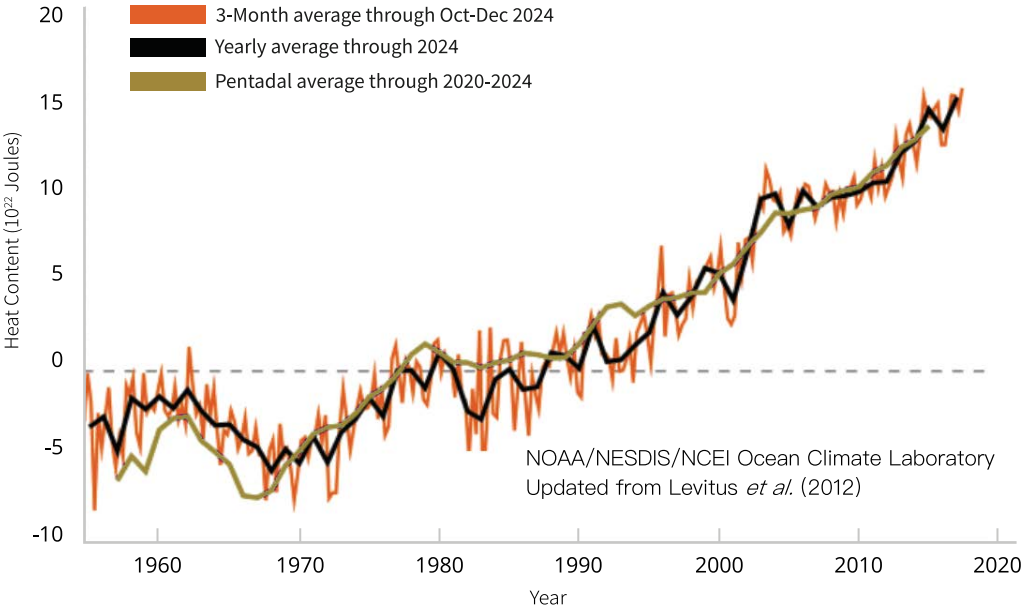


Fig 12 Global ocean heat content (0 – 700m below sea surface)
Source : US National Oceanic and Atmospheric Administration (NOAA)

More Information

Climate change: Ocean heat content

The latest ocean heat content

Ocean heat as 'fuel' for hurricanes

4.3 Shrinking sea ice

Arctic sea ice area has been decreasing in all months, with the decline particularly prominent in summer. Studies have shown that late summer Arctic sea ice area was smaller than at any time in at least the past 1,000 years. The global sea ice extent has shown an overall decreasing trend. In recent years, Antarctic sea ice extent has fluctuated significantly and dropped to a record low in February 2023 since satellite observations began (as of 2024). (Fig.13,14,15)

Fig 13 Antarctic sea ice (2007)
Source: Acaro

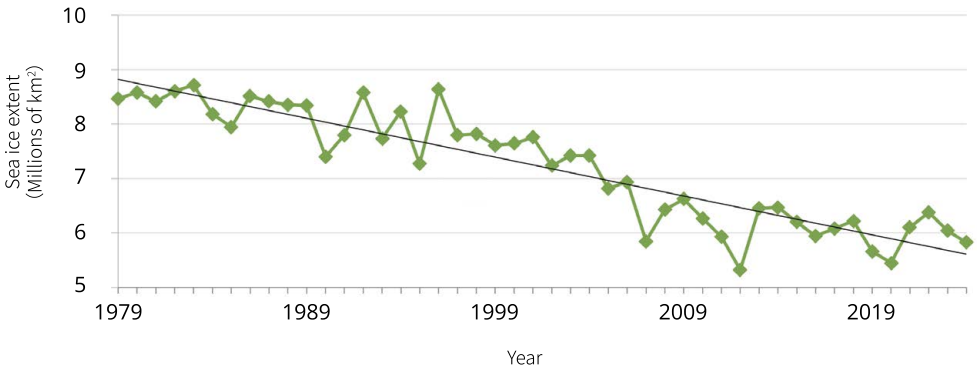


Fig 14 Arctic sea ice extent from July to September (1979–2024)
Source: National Snow and Ice Data Center (NSIDC)

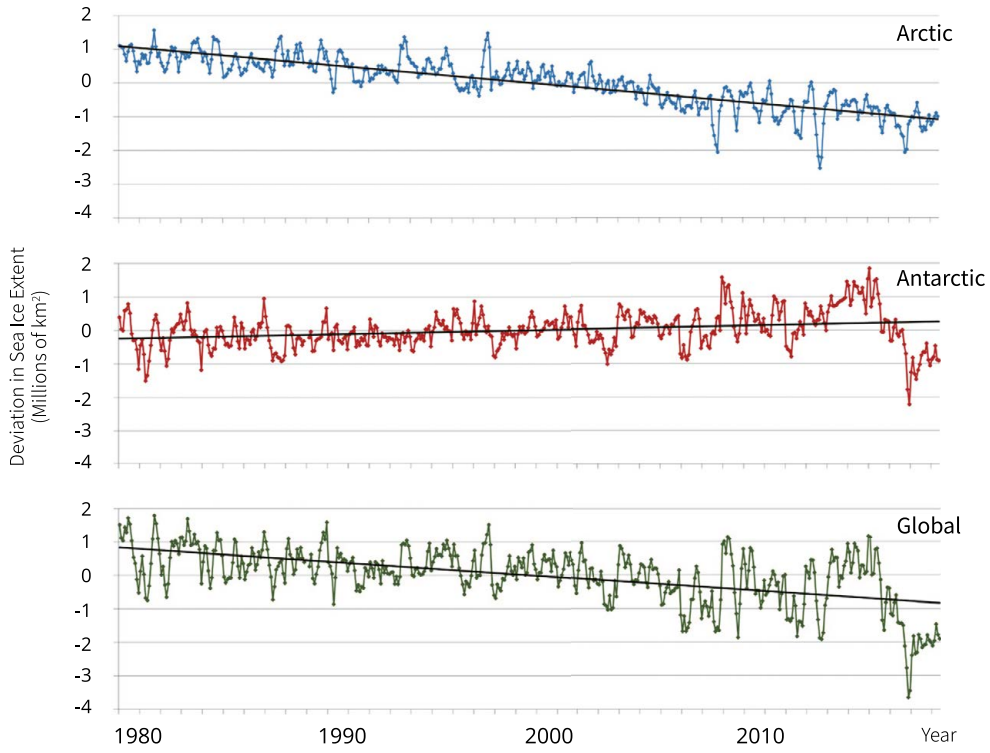


Fig 15 Arctic, Antarctic and global sea ice extent (1979–2024)
Source: National Snow and Ice Data Center (NSIDC)

More Information

Charctic interactive sea ice graph from National Snow and Ice Data Center

Change of Arctic sea ice

Change of Antarctic sea ice

4.4 Decrease in the Northern Hemisphere snow cover extent

The Northern Hemisphere spring snow cover extent has been decreasing since 1978, and there is high confidence that this trend extends back to 1950. (Fig.16)

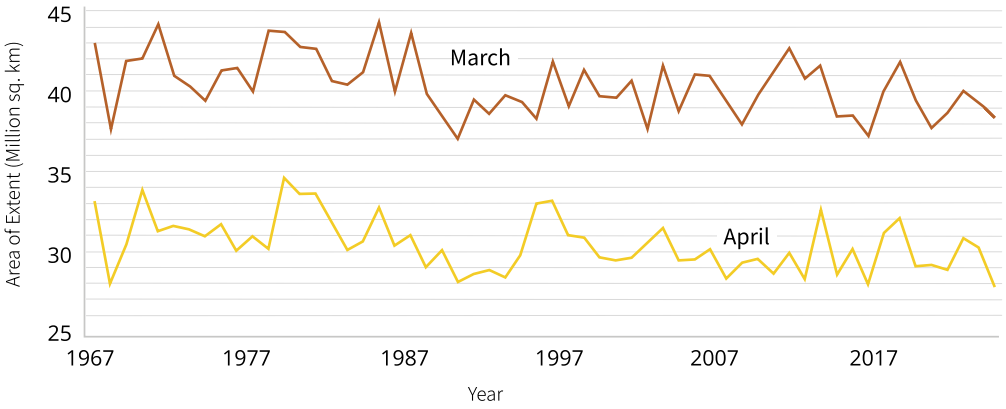


Fig 16 Change in spring snow cover extent of the Northern Hemisphere
Data Source: Rutgers University

More Information

The latest mass variation of Antarctic and Greenland ice sheets

NASA studies find previously unknown loss of Antarctic ice

4.5 Mass loss of ice sheets

An ice sheet refers to a vast area of land covered by a continuous layer of ice and snow, which is larger than 50,000 km^2. At present, such ice sheets are only found in Antarctica and Greenland.

Scientists measure the ice mass variations of Antarctic Ice Sheet and Greenland Ice Sheet with various methods, including satellite measurements of changes in Earth's gravity field, satellite altimetry to track changes in surface elevation and comparisons of inflow and outflow of ice sheets.

The Antarctic Ice Sheet and the Greenland Ice Sheet have lost 2,670 billion tonnes and 4,890 billion tonnes of mass respectively over the period 1992—2020. The rate of total ice sheet loss from 2010 to 2019 was more than four times that of the period from 1992 to 1999. (Fig. 17,18)

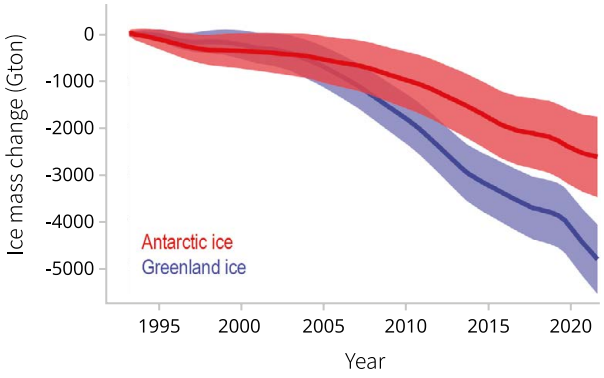


Fig 17 Cumulative Antarctic Ice Sheet (AIS) and Greenland Ice Sheet (GrIS) mass changes. The estimated uncertainties, very likely range, for the respective cumulative changes are shaded.
Source: IPCC Sixth Assessment Report

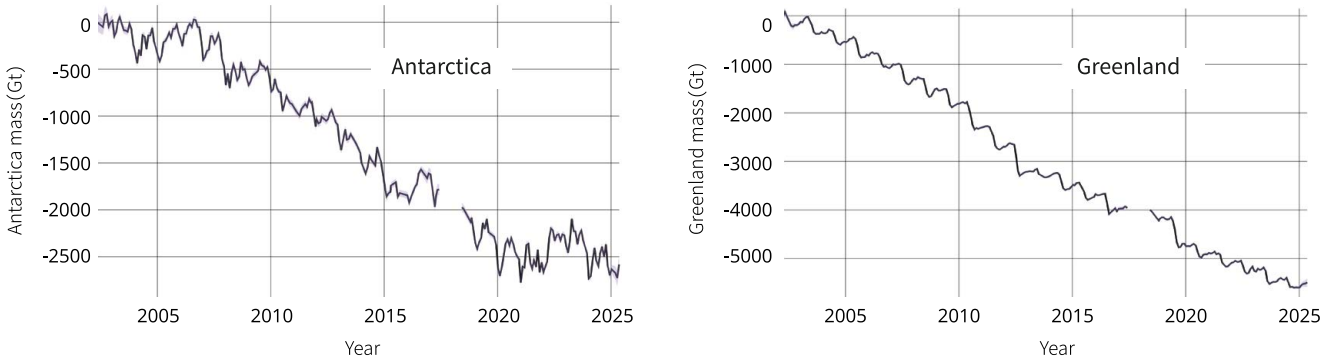


Fig 18 Mass variations of Antarctic ice sheet and Greenland ice sheet since 2002
Source: National Aeronautics and Space Administration (NASA)

4.6 Retreating glaciers

Glaciers lost 6,200 billion tonnes of mass over the period 1993–2019. Global glacier retreat since the 1950s is unprecedented in at least the last 2,000 years. (Fig. 19,20)

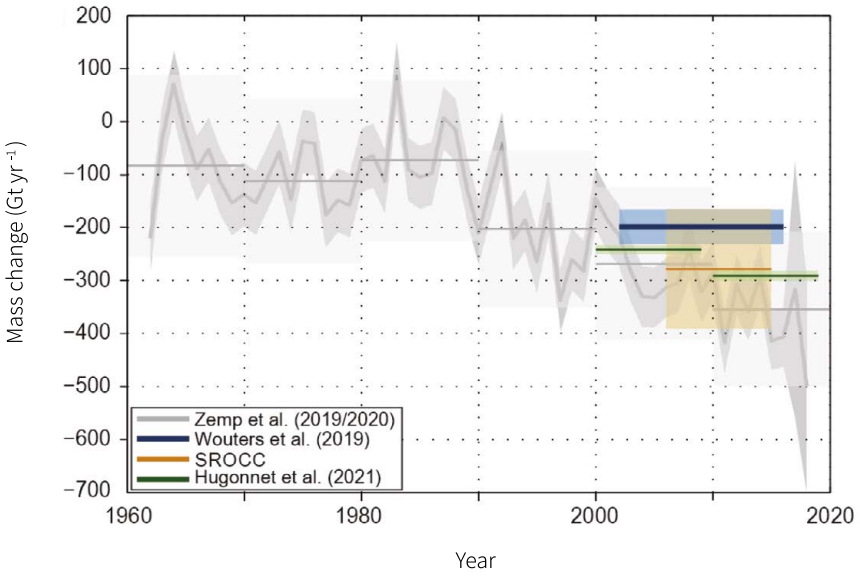


Fig 19 Annual and decadal global glacier mass change from 1961 until 2018
Source: IPCC Sixth Assessment Report

More Information

Latest glacier mass balance

The film "Chasing Ice" captured a large glacier calving event in Greenland

Fig 20 Columbia Glacier, Alaska (left photo: 2009, right photo: 2015)
Source: James Balog and the Extreme Ice Survey

4.7 Sea level rise

More Information

Latest sea level

Seawater expands as it warms and the melting of land–based ice and snow adds water to the oceans, resulting in global sea level rise. The average rate of global mean sea level rise was 1.3 mm per year between 1901 and 1971, increasing to 3.7 mm per year between 2006 and 2018. Global mean sea level has risen faster since 1900 than over any preceding century in at least the last 3,000 years. (Fig. 21)

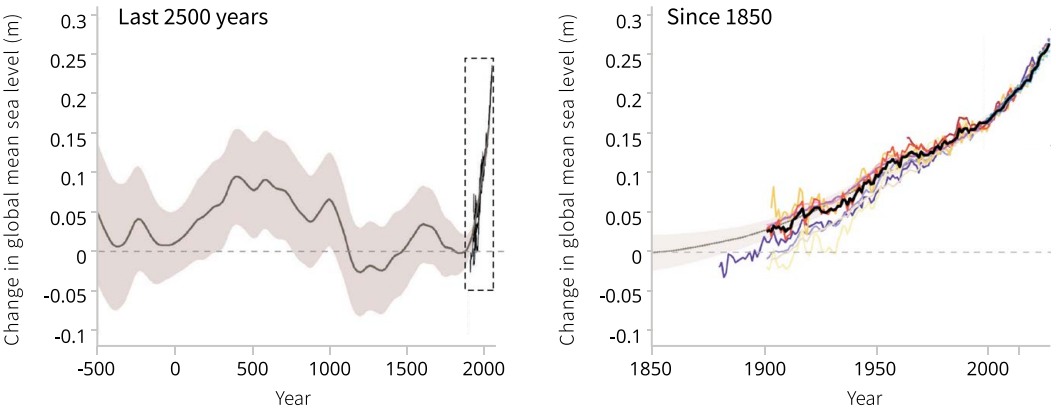


Fig 21 Changes in global mean sea level
Source: IPCC Sixth Assessment Report

As of 2024, the average rate of global mean sea level has more than doubled in the satellite altimetry era (since 1993), increasing from 2.1 mm per year (1993–2002) to 4.7 mm per year (2015–2024). In 2024, global mean sea level attained a new high in the satellite record.(Fig. 22)

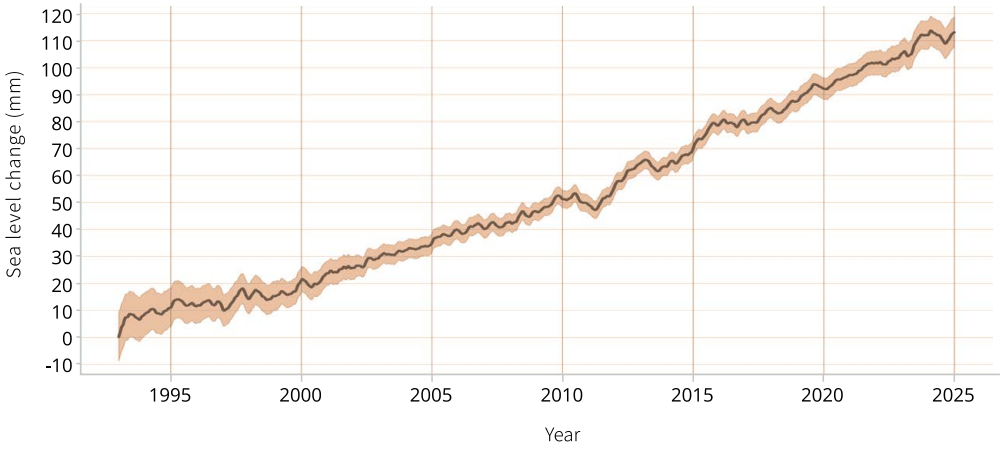


Fig 22 Global mean sea level change
(The seasonal cycle has been removed from the data. The shaded area indicates the uncertainty.)
Source: WMO State of the Global Climate 2024

4.8 More frequent extreme weather events

Human–induced climate change is affecting many weather and climate extremes in every region across the globe. Fig.23a shows that 41 regions around the world have experienced an increase in hot extremes, while Fig.23b shows that 19 regions have experienced an increase in heavy precipitation.

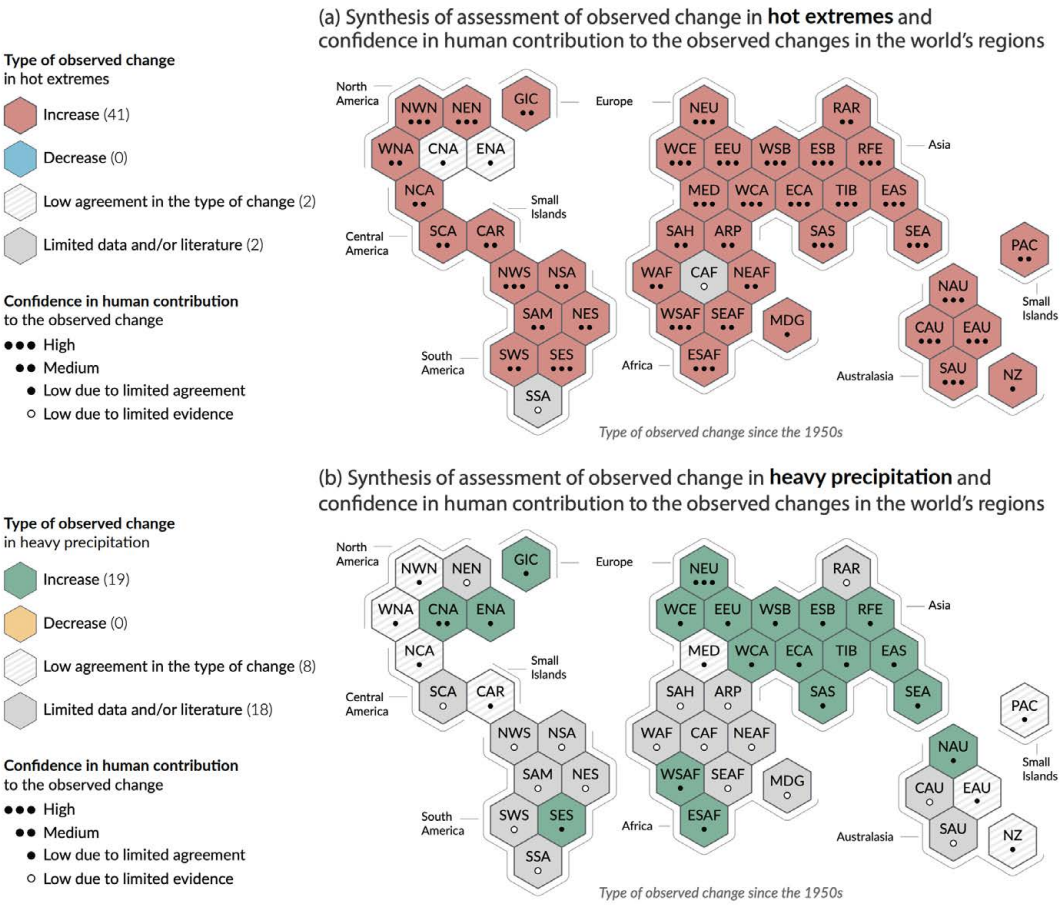


Fig 23 Assessments of human–induced hot extremes and heavy precipitation around the world
Source: IPCC Sixth Assessment Report

What is IPCC?

The Intergovernmental Panel on Climate Change (IPCC), established in 1988 by the World Meteorological Organization and the United Nations Environment Programme, is an international organization which assesses the science on climate change.

1. Main Tasks

1.1 Scientific Assessment

The IPCC conducts comprehensive assessments based on published scientific literature to evaluate and summarize the latest information on climate change, including the causes of climate change, its potential environmental and socio-economic consequences and potential future risks, and the adaptation and mitigation options to respond to its impacts.

IPCC assessments provide scientific information for climate-policy making and are also a key input into the negotiations under the United Nations Framework Convention on Climate Change (UNFCCC).

1.2 Report Compilation

The IPCC publishes assessment reports approximately every 5 to 7 years and also produces special reports and methodology reports. Experts from around the world contribute to the preparation of these reports.

The First Assessment Report in 1990 played a decisive role in the establishment of the United Nations Framework Convention on Climate Change (UNFCCC). The Second Assessment Report in 1995 provided key input to the negotiations of the Kyoto Protocol. The Third Assessment Report in 2001 and a number of special reports provided relevant information for the development of the UNFCCC and the Kyoto Protocol. The Fourth Assessment Report in 2007 confirmed that warming of the climate system was unequivocal. The Fifth Assessment Report in 2013 reaffirmed this finding and concluded that it was extremely likely that human influence had been the dominant cause behind the observed warming since the mid-20th century. This report served as the scientific foundation for the Paris Agreement. In response to the invitation of the Paris Climate Conference (COP21), the IPCC released the Special Report on Global Warming of 1.5° C in 2018.

Between 2021 and 2023, the IPCC released its Sixth Assessment Report in stages. This report reinforced that it is unequivocal that human influence has warmed the atmosphere, ocean and land. Widespread and rapid changes in the atmosphere, ocean, cryosphere and biosphere have occurred.

2. Working Groups and Task Force

The IPCC is composed of three Working Groups responsible for preparing the assessment reports, and a dedicated Task Force on National Greenhouse Gas Inventories, which develops methodologies for countries to measure and report greenhouse gas emissions and removals.

a. Working Group I (WGI): Assesses scientific aspects of the climate system and climate change.

b. Working Group II (WGII): Assesses the impacts of climate change on human and natural systems. Assesses adaptation options.

c. Working Group III (WGIII): Assesses how to stop climate change by limiting greenhouse gas emissions. (Known as "mitigation".)

3. International Awards

The IPCC builds up and disseminates greater knowledge anout man-made climate change, and lays the foundations for the measures that are needed to counteract such change. In recognition of this contribution, the IPCC was jointly awarded the Nobel Peace Prize in 2007 with former U.S. Vice President Al Gore.

In 2022, the IPCC was co-recipient of the Gulbenkian Prize for Humanity, along with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

More Information

7.1 Chapter Summary

Is the climate changing?

1 Climate and weather

- Weather describes the conditions of the atmosphere in a place within a short period of time. Climate describes the average meteorological conditions in a place over a long period of time.
- The World Meteorological Organization (WMO) calculates climate parameters based on 30–year averages.

2 Global Climate

- The climate of different regions is influenced by the amount of solar energy they receive, and can be classified by latitude into tropical, temperate, and polar zones.
- Other factors affecting climate include altitude, topography, distance from the ocean, ocean currents, and prevailing wind directions.

3 Climates of China and Hong Kong

- Climate of China is affected by the monsoons, and the climate types are complex and diverse, and precipitation is unevenly distributed across time and space.
- Hong Kong has a subtropical monsoon climate, characterized by hot and humid summers and generally cool and dry winters. Common severe weather phenomenon include heavy rain, thunderstorms with associated squalls, tropical cyclones, and strong monsoons.

4 Scientific evidence of climate change

- Global surface temperatures rise. 2024 is the warmest year on record (as of 2024).
- Sea surface temperature and ocean heat content increase.
- Ice and snow melt at an accelerating rate.
- Sea level rise.
- Extreme weather events have become more frequent, with a significant increase in hot extremes in many regions around the world.